APRIL 1990
BYTE
OS/2 2.0 • APPLICATIONS ARCHITECTURES • 386 ROUNDUP
Volume 15, Number 4

SETTING THE STANDARDS
15
YEARS

New IBM RISCs: Blazing Speed, a new Unix, runs DOS PAGE 124

BYTE

APRIL 1990
A McGRAW-HILL PUBLICATION

THE NEW
OS/2
Good-bye, DOS-in-a-Box
Hello, True 32-bit Power!
PAGE 119

Apple redefines top of the line with the 40-MHz
Mac IIfx

Lotus 1-2-3/G
Toshiba T1200XE
Mylex EISA Triple Play
Emerging Architectures: IBM's SAA, DEC's NAS, Others

REVIEWS
23 386-Clone Motherboards
NEC Prospeed CSX
Low-Cost Color Scanner
HP NewWave
Ami Pro vs. Windows Word vs. Legend
FoxPro
MPW C++ vs. Think C 4.0

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PC MAGAZINE EDITORS' CHOICE 11 29 88

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- Page mode interleaved memory architecture.
- VGA systems include a high performance 16-bit video adapter.
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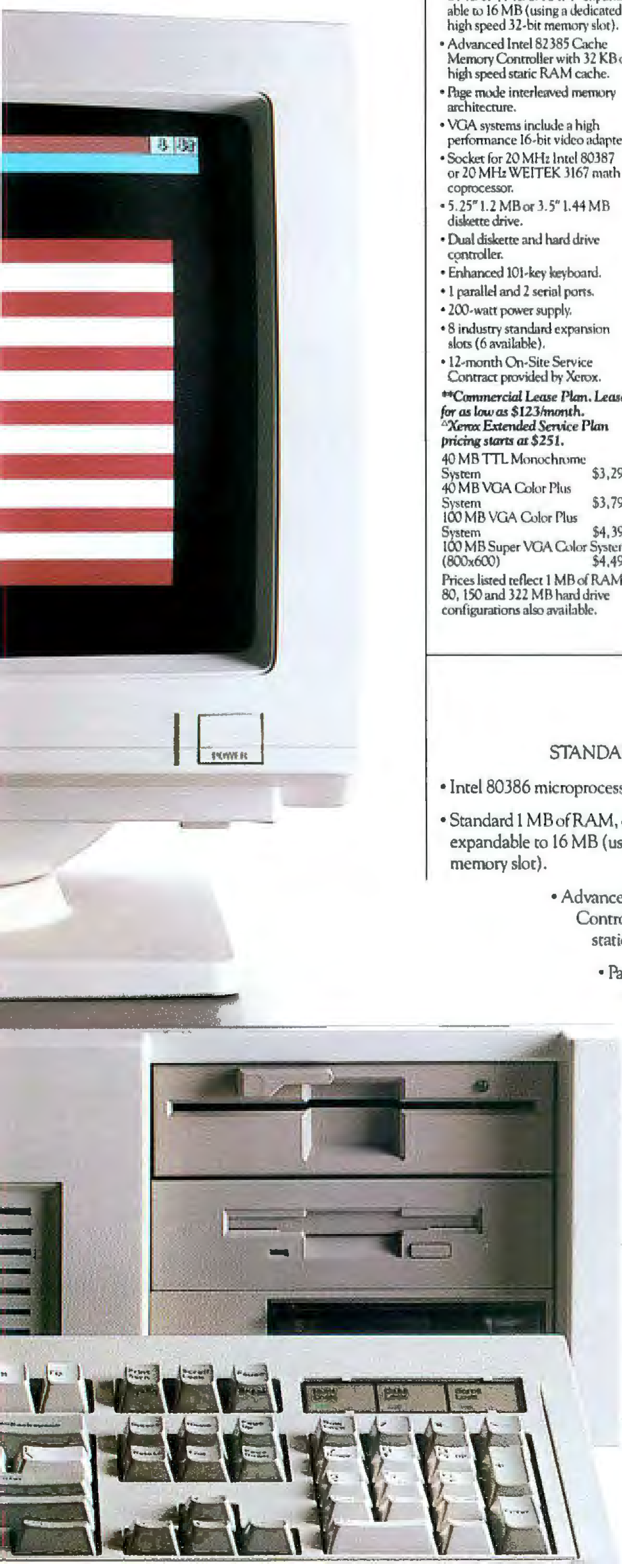

STANDARD FEATURES:

