SUNEXPERT

An Independent Forum for Open Systems

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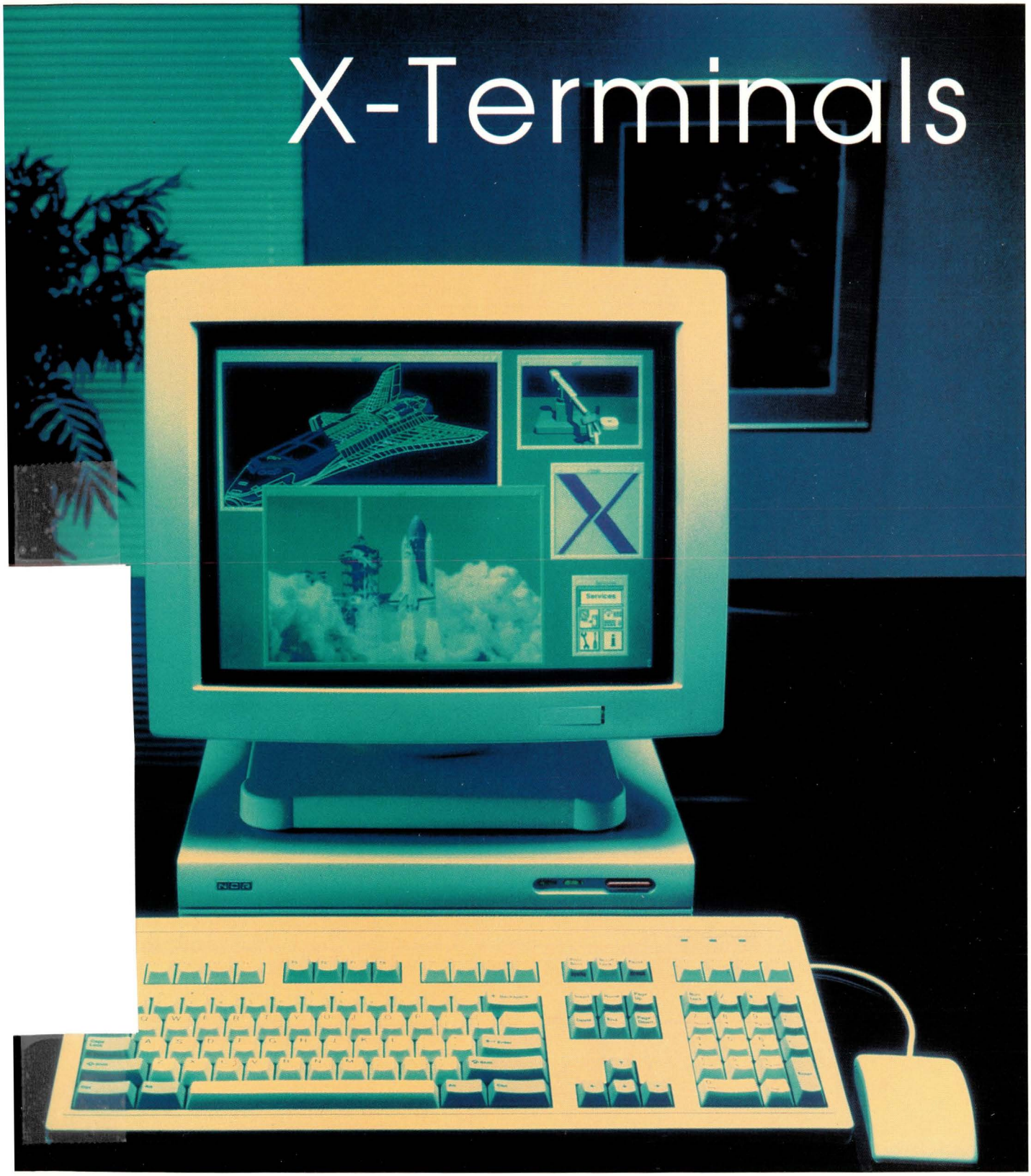

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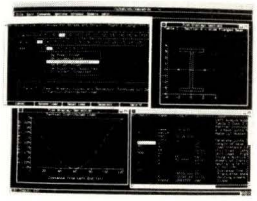

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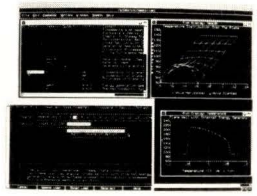

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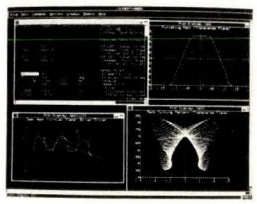

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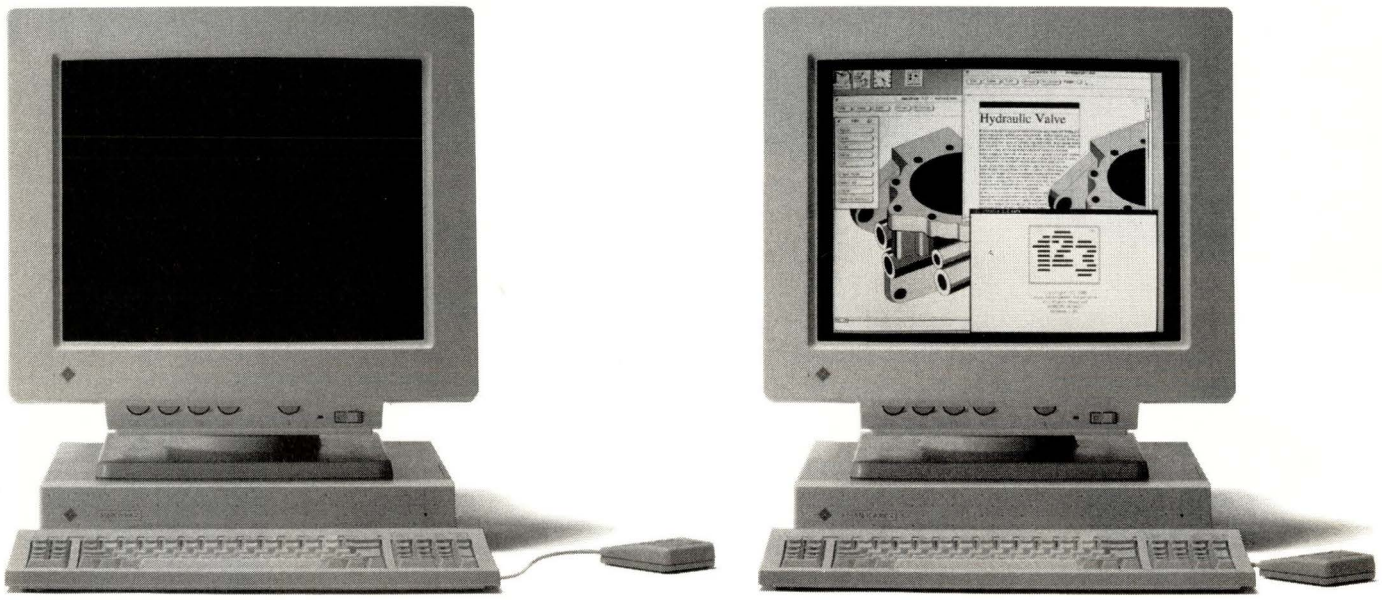

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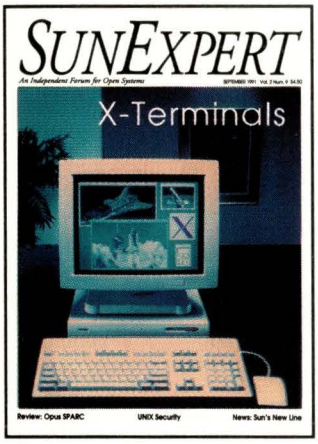

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FEATURES

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COLUMNS

DEPARTMENTS

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

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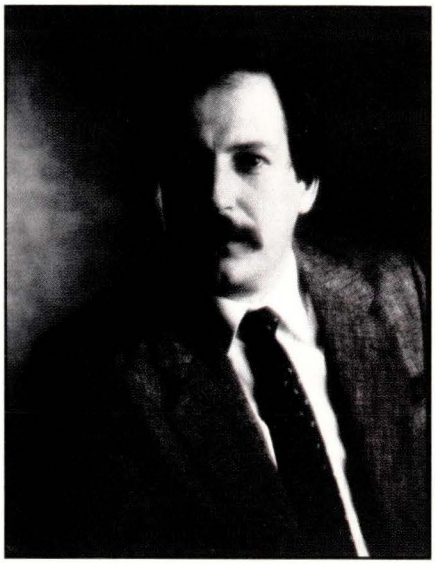

Editorial

Good News is No News

Recent Sun Microsystems product announcements–the ELC and IPX–were greeted with big yawns. Analysts, and journalists fond of citing them, seem to have decided that this batch of incremental enhancements pales in comparison to competitive products from Sun's rivals.

But "competitive" is a key idea. These new Sun machines demonstrate a concern for delivering value within acceptable, competitive performance parameters. There may be little glamour in such a position in a market accustomed to blockbusters: double the MIPS, double the SPECmarks, double the polygons per second. But double the disk, double the memory and faster data transfers at the same price mean doubles the usability. That's value. Only in a jaded market is this good news, no news. For a full description of the new product line, see our News section.

Also this month, Michael Jay Tucker revisits the X-terminal market. The technolgy has been validated by users but there's now a battle over defining the right applications for these low-cost-per-seat alternatives.

Doug Pryor

Doug Pryor

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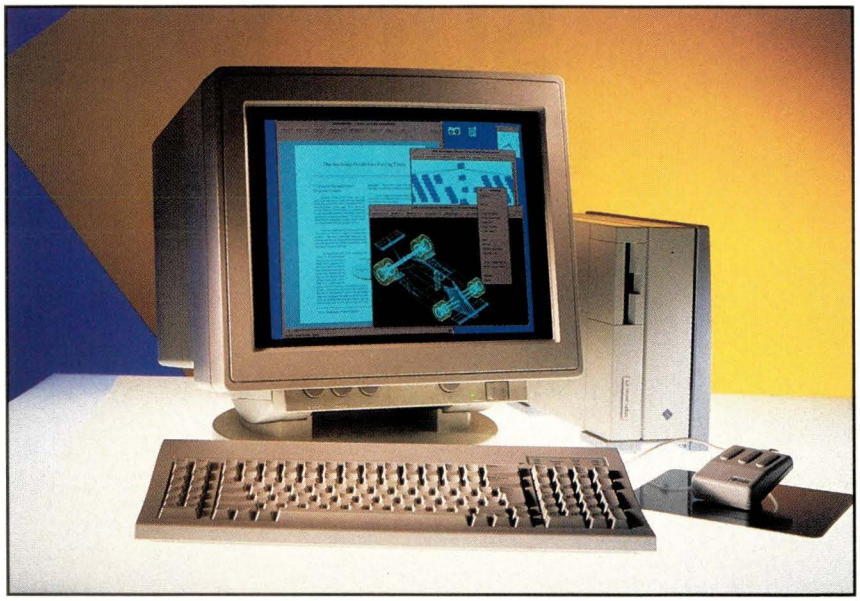
NEWS

Sun Revamps Its Desktop Family

In a move designed to further solidify its commercial-systems presence, Sun Microsystems Inc. has introduced two new SPARCstation models, the ELC and the IPX. At the same time, it has slashed prices on the IPC, enhanced its SPARCstation/SPARCserver 2 systems' capabilities, unveiled trade-up and trade-in programs, and souped-up the graphics on all its SPARCstations.

"An increasing part of our business is coming from the less technical community–users who are slightly less oriented toward increases in power and more attuned to price," explains Larry Hambly, Sun's vice president of marketing. Consequently, Sun "is trying to get the attention of high-end PC ISVs, by showing them UNIX isn't as costly [to develop for] as it used to be."

The ELC, which replaces the SLC, is Sun's new, entry-level box. It sports twice the processing power and four times the memory capacity of its predecessor. The ELC is powered by a 33-MHz SPARC processor that delivers 20.1 SPECmarks, 21 MIPS and 3 MFLOPS of performance. All of the system's components are on a single, custom CPU board, which is accessible via the machine's "pop-top." The ELC ships with a monochrome 1152-by-900 resolution monitor. A diskless, base configuration sells for $4,995.



Sun Microsystems Inc.'s SPARCstation IPX: A system for the midrange-power user who needs GX-accelerated graphics.

The IPX is designed for the midrange power user who can take advantage of GX accelerated graphics. The system benchmarks at 24.2 SPECmarks, 28.5 MIPS and 4.2 MFLOPS, and makes use of the integrated IU/FPU, 40-MHz SPARC implementations from Fujitsu Ltd. and Weitek Corp. The IPX also is the first Sun system to include, as standard, GX graphics technology in single-chip packaging. The IPX can be

The New SPARCstation Desktop Family

Model	Intro. date	SPEC-marks	SPARC clock speed (MHz)	Main memory (MB)	Disk capacity	Graphics	Package slots	Base configuration	Base price
ELC	7/91	20.1	33	8-64	207 MB-5.2 GB	Mono	NA	8 MB, 17 inches, mono, diskless	$4,995
IPC	7/90	13.4	25	8-48	207 MB-15.6 GB	Color	2 SBus connectors	8 MB, 16 inches, color, 207-MB disk	$6,995
IPX	7/91	24.2	40	16-64	207 MB-15.6 GB	Grayscale & color GX	2 SBus connectors	16 MB, 17 inches, grayscale, 207-MB disk	$11,995
2	11/90	24.7	40	32-128	424 MB-20.8 GB	Mono & color GX, GXplus GS, GT	3 SBus connectors	32 MB, 19 inches, mono, 424-MB disk	$15,495

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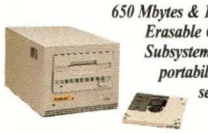

The ArteFD 3 1/2" and 5 1/4" floppy subsystems let you transfer data between Suns and PCs.

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configured as a color or gray-scale system. An IPX with 16 MB of memory, a 17-inch grayscale monitor, 207 MB of disk and GX accelerator lists for $11,995.

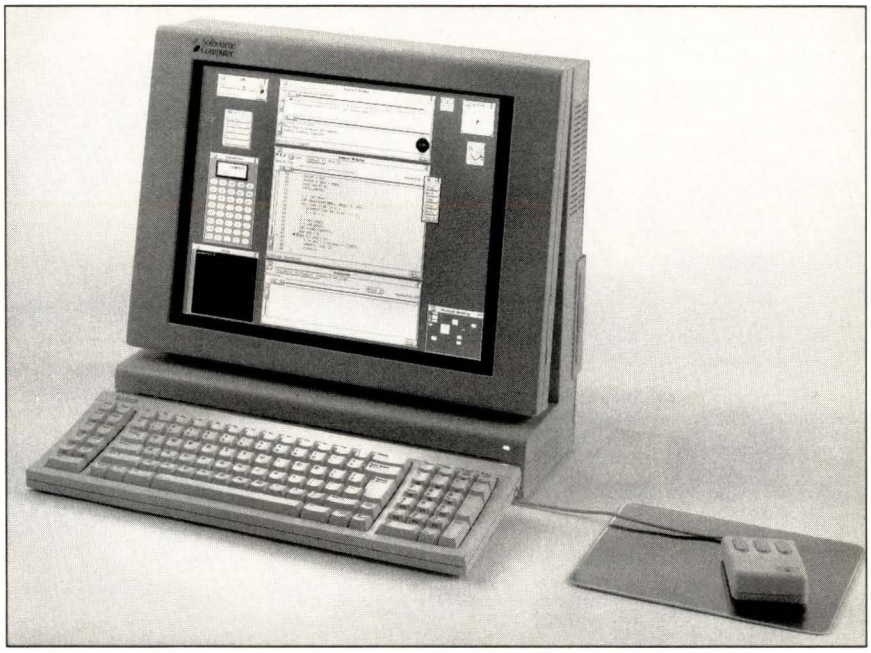
Hambly says Sun is counting on the IPX to attract high-end ISVs that haven't yet committed to porting their applications to Sun platforms. When asked for examples of ISVs and/or markets that Sun expects to better address with the IPX, Hambly admitted that he hadn't yet nailed down the particulars of this strategy.

Meanwhile, Sun is offering IPCs at fire-sale prices through the end of the year. (After December 31, IPC production will be discontinued.) A special, cost-reduced configuration of the IPC is now available for $6,995 new, and $5,995 as an upgrade. Unlike the rest of the Sun desktop family, the IPC isn't being enhanced in any way. The color system continues to run a 25-MHz processor clocking at 13.4 SPECmarks.

In order to avoid neglecting the high end of its desktop line, Sun also has added improved processor performance, and more memory and storage to its SPARCstation/SPARCserver 2s. Improvements include increasing minimum system memory from 16 MB to 32 MB and disk storage from 207 MB to 424 MB. Benefiting from new compilers from Sun and Kuck and Associates Inc., SPARCstation 2s are now able to reach performance levels of 24.7 SPECmarks. With the GX accelerator, the single-slot GX board or Sun's new, two-slot GXplus board–all of which take advantage of Sun's single-chip GX technology–a SPARCstation 2 can achieve higher resolutions (up to 1280 by 1024), and double buffering. Base price for an enhanced SPARCstation 2 is $15,495; for the SPARCserver 2, entry-level list price is $15,195 (without monitor).

To encourage customers to take advantage of its latest, greatest technologies, Sun has introduced a couple of trade-in/trade-up programs, aimed at SPARC and non-SPARC users. Existing Sun users can trade in their Sun 3s or Sun 386i's for a special, promotion version (known as LPC, or low-price color) of the IPC for $5,995. This configuration is a diskfull IPC, with 8 MB of system memory, 207 MB of internal disk and a high-resolution, 16-inch color monitor. Customers with comparable UNIX workstations from Digital Equipment Corp., Hewlett-Packard Co./Apollo and IBM Corp., or high-end personal computers from Apple Computer Inc., Compaq Computer Corp., HP and IBM also can trade in their systems for the LPC IPC for $5,995.

According to Hambly, this desktop reshuffling is part of Sun's master plan "to focus on what the volume technologies are now." Sun also plans to build volume through licensing its GX graphics to other SPARC systems vendors. Hambly says Sun will commence GX licensing once it begins selling the technology itself.–*mjf*



The S3000 from Solbourne Computer Inc. is a 25-pound transportable with a monochrome plasma display.

Three New SPARC Desktops Debut

While many SPARCalike vendors are caught up in building the ultimate 40-MHz SPARC system, a chosen few continue along their slow but steady enhancement pace. Among the latter are Solbourne Computer Inc., which has just extended its desktop line with two new models, and Tatung Science & Technology Inc. (TSTI), which has come out with a 25-MHz version of its initial SPARCalike product.

Solbourne unveiled the S4000DX (Design Xcellerator), an enhanced version of its S4000. The product has a 256-KB, second-level cache memory designed to accelerate compute-intensive design applications. The S4000DX sports 28.3-MIPS and 18.3-SPECmark performance levels. The system operates at 36 MHz.

Color systems all come standard with the SGA20 accelerator board, enabling the S4000DX to support up to three accelerated displays. Solbourne is positioning the S4000DX head-to-head with Sun Microsystems Inc.'s SPARCstation 2. A 19-inch monochrome version with a 200-MB hard disk and 1.44-MB floppy drive sells for $11,495; a 16-inch color version with hard disk and floppy sells for $15,995.

Solbourne's new S3000 is a 25-pound transportable workstation that incorporates a 16-inch monochrome plasma display. Jointly developed by Solbourne and Matsushita Electric Industrial Co., the S3000 delivers 13.3 SPECmarks, 25.5 MIPS and 1.7

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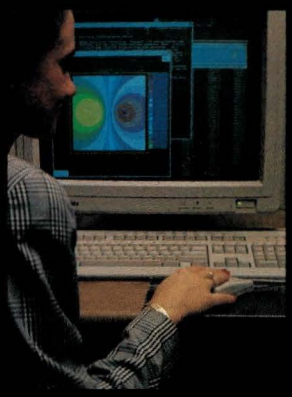

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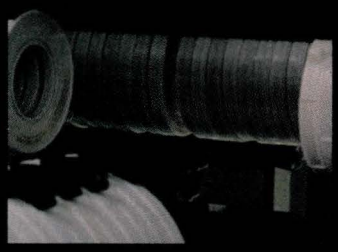

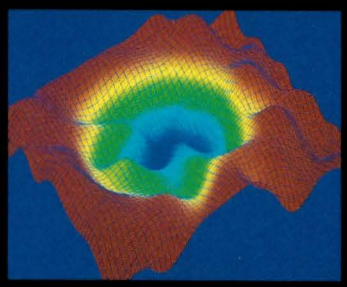

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International Spotlight

Sun U.K. Users Run The Show

The first Sun U.K. User Group conference held since its management changed hands will feature some first-time U.K. showings of new software, updated NFS benchmark results and, quite possibly, surprise announcements from Sun Microsystems Inc. itself.

Being held September 10 to 12 at the National Exhibition Center in Birmingham, the event will showcase at least 88 vendors in the United Kingdom's first and only Sun-dedicated vendor exhibition. The exhibition organizer, EMAP International Exhibitions Ltd., London, expects between 4,000 and 6,000 attendees.

Among the software products making their debut in the United Kingdom are Viewlogic Systems Inc.'s Retargeter CAE tool and Intellicorp's ProKappa 2.0 object-oriented-development tool. In the session entitled "The more I find out the less I know? NFS Fileserver Benchmarks (including one that works)," William Roberts of Queen Mary College, London, will report on the effects of using FDDI in his benchmark, according to Daphne Tregear, a system manager at the University of Manchester, who is responsible for the conference program. Sun would not say whether it was planning any announcements for the show.

Since March, the U.K. user group has been run full-time by the same secretariat (Fleming Biggons Ltd., Buntingford, Herts) that runs EurOpen, rather than part-time by a Sun employee. The users wanted to run their own show," explains Bill Barrett, administrator.–*mwj*

MFLOPS. The product has been available on the Japanese market through MEI since October 1990. Configured with 8 MB of system memory, a 500-MB hard-disk drive and a 1.44-MB, 3 1/2-inch floppy, the S3000 sells in the United States for $14,995. Like the S4000DX, the S3000 runs Solbourne OS/MP, a SunOS derivative.

TSTI continues to fill out its product line with its newest SPARCalike, known as the COMPstation 25. (Starting in July, TSTI began using the name COMPstation for its entire family of workstations.) The COMPstation 25 is a 25-MHz SPARC system that clocks at 15.8 MIPS, 10.25 SPECmarks and 1.75 MFLOPS. The machine features a high-resolution, 19-inch color monitor, 8 MB of RAM (expandable to 64 MB) and packaging with room for one floppy drive and two 3 1/2-inch hard drives.

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SPARC/OS 1.1.1 (a derivative of SunOS 4.1.1) and supports SunView, OpenWindows and Motif. With an SBus add-on option, the machine provides users with access to both UNIX and DOS applications. The base-level configuration sells for $7,995.–*mjf*

Opus Denies Its SPARC Biz Is In Trouble

Be glad you weren't Tom Lacey, the vice president of marketing for Opus Systems, during the third week of July. Lacey was basking in the glow of just having landed $8.5 million in new venture-capital financing the week before. But in the midst of his vacation, Lacey began receiving calls from distraught users, investors and the press wanting to know why Opus–which claims to be the No. 2 SPARC workstation shipper (after Sun Microsystems Inc.)–was exiting the SPARC market.

Primarily to blame was a front-page story in the *San Jose Mercury News*, which proclaimed "Opus backs off battle with Sun, casting doubt on 'Sparc market.'" The story went on to claim that, "The Mountain View clone-maker had been seen as a well-run, viable foe."

About the only piece of accurate information in the article, Lacey claims, is that Opus' president and creator of its Sun-compatible strategy, Mark Johnson, had left the company the week before. "Our president [Johnson] wanted to take on Sun, and the rest of the management team didn't," Lacey explains. "We've had all along a two-pronged strategy: Enabling the market by building clone products, and building value-added, differentiated products. We aren't backing away in any way from the SPARC market. We're just emphasizing Phase 2.

"Today our value-added is our SPARC card," Lacey continues, referring to Opus' Series 500 Personal Mainframe line of PC add-in boards. "Next year, it could be workstations." In fact, Opus is known to have waiting in the wings a "multicomputer," a server based on three, independent SPARC-based motherboards, each of which can be devoted to a single application.–*mjf*

SPARC + ACE = Double The SPACE?

Appalachia had the Hatfields and the McCoys; the computer industry has SPARC International and the ACE Confederation. Both feuds center around a form of market share. But in the case of the Intel Corp.-MIPS Computer Systems Inc. manufacturers taking press-conference potshots at the SPARC makers, you may be witnessing a confusing smokescreen over just where the market is.

In June, an announcement that SPARCalike vendor Tatung Co. had joined the ACE camp caused a minor ripple of reaction at the PC Expo press conference called by ACE to announce its current technical status and its latest membership total (61).

Was it a defection from SPARC International? Or was there a spy within? Did this indicate a weakening in the Sun-hatched SPARC consor-

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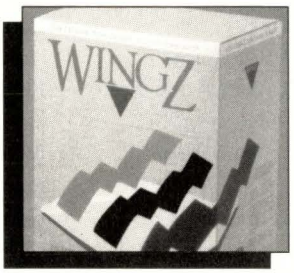
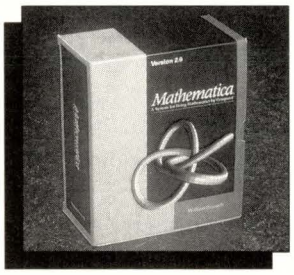
SOFTWARE

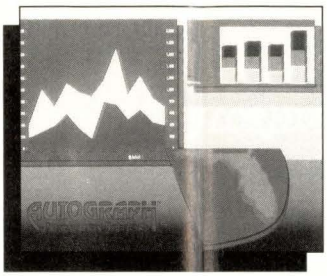
Wingz 2.0 from Informix Software
Wingz has been improved and is now available under a new true OpenLook version and also Motif for all Sun workstations. With Wingz you get powerful graphic, text processing, programming language, spreadsheet and presentation software in one highly integrated package. Takes advantage of OpenLook controls.



Island Graphics Productivity Series
Includes Island Write, IslandDraw, and IslandPaint. This is an affordable, streamlined set of publishing and graphics tools that let you create and illustrate memos, letters, specifications, and newsletters. Choose from SunView or new OpenLook version for Sun 3,4 and 386i-single user.



Mathematica 2.0 from Wolfram Research
A software system for doing numerical, symbolic, and graphical computation used both as an interactive calculation tool and a programming language. Numerical capabilities include arbitrary arithmetic and matrix manipulation. Users can create "Notebooks" that mix input, graphics, text and sound.

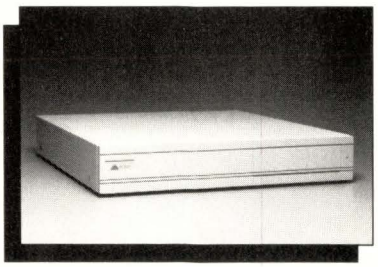


Autograph 3.2 from Ficor, Inc.
This graphics tool will give Sun users under OpenLook similiar capabilities to those using PowerPoint or Harvard Business Graphics on PC's. Included is Chart; a tool with over 25 chart styles, Illustrator; a free-style drawing and composition program and Slideshow; which is used to create slide presentations. Add voice-overs.

HARDWARE

Texas Instruments microLaser Printer
A true POSTSCRIPT laser printer available with either 35 fonts (PS35) or 17 fonts (PS17). Both print up to 6ppm at 300 dpi and come standard with 1.5 MB of memory. An excellent value. Includes cable. microLaser PS 35, **$1699**, microLaser PS17, **$1359**.

The SBox Expansion Chassis from Aurora
The SBox Expansion Chassis is a fully integrated enclosure that provides four additional Sbus slots (slaves), an internal power supply, cabling and provision for up to two 1/2 ht. SCSI devices. The SBox external dimensions match the "pizza box" form factor of the SPARCstation.



XP27 TekXpress XWindow Terminal by Tektronix
The XP27 is the new performance standard for color Xstations from the leading manufacturer of color Xstations--Tektronix. It offers Sun-compatible high-quality 1152 X 900 resolution in a 19" 256-color display. Comes standard w/5MB memory (expandable to 21 MB), dual processing architecture, X11 R.4 server, 8-bit planes and great international 3-year warranty. Other models available.

Omni-ware for Sun from Logicraft
Omni-ware for Sun is a complete hardware and software system for attaching a PC to a Sun network. It is the first complete solution that allows you to run all IBM PC software and peripheral hardware from your Sun keyboard. Access hundreds of CD-ROM libraries currently available only on PC's.

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tium? Or was the Compaq Computer Corp.-MIPS Computer-backed initiative embracing one of its own?

Labeling the PC Expo announcement "premature," John Morgan, general manager of the computer systems division of Tatung Co. of America, Inc., the San Diego, CA, subsidiary of Taiwanese parent Tatung Co., said "We're still evaluating where ACE is going."

More specifically, Morgan said Tatung was looking to see where application software for DOS and OS/2 Release 3 would be coming from because "our job is not to set standards. We are a world manufacturer and are market-driven. If the market says it wants another platform, then we'll look into it."

In addition to manufacturing SPARCalikes, Tatung Co. makes and markets a series of desktop computers running on Intel 236, 386 and 486 chips, as well as a host of consumer and electronics products. It OEMs its PCs through CAL-ABCO Inc. and Marshall Electronics. And its sister subsidiary, Tatung Science & Technology, San Jose, CA, manufactures a SPARCalike family sold under the name COMPstation.

As it turns out, Tatung is not the only foreign company to plant a foot in both the SPARC and ACE camps. Among the ACE Confederation's new members are DCM Data Products, Newport Beach, CA, a unit of DCM Ltd. of India; Epson America Inc., an affiliate of Seiko Epson (which is expected to debut its TriGem Computer Corp.-manufactured SPARCalike any time now); and Goldstar Technology Inc., San Jose, a unit of Goldstar Co. Ltd. of Korea. Like Tatung, these other SPARC systems vendors also have strong PC presences.–*hcp*

SunSoft Offers Single-Stop Software Shopping

Volume 2 of SunSoft's Catalyst CDware allows Sun Microsystems Inc. users with CD-ROM players to peruse software at their desktops.

Like other CD-ROM software distribution mechanisms, such as Software Store from Highland Software Inc. and CDID from RAD Technologies Inc., CDware lets users try out packages as diverse as Ashton-Tate Corp.'s dBASE IV, Cimage Corp.'s ImageMaster, and Saber Software Inc.'s Saber-C and -C++. Among the 40 packages from 26 vendors on the latest CDware CD are several offerings from Qualix Group Inc., a software distributor in its own right.

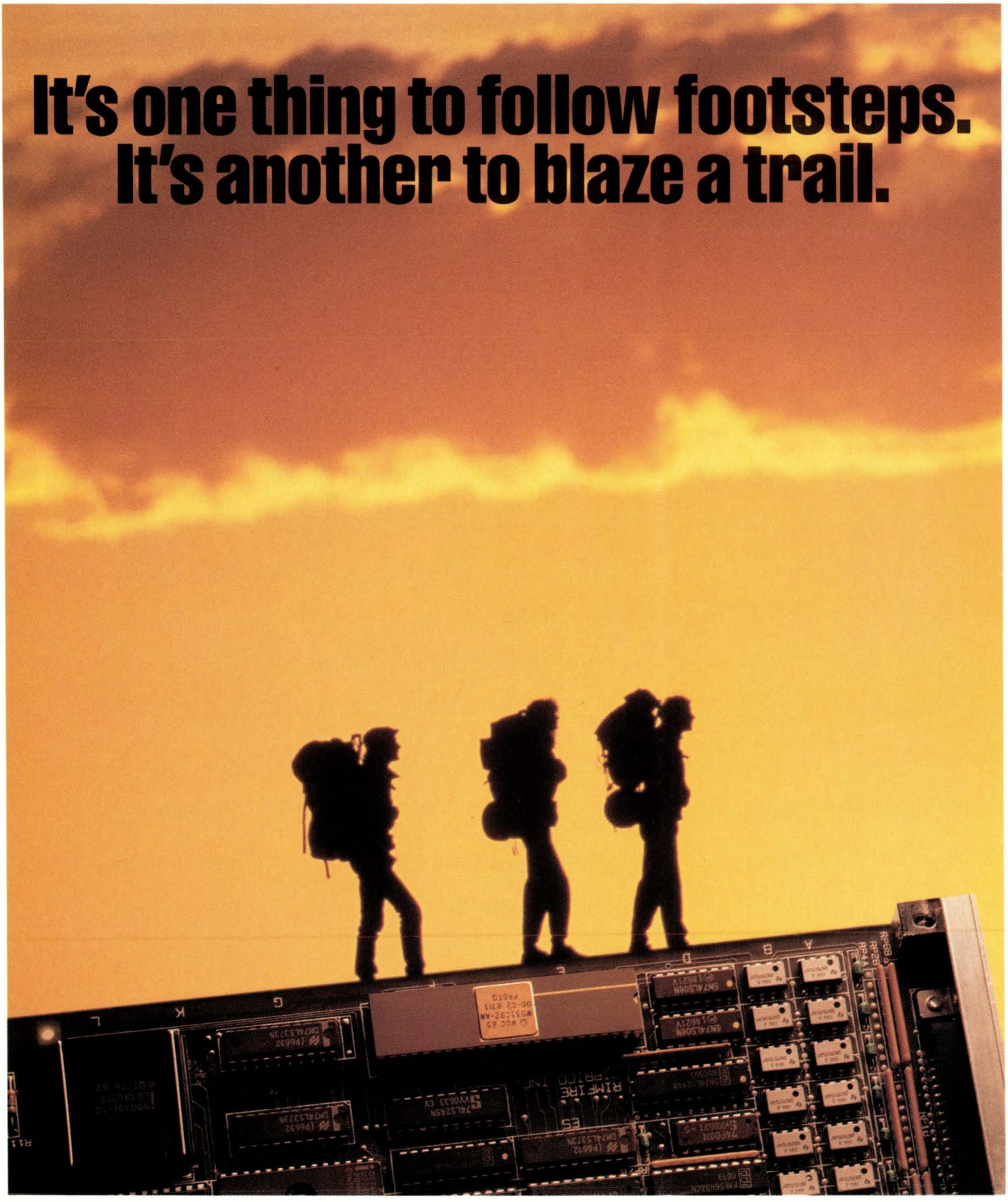
But unlike the CD-ROM disks from Highland Software and RAD Technologies, CDware does not include full, working copies of programs (with features such as save and print having been disabled). Rather, CDware offers users self-running demonstrations, electronic brochures and trial programs to help them sample products. CDware also contains an electronic catalog of the more than 3,300 available SPARCware packages from ISVs and hardware vendors.

CDware will be bundled with every SPARCstation from Sun and is available to existing SPARCstation users for no charge.–*mjf*

This Just In...

• For now, at least, don't expect to get your Mac emulation software for SPARC from **RDI Computer Corp.** RDI is the San Diego, CA, creator of the Britelite SPARC laptop, whose main claim to fame was its Mac-emulation capability provided by "Companion," software developed by Xcelerated Systems Inc. The Federal District Court of Northern California has issued a preliminary injunction against RDI, prohibiting it from marketing or distributing Companion, Companion+ or any derivative of Companion. According to the injunction, RDI infringed on Xcelerated's software copyright. The good news is that you should still be able to buy the product (now called "Liken") directly from Xcelerated before the end of the year–and maybe even through Sun Microsystems Inc., since Xcelerated is a member of Sun's Catalyst program. Xcelerated's president Dave McMillen says that RDI has returned to Xcelerated all copies of Companion that RDI had in

It's one thing to follow footsteps. It's another to blaze a trail.



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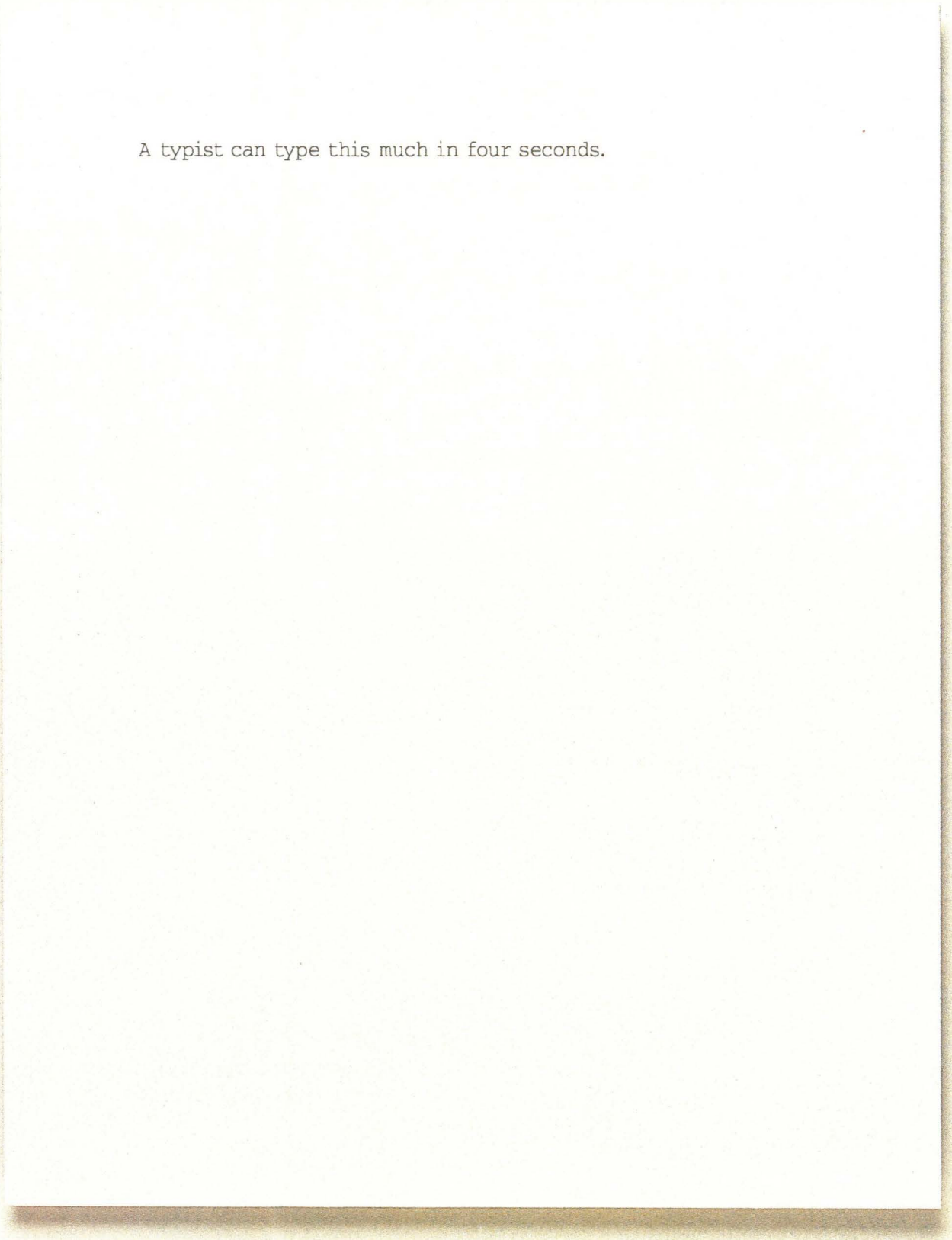

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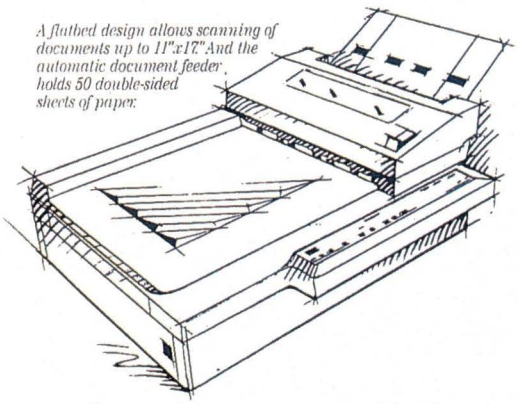

A flatbed design allows scanning of documents up to 11"x17". And the automatic document feeder holds 50 double-sided sheets of paper.

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its possession. Where does this leave the purchasers of the more than 1,100 Britelites that RDI claims were ordered with Companion? No comment from RDI.

• **SunSoft Inc.** rolled out two new additions to its Sun SHIELD software security products family. Called Account Resource Management (ARM) and Automated Enhanced Security Tool (ASET), the modules are targeted at corporate MIS managers and network administrators in commercial, technical and government installations. SunSoft also announced a joint agreement with RSA Data Security Inc., Redwood City, CA, to incorporate RSA's data-encryption technology into current and future SunSoft products.

• **Artecon Inc.**, Carlsbad, CA, began shipping this month its DynaCon software, a package designed to dynamically reconfigure the SunOS kernel in order to avoid lengthy reboots when adding or removing devices. DynaCon is designed for use with Artecon's DataVault product line, which encompasses Active Backplane Technology–a feature that allows users to remove and install devices while the system is running without creating SCSI bus glitches. Artecon also has introduced two new SBus expansion boxes and a full line of SBus serial multiplexor cards. The SB-6000X features six master/slave slots and sells for $1,995. The SB-300XD features three slots and up to two 3 1/2-inch half-height fixed disk/tape devices. The serial multiplexor cards are priced from $495 (for three serial lines and one parallel port), to $1,295 (for 16 lines/eight full modem).

• **Delta Microsystems Inc.** has introduced a new backup and retrieval system for heterogeneous UNIX sites that makes use of the latest in 8mm tape-storage technology. The Livermore, CA, company calls the product GigaGuard. The product includes an 8mm tape jukebox (which is also sold alone as Delta's Model SS-45TJ). The jukebox allows up to 225 GB of data storage. Products are custom-configured. GigaGuard prices range up to $110,000, depending on the customization and configuration. Product is available through Peripheral Devices Corp., Delta's master distributor.

• The color version of Island Write, Draw & Paint is now shipping from **Island Graphics Corp.** Version 3.0 for Open Look runs on Sun 3s, Sun 4s and SPARC-compatible workstations. The software provides color output to color PostScript printers, SPARC-printers and Hewlett-Packard Co. PaintJet printers, and monochrome output to HP LaserJet printers. In addition, Island Graphics is offering Draw and Paint unbundled from Write. Write, Draw & Paint sells for $995; upgrades for existing customers range from $295 to $395. Draw & Paint alone sells for $695.

• Sun VAR **Apunix Computer Services** has added several new peripherals to its line-up. Among them: Mitsubishi Electronics America Inc.'s CP-210U dye-sublimation printer and 37-inch auto-scanning monitor, Poloroid Corp.'s Digital Palette CI-5000 Computer Film Recorder and Soltronics Ltd.'s Protec 10 16-tape DAT stacker. The Mitsubishi printer allows users to print images of near-photographic quality from their Suns, and includes TruePrint software, which features a NeWSprint PostScript driver and raster file filter. The Polaroid CI-5000 connects to Sun SCSI ports and allows users to create 35mm slides, transparencies and chromes at their desktops.The Soltronics product allows Sun customers to store and access in less than one minute any file in up to 10 GB of data stored on 4mm DAT.

Other Open Systems News

Digital Equipment Corp.

DEC has begun in earnest to port DEC-developed applications to Sun Microsystems Inc. SPARCstation platforms. The company has ported two key desktop publishing offerings–DECwrite V2 and DECpresent V1.5–to the SPARCstation. Both products are built on DEC's Network Application Support (NAS) and Compound Document Architecture (CDA) frameworks. DECwrite is DEC's Motif-based WYSIWYG document processor, with LiveLink connections between data and applications. DECpresent is a Motif-based desktop presentation graphics product, which allows users to create slides and other presentations at their desktops. The two products will be officially released later this year.

Not limiting its heterogeneous platform support to software, DEC also unveiled a network printer for users of VAX/VMS, Ultrix and other UNIX systems on DECnet and TCP/IP Ethernet networks. Called the *turbo* PrintServer 20, the product is designed for environments with printing volumes of more than 70,000 pages per month. The *turbo* PrintServer 20 can print single- or double-sided as a standard feature. The supporting PrintServer host software enables jobs to be printed from heterogeneous DECnet or TCP/IP environments without intermediate spooling systems. The product is priced at $19,495, which includes DECnet and TCP/IP licenses for supporting host and clients.

Hewlett-Packard Co.

HP and Sun Microsystems Inc. have signed an agreement allowing HP to port its mechanical computer-aided design (MCAD) software to Sun SPARCstations. The original port will include HP ME10 2D design and drafting software, IGES translator and HP Data Management System. HP also plans to port its solid-modeling products to Sun platforms. Previously, HP's MCAD software was only available on HP workstations and IBM-compatible PCs.

Filling out its rewritable optical-storage product line, HP has added three new optical-disk libraries to its

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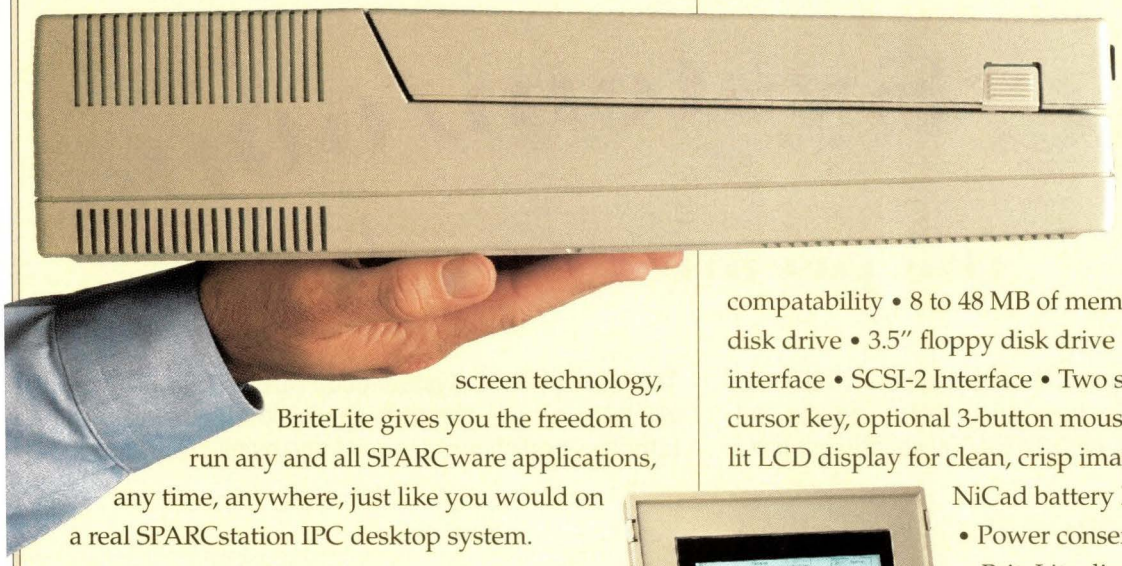
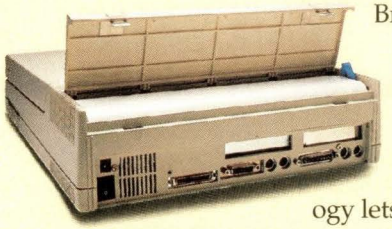


screen technology, BriteLite gives you the freedom to run any and all SPARCware applications, any time, anywhere, just like you would on a real SPARCstation IPC desktop system.

BriteLite Packages Your IPC "To Go"

Other laptops can't compete with BriteLite's power and SPARCware compatability. Just turn the unit around. It's like looking at the back of a standard SPARCstation IPC, with two SBus slots, an ethernet port, two serial ports, a SCSI-2 interface, external video and mouse connectors.



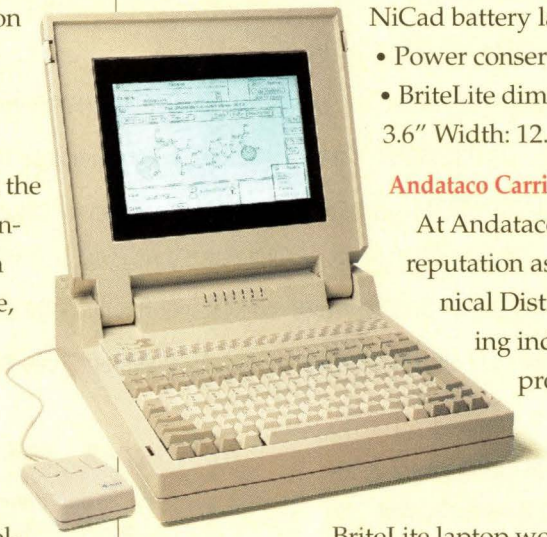
BriteLite's unique new thin-film, super-twist screen technology lets you carry all this power, and display clean, crisp images–even outdoors. And the powerful NiCad batteries assure you of two solid hours of continuous performance and six hours in standby mode before recharging.

BriteLite Features add up to SPARCstation IPC Power

Each BriteLite is packed with features that add up to less than 14 pounds (including batteries). So you travel light, without sacrificing any of the performance you've come to expect from your Sun workstation.

BriteLite Highlights

• Uses Sun SPARCstation IPC board • 103 full-size keys • Complete SunOS and OpenWindows compatability • 8 to 48 MB of memory • 240 MB hard disk drive • 3.5" floppy disk drive • Built-in ethernet interface • SCSI-2 Interface • Two serial ports • 4-axis cursor key, optional 3-button mouse • Anti-glare back-lit LCD display for clean, crisp images • Rechargeable NiCad battery lasts up to six hours • Power conservation mode • BriteLite dimensions: Height: 3.6" Width: 12.0 " Length: 15.6"



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repertoire. The HP Series 6300 Model 10GB/A is HP's new entry-level optical-library solution. Models 60GB/A and 100GB/A provide increased capacity at roughly one-half the cost per megabyte of its 20GB/A, according to the company. HP optical-storage capacities now range from 10.4 GB to 93.6 GB using 5 1/4-inch optical disks.

IBM Corp.

Continuing its new-found love affair with partnerships, IBM has entered into a multiyear development agreement with desktop rival Apple Computer Inc. The computer makers plan to develop an object-oriented operating system that will work on multiple platforms, including Intel Corp.'s 80X86 processor line, Motorola Inc.'s 680X0 chips and IBM's own RS/6000 chipset, and let applications written for AIX, OS/2 and Macintosh run on it. As part of the deal, IBM will license its RISC technology to Motorola Inc., which will supply Apple with a single-chip implementation of IBM's nine-chip RS/6000 chipset for use in future Macintoshes. Apple and IBM will also add the Macintosh interface to an enhanced version of AIX and work together on multimedia products.

IBM also filled in the midrange of its graphics product line for the RS/6000. IBM rolled out the POWER Gt4x, Gt4 and Gt3 graphics subsystems, and three new Micro Channel adapters priced between $3,500 and $17,000. In IBM performance testing, the Gt4x rated 800,000 2D or 3D vectors per second while the Gt4 rated 650,000 2D vectors per second and 400,000 3D vectors per second. IBM also brought out the IBM POWER Visualization System, a turnkey scientific-visualization system incorporating a server with up to 32 parallel processors, a dedicated RS/6000 support processor and High Performance Parallel Interface (HIPPI) networking capability. In addition, IBM announced two disk drive subsystems, starting at $23,000, for the RS/6000 5xx models and 9xx systems. ➸

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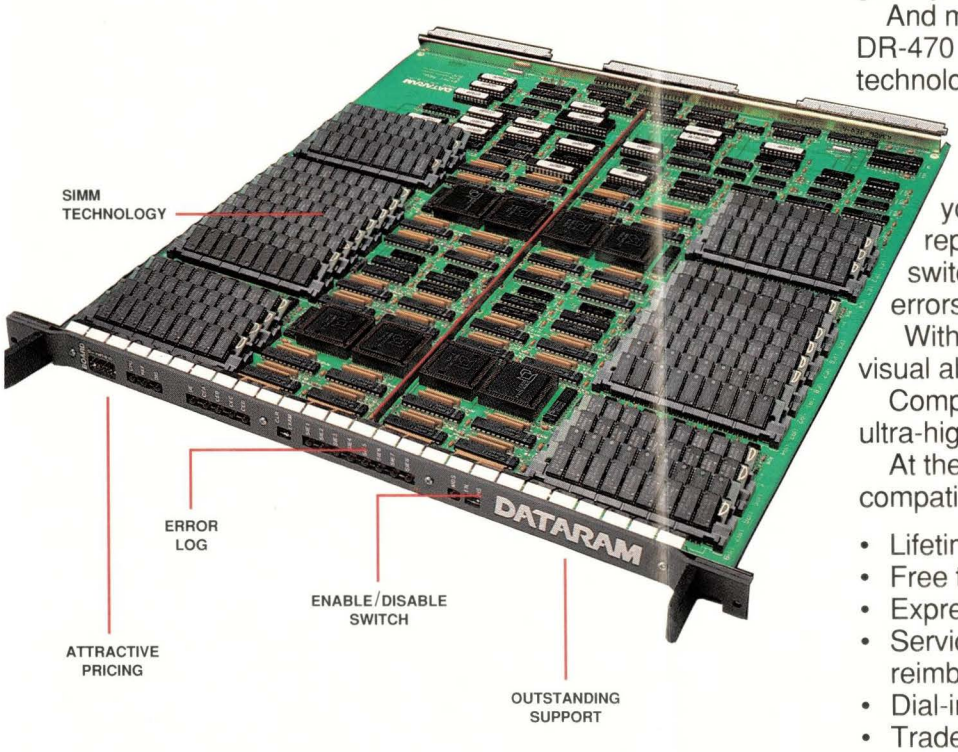

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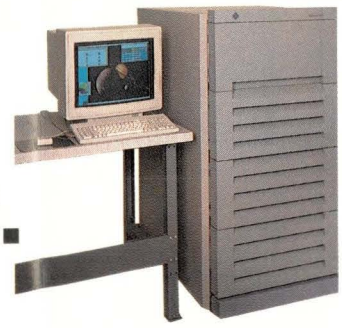

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by MICHAEL O'BRIEN

"It'll be jolly."
–Laura Breeden

"Hmmm."
–Dan Long

"We're out of M&Ms."
–R. Dennis Rockwell

"I'm not the first postmaster in my family."
–Charlotte Mooers

"Ha ha ha ha ha!"
–Diane Dustman

"...CREN will therefore discontinue all CSNET Services, including PhoneNet, Dial-Up IP, Leased-Line, West Coast Cluster, and X25Net, as of September 15, 1991. CSNET Internet Service will terminate June 30, 1991."
–Ira Fuchs

"How rustic!"
–Anon

Q: Why the black armband on Mr. Protocol? And what's with the enormous plate of chocolate-chip cookies? And what in the world is that huge pile of empty Big Stuff Ding-Dong wrappers doing in the doorway?

A: You will have to pardon Mr. Protocol. He is busy drowning his sorrows. The network that gave him his birth is coming to an end.

Although Mr. P. is about 967 years old, he was born (paradoxically, of course–how else?) in 1984 at the Coordination and Information Center of the Computer Science Research Network at BBN Labs Inc. in Cambridge, MA. (For the sake of verisimilitude, I should describe the weather attending the event. Although no special note was taken at the time, it seems safe to say that it was probably rotten. This is Massachusetts we're talking about, after all. Those who remember fine days there do so with great vividness and clarity. (It's the contrast that makes them so memorable.)

To explain how that came about we'll have to back up a little bit, and describe the genesis of this amazing conflation of a network.

The problem with a real, honest history of CSNET is that one must realize that nearly all of the principals involved had both a private and a public motive for becoming involved. It would be rash to make assumptions about which motive was stronger in any given case. In a few cases it would be rash to publicly mention the private motive at all. However, Mr.

Protocol feels that it is high praise indeed to be able to say that in no case of which he is aware was the private motive any less praiseworthy than the public one.

Consider, for example, the man who seems to have started it all: Dr. Larry Landweber of the University of Wisconsin. In May of 1979, Dr. Landweber, then chairman of the CS Department, invited representatives from other CS departments, the Defense Advanced Research Projects Agency (DARPA) and the National Science Foundation (NSF), to Wisconsin to discuss "the feasibility of establishing a computer-science-department research computer network."

The fact is that many of the participants in that meeting, including Dr. Landweber, had been victims of an unfortunate combination of two facts of computerized life:

1.) Computer science departments that had access to the Arpanet were thereby furnished with far richer computational environments than departments that were not.
2.) The government, and not the universities, decided who was going to be on the Arpanet...and who was not.

Wisconsin had tried for years to get a node on the net, without success. Other colleges and universities, big and small, were in the same boat. In fact, a case can be made that CSNET was built by the combined will and efforts of the "have-nots" in the academic CS world, acting in the sheer desperation born of watching the "have" departments pull further and further ahead in prestige, funding, faculty, funding and funding.

Others have done a magnificent job of chronicling the early days of the effort that came to be known as CSNET. What Mr. Protocol wants to do is to record some impression of what it's like on the inside of the construction of a national computer network, from the viewpoint of the front lines. Some of the surrounding facts have to be given, though, to provide a context.

After several go-rounds, the NSF decided to provide $5 million in seed money to construct the network. This amount of money isn't enough to clone the Arpanet or anything like it. Also, the NSF wasn't willing to actually run the network beyond the stages of initial construction, so the money had to go to building an administrative skeleton as well. Initially, NSF managed the project because there was no way that an administrator at one institution could provide real authority for coordination of the efforts of others on the project who were employed elsewhere.

Even so, this provided a hallmark of the early days of CSNET. The original group of five people who ran the network, a "management committee" consisting of Landweber, David Farber at the University of Delaware, Peter Denning of Purdue, Tony Hearn, first of the University of Utah and later The Rand Corp. (which in a baffling move later changed its name to The RAND Corp.), and Bill Kern of the NSF. Bill Kern was in charge of the project while the NSF funded it. This was peculiar as Kern was a chemist, with no particular experience in computers or computer networking. He was, however, a believer in the project, and did a splendid job under what turned out to be difficult conditions.

So far as they knew, no one had ever run a distributed project like this before. They met face-to-face as often as the budget allowed, of course, but day-to-day operation and emergency situations alike had to be handled by a combination of telephone and electronic mail. Dr. Hearn reports the primary lesson to be learned from these early days was that all concerned had to learn to be very careful in using electronic mail for sensitive subjects. It's now well known that the absence of body language and other subtextual cues in electronic mail make for massive misunderstanding. The Usenet is a monumental tribute to the fact that this lesson is rarely learned. Certainly the members of the CSNET Management Committee had never been so thoroughly exposed to this effect before.

Misconstruction after misconstruction led to roadblock after roadblock. The other side of the coin is that the professionalism of those involved kept the damage limited to the members of the committee, so that the front-line troops were rarely if ever exposed to the fallout.

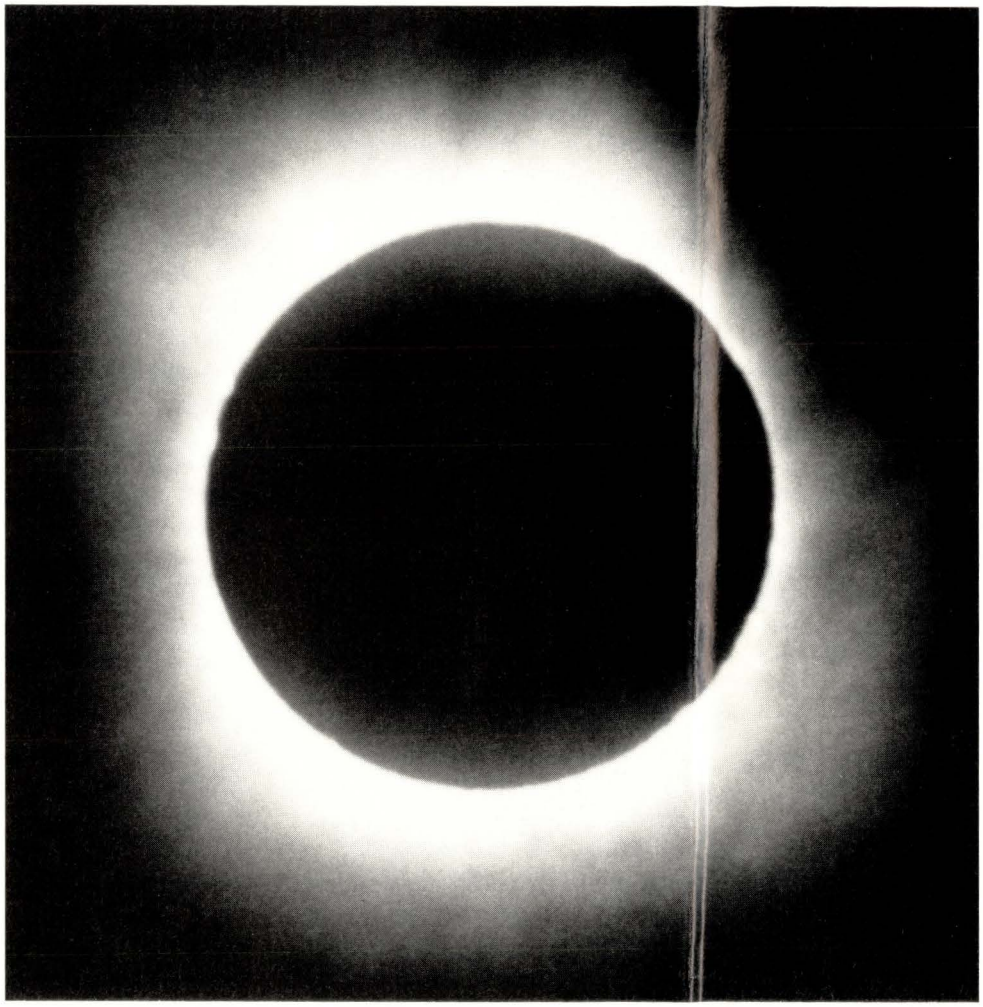
None of this prevented the committee from doing its job well, and in a timely manner, it must be said. The limitations of electronic mail merely made a number of gastroenterologists around the country very rich. The downside of the cloak of professionalism is the unwillingness to attempt to transcend the limitations of the medium. Mr. Protocol predicts that the "smiley face" made up of colon, hyphen and parenthesis will become accepted usage. Mr. Protocol even remembers the very first message on Usenet from the woman who thought that up, and kicks himself as a penance every night for not remembering who it was. :-) It looks pretty silly in print, though.

So what came out of all of this? Mr. Protocol is VERY glad you asked. These are his roots, after all.

Since CSNET couldn't be a physical network, it had to be a logical network. Initially, it provided dial-up mail service, via two "relay machines," which were also on the Arpanet. One was at BBN in Cambridge, and one at The Rand Corp. in Santa Monica; between them they hoped to cut down on phone charges, by having the closer machine do the calling to any particular site. In the final analysis, it was found that phone charges more than a couple of hundred miles away were rather flat, so the Rand machine was eventually decommissioned and moved to BBN.

Also implemented was a wing-ding User Name Server, which could look people up by name, partial name, affiliation, keyword and, seemingly, mental telepathy. There was also a Service Host, at Wisconsin, which was to be used for dial-up mail service for those folks at institutions with CSNET user populations so small that it didn't even make sense to have a computer do dial-up mail service to one of the relays. The Service Host notion was

What good is service that promises the moon when it means going for days without sun.



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based on the successful operation of THEORYNET, which Dr. Landweber had put together some years before that worked this way.

Here lie the dangers of predicting customer demands. The concept as a whole did fly. People signed up, even though large corporations had to fork over $30,000 per year for the privilege. Tiny places usually got routine fee reductions from the $5,000 academic price down to $2,500. The National Center for Atmospheric Research agreed to act as an umbrella organization, managing the contracts and the funds. However, the User Name Server, though it was used, proved difficult to keep up to date, despite (or perhaps because of) a really spiffy password-protected re-registration feature that let people change their network addresses when they moved from one place to another–no one ever remembered a password they'd last used five years before!

Meanwhile, THEORYNET history notwithstanding, the Service Host got about three people signed up, period, and was promptly moved to BBN and given a different role: administrative cycles for the newly formed Coordination and Information Center. And that's how `sh.cs.net` got its name, folks.

Running the Rand relay machine was an interesting exercise in networking. There was only one technical staff member on-site who understood the workings of the incredibly arcane MMDF software that ran the mail system, and one administrative staff member who understood the technical staff member's position. Everything was handled over the network. If the lone techie zoned, half the country's mail went down a rathole. This only happened once. Once was enough. CSNET being what it was, the boo-boo was promptly escalated to the very highest levels of the organization. Since no attempt at a cover-up had been made, no hot lava flowed back down in response. It was a nervy business, though.

Eventually, it was decided that running three service sites, then two, was just too expensive, partly because, as noted above, the expected savings in dial-up phone charges just didn't materialize. All the hardware was moved to BBN. Some of the people followed of their own volition (all right, two: me and Mr. Protocol, who hadn't even been born yet. Patience).

CSNET settled into what might be called its "middle years," using every communications technology in sight. First it got X.25 off the ground, so those who couldn't get on the Arpanet could still use all the networking services. Those folks got on Telenet instead, and sent IP packets hidden inside X.25 packets to the relay machine, which was on both Arpanet and Telenet. This poor overworked relay also handled dialing up all the PhoneNet sites on various schedules.

There were three main technical wizards at CSNET who traded around front-line responsibility for running the relay machine on what amounted to an hour-by-hour basis. You got one week on and two weeks off. During those two weeks you actually got some other work done sometimes. Because this "hot squat" job was so important, handing it off had to be exact. This was done by taking a piece of artwork owned by one of the wizards (a gorgeous rosewood-and-quartz-crystal wizard staff about seven feet high), and making it the "baton of office." Whoever had that staff leaning against the wall of their office was the Wizard of the Week. Every Monday morning, the previous week's wizard would gleefully march the staff into the office of the next victim, who had to be physically present to receive it. This resulted in possibly the only managment arrangement in the history of CSNET about which there was never any argument.

Eventually a permanent front-line warrior was hired to run the relay machine on a permanent basis. The first person to take this job came out of BBN's computer-operations arena, and hence was no stranger to trench warfare. Life became much easier on everyone else at this point. Continued sanity had been rendered possible from the beginning only by the choice of postmaster–CSNET has only had one, and has only needed one.

This was one of CSNET's more fortunate features–extremely high-quality, extremely capable, extremely compatible staff members. Socially as well as professionally, these people got along better than almost any other group of people of whom Mr. Protocol is aware. Eating soft-shelled lobster together by candlelight in a cottage on an island off the Maine coast acted as a powerful bonding experience, it must be admitted. Not to mention coming in the Monday after Easter and finding chocolate eggs all over one's office. Now that Mr. Protocol comes to consider the matter, he realizes that the whole operation was food-oriented. The main CSNET filing cabinet invariably had a gigantic Tupperware container at the back, filled to the brim with M&Ms. Hacker food, indeed.

Probably the greatest obstacle that CSNET had to overcome was to become solvent. This it managed to do, until expedience finally forced a merger with BITNET, and CREN was formed as an umbrella organization for both. When the regional networks finally firmed up as the delivery agents for the new NSFNet backbone, and the Arpanet was replaced, the need for CSNET dwindled. Finally, as the introductory quotation indicates, it was decided to terminate the network and dismantle it.

Mr. Protocol was born at a point where it was becoming painfully clear that ordinary documentation just was not getting the details and intricacies of electronic mail across to the users. Like `sendmail`, MMDF has the capability of rewriting mail addresses and bridging networks, but not all the network bridges were as competent, UUCP mail being a prime example. It was finally decided that a highly readable (so it would be read!) question-and-answer advice column was needed in the CSNET Forum, the on-line electronic publication that is sent periodically to CSNET member sites. Thus was born a Mr. Protocol who was edgier, more political and altogether whackier than the fellow who graces these pages. A restricted audience permits greater freedom, at times.

(Readers may always vote by paper or electronic mail, of course! Opinions are always welcome–we frequently run out of firestarters and fish-wrapping paper here at the Protocol Farm.)

As you read this, the last pieces of CSNET are being dismantled. The first real alternative to the Arpanet has been through its entire life cycle, and we are witnessing the death of the second national net. How long will the current Internet last? How long will Usenet last? "Imminent death of the net predicted" is a humorous phrase over on Usenet, invoked to chide those of an overly apocalyptic outlook. Two nets have died already, though. Which one is next? And what will take its place?

In Perspective

For only the second time, Mr. Protocol insists I quote him directly: "Ave, CSNET. Requiescat in pace. I must name and thank those who most immediately made it possible. No administrators, who have their names in the literature and are well enough known anyhow. No, I thank, personally, those who helped me. Tony Hearn, Dick Edmiston, thank you both. My thanks and my love to Laura Breeden, Dan Long, Diane Dustman, Charlotte Mooers, Dennis Rockwell and Joanne Rheaume. May you continue to find my M&Ms and chocolate eggs when CSNET is a memory. And finally, thanks and gratitude to the heroes of our story: `sh.cs.net`, `relay.cs.net`, and `dev.cs.net`. You have done well, all of you. As long as I can still fuss, you will not be forgotten."

Acknowledgements

1. Comer, D., "The Computer Science Research Network CSNET: A History and Status Report," CACM V3n10, October 1983, pp. 747-753.
2. Denning, P., Hearn, A., & Kern, C.W., "History and Overview of CSNET," Proc. ACM SIGCOMM, 1983, pp. 138-145. ⊸

Michael O'Brien and **Mr. Protocol** both helped to build CSNET, the Computer Science Research Net.

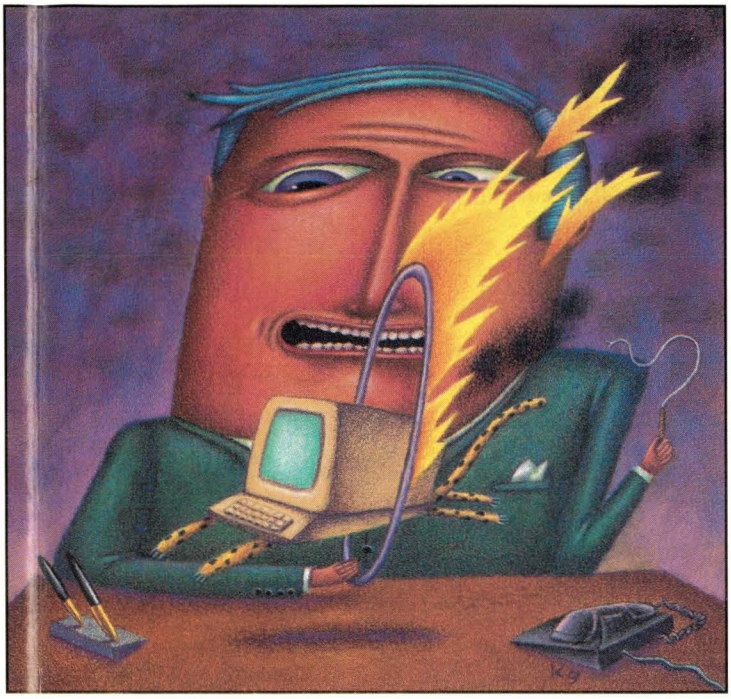

ILLUSTRATION BY KEITH GRAVES

by **PETER COLLINSON**,
Hillside Systems

Job Control

When I first came across job control in 4.0 BSD, it was a revelation. I felt that this was something that I had always wanted and had always needed on a UNIX system. Job control was the main reason I decided to run BSD `vmunix` on the VAX 11/780 that was the mainframe UNIX service at the University of Kent (United Kingdom) where I worked. We had no other machine; this was *the* UNIX system. It was even called "UNIX." The name was changed later when we realized that riches in the form of other machines running UNIX were likely to materialize.

Job control is good because you don't have to plan ahead. You are freed from the responsibility of guessing when a sequence of commands needs to run in the background. With job control, you can start a command running and decide later that you need to type Control-Z to suspend it, and perhaps type `bg` to restart it in the background.

The decision to suspend the command can happen because it is taking too long and you want to do something else; or perhaps someone walks into the room and asks you a question. The strength of job control is that you can suspend the job and do something else with no prior planning. You don't have to type an ampersand at the end of the line to launch the program in the background. You don't need to have a shell layer ready and waiting for use when the unexpected visitor calls.

Processes

All work on UNIX is achieved by creating and running processes. After you login, you are presented with a shell prompt perhaps a percent character: `%`. You are talking to a single process, the C shell in this case. When you type an `ls` command, you will create a new process. The shell *forks* to create a new process that is an exact copy of the original shell. This new process will *exec* a file containing the binary of the `ls` command. The *exec* system call overlays the current process creating a new virtual machine containing a new program.

The important notion to grasp is that the original shell *and* the new process are running in parallel. This parallelism isn't readily apparent after you type a command because the shell is waiting for the new process to terminate. The shell has gone to sleep until its child dies. If you don't want the shell to wait, then you can start the command "in the background" by ending the line with the ampersand character.

```
% ls &
```

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The "in the background" is a slight fiction. In reality both processes are running with equal status. This is easy to see. Type:

```
% ls & ls &
```

What you should see is intermingled output from three processes: the two `ls` programs and the shell.

In early UNIX systems, this intermingling was also possible on input. Two programs could be started with both taking input from the keyboard. Both processes vied for possession of the valuable text that you were typing, often with unpredictable results.

Keyboard Signals

One way of highlighting the difference between background and foreground processes is to think about how signals from the keyboard are generated. When you hit the interrupt key on your keyboard (usually Control-C), a signal, SIGINT, is delivered to the command that you have just started. The process will take the hint and die, if the signal is not being ignored.

The terminal driver has a problem. It needs to send the signal to all the processes that are currently attached to the particular line, owned by the user and not in the background. Remember that the user can have started a complex pipeline from the command line, and each of the constituent processes should be sent the signal. When the user hits the interrupt key, the kernel needs to search through all the processes running on the system to find suitable candidates to receive the signal. The scan needs to be as simple and fast as possible.

The process hierarchy of UNIX begins to help here. First, every process is descended from a parent by virtue of the `fork` system call. If the system knows something about a process, then this information is passed into its children "for free." Second, every process has the notion of a "controlling terminal." This is acquired when a process with no controlling terminal first opens a particular line. Again, the fork operation passes the knowledge of this into any children.

Early UNIX systems simply used the controlling terminal as an indicator of where to dispatch signals. When the user hit interrupt, the system scanned all the processes looking for any whose controlling terminal matched the user's line. When a process was found, the signal was posted. This was a little rough and ready. Shells and other programs have to work hard to ensure that processes started in the background are ignoring signals appropriately.

Process Groups

To provide finer control, UNIX Version 7 introduced the idea of process groups. All the processes for a particular user contain a numeric field holding a unique process group ID. The terminal driver knows this number and uses it to send signals to the members of the group. Scanning for appropriate processes is now easy, the kernel just needs to look for the process group value and post the signal.

Since the group id needs to be a unique number, it is set to the process id (PID) of the user's shell. This is guaranteed to be unique for the life of the shell. When the first process opens the terminal, the terminal driver code will notice that the process group id field in its internal data structure is empty. The code takes the PID of the current process and loads the process group id field from it. The terminal driver stores the process group id so that it may be used when dispatching signals. The user then merrily types commands and each forked child automatically inherits the process group id.

The process group mechanism leads the way towards job control. On UNIX V7, all the user's processes from one login session were in the same process group. The first significant change was to make the C shell place the processes from each command line into a separate process group. This is a "job."

The idea is to change the process group stored in the terminal so that it is the same value as the foreground job. Then signals can be dispatched to the processes of interest, and only to the processes of interest, the ones in the foreground process group.

Also, the terminal driver can distinguish between background and foreground processes by comparing the terminal process group id with the one stored in a process. If they differ, it's a background process. If a background process attempts to read from the terminal, then the kernel sends it a signal that puts it to sleep. Optionally, a similar action can be made to happen if a background process attempts to write to the terminal.

Process group control needs a new system call, `setpgrp`, to set the process group in the current process. Also it needs some method of changing the process group stored in the terminal. On BSD systems, this was accomplished by an `ioctl` call. The BSD systems also support a `getpgrp` call to return the current process group.

Signals

The final piece in the puzzle is the provision of three special signals that are used to control switching of foreground and background jobs. The first is called SIGTSTP; it is sent to the process group of the current foreground job from the terminal handler. The signal is usually bound to Control-Z, and with `csh`, the user gets some interaction like:

```
% cc -O hello.c
^Z
Stopped
%
```

The word "Stopped" here is confusing, especially to VMS users who think that the job has been killed. But the process hasn't stopped forever, it has merely been suspended. It would be better if `csh` printed "Suspended."

When the user types Control-Z, the SIGTSTP signal is sent to all the processes in the current foreground process group. Many commands are naive and will have taken no special action to ignore or catch this signal. The default action is to put the process to sleep and inform its parent

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that something has changed by sending it a signal, SIGCHLD. The user's csh wakes up and notices that its current foreground job has been suspended, tells the user this by printing the "Stopped" message and then grabs the terminal back by loading its process group. Finally, it prints a prompt.

The SIGTSTP signal can be caught by process. This is desirable for applications like vi that mess with the terminal state to allow users to randomly access the screen. When a SIGTSTP signal is received, vi will reset the terminal to a known friendly state before relinquishing control to the shell. POSIX has changed this, and made it the shell's responsibility to reset the terminal state.

The SIGSTOP signal behaves in exactly the same way as SIGTSTP except that it cannot be caught by the process. This signal is used when sending a STOP instruction from a kill command.

Managing Jobs

There are several built-in csh commands that manipulate jobs. The first lists all the current jobs that csh knows about.

```
% jobs
[1] + Stopped. cc -O hello.c
% mail pc
Subject:^Z
Stopped
% jobs
[1] - Stopped. cc -O hello.c
[2] + Stopped mail pc
%
```

Each job is given a number and this appears in square brackets at the start of the output from the jobs command. The plus symbol identifies the current default foreground job. Saying % fg will restart the mail command as a foreground job. When preceded by a percent "%" character, the job number is used to identify a particular job. So, for example, you can type

```
% fg %1
```

to start the cc command running again in the foreground. A shorthand for this is simply % %1. More usefully, the command bg will start the command running again in the background.

```
% bg %1
[1] cc -O hello.c &
%
```

The fg and bg commands manipulate the stored process group in the terminal driver and then restart the processes in the group by sending the continue signal, SIGCONT.

I/O From Background Processes

If a background process attempts to read from the controlling terminal, then the terminal driver sends it a signal, SIGTTIN, that behaves like SIGTSTP. The process is put to sleep until it is placed in the foreground. csh tells you the job needs input.

```
% jobs
[1] + Stopped (tty input) dump 0f /dev/rsd0g
%
```

When you put the job in the foreground, the program is restarted from where it was stopped, in the read system call. If the program printed a prompt, then it will not be reprinted.

Traditionally, UNIX systems permitted background programs to write on the screen when output was available. Most people continue with this setup. However, you can force a background job to be suspended if it tries to write on the screen. To turn this feature on, you say:

```
% stty tostop
```

Then when a background process tries to write to the screen, it will be sent a signal, SIGTTOU, that again acts like SIGTSTP.

POSIX

The POSIX.1 system-interface standard has adopted the BSD job-control model, but has changed it slightly. The POSIX interface seems to be supported by my Sun running 4.1.1. The getpgrp call has been removed since setpgrp returns the value anyway. The handling of SIGCONT is slightly different. Most of the changes provide rational interfaces to activities that were previously implemented by direct calls to ioctl routines.

For example, the routine tcgetpgrp replaces the previous ioctl call to load a process group into the controlling terminal. At least, the promotion to a "real" routine means that the action now has its own manual page rather than being hidden deep in the description of a zillion other things.

Another new addition is the invention of *sessions*. A session implements what process groups did originally. A session is a set of process groups that are associated with a controlling terminal. The new system call setsid() detaches the current process from its controlling terminal and uses the process id to create a new session. The next terminal that is opened becomes the new controlling terminal for the session. Again, this is a tidy-up of some fairly disgusting bits of code. It was always messy to detach programs from controlling terminals.

Do We Need Job Control Now?

Some of the reasons for job control's existence disappeared when systems began to support windows. If someone walks in to ask a question these days, you probably just open another window on your workstation and type there. If one window is busy doing something, then that other task can be done in another window.

I persist in using job control on my Sun running X windows. One reason is that the body is lazy and reluctant to move it's hands from the keyboard to grasp the mouse, find

a root window, click the button, select the "New Window" option from the menu and finally sweep out a new area. Typing Control-Z is less effort.

X freaks will no doubt suggest that I should bind all these actions to a special key on the keyboard to make life easier. Well, I hate that too. You invent some task and bind it to some secret key that you cannot find easily on the keyboard when you want it. It's the secrecy I detest; this is just not good interface design.

Another reason for not creating a new window is that it just takes too long. There is a perceptible wait while the window is established, the delay gets in the way of the chain of thought. It interferes with the question that was the original reason for starting a new window.

Again, X freaks have heard all this before and will leap to defend the system with shouts of "get a faster processor." Yes, this is a solution but it's a little less available when you are buying the machine with your own money. I note that this shout greatly pleases the hardware manufacturers. All the MIPS and MFLOPS that the hardware folks keep finding for us are seemingly ending up in the mechanism of the system and not in the jobs that we have to do. I will agree that this is an overstatement of the fact, but there is a grain of truth in it.

Ask yourself, "why do X systems need to support icons and the notion of iconization?" Mostly it's because it's the only way to have something pop up on the screen without that annoying delay. I contend that you shouldn't need to do this. It's back to the old reason why job control is desirable. If I have to create an icon, then I have to plan ahead and I just don't want to. Typing Control-Z is easier.

Reading

For the BSD view of the world, consult: *The Design and Implementation of the 4.3BSD UNIX Operating System* by Sam Leffler, Kirk McKusick, Mike Karels and John Quarterman. This is published by Addison-Wesley.

For POSIX, there is a lot of informative stuff about job control in the actual standard P1003.1:1990, now published as ISO/IEC 9945-1 by the IEEE. Its full title is *Information Technology–Portable Operating System Interface (POSIX)–Part 1: System Application Program Interface (API)* [C Language]. There aren't many books with such a succinct title.

If this is impenetrable, you might like to look at *The POSIX.1 Standard, A Programmer's Guide* by Fred Zlotnick, published by Benjamin/Cummings.

Thanks

Thanks to Kirk McKusick who read a draft of this and made helpful comments.

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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I/Opener

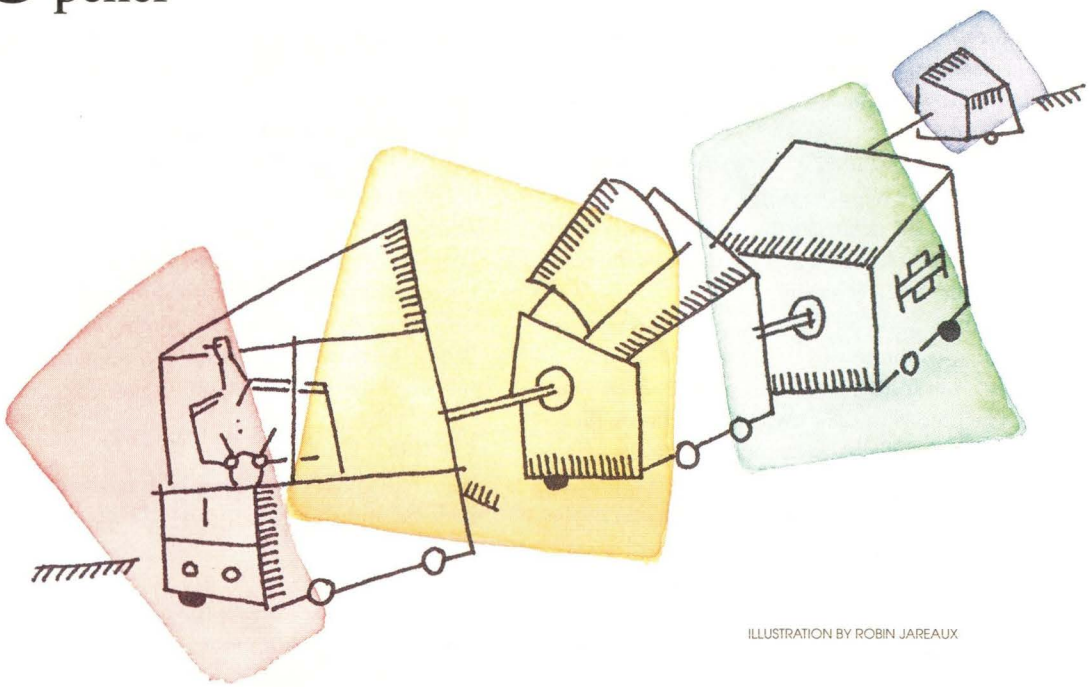


ILLUSTRATION BY ROBIN JAREAUX

The Dark Side of SCSI

by RICHARD MORIN,
Technical Editor

Followers of this space may recall that I am a strong enthusiast for the SCSI bus. Last month, for instance, I used it to introduce some concepts of object orientation. Far earlier (*SunExpert*, November 1989, Page 23 and December 1989, Page 23), I touted SCSI in a pair of columns on interfaces.

In any case, let me reassert my position: SCSI is a big win for workstations, providing convenient access to a wide range of devices. The cabling is user friendly, the devices are generally small and quiet and the drivers are relatively uncomplicated.

Nonetheless, SCSI is not without problems, both for vendors and users. Things get even more complicated when UNIX is involved. This column, in any event, will review the origins of the difficulties, offering a few hints, rants and possible solutions. To get started, let's look at some hardware issues.

Bus Basics

Buses provide devices (processors, peripherals, memory, etc.) with shared, generalized connections. Instead of running a specialized communication protocol, bus participants agree to accept a common (abstract) vocabulary. An arbitrated set of wires is substituted for the dedicated connection that might otherwise be used.

These compromises provide several benefits. Different combinations of devices can be put on a bus, providing great flexibility. Bus-interface chips can be mass produced, reducing their cost. Software interfacing becomes more standardized, at some cost in increased complexity.

If the bus is standardized, a broader market may develop. SCSI peripherals, for instance, can be used with a broad range of machines. This increases their availability for all participating machines, while reducing costs. The Ethernet, a bus in all but name, is another wildly successful example.

Bus-addressing methods vary. On the SCSI bus, each device has a unique ID number, ranging from zero through seven. The CPU uses one ID (typically ID seven), leaving IDs zero through six free for use by peripherals. Each SCSI device is allowed to have up to eight logical units (LUNs), but this option is seldom exercised. Instead, one commonly sees three SCSI disks sitting on the bus, each taking up an entire SCSI ID.

Termination

If the bus is long, compared to the speed of the signals used, reflections

Trial and error, combined with frequent `sync (1)` commands seems to be the only way to tell what will work.

can become a problem. Consider the following description of a properly terminated bus. A device at one end emits a series of pulses, which travel down the bus in both directions. The pulses are absorbed at each end by a set of resistors, or perhaps an active termination circuit.

If the bus lacks termination at one end, the scenario is somewhat different. The pulses, hitting the end of the bus, bounce back toward the sender. Interfering with following pulses, they confuse any receiving devices. If neither end is terminated, multiple reflections and the lack of stabilizing circuitry will cause utter chaos. A sufficiently short SCSI bus may squeak by with improper termination, but this is luck, not engineering.

Bus length is a factor because of the time (about a foot per nanosecond) pulses take in traversing the bus. If the bus is short, echoes only add a bit of noise after each pulse. Most interface electronics can deal with this quite easily. As the bus gets longer, noise can extend into following pulses. Eventually, the degradation can prevent devices from working properly.

On most SCSI implementations, the computer sits at one end of the bus. Devices are "daisy-chained" (cabled together) for a maximum length of six meters. The computer handles termination of one end of the bus; the other end must be handled by the last device or by an external terminator.

Many erratic SCSI buses are caused by termination errors. You want one terminator at each end of the bus, no more, no less, and none in the middle. Consequently, external termination is the safest and most convenient approach. Internal terminators are difficult to add or remove, and aren't obvious on casual inspection. I remove all internal terminators, and install a single external terminator at the end of the chain.

Saving Power

A system with several SCSI devices can generate unwanted heat and noise, while consuming excess power. To avoid these problems, some users power down devices that are not in use. Most SCSI devices turn off and on quietly, leaving the bus alone when they are off.

The Sun literature explicitly warns against doing this with the CD-ROM drive, however, and power-cycling my QIC-24 shoebox appears to confuse my EOD drive. Trial and error, combined with frequent `sync(1)` commands, seems to be the only way to tell what will work. If power, heat and noise are not important, just leave everything turned on.

SCSI Stubs and Flubs

Properly speaking, the SCSI bus should run in a clean line past all of the devices. The bus travels along the cable, enters the device enclosure, loops past the device(s), then exits to the next cable (or terminator). In practice, some vendors cheat by using stubs inside their enclosures.

This is convenient because it allows the vendor to connect the two SCSI plugs, then trail a cable off to the device(s). Unfortunately, it puts an

unterminated stub on the bus, causing reflections and/or other electrical problems. With the increasing speed of SCSI buses, this practice can produce real performance problems. Most modern SCSI peripherals will not have stubs; check out your older ones if you are having problems.

Terminator power is another trouble spot. SCSI devices are free to ignore the terminator power line, use power from it or supply it with power. If two or more devices supply different voltage levels, an argument can occur, generating heat and possible smoke. Fortunately, most devices fuse and/or current-limit their power lines, avoiding any real damage.

Occasionally, however, a vendor pulls a real lulu. Sun's 3/60 and 4/110 models grounded the terminator power line, defeating any attempts to supply power to the line. Despite some snide comments on *Sun-Spots*, this was not an attempt to close the Sun to third-party peripherals. Instead, it was a simple (though embarrassing) mistake.

Sun is by no means the only culprit, however. Some low-cost devices have a single SCSI plug and/or soldered-in termination resistors. Either of these prevents the device from sitting in the middle of the bus. More critically, two such devices cannot be used together at all.

At least one SCSI interface employs a low-pass filter, presumably making it less susceptible to noise. Sadly, it also makes it unable to respond to modern, high-speed SCSI chips. The device in question didn't respond at all to INQUIRE commands from an SGI IRIS, but worked just fine on a slower platform.

Devices sometimes fail to wait for processor acknowledgement of data before changing the bus phase. This presents the computer with conflicting information, and can make the device unusable on some machines.

Incompatibilities between SCSI and SCSI-2 can highlight existing problems. SCSI devices are supposed to reject messages that they do not support. If the driver sends a message asking about synchronous mode, the device should not lock up, reset or show other antisocial behavior.

Going the other direction, a SCSI driver should not enforce arbitrary limits on device capabilities. Some disk drivers, using the short forms of certain SCSI commands, limit the usable disk size to 1 GB. This is not acceptable in a world of economical 2-GB disk drives.

UNIX Gotchas

UNIX has some inherent drawbacks as a user of SCSI devices. In particular, UNIX works poorly with time-sensitive devices. With a single-tasking operating system, such as MS-DOS, devices can expect an immediate response to any signal. SCSI vendors occasionally rely on this fact, putting only minimal buffering into their devices.

Multitasking systems (e.g., UNIX) may not respond in anything like real time, however. If a higher-priority device has the kernel occupied, the lesser interrupt will be forced to wait its turn. In the interim, buffers can over or underflow, causing the device to malfunction.

The clock interrupt is a particularly insidious culprit. UNIX treats the clock with great reverence, giving it the highest possible interrupt level. Normally, this doesn't present a problem; the clock-interrupt code runs quickly and then exits. Periodically, however, the code does a sweep of the system's virtual memory, taking a substantial number of milliseconds. If a device gets caught by this, it had better be prepared to wait.

UNIX processes are even less capable of dealing with real-time events. Latencies of hundreds of milliseconds are quite common. In a really extreme situation, a process can be locked out for well over a second. To determine whether a SCSI device can be driven from a UNIX process, you must calculate how long it can wait for servicing of its requests. If the time isn't substantial, you may have a problem.

A SCSI Scenario

Assume that you are the local SCSI guru, and Fred has just walked in with

an inoperable SCSI disk drive. "I just got a great deal on this 200-MB disk, but I can't seem to make it work." After searching around for an appropriate combination of adapter cables (several different plugs are used in the industry), you get the drive hooked up to your testbed.

Doing a TEST UNIT READY, you determine that the drive actually answers to its ID, and says it is ready for use. The INQUIRE command then retrieves and displays the manufacturer's device-information table, which confirms the device manufacturer, size, type, etc. Unfortunately, placing a hand on the disk, you can't feel any reassuring vibration.

Inspiration strikes. You send a START UNIT command, and the thing spins up. Reads and writes now work, and the disk appears to be functional. Of course, Fred will need to issue a START UNIT command at system start-up time, but `/etc/rc.local` will do that readily enough. Fred's real complaint, in any case, is that his bargain 200-MB disk only appears to hold 100 MB. Can't please everyone, I guess. ...

The scenario above presupposes a set of SCSI access tools, similar in concept to `stty`, `tset`, etc. Unfortunately, no such toolkit is supplied by most UNIX vendors. Even the library calls needed to generate basic SCSI commands are missing. Consequently, you might find yourself needing to write kernel code, when all you want to do is issue an INQUIRE command.

Vulcan Software, a SCSI toolkit for SPARC (and some other) platforms, fills this gap. It consists of a generic pass-through device driver, a set of generic and device-specific interface routines, and a handful of SCSI administration commands. Contact Vulcan Laboratories at (415) 863-7988 for more information.

Further Reading

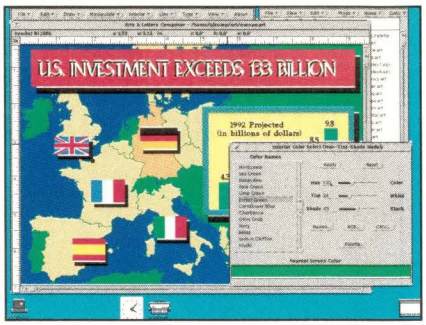
There isn't much published literature on SCSI. The ANSI SCSI-2 draft specification (X3.131), is available from Global Engineering Documents (P.O. Box 19539, 2805 McGaw Ave., Irvine, CA 92713, (800) 854-7179). Unfortunately, it is voluminous and largely unreadable, and is suitable only for desperate or severely masochistic engineers. For a lightweight introductory work, try *SCSI: Understanding the Small Computer System Interface* (NCR, Prentice-Hall, 1990). *The Fast Track to SCSI* (Fujitsu, Prentice-Hall, 1991) is a much larger work, suitable for SCSI designers. As its name implies, it is a guide to using Fujitsu SCSI chips. It contains a number of useful figures and explanations, however, and should be useful to a SCSI designer.

Finally, ENDL has produced the very readable and concise *SCSI Bench Reference* (Stai, ENDL Publications, 1989), and is putting out an extended set of SCSI references, entitled *The SCSI Encyclopedia.* Contact ENDL Publications (14426 Black Walnut Court, Saratoga, CA 95070) for more information.

Acknowledgements

The material in this column was prepared with the help of several SCSI experts, who regularly battle SCSI's more obscure aspects. I would particularly like to thank Gene Dronek of Vulcan Laboratories. Gene has convinced a number of SCSI devices and UNIX drivers to work together, despite their serious and committed resistance. He has also attempted to teach me the rudiments of SCSI, with considerably less success.

Richard Morin may be reached at Canta Forda Computer Laboratory, P.O. Box 1488, Pacifica, CA 94044. His electronic address is `cfcl!rdm@apple.com`, or he can be reached at `rdm@expert.com`.



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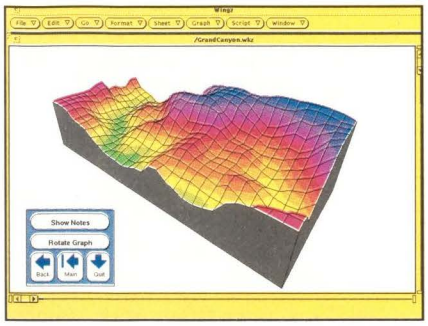

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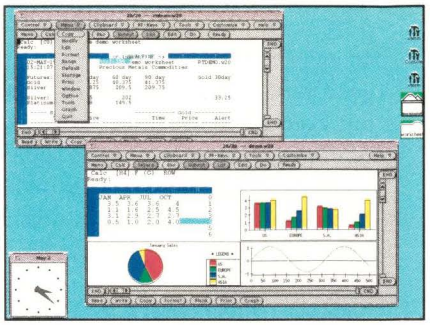

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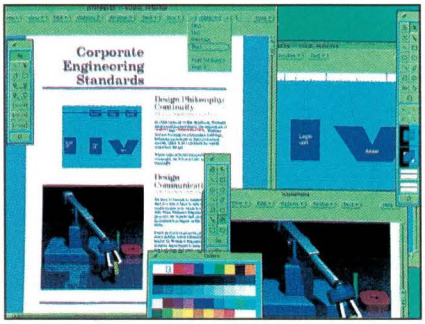

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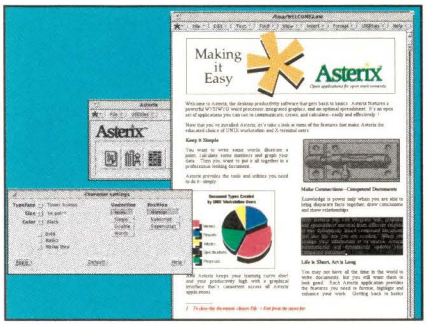

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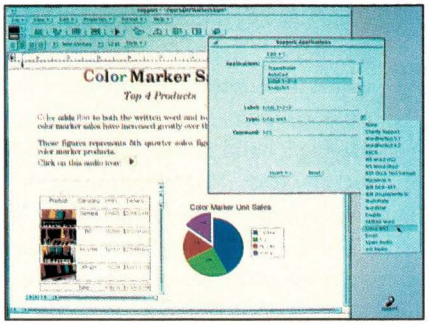

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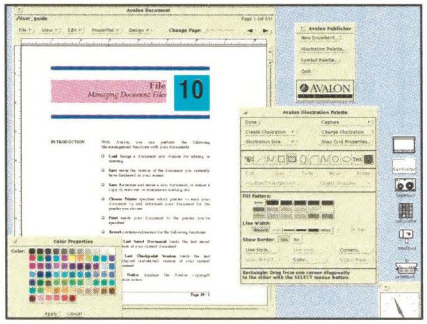

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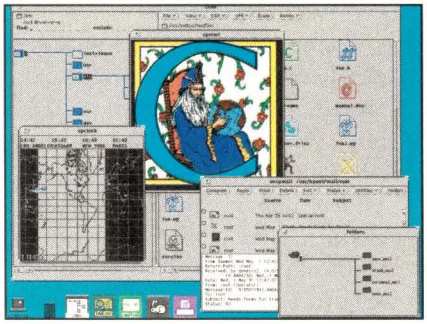

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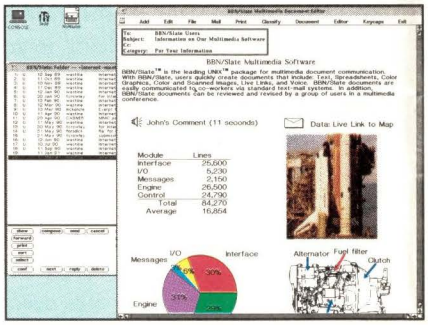

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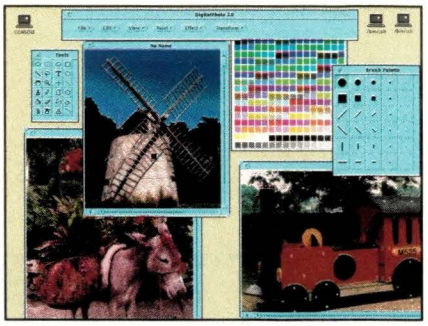

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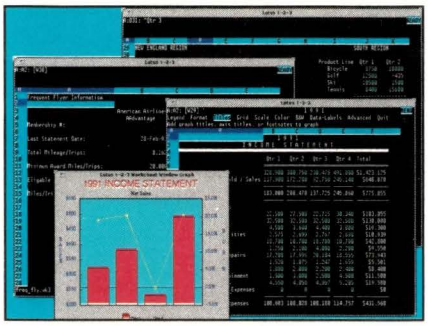

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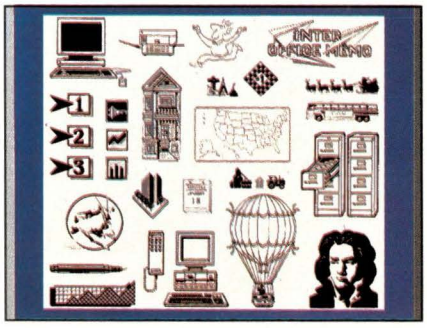

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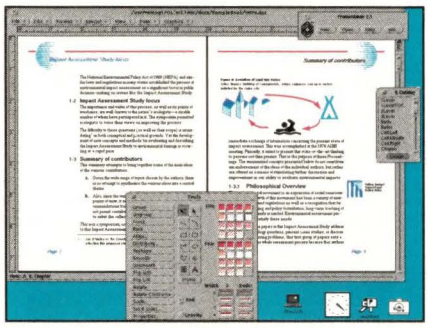

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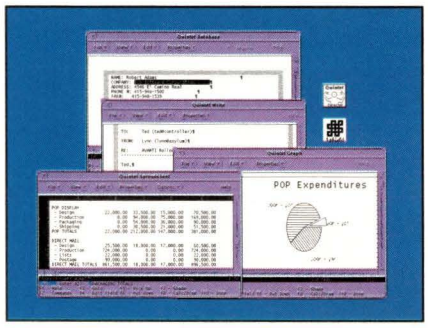

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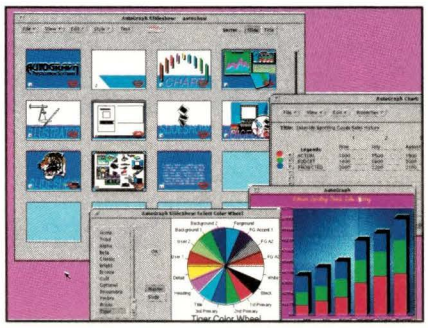

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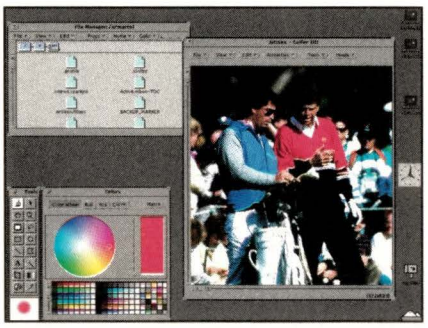

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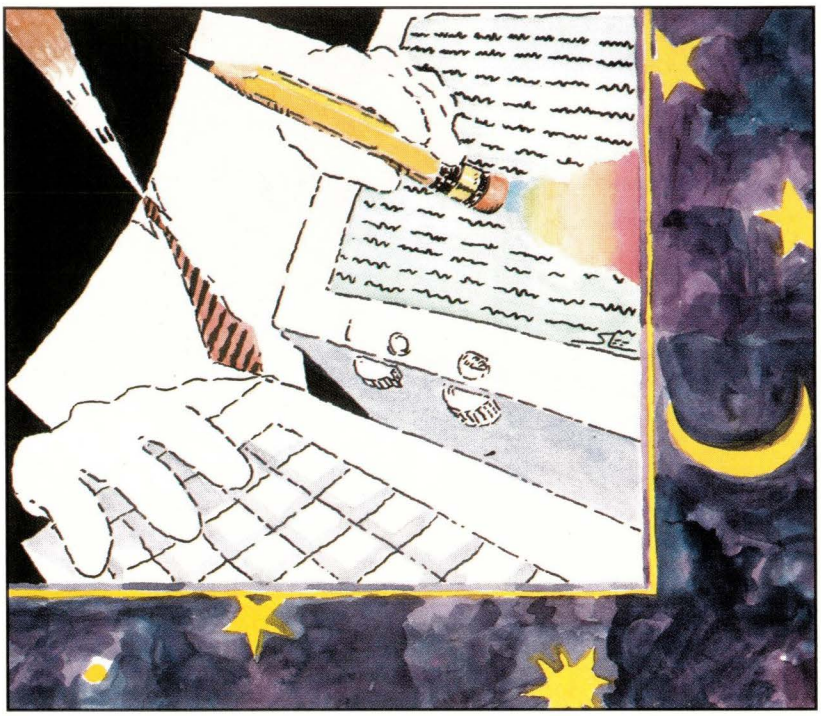

ILLUSTRATION BY S. H. LEE

Characters, Systems, Standards, Orthography

by PETER H. SALUS

Long ago, in a previous incarnation, I was a professor of linguistics. In addition to this column, I still read and write in that field. As a consequence, I most likely care too much about representing languages on a screen and in print.

Over the past months, discussion has raged in groups concerning standards and on the linguist mailing list concerning representations of variant scripts, alphabetic and syllabic scripts other than Roman, characters, and accents and other diacritics. The discussions have involved emminent typographers (like Charles Bigelow), computer scientists (like Stavros Macrakis and Hitoshi Doi) and a number of linguists. One commentator remarked that he had "been arguing from the beginning that character sets are too important to be left entirely to specialists in computer languages (who have their own priorities) and that natural-language orthography is serious business."

Right now, there are two opposing views of the way that natural languages should be approached: that of ISO DIS 10646 and Unicode. The question is whether to have a "closed-repertoire" character set (like the ISO proposal, which fixes single character codes for a limited, but large, set of letter plus diacritic combinations) or an "open-repertoire" set (like Unicode, which allows arbitrary combinations, but as multiple codes).

As Bigelow has pointed out, "Most major font formats in use today, including PostScript Type1, Apple/Microsoft TrueType, and Sun F3, etc., actually store most letter plus diacritic combinations as subroutine calls to the separate elements–letter, diacritic–rather than as a fully formed character comprising letter and diacritic. That is to say, when a program like a wordprocessor calls out the character code for, say, a-acute, the font looks up the a, and then looks up the acute, and then looks up some information about where to position the acute over the a, puts the pieces together, rasterizes the new composite and hands it over for display and/or printing."

This has two advantages: economy (it reduces the memory requirements) and power (it allows the potential for arbitrary production of all possible letter plus accent combinations).

As Bigelow states, "the technology of

The Cast of Characters

Code Set	Format				Character Set		
CS0	0xxxxxxx				ASCII		
CS1	1xxxxxxx	1xxxxxxx			SICGCC plane	1	
CS2	8E	A2	1xxxxxxx	1xxxxxxx	SICGCC plane	2	
CS2	8E	A3	1xxxxxxx	1xxxxxxx	SICGCC plane	3	
:		A4				4	
:	8E	|	1xxxxxxx	1xxxxxxx	SICGCC plane	|	
:		AD				13	
CS2	8E	AE	1xxxxxxx	1xxxxxxx	SICGCC plane	14	(EDPC 6319 Characters)
CS2	8E	AF	1xxxxxxx	1xxxxxxx	SICGCC plane	15	(III 7xxx Characters)
CS2	8E	B0	1xxxxxxx	1xxxxxxx	SICGCC plane	16	

The Chinese system of characters and "planes" allows a large number of constructs. Currently, only the first two or three planes are employed.

fonts and the art of type design provide the means for either closed or open character sets. The decision of which to use is based on other factors, including politics."

Paul Hackney (from the United Kingdom) noted that "The most commonly used coding for text is the ASCII (American Standard Code for Information Interchange) character set, which does not provide for characters containing diacritical marks. As it stands, only seven bits of a possible eight bits are used, giving 128 encodings (the reason for this is historical–the 8th bit was used for parity checking). Various extensions are in use (ISO multinational, DEC multinational, et al.) that provide another 128 encodings containing the commonly used European characters.

"I recently came across an article in *New Scientist* (a popular and serious scientific magazine), which described a new coding system ["Computer code speaks many tongues," *New Scientist,* 9 March, Page 28]. Apparently a consortium of American companies called "Unicode" (including IBM, Apple, Sun, etc.) have chosen to represent their character set using a 16-bit code, which will give a possible 65,536 characters. They suggest that 6,000 codes suffice for all the alphabets of Europe, the Middle East and the Indian subcontinent. Chinese, Japanese and Korean require about another 18,000 codes."

It is this last (highly publicized) set of statements that have agitated the community of those who speak, write or work with languages of South and East Asia.

For example, Masataka Ohta has written that: "The largest portion of the [Unicode] space has been set aside for the unified Han characters–some 27,000 characters, as specified by the Chinese National Standard GB 13000." Sean Fagan noted "Actually, Unicode has 43,007 characters in that space." But, Hitoshi Doi responded:

"According to the way Chinix, Chinese EUC, is laid out, Taiwan needs over 100,000 characters" (see Doi's figure above).

The obvious question, of course, centers about the fact of just what/how many characters, etc., does one want to put in one's computer. Erik van der Poel answered this with:

"That depends on what you mean by 'put into your computer.' In order to display characters, e.g., on a bitmap display, you need (to produce) bitmap images of the characters. Whether that is done directly by storing bitmaps, or indirectly through outline fonts or some such technique, the larger the number of characters, the larger the amount of data that you store (locally or on a font server, or whatever).

"It is easy to add characters to the database, but it is not very easy to increase the size of a data type used to process characters conveniently within programs, since it is generally desirable to maintain compatibility between revisions of application-program interfaces.

"So it would be wise to decide on a data-type size that is large enough to accommodate all of the world's 'characters' uniquely in the foreseeable future. I would say that it is not very wise to limit ourselves to 16 bits, given that tens of thousands of Chinese characters have already been identified."

I'd like to note two things in ending this attempt at pointing out current problems. First, even a conservative rendering of just what one needs in Chinese leads to a very large number of characters (the standard Japanese-Chinese dictionary, to take a non-Western example, has over 60,000 entries). Second, I find myself leaving blanks in manuscripts so that I can fill in the devanagari or cuneiform or whatever by hand. Truly high-tech! ➸

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.

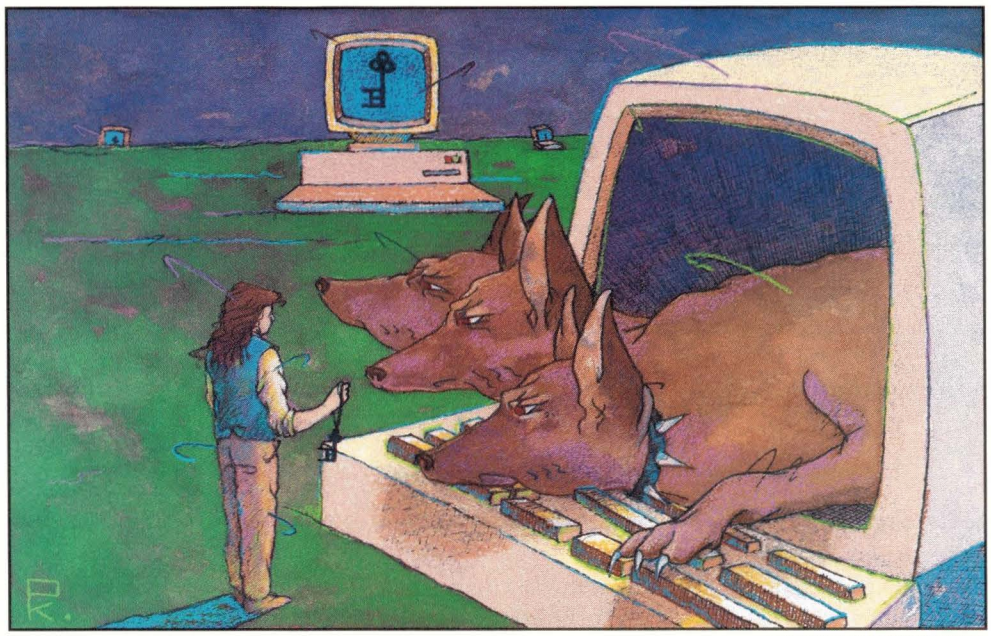

ILLUSTRATION BY PETER KALABOKIS

System Administration and Project Athena

by DINAH MCNUTT,
Pencom Software Inc.

Project Athena, at the Massachusetts Institute of Technology, Cambridge, MA, is now eight years old and its impact has been considerable. Everyone knows what the X Window System is, but names like Hesiod, Kerberos and Zephyr keep popping up on the net and in vendor announcements. This month I will describe what these services are and why they are important to system administrators.

One goal of Project Athena was to improve education through the use of workstations. With over 10,000 staff, faculty and students, supporting this effort would be no small feat. Fortunately, with support from the MIT administration and vendors, they were able to "do it right" (IMHO) and devise a solution that is not only supportable, but works.

Requirements

Some of the requirements defined for this computing environment were:

Scalability–The support structure must be able to support 10,000 workstations or more in a scalable manner. In other words, if it takes one staff to support 100 workstations, it should not take 100 staff to support 10,000 systems.
Security–The services provided should be secure even if some systems are not. This requirement makes a lot of sense. If I can pick the system up and drop it on the floor, why shouldn't I be able to do anything I want to the operating system? A more likely scenario is one in which I open the system and replace the disk drive with my own or boot off my personal removable media (giving me root access and who knows what else). So set up some hosts as trusted and find a way to secure them physically and protect them from network intruders. These hosts will then provide secure services for the whole network.
Heterogeneity–This requirement exists everywhere. If you are asked to administer a homogeneous network, think twice! You'll miss half the fun.
Coherency–Coherence is the ability to run all applications software on all workstations or in an environment where all systems look as similar as possible.

This article will focus on scalability and security since they are two of the biggest issues system administrators wrestle with every day.

Scalability

In an environment that not only has many systems, but is physically spread out, having highly trained staff go to workstations to troubleshoot and solve problems can be costly. Therefore, streamlining operational tasks through automa-

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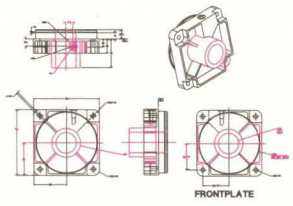

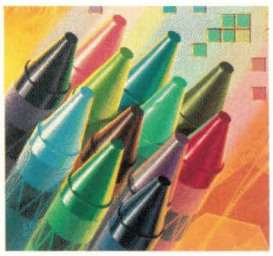

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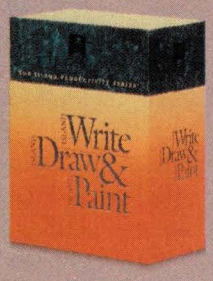

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It is now possible to provide some decentralized systems administration of services.

tion and coherency is critical. I am expanding on the use of coherency as it applies to Project Athena to include coherency at the system-administration level. Administration software and tasks should operate similarly across all platforms.

Scalability applies to more than just staffing. Filesystem space, network bandwidth and network servers are limited resources and, optimally, the cost to add a workstation should be very close to the cost of the workstation itself.

Finally, centralized management of name and network services must be provided in order to make changes manageable. If a printer moves from one system to another, you do not want to have to update 1,000 printcap files.

Security

There are two key security issues: *authentication* and *authorization*. Authentication is the process of verifying the user is who they say they are. Traditionally this is done with a username/password combination verified by the system-password file. Maintaining consistent copies of this file (and propagating password changes) on all systems can be difficult. Sun's NIS offers a reasonable solution for small networks, but not a viable solution for a large number of users and workstations. (Keep in mind one of the requirements is that users be able to log in from any workstation.) With root access, it is also possible to masquerade as another user without having to know their password. In other words, a single user with root access on a system cannot be trusted by all systems.

Authorization involves two pieces:

1. determining whether or not the user has legitimate access to resources and,
2. allowing the owner of the resource to define who has what access to the resource.

If one department owns a printer, the department should be able to define who can use the printer. Once a user has been authenticated, then the authorization system will determine if the user can print on that particular printer or not.

Solutions

The solutions are presented here in terms of the Athena services that meet the requirements stated above. Again, the emphasis in this column is on system administration; the services provided include name service, file service, printing, mail, notification, service management, authentication, and installations and updates.

Kerberos–(The three headed dog who guarded Hades)–Kerberos provides network authentication using a trusted third-party and private-key system. When a user logs on to a workstation, they are automatically authenticated by Kerberos. The authentication is transparent to the user because modified versions of standard UNIX programs are used (`login`, `rlogin`, etc.) Passwords are not sent in clear text over the network, and session tickets are granted as proof of authentication, which are then used (transparent to the user) for authorization to other services (access to network files, etc.) The ticket has an expiration associated with it and is only good from the workstation where you were authenticated. Logins to other workstations will require additional authentication.

One key to the success of this system is that the Kerberos server must be trusted. By securing the server physically and using network routers for subnetting workstations from the main backbone, it is difficult for other systems to masquerade as the Kerberos server. Also, the server only provides authentication. Authorization and administration services are provided by other systems.

Therefore, it is now possible to provide some decentralized systems administration of services. One of the problems with supporting distributed UNIX systems has been not being able to trust systems outside your administrative domain. If you use Kerberos to authenticate users and other servers to authorize who can have access to which network resources, then authorization can be administered by those who own the resources. Traditionally, authorization is done by system administrators who not only don't own the resources, but don't always have the information available to make the appropriate decisions about who should have access to what resources.

Hesiod–(a Greek poet)–Hesiod provides dynamic linking between names and objects using a modified version of BIND. A name can refer to a username for an account, a hostname or a network service (such as a printer.) An object may be an IP address or a system hosting a network service. Changes to the Hesiod database are made from Moira.

Moira–(Fate, whose decisions were irrevocable)–This system automates many of the routine management tasks and includes a centralized database of configuration information and rules and configuration tools. Information managed by Moira includes disk quotas, system-specific configuration files and access-control lists.

Zephyr–(The west wind)–Zephyr provides real-time message notification. Users can subscribe to selected classes of Zephyr messages and receive messages in pop-up windows on their workstation no matter where they are logged in. If they are not logged in, the messages are discarded since they are considered to be time sensitive and no longer applicable or important if not received immediately.

One application for this system at MIT is an electronic con-

ference system: Users can ask questions on different topics, and interested subscribers will answer the questions in real time. You could also use Zephyr to receive real-time messages about the completion of a print job or an unscheduled system outage. You could re-write your current back-up script to send you a Zephyr message when it is completed or has a problem. The advantage of Zephyr is you would receive the message no matter where you were logged in, and you could use Zephyr to help distinguish between "urgent" requests and problems that can wait until you finish your current task.

Some of the differences between Zephyr and electronic mail include:

• efficient distribution of Zephyr messages. Each machine only receives one copy of each message regardless of the number of subscribers.
• Zephyr messages have a fixed length of around 800 bytes.
• Zephyr users do not have to know the names and addresses of the recipients and only interested subscribers receive the messages.
• Zephyr users can subscribe and unsubscribe to services at will without having to have a postmaster or mailing-list administrator intervene.

Conclusions

Admittedly, not everyone has the luxury of being able to define and implement some of the policies that make this system work at MIT. However, many of the ideas and design goals do apply and we should look for ways to implement and improve upon these ideas. It is not unreasonable to ask vendors for Kerberos support and make that one of your decision criteria when recommending vendor products.

This column has been limited to discussing Project Athena as it applies to system administration (after all, this is a system-administration column.) If you want to know more, please refer to the references I've included. As an aside, I recommend subscribing to the *Usenix Conference Proceedings* each year. The cost is $140 for Usenix members and $170 for non-members, and the proceedings are mailed automatically after each conference. I find them a valuable reference for this column.

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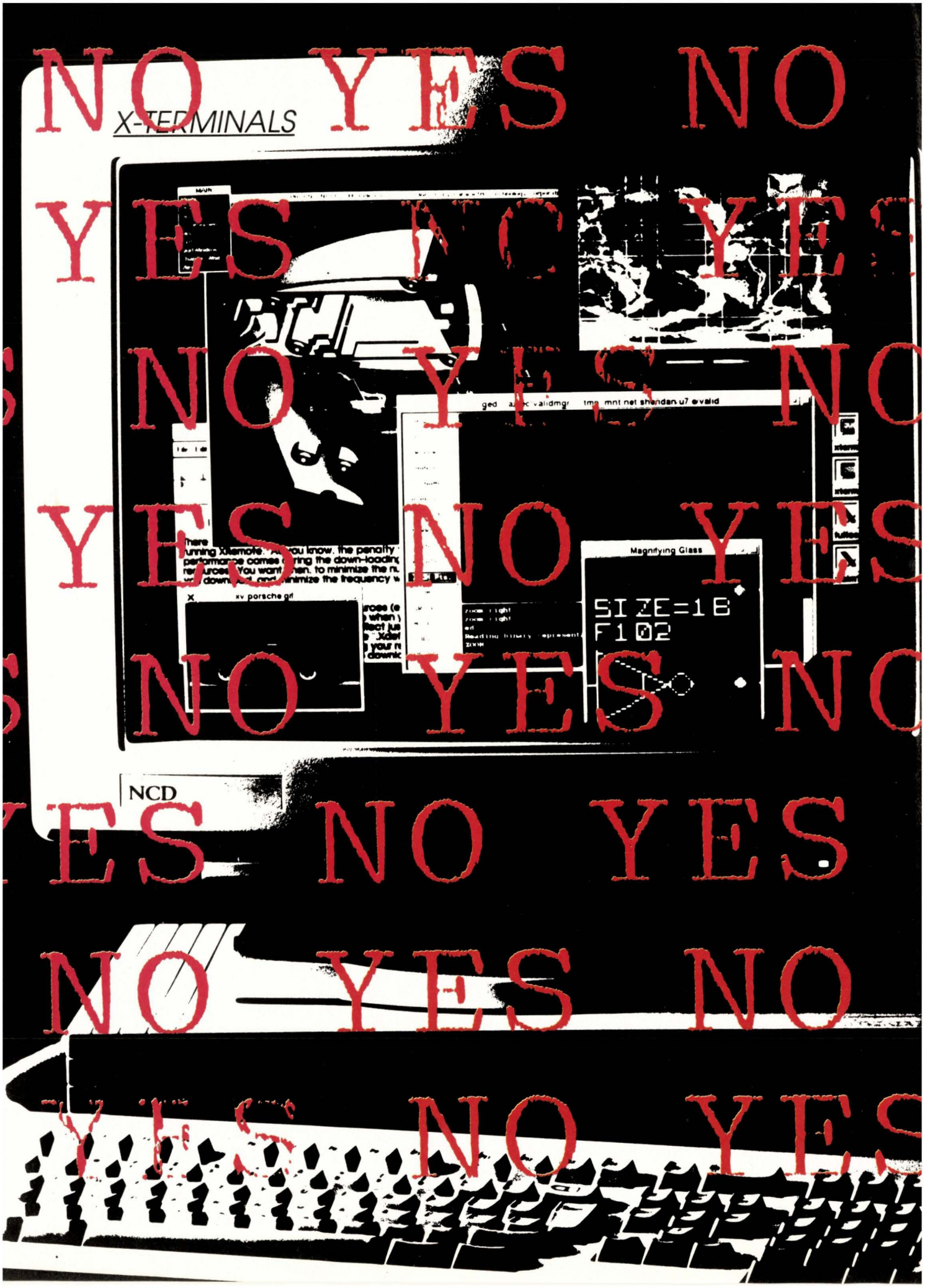
X-TERMINALS
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Magnifying Glass
SIZE=18
F102
NCD
YES NO YES
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YES NO YES

X-terminals:

Wild And Fierce Fanaticism

X-terminals have proved their worth. Now they're finding their place.

by MICHAEL JAY TUCKER, Executive Editor

Once again, X-terminals are starting a fight.

A year ago, the fight was over the technology they represented. More than a few industry analysts, observers, insiders and vendors argued that they were *the* future of desktop computing–the replacement for workstations and, at least in larger corporations, for PCs as well. Just as vehemently, other industry analysts, observers, et al., argued that they weren't worth the cost of junking them.

That debate, at least, is now mostly over. X-terminals have neither emerged as the dominant platform of computer, nor have they retreated to land-fills.

The question is, though, where *do* they go?

The X Factor

It is possible to argue the value of X-terminals. "We think they're kind of a waste of time," notes John Logan, vice president of the Boston-based high-technology consulting company, the Aberdeen Group. "At the price of X-terminals...it makes better sense to go to true client/server computing with PCs as the front end."

Even people who like X-terminals say there are places they just don't fit–specifically, where ever you need desktop CPU power. "I think there are applications that don't lend themselves to X-terminals," says Vic Bellemare, X-terminal business manager for Digital Equipment Corp. "Specifically, anything that is compute intense, but everything else is just fine."

1990 X-Terminal Shipments By Vendor

(Worldwide)

Manufacturer	Units	Total Revenue ($Millions)	Mono Units	Color Units
Digital Equipment Corp.	11,000	36.12	9,870	1,130
GraphOn Corp.	5,240	5.68	5,240	–
Hewlett-Packard Ltd.	6,500	20.28	1,625	4,875
Human Design Systems	1,800	2.60	900	900
IBM Corp.	5,400	16.65	1,350	4,050
Jupiter Systems	100	.65	–	100
Micronics Computers Inc.	210	.56	210	–
Network Computing Devices Inc.	23,070	52.00	18,450	4,620
NCR Corp.	2,990	5.98	2,750	240
Tektronix Inc.	3,800	11.75	700	3,100
Visual Technology Inc.	4,940	10.32	4,930	10
Others	1,920	3.19	1,010	910
Totals	**66,970**	**165.78**	**47,035**	**19,935**

While it is possible to argue the technical merits of X-terminals, they are a hit with buyers. Network Computing Devices Inc. continues to be the market leader, but other companies–including such giants as Digital Equipment Corp., Hewlett-Packard Ltd. and IBM Corp.–are coming up fast. Source: The X Business Group Inc.

It is easy to find users who agree. "We haven't adopted X-terminals simply because the nature of our work makes it better to put low-cost workstations on desktops," says Sesha Pratap, president of Saber Software Inc. Saber produces programming environments, notably Saber-C and Saber-C++.

That could be disturbing for X-terminal partisans because, as a software developer, Saber would seem to be a customer for X-terminals. Developers have been traditionally viewed as one of *the* markets for X-terminals. The idea was that developers needed low cost per seat. But Saber found that its programmers need to be able to perform fairly compute-intensive applications at their desktop–notably compilation and revision control. For those sorts of tasks, X-terminals just weren't right.

X-terminal vendors say they don't even try to sell their products to customers with computing requirements like Saber's. "With workstation people," says Tom Arthur, X Station product-development manager for IBM Corp., "X-terminals are the last thing you'd want to propose to them. You'd run the risk of giving them the wrong machine...and you'd run the risk of making them mad."

But, still, somebody likes them. Several somebodies, in fact. "In 1989, there were 13,000 X-terminals shipped," says Eileen O'Brien, manager of the terminal program at market-analysis firm, International Data Corp., Framingham, MA. "In 1990, there were 64,000. In 1991, I am projecting 136,000."

The X Business Group Inc., a Fremont, CA-based market-research firm, forecasts even stronger growth for X-terminals. Its numbers say that, worldwide, there will be 177,800 X-terminals shipped in 1991, then up to 379,600 in 1992, followed by 787,000 in 1993, and 1,244,400 by 1994.

The list of leading X-terminal vendors, meanwhile, generally starts with Network Computing Devices Inc., with large newcomers directly behind. "NCD was the leader, with 36% [of the market] in 1990," says IDC's O'Brien. "Digital was number two, and Hewlett-Packard [Ltd.] was number three."

IBM, however, is on the outside coming up fast. It introduced an X-terminal along with its RS/6000. In fact, IBM has said that up to 50% of its RS/6000 sales have been as multiuser systems configured with X-terminals.

Some vendors, indeed, argue that fundamental forces are now at work to accelerate the X-terminal market. "The major trends of the industry are driving demand for X-terminals," says Bruce Huibregtse, general manager of HP's Panacom automation division, which handles X-terminals. "A lot more software supports X, and the workstations...while their prices are flattening, their MIPS are going out of this world...and with all those unused MIPS, you can drive a lot of X-terminals."

The X Advocates

So where are X-terminals being used? Basically, says Stephen Auditore, president of the X Business Group, "I think the market has bifurcated... [into] a market where they are being used as alternatives to workstations and another where they are being used as alternatives to character terminals." Of the two, he says, the workstation side of the market is currently the biggest, though the equation will shift rapidly in favor of character-terminal-style applications.

And, indeed, user profiles fit that model well. "We're fairly classic," says Steven Swinkles, manager of UTS CASE development at Amdahl Corp. His group owns 182 NCD X-terminals "plus one [each of] Tektronix [Inc.], HP and Visual [Technology Inc.]." On those machines, Amdahl's people do software development.

It is an installation that dates from the late 1980s. "Two years ago," says Swinkles, "the work environment for any developer could be called Kennedy Control–a lot of screens and very little deskspace." Every programmer had multiple tubes on the desk–character terminals, PCs, perhaps a workstation.

"I began to push for some sort of consistency," remembers Swindles. "I had some motive to do so, since I had to write the development tools that would be running on those machines." The result was servers–initially SPARCstations, though now the com-

pany is shifting to an Amdahl high-end system–with X-terminals as the display platforms.

There are now only a few CPUs left on desktops. "Some of our real hard-core guys have their own workstations," says Swinkles. "But only because they have to test what they're doing, right there, while they're doing it." Everyone else goes with X-terminals, and terminals meet their needs. "You don't need local CPU, you don't need local store, but you have all the bennies of a workstation."

Similar words come from Ira Winston, director of computing for the School of Engineering and Applied Science at the University of Pennsylvania, Pittsburgh, PA. "We use them [X-terminals] in student offices," he says, "where we don't have people doing heavy computing, 9 to 5. We can't justify putting workstations in 50 student offices."

Instead, the university puts workstations in its laboratories, with NCD and Tektronix terminals in the student offices. "These people tend to do things like read their mail, document preparation, and so forth...on the X-terminals," he explains. "Heavy computing they tend to do in their labs."

He views X-terminals frankly as ASCII terminal replacements–with much of the same mission as character terminals. "We also have them on secretaries' desks," he says, "so they can do things like document preview and the like."

His servers are mostly larger Sun Microsystems Inc. systems. "One of the servers has over 2,000 users." In fact, he's found that some SunOS applications can be exploited by terminal users. "We've been able to use a lot of the OpenWindows applications on the X-terminals, at least the newer ones that are pure Xview," he says. "The Calendar is up, for instance."

What advice would he offer other X-terminal buyers? "Test them first," he says. Specifically, he says, X-terminals can be very different from machine to machine. Users, who've become accustomed to one brand, may find another uncomfortable, even unusable. He recounts a story of an organization on campus that had already invested in one brand of X-terminals, then got a special deal on another. "Basically, the

What About X-PCs?

One alternative to X-terminals and workstations is a networked PC running the X Window System. Open Text Systems Inc. senior vice president, Tim Bray, notes that "In the universities, there are a lot of X-terminals. In the governments, there aren't...what we are seeing there is PCs running X."

Could X-PCs then seriously challenge X-terminals? Most industry observers don't think so. "I don't think the PCs are a big concern," says Jay Wettlaufer, chairman and president of software vendor Visix Software Inc. "A lot of the PC stuff has turned into shelfware."

Why? A variety of reasons, including the fact that most PCs were never meant to be bit-mapped displays. "Certainly you can run X on PCs," says Travis White, vice president of marketing for Solbourne Computer Inc. "But then, you pay for the cost of local intelligence... and besides, the real limitation is the resolution of the screen."

Then, too, PCs are computers and have to be managed as such by their users. X-terminals can be managed by system administrators. "With PCs," says David Pinckard, engineering program manager at Tektronix Inc., "you have all the administration problems of a complete system."

On the other hand, there is a mountain of software available for machines based on Intel Corp. processors. At least some people would like to have access to that software, at least part of the time, on the X-display devices.

And, some companies have set out to provide X-terminal PC hybrids. Micronics Computer Inc., for instance, is a well-known maker of '386/'486 motherboards for PCs. This year, the company announced an X-terminal that would be based on the '386, and which would be able to run both X and PC software.

"A lot of engineers already have two tubes on their desk–a PC and an X-terminal," says Jack Porterfield, general manager of the X-terminal division at Micronics. "This way, they can have one box that functions as both."

But What About the Cost?

One of the on-going questions about X-terminals is in regard to their cost. At the moment, they are less expensive than workstations. But workstations are coming down in price at a breathtaking pace. Could it be that X-terminals will eventually be undercut by low-cost workstations?

"Well," says David Cornell, product manager, X-terminals, at NCR Corp., "doesn't it stand to reason that if workstations are coming down in price, that X-terminals will too?"

Just how cheap they will get isn't clear. But, notes Julie Nelson, product marketing manager for Tektronix, "For the commercial market, we think it really very important [for X-terminals] to get under $3,000."

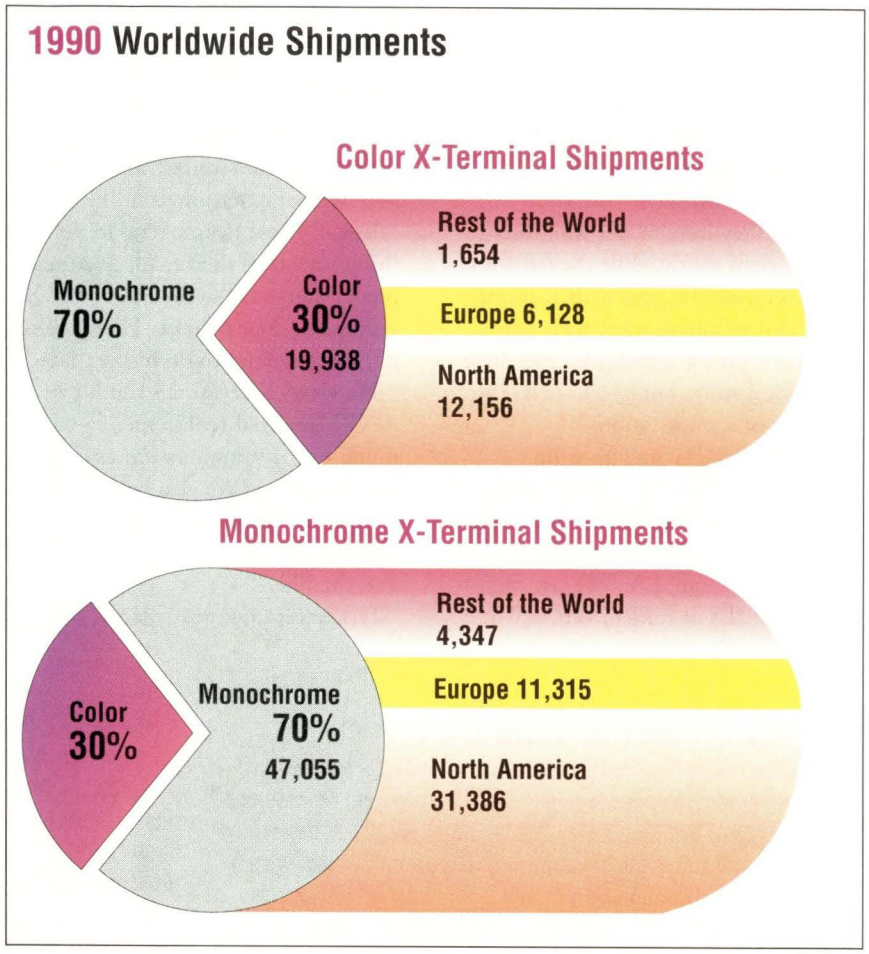
It could go much lower than even $3K. Peter Shaw is the president and CEO of AGE, a software vendor that provides the X Window System for a number of X-terminal vendors. He notes, "We've been dealing with large numbers of manufacturers in the Far East." He says that Asian manufacturers are gearing up to produce very low-cost X-terminals. "Interestingly enough," he adds, "many of these companies are the same companies that manufacture character terminals."

At What RISC?

Several companies have recently debuted X-terminals based on RISC processors. Hewlett-Packard Ltd., for instance, has recently introduced X-terminals based on the i960 processor from Intel.

Market analyst Eileen O'Brien of market-research firm International Data Corp., Framingham, MA, thinks that this is actually a trend. "RISC seems to be important for X-terminals...in that the workstation market is going that way [to RISC] and the two markets are so complementary."

But does RISC really buy you anything in a terminal? "Well," says O'Brien, "people might not really need it, but it is a nice check-off item."



North America is the home of most X-terminals. However, European buyers are growing increasingly interested in X-terminals because of their low cost per seat. Source: The X Business Group Inc.

users revolted," he says. "Even though they [X-terminals] are supposed to be a commodity product, you really have to look at them."

All these same themes show up at the Federal Research Board, Washington, DC, a governmental organization that does economic data analysis. "We've got a large number of X-terminals running off a variety of servers," says Libby Flanagan, section chief of the Board's automated and research computing section. "Right now, mostly the servers are Solbourne [Computer Inc.] systems, but it really doesn't matter. We'll have SPARCstations too."

The X-terminals are used for everything from word processing to graphical analysis, and, as before, they go to people for whom a local workstation wasn't an option. "Workstations just weren't cost effective," she says. "And in this town, everyone is looking for cost effectiveness."

Currently, she has 50 NCD terminals, "but that is a moving target. Ask me six months from now, and it will be closer to 150."

The Billion-Dollar Question

But, there is *another* audience that X-terminals must win.

End users are important, but there is another group that must be sold on X-terminals–a group which, paradoxically, can actually be more vital to X-terminals' success than the people who actually buy them–i.e., software developers. Without X-oriented software configured for X-terminals, there is *no* X-terminal market.

Indeed, the lack of X applications has been long cited as a major drawback of the market. As of this year, software vendors do seem to be buying into X-terminals, but they are doing so largely as a matter of accident.

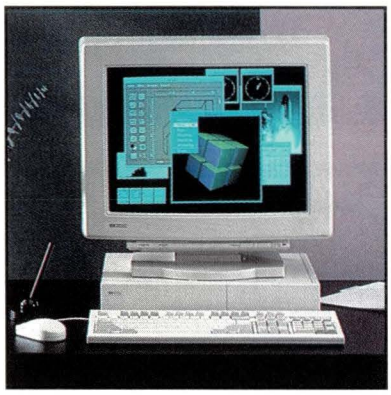
"Once you port your application to the X Window System," explains Jit Saxena, president of Applix Inc., Westboro, MA, "support of X-terminals comes along sort of free." The ISVs are already producing versions of their products for X on workstations. From there, it is an easy step to running applications on servers that support X-terminals. "There are some difficulties," says Saxena, "but mostly it is transparent."

Thus it is that Applix has its own office-automation and business-productivity products on X-terminals, though Saxena isn't entirely certain about their future. "We believe that the X Window market is significant." But how much of that market will be X-terminals? "Well," he says, "that's the billion-dollar question, isn't it?"

At least some ISVs are betting that the billion-dollar answer will come from the servers. In other words, that so long as multiuser UNIX systems can provide any sort of cost advantage over linked workstations, then X-terminals will be a safe bet. "My feeling is that the UNIX mainframe, such as the Sequent [Computer Systems Inc.] machines, will do well for a few more years," says Paul Rember, executive vice president of software developer Island Graphics Corp. "And that being the case, X-terminals will do well."

He notes that this is particularly true outside the United States. "In Europe, people are much more concerned about cost per seat."

ISVs have also begun to address the delicate issue of pricing. X-terminals, after all, present developers with unusual problems, in that they allow applications originally designed as single-user workstation products to be exploited in a multiuser environment. "I think most developers," says Jay Wettlaufer, chairman of software



Where once X-terminals were the concern of only a few vendors, now most major computer companies include them in their product lines. Hewlett-Packard Ltd., for example, has recently introduced the HP 700/RX family of X stations.

developer Visix Software Inc., "will come to view X-terminals as just another kind of workstation."

Wettlaufer says that the mechanics of selling software for X-terminals has proved to be not nearly as distressing as once thought. ISVs view X-terminals as simply one more device that needs a user license. "I don't really distinguish between X-terminals and workstations," he says. "X-terminals are just another seat that needs to reach out there and grab a license."

Visix actually unites X-terminals' most important audience. The company both uses X-terminals and develops for them. "We have about 25 of them," notes Wettlauffer. "A lot of engineers like them...they're quiet."

Open Text Systems Inc., a Waterloo, Ontario-based spin-off of the University of Waterloo, similarly combines user and developer. "We were a cooperative research project between Oxford Publishing and the University of Waterloo," says Tim Bray, Open Text's vice president. "We have the Oxford English Dictionary, on-line, accessible and maintainable."

The OED is perhaps the most complete dictionary of the English language. Its publisher was interested in putting the book into an electronic form, and ultimately went to Waterloo for help in getting the job done. "It turns out," says Bray, "that our particular application is very text intensive...there are some pictures and charts, of course, but mostly it is text."

Which meant X-terminals were a natural. "For that kind of database," he explains, "the X-terminal is really, really, really cost effective...our software is sophisticated, but it isn't that CPU hungry." In fact, the project was so successful that many of the people involved set up a company to commercialize the technology–that is, Open Text Systems.

Round Two

But if ISVs end up on X-terminals because it is relatively easy for them to be there, what applications are actually best there? Warns Open Text's Bray, "The cost effectiveness of X-terminals is overwhelming in some applications, and zero in others."

The physical parameters are fairly well understood. "They're showing up in places where you need real good interactivity, but not compute power on the desktop," explains Travis White, vice president of marketing at Boulder, CO-based Solbourne whose systems frequently show up as servers for X-terminals.

But, that kind of computing does not necessarily include a lot of the services that X-terminals were originally thought to be able to provide–like, for example, office automation. Spreadsheets do quite a lot of local processing, after all, and personal databases require local files. Thus, notes David Cornell, product manager, X-terminals, at NCR Corp., "I don't think it will be the OA display of choice. That's the PC."

What then, are X-terminals for? Cornell argues that the answer is back with the sort of applications that ASCII terminals have traditionally held–that is, applications that are heavily oriented toward display, have a dedicated function and are frequently turnkey solutions provides by systems integrators. "The best example I think of," says NCR's Cornell, "is customer service"

Mike Braca, vice president of advanced marketing and technology of X-terminal vendor Visual Technology Inc., agrees. "You have VARS who are using them as applications delivery vehicles...with dedicated functions." In fact, he sees dedicated functionality as a third market for X-terminals; something removed and distinctly different from the more traditional workstation-replacement and character-terminal replacement missions of X-terminals.

But, whatever the delivery channel, it is clear that the X-terminal industry is betting on the low-end of its market. It sees its future in almost a new kind of computing, in which users are non-computing professionals and their support personnel–a group composed of everything from business executives to doctors to lawyers to secretaries to airline reservation clerks. The users are, in other words, the "knowledge workers" that the MIS community courted in the late 1980s.

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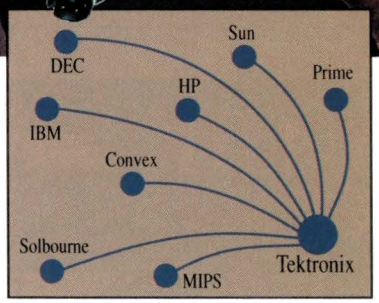

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Waterloo, Ontario N2J 3Z3
Circle 102

IBM Corp.
1133 Westchester Ave.
White Plains, NY 10604
Circle 103

Micronics Computer Inc.
232 E. Warren Ave.
Fremont, CA 94539
Circle 104

Network Computing Devices Inc.
350 North Bernardo Ave.
Mountain View, CA 94043
Circle 105

NCR Corp.
3200 Lake Emma Road
Lake Mary, FL 32746-3393
Circle 106

Tektronix Inc.
Wilsonville Industrial Park
P.O. Box 1000
Wilsonville, OR 97070
Circle 107

Visual Technology Inc.
120 Flanders Road
Westboro, MA 01581
Circle 108

And X-terminal partisans envision such people using X-terminals to "cruise" networks of dedicated resources, hitting this database or that printer, depending on the job at hand, while at the same time being carefully shielded from the difficulties of system administration. "The users are professionals who are highly competent," explains Nina Hargus, DEC's X-terminal product manager "But they're not computer users." To illustrate her point, she cites sales DEC has had in health-management organizations (HMOs.)

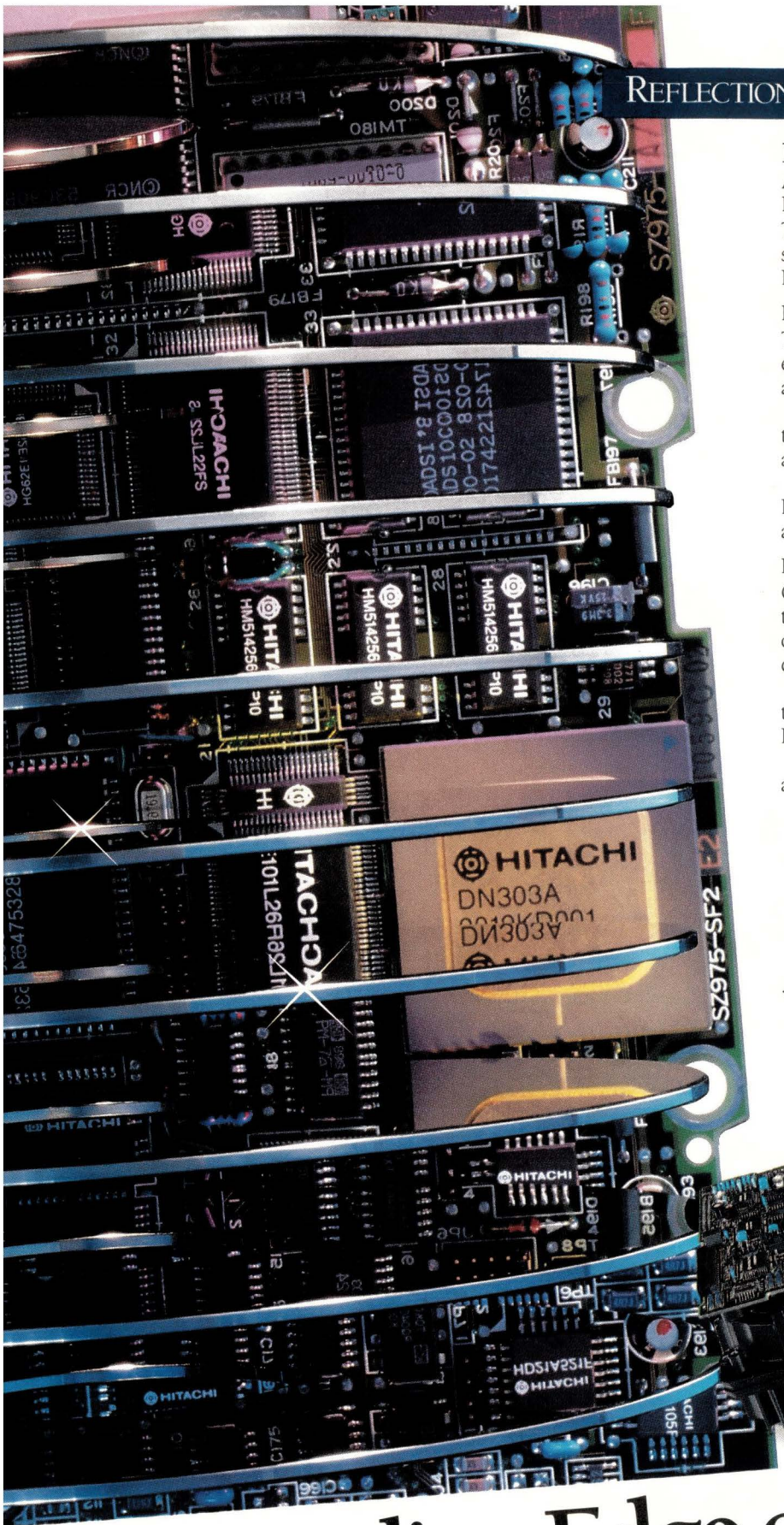
At the moment, such people are either not using computers at all, or they've got ASCII terminals. And *that* neatly defines the market. "There is no question," says Judy Estrin, vice president of NCD, "that in the long run, the growth in the [X-terminal] market will be in the ASCII-terminal area."

In fact, IBM's Arthur thinks the market magic for X-terminals is going to be in these commercial markets. "In the scientific/technical markets, the glamour will stay with the workstations," he says. "But in the commercial market, it will be the other way around. The glamour will be with the X-terminal."

But there's the rub. "The workstations are going after the terminal-replacement market too," says NCD's Estrin. The workstation vendors also see the knowledge worker as a potential market, and they too are seeking to own it with small, low-cost networked workstations like Sun's SLC.

So, once again, X-terminals are in a fight. This time, the battle is not to replace workstations or PCs, but rather to win the desktop that is now either empty, or occupied by aging ASCII terminals. As before, the victory is by no means certain.

But the X-terminal vendors are–as always–confident. Says NCD's Estrin, "If you go out and talk to the MIS people of the world, and you ask them whether they're going to replace their thousands of ASCII terminals with thousands of workstations, with *their* administration headaches, I think they'll tell you workstations just aren't a manageable solution."



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X-TERMINAL SURVEY

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Company and address / Model	Resolution (pixels)	Processor	Local memory (MB)	Refresh rate (Hz)	X11 release	X-server location	Monochrome/Color	Input devices	Screen size (inches)	Interfaces	Warranty (months)	List Price ($)
C. Itoh Technology Inc., 2515 McCabe Way, P.O. Box 19657, Irvine, CA 92713-9657. **Circle 200**												
CIT-XE	1280 x 1024	TMS34020	5	60	R4	downloaded, ROM, RAM	M	keyboard, mouse	17, 19	AUI, serial	12	2,995
CIT-XE 1PL	1280 x 1024	TMS34020	5	30	R4	downloaded, ROM, RAM	M	keyboard, mouse	16	AUI, serial	12	6,995
CIT-XE 256C	1280 x 1024	TMS34020	6	70	R4	downloaded, ROM, RAM	C	keyboard, mouse	17, 21	AUI, serial	12	4,995 (17 in.), 5,995 (21 in.)
Convex Computer Corp., 3000 Waterview Pkwy., Richardson, TX 75080. **Circle 201**												
CXterminal 19	1280 x 1024	68020	4	70	R4	downloaded	M	keyboard, mouse	19	Ethernet, RS232	3	4,700
Data General Corp., 4400 Computer Drive, Westboro, MA 01580. **Circle 202**												
7701	1024 x 1024	68000	.5	70	R4	downloaded	M	keyboard, mouse	16	Ethernet, RS232	3	2,795
Digital Equipment Corp., 146 Main St., Maynard, MA 01754-2571. **Circle 203**												
DECImage 1200 (19 in.)	1280 x 1024	TI34010	2	72	R3	ROM	M	keyboard, mouse	19	TCP/IP, LAT	12	3,395
DECImage 1200 (15 in.)	1280 x 864	TI34010	2	72	R3	ROM	M	keyboard, mouse	15	TCP/IP, LAT	12	3,395
VT1200 (19 in.)	1280 x 1024	TI34010	2	72	R3	ROM	M	keyboard, mouse	19	TCP/IP, LAT	12	2,195
VT1200 (15 in.)	1280 x 864	TI34010	2	72	R3	ROM	M	keyboard, mouse	15	TCP/IP, LAT	12	2,195
VT1300	1280 x 1024	CVAX	8	66	R3	downloaded	C	keyboard, mouse	19	TCP/IP, Ethernet,etc.	12	7,870
Everex/Advanced Systems Group, 18872 Bardeen Ave., Irvine, CA 92715. **Circle 204**												
DUX2001	1024 x 768	286	2.5	60	R4	hard disk resident	C	keyboard, mouse	N/A	TCP/IP, serial, etc.	12	2,526
DUX3001	1024 x 768	386SX	8	72	R4	downloaded, ROM	C	keyboard, mouse	N/A	TCP/IP, serial, etc.	12	3,000
Hewlett-Packard Co., 19310 Pruneridge Ave., Cupertino, CA 95014. **Circle 205**												
HP 700/RX Model 19M	1280 x 1024	80960	2.25	72	R4	downloaded, ROM	M	keyboard, mouse, bar code	19	Ethernet, RS232C, etc.	12	2,995
HP 700/RX ModelM	1280 x 1024	80186, 80960	2.25	72	R4	downloaded, ROM	M	keyboard, mouse, bar code	N/A	Ethernet, RS232C, etc.	12	2,395
HP 700/RX Model 19Ca	1280 x 1024	80960	6	72	R4	downloaded, ROM	C	keyboard, mouse, bar code	19	Ethernet, RS232C, etc.	12	5,995
HP 700/RX Model 16Ca	1024 x 768	80960	5	75	R4	downloaded, ROM	C	keyboard, mouse, bar code	16	Ethernet, RS232C, etc.	12	5,195
HP 700/RX Model Ca	1280 x 1024	80960	6	75	R4	downloaded, ROM	C	keyboard, mouse, bar code	N/A	Ethernet, RS232C, etc.	12	3,895
HP 700/RX Model 16C	1024 x 768	80960	5	75	R4	downloaded, ROM	C	keyboard, mouse, bar code	16	Ethernet, RS232C, etc.	12	4,495
HP 700/RX Model C	1024 x 768	80960	5	75	R4	downloaded, ROM	C	keyboard, mouse, bar code	N/A	Ethernet, RS232C, etc.	12	2,995
Human Designed Systems Inc., 421 Feheley Drive, King of Prussia, PA 19406. **Circle 206**												
View Station V14C	1024 x 768	80186, TI34010	1	70	R3 R4	downloaded, ROM	C	keyboard, mouse	14	Ethernet, RS232, etc.	48	2,999
View Station V15	1024 x 864	80186, TI34010	–	72	R3, R4	downloaded, ROM	M	keyboard, mouse	15	Ethernet, RS232, etc.	48	1,699
View Station VX15	1024 x 864	80186 TI34010	–	72	R3, R4	downloaded, ROM	M	keyboard, mouse	15	Ethernet, RS232, etc.	48	1,499

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Company and address / Model	Resolution (pixels)	Processor	Local memory (MB)	Refresh rate (Hz)	X11 release	X-server location	Monochrome/Color	Input devices	Screen size (inches)	Interfaces	Warranty (months)	List Price ($)
View Station V16C	1024 x 864	80186, TI34010	1	72	R3, R4	downloaded, ROM	C	keyboard, mouse	16	Ethernet, RS232, etc.	48	3,999
View Station V16C+	1280 x 1024	80186, TI34010	1	72	R3, R4	downloaded, ROM	C	keyboard, mouse	16	Ethernet, RS232, etc.	48	4,199
View Station V19	1024 x 864	80186, TI34010	1	72	R3, R4	downloaded, ROM	M	keyboard, mouse	19	Ethernet, RS232, etc.	48	2,599
View Station V19+	1280 x 1024	80186, TI34010	1	72	R3, R4	downloaded, ROM	M	keyboard, mouse	19	Ethernet, RS232, etc.	48	2,899
View Station V19C	1280 x 1024	80186, TI34010	1	70	R3, R4	downloaded, ROM	C	keyboard, mouse	19	Ethernet, RS232, etc.	48	5,199
View Station VX19	1024 x 864	80186, TI34010	1	72	R3, R4	downloaded, ROM	M	keyboard, mouse	19	Ethernet, RS232, etc.	48	2,399
View Station V21C	1280 x 1024	80186, TI34010	1	70	R3, R4	downloaded, ROM	C	keyboard, mouse	21	Ethernet, RS232, etc.	48	5,999
Hyundai Electronics America, 166 Baypointe Pkwy., San Jose, CA 95134. **Circle 207**												
Super-X1	1152 x 900	80960	4	65	R4	downloaded	M	keyboard, mouse	19	RS232C	18	3,000
Super-X1C	1152 x 900	80960	4	66	R4	downloaded	C	keyboard, mouse	20	RS232C	18	5,800
Super-X2	1280 x 1024	80960	4	65	R4	downloaded	M	keyboard, mouse	19	RS232C	18	3,100
Super-X2C	1280 x 1024	80960	4	67	R4	downloaded	C	keyboard, mouse	20	RS232C	18	5,800
IBM Corp., Old Orchard Road, Armonk, NY 10504. **Circle 208**												
Xstation 130	640 x 480 to 1600 x 1200	80C186, TMS34020	2.5	70	R4	downloaded	M/C	keyboard, mouse, tablet	12-19	Ethernet, RS232C, etc.	12	2,650+
Intecolor Corp., 2150 Boggs Road, Duluth, GA 30136. **Circle 209**												
iX3000	1024 x 768	80386sx, TI34010	2	60	R4	downloaded, ROM	C	keyboard, mouse	20	Ethernet	12	8,250
Japan Computer Corp., One Bridge Plaza, Suite 400, Fort Lee, NJ 07024. **Circle 210**												
FX-21	1280 x 1024	68030, ASIC	2	72	R4	downloaded, ROM	C	keyboard, mouse	21	Ethernet, RS232C, etc.	12	13,000
FX-17	1280 x 1024	68030, ASIC	2	72	R4	downloaded, ROM	C	keyboard, mouse	17	Ethernet, RS232C, etc.	12	12,000
SuperX-21	1280 x 1024	68030, ASIC	2	72	R4	downloaded, ROM	C	keyboard, mouse	21	Ethernet, RS232C, etc.	12	6,500
Super X-17	1280 x 1024	68030, ASIC	2	72	R4	downloaded, ROM	C	keyboard, mouse	17	Ethernet, RS232C, etc.	12	5,500
xface	1152 x 900	68030	2	N/A	R4	downloaded, ROM	M	keyboard, mouse	11.5	Ethernet, RS232C, etc.	12	5,500
Jupiter Systems, 1100 Marina Village Pkwy., Alameda, CA 94501. **Circle 211**												
410	1280 x 1024	68030	4	60	R4	downloaded	C	keyboard, mouse, trackball	19	Ethernet	6	7,950
Micronics Computers Inc., 232 E. Warren Ave., Fremont, CA 94539. **Circle 212**												
Maxterm 19	1280 x 1024	80386	2	70	R4	downloaded, ROM	M	keyboard, mouse	19	Ethernet, RS232	12	2,995
Maxterm 4X	1024 x 768	80486	2	70	R4	ROM	C	keyboard, mouse	14, 17	Ethernet, RS232	12	4,499 (14 in.), 4,999 (17 in.)
Maxterm 3x	1024 x 768	80386	2	70	R4	downloaded ROM	C	keyboard, mouse	14, 17	Ethernet, RS232	12	3,499 (14 in.), 3,999 (17 in.)
Motorola Inc., Computer Group, Commercial Systems Division, 10700 N. De Anza Blvd., Cupertino, CA 95014. **Circle 213**												
NDS16	1024 x 1024	68000	2.5	70	–	downloaded	M	keyboard, mouse	16	Ethernet, RS232, etc.	12	2,375
NDS17C	1024 x 768	68020	4	70	–	downloaded	C	keyboard, mouse	17	Ethernet, RS232	12	4,400
NDS19	1280 x 1024	68020	4	70	–	downloaded	M	keyboard, mouse	19	Ethernet, RS232	12	3,300

Company and address / Model	Resolution (pixels)	Processor	Local memory (MB)	Refresh rate (Hz)	X11 release	X-server location	Monochrome/Color	Input devices	Screen size (inches)	Interfaces	Warranty (months)	List Price ($)
Network Computing Devices Inc., 350 N. Bernardo Ave., Mountain View, CA 94043. **Circle 214**												
NCD 15b	1024 x 800	68000, ASIC	2	70	R4	downloaded, ROM, etc.	M	keyboard, mouse	15	AUI, RS232, etc.	12	1,495
NCD16e	1024 x 1024	68020	2	70	R4	downloaded, ROM, etc.	M	keyboard, mouse	16	AUI, RS232, etc.	12	2,595
NCD19b	1024 x 800	68000, ASIC	2	70	R4	downloaded, ROM, etc.	M	keyboard, mouse	19	AUI, RS232,etc.	12	2,295
NCD19	1280 x 1024	68020	4	70	R4	downloaded, ROM, etc.	M	keyboard, mouse	19	AUI, RS232,etc.	12	3,400
NCD14c	1024 x 768	68020, ASIC	4	70	R4	downloaded, ROM, etc.	C	keyboard, mouse	14	AUI, RS232, etc.		3,000
NCD17c	1024 x 768	68020, ASIC	4	70	R4	downloaded, ROM, etc.	C	keyboard, mouse	17	AUI, RS232 etc.	12	4,500
NCR Corp., 1334 S. Patterson Blvd., Dayton, OH 45479. **Circle 215**												
3413 XL19E	1280 x 1024	68020	1	70	R4	downloaded, ROM	M	keyboard, mouse	19	Ethernet, RS232	12	3,350
3413 XL15E	1024 x 800	68020	1	76	R4	downloaded, ROM	M	keyboard, mouse	15	Ethernet, RS232	12	2,500
3414 X617CE	1024 x 768	68020, TI34020	5	70	R4	downloaded, ROM	C	keyboard, mouse	17	Ethernet, RS232	12	4,770
3414 XL 14CE	1024 x 768	68020, TI34020	5	70	R4	downloaded, ROM	C	keyboard, mouse	14	Ethernet, RS232	12	3,495
Northwest Digital Systems, P.O. Box 15288, Seattle, WA 98115. **Circle 216**												
XT.15	1024 x 800	34010	1	76	R4	downloaded, ROM	M	keyboard, mouse	15	Ethernet, serial	12	2,095
XT.19	1024 x 800	34010	1	76	R4	downloaded, ROM	M	keyboard, mouse	19	Ethernet, serial	12	2,295
Night Owl Technology, Bishops Cottage, Park House Lane, Reading, Berkshire, United Kingdom. **Circle 217**												
FX14C	1024 x 768	80286, TMS34010	1	75	R4	downloaded	C	keyboard, mouse	14	Ethernet	12	£2,049
FX19C	1024 x 768	80286, TMS34010	1	75	R4	downloaded	C	keyboard, mouse	19	Ethernet	12	£2,999
FX16C	1024 x 768	80286, TMS34010	1	75	R4	downloaded	C	keyboard, mouse	16	Ethernet	12	£4,798
PC Upgrades	1024 x 768	80286, TMS34010	1	75	R4	downloaded	C	keyboard, mouse	various	Ethernet	12	£900+
FX14CI	1024 x 768	80286, TMS34010	1	75	R4	downloaded	C	keyboard, mouse	14	Ethernet	12	£1,849
Omnicomp Graphics Corp., 1734 W. Sam Houston Pkwy. N., Houston, TX 77043. **Circle 218**												
Omni 8600 GDC	1280 x 1024	TMS34020	4	70	R4	downloaded, DRAM	M/C	keyboard, mouse	various	VME	12	3,660
Samsung Information Systems America Inc., 3655 N. First St., San Jose, CA 95134-1708. **Circle 219**												
SGS 19 M	1280 x 1024	AMD2900	2	66	R4	downloaded	M	keyboard, mouse	19	Ethernet, serial	12	2,995
SGS 17C	1024 x 768	AMD2900	2	66	R4	downloaded	C	keyboard, mouse	17	Ethernet, serial	12	3,995
Solbourne Computer Inc., 1900 Pike Road, Longmont, CO 80501. **Circle 220**												
XDS19	1280 x 1024	68020	4	70	R4	running on host	M	keyboard, mouse	19	TCP/IP, SLIP, etc.	12	4,395
XDS17c	1024 x 768	68020	4	70	R4	running on host	C	keyboard, mouse	17	TCP/IP, SLIP, etc.	12	5,595
XDS16	1024 x 1024	68000	2.5	70	R4	running on host	M	keyboard, mouse	16	TCP/IP, SLIP, etc.	12	2,795

Company and address / Model	Resolution (pixels)	Processor	Local memory (MB)	Refresh rate (Hz)	X11 release	X-server location	Monochrome/Color	Input devices	Screen size (inches)	Interfaces	Warranty (months)	List Price ($)
Tandberg Data A/S, P.O. Box 9, Korsvoll, 0808 Oslo 8, Norway. **Circle 221**												
TDV 6230	1024 x 768	TMS34010	2	78	R4	downloaded	M	keyboard, mouse	17	Ethernet, serial, etc.	12	2,500
Tektronix Inc., P.O. Box 1000, Wilsonville, OR 97070. **Circle 222**												
TekXpress XP21	1152 x 900	68020, TI34020	5	72	R4	downloaded, ROM	M	keyboard, mouse, touchscreen	17	Ethernet, RS232C, etc.	36	2,995
TekXpress XP23	1280 x 1024	68030, TI34020	5	72	R4	downloaded, ROM	M	keyboard, mouse, touchscreen	19	Ethernet, RS232C, etc.	36	3,495
TekXpress XP25	1152 x 900	68030, TI34020	5	60	R4	downloaded, ROM	C	keyboard, mouse, touchscreen	14	Ethernet, RS232C, etc.	36	3,995
TekXpress XP27	1152 x 900	68030, TI34020	5	72	R4	downloaded, ROM	C	keyboard, mouse, touchscreen	19	Ethernet, RS232C, etc.	36	4,995
TekXpress XP29	1280 x 1024	68030, TI34020	5	72	R4	downloaded, ROM	C	keyboard, mouse, touchscreen	19	Ethernet, RS232C, etc.	36	5,995
TekXpress XP29P (PEX)	1280 x 1024	68030, TI34020, TI34082	7	72	R4	downloaded	C	keyboard, mouse, touchscreen	19	Ethernet, RS232C, etc.	36	6,995
Visual Technologies Inc., 120 Flanders Road, P.O. Box 5033, Westboro, MA 01581. **Circle 223**												
X-14/ES	1024 x 800	68000	1	82	R4	ROM	M	keyboard, mouse, touchscreen	14	Ethernet, DECnet, etc.	12	995
X-15	1024 x 800	68000	2	76	R4	downloaded, ROM	M	keyboard, mouse, touchscreen	15	Ethernet, DECnet, etc.	12	2,095
X-19	1152 x 900	68000	2	72	R4	downloaded, ROM	M	keyboard, mouse, touchscreen	19	Ethernet, DECnet, etc.	12	2,095
X-19 Turbo	1280 x 1024	68020	2	72	R4	downloaded, ROM	M	keyboard, mouse, touchscreen	19	Ethernet, DECnet, etc.	12	3,095
X19PQD	1280 x 1024	68020, TMS34020	2	72	R4	downloaded, ROM	M	keyboard, mouse, touchscreen	19	Ethernet, DECnet, etc.	12	4,295
X15 Color	1024 x 768	68020, TMS34020	4	60	R4	downloaded, ROM	C	keyboard, mouse, touchscreen	15	Ethernet, DECnet, etc.	12	3,545
Visual X19 Color	1152 x 900	68020, TMS34020	4	68	R4	downloaded, ROM	C	keyboard, mouse, touchscreen	19	Ethernet, DECnet, etc.	12	5,365
X19 Color	1280 x 1024	68020, TMS34020	4	71	R4	downloaded, ROM	C	keyboard, mouse, touchscreen	19	Ethernet, DECnet, etc.	12	5,865
X21 Color	1280 x 1024	68020, TMS34020	4	71	R4	downloaded, ROM	C	keyboard, mouse, touchscreen	21	Ethernet, DECnet, etc.	12	6,055
Wyse Technology Inc., 3471 N. First St., San Jose, CA 95134. **Circle 224**												
WY-X5	1280 x 1024	68020	5	72	R4	downloaded, Flash EPROM	M	keyboard, mouse, bit pad	17	Ethernet, DECnet, etc.	12	1,799

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OPUS
OPUS

Magnum Opus

Cost, binary compatibility, performance: three good reasons for checking out the Personal Mainframe.

by BARRY SHEIN, Technical Editor

For a no-nonsense SPARCalike, Opus Systems' Personal Mainframe 5120 fits the bill. With SPARCstation 1+ performance, room for four internal 3 1/2-inch disk drives and 64 MB of memory the system covers a wide range of configuration needs. Those of you accustomed to fully loaded SPARC workstations will be satisfied with Opus packaging and design choices.

The system box is about the size of Sun's pizza boxes. The keyboard is very similar to the type 4 keyboard and layout Sun uses. Opus' version of SunOS, which they call OpusOS (one of the less mellifluous names I've come across in this business), is basically a 4.1.1 SunOS release with modifications to accommodate their SPARC implementation, an LSI Logic Corp. 25-MHz CPU with a 64-KB cache.

The machine we reviewed came with 16 MB; a 19-inch, 1152-by-900-pixel color monitor; an internal 3 1/2-inch 207-MB disk drive; a 3 1/2-inch floppy; and a 150-MB QIC 1/4-inch tape drive (also internal). The tape is a $1,395 add-on option and base systems come with 8 MB installed. The hardware we received represents a configuration priced at $11,995 list.

Performance/Compatibility

Integer performance, as measured by Dhrystone 2.1, was fine compared with the manufacturer's claims of 15.8 MIPS: over 27,000 Dhrystones or more than 16 MIPS. We ran the X Window System using the `twm` window manager on it and tried a bunch of our favorite programs. Color-window performance was good and subjectively snappy, comparable to an IPC.

Binary compatibility was excellent. We simply mounted our Sun 4/280's local binary area and ran whatever we wanted–GNU Emacs, xloadimage, xterm and gcc (GNU C compiler). There was no need to recompile anything. Opus gets a gold star from us for this. There are few things more annoying than gratuitous binary incompatibilities between SPARCs, which force you to go back and rebuild programs.

Opus' kernel differs sufficiently from a stock SunOS kernel so that if you wish to run an Opus diskless, you will have to move their kernel images onto your server (easily done). This is due to differences in memory-management units between Sun and Opus' SPARC implementations, among other things (e.g., device drivers). However, this is a common situation with SPARCalikes and I'd expect to have to do this with any SPARC clone.

Their standard 19-inch color screen was crisp and bright. This screen compares well with the 19-inch screen on the IPC–an extra-cost add-on from Sun.

Opus: The Company

Opus' story is one of the more interesting in the SPARCalike market. If you're running any of about a dozen different label SPARC clones, it probably already has Opus' board inside of it.

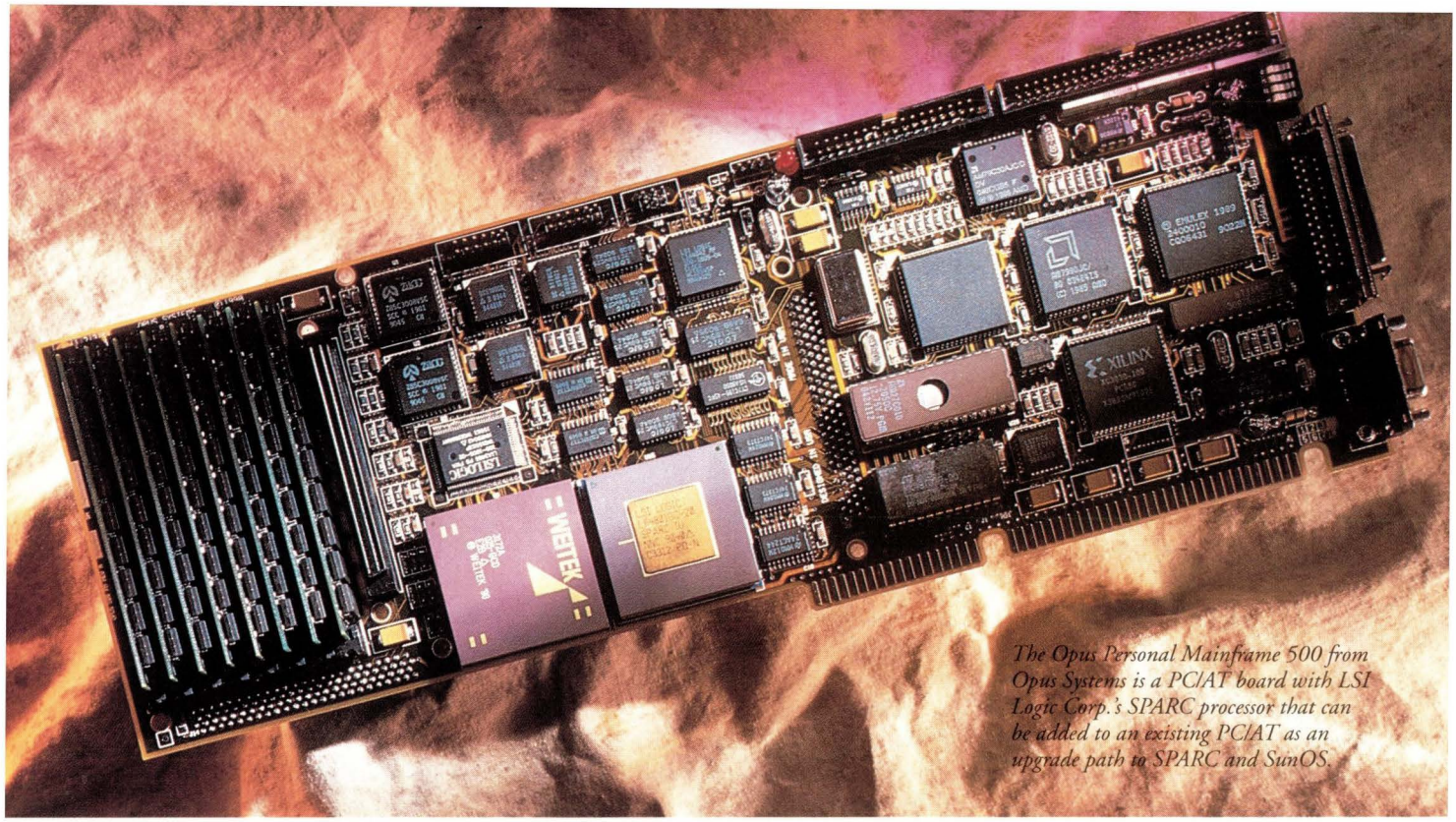
Opus designed a "manufacturing kit" for SPARC clone makers that includes a hardware motherboard based on LSI Logic's SPARC CPU implementation and a port of SunOS to that board. Several vendors, including Tatung Co., CompuAdd Corp. and TriGem Corp., incorporate that kit into their SPARC products. At this time there are 15 companies incorporating Opus' manufacturing kit into their own products.

The company has been in the UNIX business for all of its eight years' existence. Besides SPARC products they produce a line of systems based upon the Motorola Inc. 88000 RISC chip, which they still sell and service. But, according to Tom Lacey, vice president of marketing at Opus, SPARC is their main focus and where they expect the company's fortunes to lie.

Opus was founded by Craig Forney and John Lundell, both previously of Plexus Systems. Another pre-eminent SPARC player hails from Plexus, Scott McNealy, who joined Plexus just after the Opus founders left to follow their own rising star.

Lacey emphasizes Opus' commitment to building a large, worldwide reseller and service market around their systems. They currently have 160 reseller offices (third-party) in the United States and are negotiating with a "major player" in Japan to launch Opus Japan. In Europe, Opus sells through 23 primary resellers many of which, in turn, use their own resellers.

Opus' manufacturing is done by SCI Technology Inc. in Huntsville, AL, and service is arranged through a partnership with Motorola Inc.



The Opus Personal Mainframe 500 from Opus Systems is a PC/AT board with LSI Logic Corp.'s SPARC processor that can be added to an existing PC/AT as an upgrade path to SPARC and SunOS.

more

Personal Mainframe 5120

Performance: 18 MIPS with LSI Logic Corp.'s 25-MHz SPARC, 1.7 MFLOPS double-precision Linpack

Operating environment: SCD-compliant SunOS 4.1 bundled with C compiler and SunView 1.8, supports NFS, TCP/IP

Memory: 8 MB standard, up to 64 MB using 1- or 4-MB SIMMS

Disk options: one 3 1/2-inch, 1.44-MB internal floppy; up to three 3 1/2-inch internal SCSI and one half-height, 5 1/4-inch hard-disk drives

Slots and ports: 15-pin Ethernet connector, three SBus slots, two serial ports

Displays: 1152-by-900 pixel frame buffer, either 19-inch color or monochrome

Price: begins at $7,995, diskless with 19-inch monochrome monitor. Available only through resellers.

Opus Systems
329 N. Bernardo
Mountain View, CA 94043
Circle 118

Motorola offers on-site and other service contracts to owners of Opus' computers, and supports Opus' one-year warranty on systems.

Lacey claims that Opus is now the second largest SPARC vendor, after Sun, and accounts for 15% of sales through reseller units (that does not include Sun's direct sales volume). They are currently shipping about 1,000 units per month. Their goal is to become the "Compaq" of the SPARC market. In the 1980s, Compaq Computer Corp. followed IBM Corp.'s PC success closely and developed their own internal technical and support networks. Opus plans to develop the same relationship relative to Sun.

Futures

Opus has recently announced an implementation of LSI's SPARC CPU, the Opus Personal Mainframe 500, on a PC/AT board. This board can be added to an existing PC/AT as an upgrade path to SPARC and SunOS. The company hopes that owners of PC systems considering going to Intel's 486 chip will instead choose Opus' SPARC add-in. This upgrade supports both DOS and Windows 3.0 applications to be run in native mode concurrently with SunOS on the SPARC board. The board/SunOS bundle, with built-in Ethernet support, can be used to configure PCs as diskless nodes or standalone workstations.

The Opus Personal Mainframe 5120 we reviewed will be upgradeable in the next few months to a 40-MHz SPARC implementation. This will represent a performance improvement from 15.8 MIPS to about 28.5 MIPS or 10 to 15% over Sun's current SPARCstation 2 product. This upgrade involves only a motherboard swap when the board is available.

Summary

The Opus Personal Mainframe 5120 is a solid, highly compatible SPARC implementation with attractive future plans. The company seems to be in the main track of the SPARC-compatible business and is likely to become the premier clone player over the next few years. Their expandability, which exceeds that of Sun's IPC workstation in some important areas including four internal hard drives, room for 64 MB of memory and near-term plans for a motherboard upgrade to 40 MHz, makes this system one to consider seriously in the SPARCalike market. ⊸

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Practical UNIX Security

FTP and the X Window System can be soft spots in your security armor.

by SIMSON GARFINKEL
and
GENE SPAFFORD

Editor's note: Managing anonymous `ftp` *and* `xhost` *requires a little ingenuity. This month's installment gives networkers advice on how to maintain their guards while retaining functionality. There's also a summary of the security implications of the network services discussed in July, August and September.*

The File Transfer Protocol (FTP) allows you to transfer complete files between systems. `ftp` is the client program; `/etc/ftpd` (sometimes called `/usr/etc/in.ftpd`) is the server.

When you use FTP to contact a remote machine, the remote computer requires that you log in by providing your username and password; `ftp` logins are recorded on the remote machine in the `/usr/adm/wtmp` file. Because the passwords typed to FTP are transmitted over the network, they can be intercepted (just like the `telnet` and `rexec` commands); for this reason, some sites may wish to disable the `ftp` and `ftpd` programs.

Older versions of `ftpd` had bugs in them that allowed crackers to break into a system. If your version of `ftpd` is older than December 1988, replace it with a newer version. (One way to tell the age of your `ftpd` program is to do an `ls -l` on the executable. This may not be reliable, however.) FTP can be set up for "anonymous" access, which allows people on the network who do not have an account on your machine to deposit or retrieve files from a special directory. Many institutions use anonymous FTP as a low-cost method to distribute software and databases to the public free of charge.

To use anonymous FTP, simply specify "anonymous" as your username, and your real identity as the password. (The real name that you provide is merely a courtesy to the person who manages the computer to which you are connecting. It is written into the log file used by `last`.)

```
% ftp athenadist.mit.edu
Connected to AENEAS.MIT.EDU.
220 aeneas FTP server (Version 4.136 Mon Oct 31
        23:18:38 EST 1988) ready
Name (athena-dist.mit.edu:fred): anonymous
331 Guest login ok, send ident as password.
password:
230 Guest login ok, access restrictions apply.
ftp>
```

If you want to restrict FTP access, it can be done. The `/etc/ftpusers` file contains a list of the users who are NOT allowed to use FTP to access any files. This file should contain all accounts that do not belong to bona fide human beings:

```
# cat /etc/ftpusers
root
uucp
news
bin
ingres
nobody
daemon
```

Setting Up Anonymous FTP

It is relatively easy to set up anonymous FTP on a server, but important to do it correctly, because you are potentially giving access to your system to everybody on the network.

To set up anonymous FTP, you must create a special account with the name `ftp`. Files that are available by anonymous FTP will be placed in the `ftp` home directory; you should therefore put the directory in a special place, such as `/usr/spool/ftp`. Remote users can transfer large files to your system. Therefore, it might be a good idea to put a file quota on user `ftp`, or else locate the home directory on an isolated partition.

When it is used for anonymous FTP, `ftpd` uses the `chroot(2)` function call to change the root of the file system to the home directory of the `ftp` account. For this reason, you must set up that account's home directory as a mini-filesystem. Three directories go into this mini-filesystem:

- `bin` – This directory holds a copy of the `/bin/ls` program, which `ftpd` uses to list files. If your system uses dynamic linking, not symbolic links, like `ls -s`, but dynamically linked, shared libraries, you must either install the dynamic libraries in the appropriate directory (viz; `/usr/spool/ftp/lib`), or else install programs that are statically linked.
- `etc` – This directory holds a copy of the `/etc/passwd` and `/etc/group` files, which are put there so the `/bin/ls` command will print user names and group names when it lists files. Replace the encrypted passwords in this file with asterisks. Some security-conscious sites may wish to delete some or all account names from the `passwd` file; the only one that needs to be present is `ftp`.
- `pub` – This directory, short for "public," holds the files that are actually made available for anonymous FTP transfer. You can have as many subdirectories as you wish in the `pub` directory.

Be sure to place the actual files in these directories, rather than using symbolic links pointing to other places on your system. Because the `ftpd` program uses the `chroot(2)` system call, symbolic links will not behave properly with anonymous FTP. (To set up FTP directories, execute the commands in Figure 1 as the superuser.)

Some sites set the mode of the `~ftp/pub` directory to 1777, which allows people on the network to leave files anonymously. Alternatively, you can create a subdirectory in the `pub` directory called open, and set the mode of that directory to be 1777. In either case, you may wish to establish a quota for the `ftp` account, so files left anonymously do not overrun the available space on your system. You should also monitor the contents of the directory on a regular basis, and delete anything that looks suspicious. In addition, you should set up a mail alias for the `ftp` user so that mail sent to `ftp` is delivered to a system managers.

TFPT

TFTP is the Trivial File Transfer Protocol. TFTP is a UDP-based file-transfer program that provides no security. There is a set of files that the TFTP program is allowed to transmit from your computer, and the program will transmit them to anybody on the Internet who asks for them. One of the main uses of TFTP is to allow workstations to boot over the network; the TFTP protocol is simple enough to be programmed into a small read-only memory.

Because TFTP has no security, `tftpd`, the TFTP daemon, is normally restricted so that it can transfer files only to or from a certain directory. Unfortunately, many early versions of `tftpd` had no such restriction.

You can test your version of `tftpd` with the `tftp` program for this restriction with the following sequence:

```
% tftp localhost
tftp> get /etc/passwd tmp
Error code 1: File not found
tftp> quit
%
```

If `tftp` does not respond `Error code 1: File not found`, or simply hang with no message, then get a current version of the program. Sun Microsystems Inc. operating systems prior to release 4.0 did not restrict file transfer from the TFTP program.

The X Window System

X is a popular network-based window system that allows many programs to share a single graphical display. X-based

programs display their output in windows, which can be either on the same computer on which the program is running or on any other computer on the network.

Each graphical device that runs X is controlled by a special program, called the X Window Server. Other programs, called X clients, connect to the X Window Server over the network and tell it what to display. Two popular X clients are `xterm` (the X terminal emulator) and `xclock` (which displays an analog or digital clock on the screen).

The X Window System can be a security hazard. Although there are a number of mechanisms inside X to give some security features, these can be circumvented in many circumstances.

The xhost Facility

X uses a system called `xhost` to provide a minimal amount of security for window system users. Each X Window Server has a built-in list of hosts from which it will accept connections; connections from all other hosts are refused. The `xhost` command lets users view and change the current list of "X hosted" hosts.

Typing `xhost` by itself displays a list of the current hosts that may connect to your X Window Server.

```
% xhost
prose.cambridge.ma.us
next.cambridge.ma.us
%
```

You can add a host to the `xhost` list by supplying a plus sign, followed by the host's name on the command line after the `xhost` command. You can remove a host from the `xhost` list by supplying its name preceded by a hyphen:

```
% xhost +idr.cambridge.ma.us
% xhost next.cambridge.ma.us
prose.cambridge.ma.us
idr.cambridge.ma.us
% xhost -next.cambridge.ma.us
prose.cambridge.ma.us
idr.cambridge.ma.us
```

Figure 1. Establishing FTP

```
# mkdir ~ftp/bin ~ftp/etc ~ftp/pub                    Create needed directories

Set up ~ftp/bin:

# /bin/ls ~ftp/bin                                    Make a copy of the ls program.
# chmod 111 ~ftp/fin/ls                               Make sure ls can't be changed.
# chmod 111 ~ftp/bin                                  Make directory execute-only.
# chown root ~ftp/bin                                 Make sure root owns the directory

Set up ~ftp/etc:

# sed -e 's/:[^:]*:/:*:/' /etc/passwd > ~ftp/etc/passwd  Make a copy of etc/passwd with all passwords changed to asterisks.
# sed -e 's/:[^:]*:/:*:/' /etc/passwd > ~ftp/etc/group   Make a copy of etc/group.
# chmod 444 ~ftp/etc/*                                Make sure files in etc are not writeable.
# chmod 111 ~ftp/etc                                  Make directory execute-only.
# chown root ~ftp/etc                                 Make sure root owns the directory.

Set up ~ftp/pub:

# chmod 1777 ~ftp/pub                                 Make directory writeable by anyone.
# chown ftp ~ftp/pub                                  Make sure ftp owns the directory.
# chgrp ftp ~ftp/pub                                  Make sure directory is in group ftp.

Secure the ftp directory:

# chmod 555 ~ftp
# chown root ~ftp
```

You can disable xhost protection by typing:

```
prose% xhost +
```

If you xhost a computer, any user on that computer can connect to your X Server and issue commands. Because of the design of X, this effectively gives any user on that computer the ability to type any command on your keyboard. (For example, although it is difficult, it is possible to write an X application that takes over a user's cursor, moves the cursor to an X-terminal window, and then stuffs keypresses into the X-event queue.) If a client connects to your X Window Server, removing that host from your xhost list will not terminate the connection. It will simply prevent future access. The design of the X Window System allows any client that successfully connects to the X Window Server to exercise complete control over the display. Clients can take over the mouse or the keyboard, send keystrokes to other applications or even kill the windows associated with other clients.

For example, someone could overlay your entire screen with a transparent, invisible window, so that everything you type goes into that window and is copied. The program could then take those keystrokes and push them into the appropriate subwindows, so that you can't tell that you're being monitored. If you then remote login to another system or su, it is possible for someone to capture your password as you type it, without your knowing what has happened. If a person can log into your system, they can capture your keystrokes no matter how your xhosts is set.

Revision 4 of the X Window Protocol has a "secure" feature on the xterm command that makes the window change its color if it is not receiving its input directly from the keyboard. This is a partial fix, but it is not complete. Future versions of X are expected to address this problem in a better way, although it is not immediately obvious how this is going to be accomplished. Even if you use the xhost facility, your X Window System may be vulnerable to attack from computers that are not in your xhost list. The X11R3 Window Server reads a small packet from the client before it determines whether or not the client is in the xhost list. If a client connects to the X Server but does not transmit this initial packet, the X Server halts all operation until it times out in 30 seconds. You can determine whether your X server has this problem by executing the following command:

```
prose% telnet localhost 6001
```

Here "6001" is the TCP/IP port address of the first X server on the system. (The second X display on the system has a TCP/IP address of "6002.")

If your X server has this problem, your workstation's display will freeze. The cursor will not move, and you will be unable to type anything. In some X implementations, the X server will time out after 30 seconds and resume normal operations. Under other X implementations, the server will remain blocked until the connection is aborted.

Although this attack cannot be used to destroy information, it can be used to incapacitate any workstation that runs X11R3 and is connected to the network. If you have this problem with your software, ask your vendor for a corrected update.

Security and Network Services

Network servers are the portals through which the outside world accesses the information stored on your computer. Every server must:

- Determine what information or action the client requests.
- Decide whether or not the client is entitled to the information (optionally authenticating the person [or program] on the other side of the network that is requesting service).
- Transfer the requested information or perform the desired service.

By design, many servers must run with root privileges. A bug or an intentional back door built into a server can therefore compromise the security of an entire computer, opening the system to any user of the network who is aware of the flaw. Even a relatively innocuous program can be the downfall of an entire computer. Flaws may remain in programs distributed by vendors for many years, only to be uncovered sometime in the future.

Perhaps the best-known example of such a flaw was a single line of code in the program /etc/fingerd, the finger server, exploited in1988 by Robert T. Morris' Internet Worm. fingerd provides finger(1) service over the network. One of the very first lines of the program reads a single line of text from stdin containing the name of the user to be fingered.

The original fingerd program contained the lines of code:

```
char line[512];

line[0] = '\0';
gets(line);
```

Because the gets(3) function does not check the length of the line read, it was possible for a rogue program to supply more than 512 bytes of valid data, causing the stack frame of the fingerd server to be overrun. Morris wrote code that caused fingerd to execute a shell, giving the rogue program virtually unrestricted access to the server computer.

The fix for the finger program is simple: Replace the gets(3) function with the fgets(3) function, which does not allow its input buffer to be overridden:

```
fgets(line,sizeof(line),stdin);
```

Fortunately, Morris' program did not actually damage programs or data on computers that it broke into. Nevertheless, it illustrates the fact that any portal program can potentially compromise the system. Remember that just because a hole has never been discovered in a program does not mean that no hole exists. You can use the netstat(1) command to list all of the active and pending TCP/IP connections between your machine and every other machine on the Internet. This is very important if you suspect that somebody is breaking

into your computer or using your computer to break into another one. `netstat` lets you see which machines your machine is talking to. The command's output includes the host and port number of each end of the connection, as well as the number of bytes in the receive and transmit queues.

Monitoring the Net with netstat

If a port has a name assigned in the `/etc/services` file, `netstat` will print it instead of the port number. (See Figure 2 for sample output from the `netstat` command.) The `netstat` command is a powerful way to monitor which computers are "talking" to your computer over the network.

The first two lines indicate `telnet` connections between the machines GHOTI.LCS.MIT.EDU and AMWAY.CH.APOLLO.COM and the machine CHARON.MIT.EDU. Both of these connections originated at the remote machine and represent interactive sessions currently being run on CHARON. You can tell this because unnamed port numbers

Figure 2. Monitoring the Network

```
charon% netstat
Active Internet connections
Proto   Recv-Q  Send-Q     Local Address              Foreign Address            (state)
tcp     0       0          CHARON.MIT.EDU.telnet      GHOTI.LCS.MIT.ED.1300      ESTABLISHED
tcp     0       0          CHARON.MIT.EDU.telnet      amway.ch.apollo..4196      ESTABLISHED
tcp     4096    0          CHARON.MIT.EDU.1313        E40-0087.MIT.ED.telne      ESTABLISHED
tcp     0       0          CHARON.MIT.EDU.1312        MINT.LCS.MIT.EDU.6001      ESTABLISHED
tcp     0       0          CHARON.MIT.EDU.1309        MINT.LCS.MIT.EDU.6001      ESTABLISHED
tcp     0       0          CHARON.MIT.EDU.telnet      MINT.LCS.MIT.EDU.1218      ESTABLISHED
tcp     0       0          CHARON.MIT.EDU.1308        E40-0087.MIT.ED.telne      ESTABLISHED
tcp     0       0          CHARON.MIT.EDU.login       RING0.MIT.EDU.1023         ESTABLISHED
tcp     0       0          CHARON.MIT.EDU.1030        *.*                        LISTEN

charon% netstat -a
...
(Previous netstat printout)
...
tcp     0       0          *.telnet                   *.*                        LISTEN
tcp     0       0          *.smtp                     *.*                        LISTEN
tcp     0       0          *.finger                   *.*                        LISTEN
tcp     0       0          *.printer                  *.*                        LISTEN
tcp     0       0          *.time                     *.*                        LISTEN
tcp     0       0          *.daytime                  *.*                        LISTEN
tcp     0       0          *.chargen                  *.*                        LISTEN
tcp     0       0          *.discard                  *.*                        LISTEN
tcp     0       0          *.echo                     *.*                        LISTEN
tcp     0       0          *.exec                     *.*                        LISTEN
tcp     0       0          *.login                    *.*                        LISTEN
tcp     0       0          *.shell                    *.*                        LISTEN
tcp     0       0          *.ftp                      *.*                        LISTEN
udp     0       0          *.time                     *.*
udp     0       0          *.daytime                  *.*
udp     0       0          *.chargen                  *.*
udp     0       0          *.discard                  *.*
udp     0       0          *.echo                     *.*
udp     0       0          *.ntalk                    *.*
udp     0       0          *.talk                     *.*
udp     0       0          *.biff                     *.*
udp     0       0          *.tftp                     *.*
udp     0       0          *.syslog                   *.*
%
```

on the foreign machines are connecting to CHARON's `telnet` port (used for remote virtual terminal service). Likewise, the third `telnet` connection, between CHARON and E40-008-7.MIT.EDU originated at CHARON to the machine E40-008-7. The next two lines are connections to port 6001 (the X Window Server) on MINT.LCS.MIT. EDU. There is a `telnet` from MINT to CHARON, one from CHARON to E40-008-7.MIT.EDU and `rlogin` from RINGO.MIT. EDU to CHARON. The last line indicates that a user program running on CHARON is listening for connections on port 1030. If you run `netstat` on your computer, you will likely see many connections. If you use the X Window System, you may also see "UNIX domain sockets," which are the local network connections from your X clients to the X Window Server.

With the `-a` option, `netstat` will also print a list of all of the TCP and UDP sockets to which programs are listening. Using the `-a` option will provide you with a list of all the ports that programs and users outside your computer can use to enter the system via the network. (Unfortunately, `netstat` will not give you the name of the program that is listening on the socket).

There are weaknesses in the implementation of network services that can be exploited to masquerade temporarily as another machine. There is nothing that you can do to prevent this, assuming the attacker gets the code correct and has access to the network.

This kind of "spoof" is not easy to carry out, may require physical access to your local network and needs exact timing of events to occur. It is also the case that such spoofs are possible to spot afterwards.

Nonetheless, if you are storing something extremely critical on your system, you should consider keeping that system isolated from local and external networks. At the very least, disable all trusted hosts/trusted users. A network connection lets your computer communicate with the outside world, but it also makes it possible for attackers in the outside world to reach into your computer and do damage.

Finally, you should know all of the services that your computer makes available on the network and remove or disable those that you think are too dangerous. You should also decide if the convenience of `.rhosts` files is outweighed by their danger. If so, delete them, or modify your system software to disable the feature. ⊸

***This article** is excerpted from material in* Practical UNIX Security, *by Simson Garfinkel and Gene Spafford, ISBN 0-937175-72-2, published by O'Reilly & Associates, Sebastopol CA, (800) 338-6887 or (707) 829-0515. For further information, contact Linda Lamb, Director of Marketing, O'Reilly & Associates, (617) 354-5800.*

NEW PRODUCTS

Macintosh Servers

Cayman Systems has introduced a product that turns Macintosh applications into X Window System clients that can be accessed on workstations and X terminals.

Called Xgator, the product is meant to turn Macs into servers in TCP/IP networks. A user on an X-oriented device can then access popular Mac applications from their own systems. The company says the product is meant as a low-cost alternative to putting Macs on every desk in a network.

Xgator is priced at $495. It runs on Mac Plus, SE or II series machines with System 5.0 or higher.

Cayman Systems Inc., University Park at MIT, 26 Landsdowne St., Cambridge, MA 02139.

Circle 119

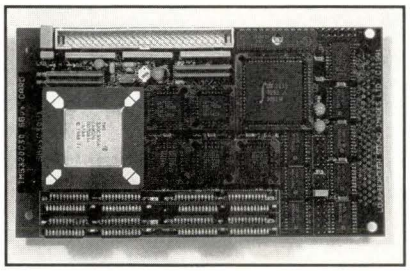
Windowing ASCII Terminals

The Microterm 6600 is a classic ASCII terminal, but it also has its own windowing facilities. It can support a split screen in vertical or horizontal; a floating window that can be placed anywhere on the screen; plus such user functions as zoom. It also supports menus in English, German and French.

The 6000's monochrome screen is 14 inches. The machine itself is 13.7 by 12.6 by 12.8 inches. Pricing begins at $795.

Microterm, 512 Rudder Road, St. Louis, MO 63026.

Circle 120



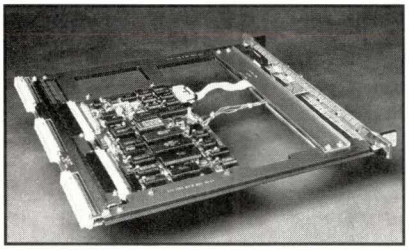
DSP On SBus

A new SBus board built around the TI TMS320C30 digital-signal processor has been introduced by Spectrum Signal Processing. The new board is particularly geared to real-time data acquisition. The product has up to 512 K words of SRAM, dual port RAM and analog-to-digital I/O options.

Pricing on the board is $4,595, or $9,595 with an assembler/linker, a C compiler and the SPOX real-time, DSP operating system. It occupies a single SBus slot.

Spectrum Signal Processing Inc., Gilmore Way, Ste. 301-3700, Burnaby, BC, V5G 4M1, Canada.

Circle 121



Timing Boards For Sun

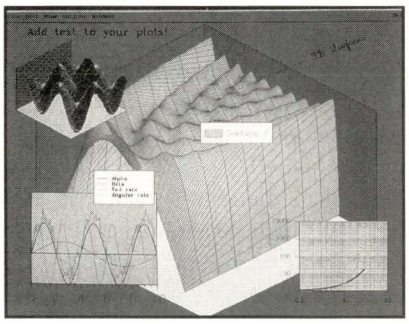
The AITG time-code generator boards allows users to precisely synchronize computer systems to an external time code.

Applications include financial time tagging, precise synchronization of multiple systems/processes, radar data collection, etc.

The two boards are available in VME and SBus versions. The VME version is a 9U machine priced at $2,250; the SBus version is $2,350.

Odetics, Precision Time Division, 1515 South Manchester Ave., Anaheim, CA 92802-2907.

Circle 122



Math Environment For X

The Xmath mathematical analysis and scripting environment for the X Window System provides interactive data analysis and 2D and 3D graphics as well as numerical programming. Xmath comes standard with over 200 built-in math functions, including code for linear algebra and general math.

Xmath is built around the OSF/Motif GUI. It is currently available for Sun workstations and compatibles. A single user license is $2,495.

Integrated Systems Inc., 3260 Jay St., Santa Clara, CA 95054-3309.

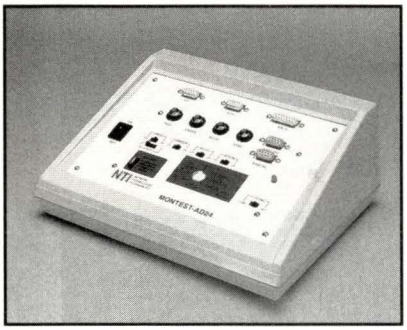
Circle 123

Digitizer Product On SPARC

The DrawingBoard II (Model 3300) digitizer for Suns and other systems is available in six tablet sizes, ranging from 12 by 12 inches to 44 by 60 inches. The product offers resolution of up to 2,540 lines per inch and an accuracy of plus or minus .010 inches. Moreover, the product is available with either a corded or cordless stylus.

The products range in price from $645 (for the 12-by-12-inch 33120) to $2,995 (for the 44-by-60-inch 33600). Device drivers for Sun and compatible products are already available, as are drivers for the Macintosh, the X Window System, Autodesk and

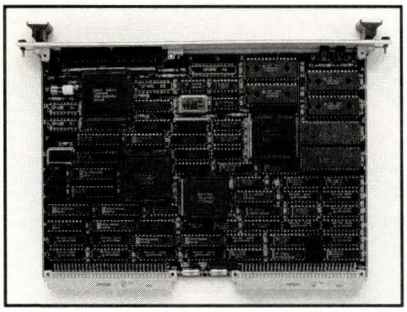
Microsoft Windows environments.
CalComp Inc., Digitizer Products Group, 14555 North 82nd St., Scottsdale, AZ 85260.
Circle 124



Monitor Tester Debuts

The Montest-Ad24, a computer-video generator that simulates 24 different video formats can test, align and color-balance workstation monitors.

The device covers the horizontal-scanning-frequency range from 15.7 kHz to 89.3 kHz. It generates four different test patterns: color bars, cross hatch tests, full raster tests and a test window. Pricing begins at $1,450.
Network Technologies Inc., 7322 Pettibone Road, Chagrin Falls, OH 44022.
Circle 125



VME-to-SCSI Adapter

Ciprico has announced a VME-to-SCSI-2 adapter. The RF35760 VMEbus SCSI-2 host bus adapter independently controls data transfers, SCSI messages, peripheral status and error recovery between the host system and up to seven SCSI-2 peripherals.

A 6U VME board, the product supports asynchronous and up to 10 MB-per-second synchronous SCSI transfer rates on assorted SCSI-1 and SCSI-2 disks, CD-ROM, 1/4-inch tape, 1/2-inch tape, DAT and helical-scan tape transports. It also offers 8-, 16- and 32-bit VMEbus data transfers at rates up to 30 MB per second. OEM pricing begins at $2,170
Ciprico Inc., 2955 Xenium Lane, Plymouth, MN 55441.
Circle 126

New Ports For Sun

The PortMaster PM-11 serial/parallel communications expander attaches to an Ethernet network and acts as link between Sun workstations and RS232 or parallel devices, such as terminals, personal computers, printers, modems, and so on. In addition, the product can be made into a full IP router via an optional SLIP package known as Dialnet. Thus it can provide wide-area-network computing via modems and phone lines.

PortMaster can support 10 RS232 devices and one Centronics device. It can be remotely managed and controlled from Sun workstations or compatibles. The Dialnet option offers

Coming Next Month

Graphics, Part I: The Role of Hardware

With this article, *SunExpert* launches a two-part exploration of high-performance graphics. In the October installment, we'll look at hardware–subsystems, add-in and add-on products for Sun and Sun-compatible workstations–and services. The array of available products make it increasingly possible for users to put together low-cost graphics engines based on Sun workstations and SPARCalikes that have the horsepower to compete with the most advanced dedicated graphics boxes.

such security features as user IDs.

Price is $2,495.

Livingston Enterprises Inc., 6920 Koll Center Parkway, #209, Pleasanton, CA 94566.

Circle 127

Solbourne Server

Solbourne has introduced a server version of its S4000 desktop system.

The S4000 Workgroup server offers 25.5 MIPS, three SBus slots, up to 104 MB of memory and up to 1 GB of internal disk. The company says the system is particularly targeted to users of X-terminals.

Standard features of the S4000 include an Ethernet controller, two RS423 ports, an external SCSI-2 bus interface, an audio port, the OS/MP operating system (a SunOS derivative), the SunView GUI and a C language compiler.

Pricing begins at $6,995.

Solbourne Computer Inc., 1900 Pike Road, Longmont, CO 80501.

Circle 128

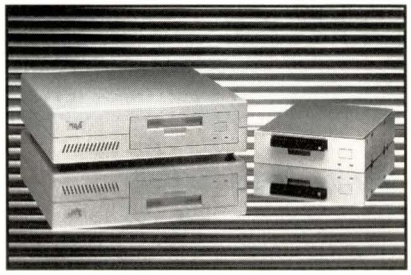
HP Business Systems

HP has introduced 16 different business systems and servers. The new systems comprise additions to the RISC-based HP 9000 and HP 3000 lines. All are small to mid-level systems for small businesses or the smaller departments of large ones. They differ, however, in that the 9000 machines are PA-RISC systems running the HP-UX version of UNIX, while the 3000s run HP's own MPE/XL operating system.

The 9000s range from the Model 807S, at $12,895, to the Model 857S, at $95,000. The 3000s range from the Series 917Lx, at $14,500, to the Series 967 at $170,000.

Hewlett-Packard Co., 3000 Hanover St., Palo Alto, CA 94304.

Circle 129



Half-Height, 1-GB DAT Drives

The Slim Line 1-GB, half-height, 5 1/4-inch DAT drives sport flash-memory technology, allowing for on-site tape-drive upgrades in fewer than 90 seconds. All members of the line

are SCSI-2-compatible.The Slim Line series can be configured differently on LANs, depending on needs and data storage applications of the end user.

LanDat SL is workstation-based, and permits all file-server data to be backed up from the supervisory workstation. The ServerDat SL is a server-based model that backs up all file-server data, as well as local disk drives.

The entire series of Slim Line drives will also be available with extended 90-meter tape in a future product release. Pricing for the Slim Line family ranges from $4,000 to $6,000.
GigaTrend Inc., 2234 Rutherford Road, Carlsbad, CA 92008.
Circle 130

CMU for MultiSPARC

The Cypress CY7C605 cache controller and memory-management unit for multiple SPARCs facilitates the construction of multiprocessor systems of up to four SPARCs. The CMU provides bus snooping, dual cache tag memories, direct data intervention and reflective memory.

The CY7C605 comes in a 243-ceramic-pin, grid-array package. It will be available in 25-, 33-, and 40-MHz versions. The unit price for a 40-MHz version, in quantities of 100, is $1,200.
Cypress Semiconductor, 3901 North First St., San Jose, CA 95134-1599.
Circle 131

Removable Storage

The Bernoulli box people have come out with three new removable storage products. The first two–the Bernoulli 90 WorkStation Transportable and the 90 WorkStation Dual–combine hard-disk performance, the crash-resistant Iomega design and 90-MB capacity. The third product is Iomega's LaserSafe WorkStation, an erasable, optical mass-storage system that stores up to 600 MB on a single, removable optical disk.

The Bernoulli 90s have effective access times of 19 msec. The drives also feature new, automated self-cleaning heads. And the products are the first to use metal-particle recording media and metal-in-gap heads, allowing higher linear-density recording.

A single-drive 90 WorkStation Transportable lists for $1,399. The 90 WorkStation Dual lists for $2,599 and the LaserSafe WorkStation for $4,999. All three products are available for use with the SPARCstation via the company's WorkStation Interface kit, which retails for $79.
Iomega Corp., 1821 West 4000 South, Roy, UT 84067.
Circle 132

NDS Announces X-terminal

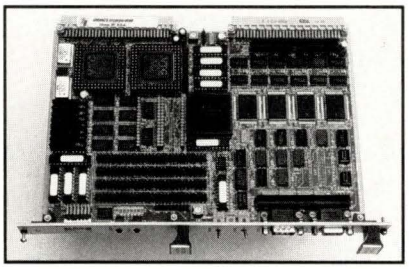
The X20 X-terminal, based on the TI 40-MHz TMS 34020 microproces-

sor, benchmarks in excess of 90,000 XStones.

The product can be configured to support resolutions of 1024 by 768, 1152 by 900 and 1280 by 1024 with monochrome, grayscale and 16 or 256 displayable colors. For multimedia and image-processing applications, the X20 supports true color at 512 by 512 resolutions. The product can be upgraded to support PEX for 3D applications.

The company offers this technology to OEMs through licensing agreements or manufacturing kits and is now available packaged and marketed to distributors under the name "NDS X Station."

Northwest Digital Systems, P.O. Box 15288, Seattle, WA 98115.
Circle 133



Smart Serial I/O Controller

The IV-3234 next-generation 16-port serial I/O controller is based on the 68EC030 or 68030 communications controller. The controller also incorporates the latest multiprotocol communications controllers from Cirrus Logics. The IV-3234 includes a 680X0-type mezzanine bus, which gives compatible daughter boards direct access to the CPU, the VMEbus and the four Cirrus Logics CD2401 processors.

For those instances requiring higher data rates, the IV-3234 can be fitted with a Z85C30-based daughterboard. This creates eight additional serial ports and can yield data rates exceeding T1 speeds on several of its ports simultaneously.

The IV-3234 is available in quantities of 100 (with 1 MB DRAM) for $1,915.

Ironics Inc., 798 Cascadilla St., Ithaca, NY 14850.
Circle 134

Mach For The Mac

Mach[Ten] offers users a new way to run UNIX on the Apple Macintosh. It is not a UNIX workalike; rather, it is Berkeley 4.3 BSD UNIX built on a Carnegie Mellon Mach foundation.

Mach[Ten] is a complete execution environment and development environment both. With the product, you can continue to run off-the-shelf Mac software, while simultaneously running UNIX programs. Mach[Ten] maintains consistency with the MacOS interface, and runs a version of the Sun Network File System (NFS). The company promises server and client X Window System support for some time in the fourth quarter, and System 7 compatibility by the first quarter of 1992.

The hardware required includes the Mac Classic, LC, SE, SE/30, II, IIcx or IIfx with a minimum of 2 MB of RAM (4 MB recommended for software developers). A run-time license sells for $595 (workstation with two users) or $835 (server with unlimited users). A development license goes for $990 (workstation) or $1,230 (server).

Tenon Intersystems, 1123 Chapala St., Santa Barbara, CA 93101.
Circle 135

Centrally Managed Security

The ACE/Server system provides centrally managed, integrated information security and prevents unauthorized access to network information resources.

The product uses the company's two-factor SecurID identity verification technology on a remote, physically secure platform and requires no new hardware at the diverse resources that comprise the network. The SecurID card is a credit-card-sized device with an LCD that displays a code, unique

to each user, which automatically changes every 60 seconds. This bypasses the easily exploited static password. If remote two-factor identity verification via the SecurID card is successful, a unique one-time ignition key is sent by the server to release access to desktop resources. Although encryption keys are used, they are not stored on the devices they protect, nor is any key transmission necessary to secure peripheral resources.

Entry-level price is less than $5,000.
Security Dynamics Inc., One Alewife Center, Cambridge, MA 02140.
Circle 136

New Printers For QMS

The QMS-PS 815 MR and the QMS-PS 825 MR PostScript printers allow users to choose resolutions of either 600 by 600 dpi or 300 by 300 dpi via the printer control panel or software commands.

Both models are compatible with PC, Macs and most mini and mainframe networked systems. They have LocalTalk, RS232 serial and Centronics parallel interfaces.

The single-tray QMS-PS 815 MR has a suggested list price of $5,495, and the dual-tray QMS-PS 825 MR lists for $6,495.
QMS Inc., One Magnum Pass, Mobile, AL 36689.
Circle 137

Live Video With Image Compression

Parallax's new XVideo card provides SBus-based SPARCstations with photo-realistic imaging, real-time video digitizing and JPEG hardware image-compression capabilities.

XVideo's other imaging features allow users to overlay 24-bit graphics on 24-bit live video, render graphics and/or text in "live video" colors, and implement "movie loops." The product provides full support for OpenWindows and the X Window System. The company also offers XView toolkit extensions to help software developers take advantage of XVideo's video and compression features.

Pricing for the XVideo-24SV (base card with single video input) is $5,995. XVideo-24SVC, which includes JPEG compression, is $7,490. XVideo-24SV-VIO, which includes video-out and second-video-in, is $7,990.
Parallax Graphics Inc., 2500 Condensa St., Santa Clara, CA 95051.
Circle 138

FYI

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.

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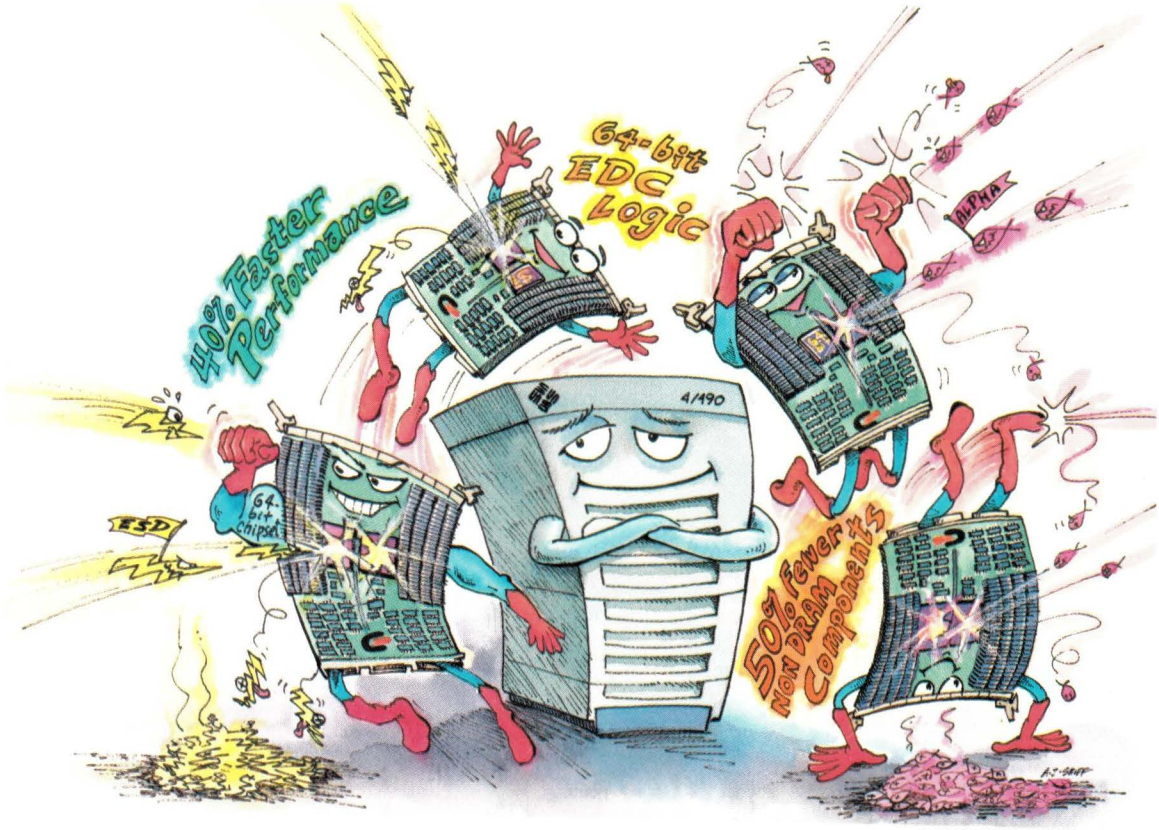
Circle No. 29 on Inquiry Card

The Only Fault-Tolerant Memory for SPARCserver 490 Systems



Unstoppable Memory from Clearpoint, of course!

Clearpoint's design philosophy strives for maximum reliability and superior value. Our SNME-490 memory for SPARCstation/ SPARCserver 470 and 490 systems, available in 32 and 128 MB densities, is the only fault-tolerant solution for Sun servers.

Dynamic Bad-Bit Replacement

The Clearpoint 64-bit EDC chip set with dynamic bad-bit replacement provides fault tolerant operations. If the logic identifies a hard error, a spare DRAM is immediately swapped in to prevent the possibility of a system-stopping double-bit error. The chip set then reallocates the address range to the spare DRAM. If a soft error occurs – caused by ESD or alpha particles, for example – the EDC logic corrects the data and scrubs the location. All correction and remapping operations are transparent to the user.

Increased Performance

The SNME-490 operates up to 40% faster than Sun's 4/490 memory boards. Clearpoint takes full advantage of the Sun 64-bit memory bus by implementing a 64-bit EDC chip set (Sun uses 32-bit), allowing faster data transfers.

Increased Reliability is Built In

Clearpoint's hard-soldered DRAM solution provides a significantly better Mean Time Between Failure rate than a SIMM-based board.

Additionally, state-of-the-art components and high-level design integration have reduced the non-DRAM chip count on the SNME-490 by over 50%. A lower component count insures fewer field failures and less downtime.

Call or write for more information!

- ❒ SNME-490 spec sheet
- ❒ *The Designer's Guide to Add-in Memory*
- ❒ *Pointers* newsletter
- ❒ *Memory Applications Casebook*

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