- Intel 80386 microprocessor running at 25 MHz.
- Standard 1 MB of RAM, optional 2 MB or 4 MB of RAM* expandable to 16 MB (using a dedicated high speed 32-bit memory slot).
- Advanced Intel 82385 Cache Memory Controller with 32 KB of high speed static RAM cache.
- Page mode interleaved memory architecture.
- VGA systems include a high performance 16-bit video adapter.
- Socket for 25 MHz Intel 80387 or 25 MHz WEITEK 3167 math coprocessor.
- 5.25" 1.2 MB or 3.5" 1.44 MB diskette drive.
- Dual diskette and hard drive controller.
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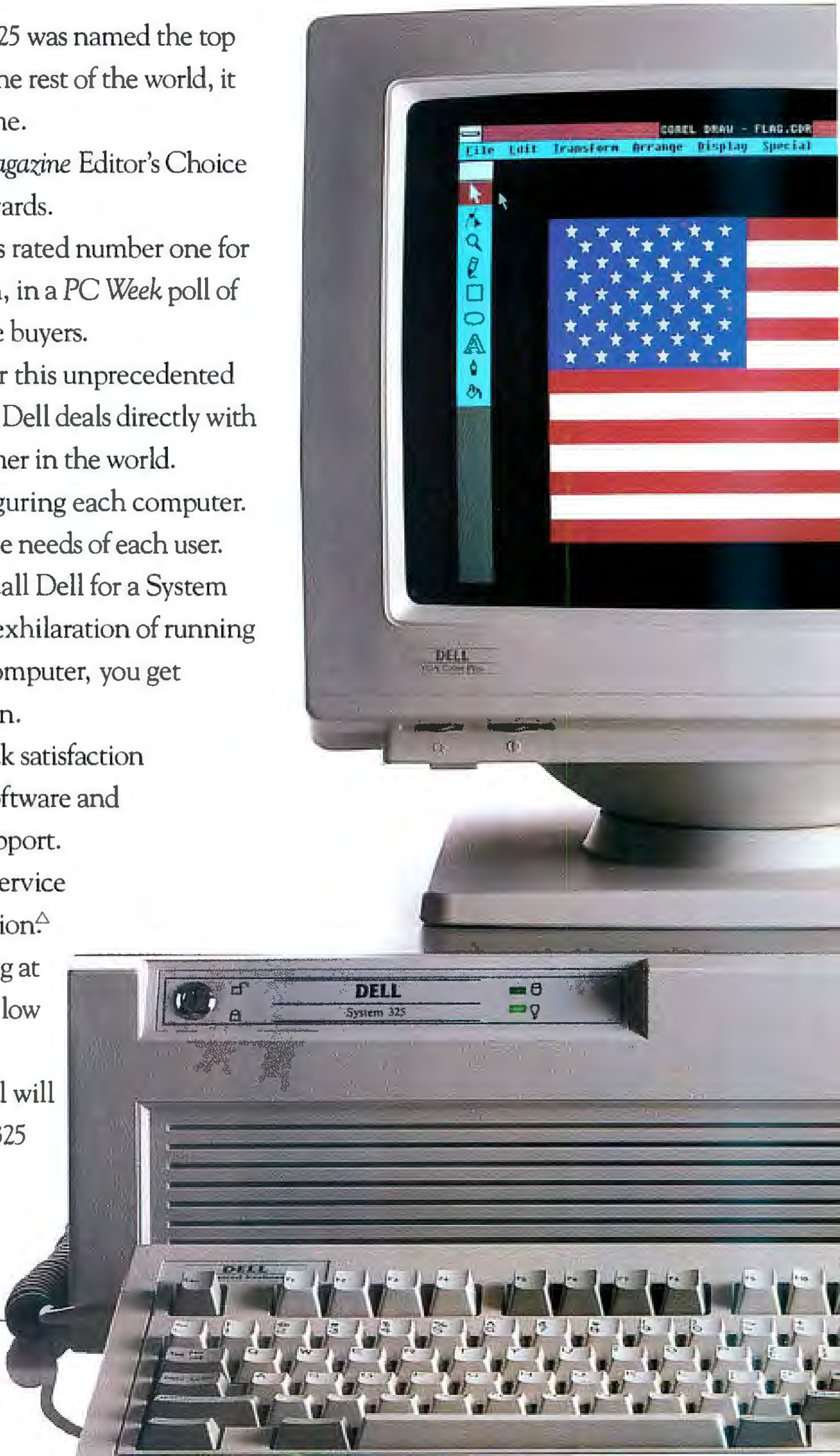

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PowerCache 4... The most advanced What else would you expect

PC MAGAZINE, *January 1989,*
"In a field of powerhouse machines there can only be one winner, and ALR's FlexCache is it."

INFO WORLD, *July 1989,*
"ALR Systems Unleash 486 Power. The PowerCache 4 shines in the CPU-specific portion of the InfoWorld Automated Benchmark Test, gaining a score of 16.3."

PC WEEK, *July 1989,*
"Based on a series of benchmarks run last week on Advanced Logic Research, Inc.'s prototype 486 desktop system, ALR will enter the 486 market with a bang."

At ALR, we will never rest on our laurels. We strive to be the best, as proven by our past achievements. Now with the introduction of the new ALR PowerCache 4™, we've designed a system that is far beyond comparison. Again, we have taken PC-microprocessing power a step further by designing a unique proprietary PowerCache 4 cache controller using ALR's custom ASIC chips which deliver the fastest processing speed ever.

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Bus	MCA	MCA	MCA
External Cache	128 KB cache Read and Write-Back	128 KB cache Read and Write-Back	None
Video Opt. on board	640x480 1024x768	640x480 1024x768	640x480 None
I/O Slots	6 expansion slots	6 expansion slots	3 expansion slots
Storage Expansion	4-3 1/2"	1-full height 2-1/2"-height 2-3 1/2" drives	3-3 1/2" drives
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Circle 16 on Reader Service Card (DEALERS: 17)

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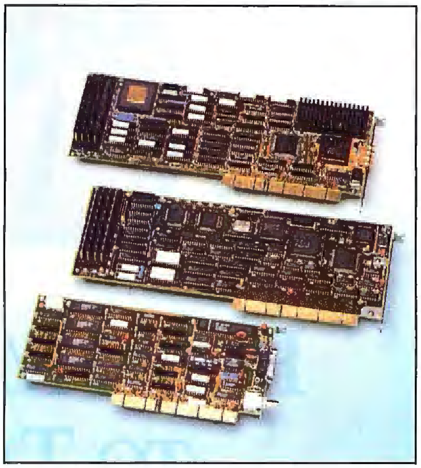

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From BYTEnet: call (617) 861-9764
On disk: See card after **336**

EXPERT ADVICE

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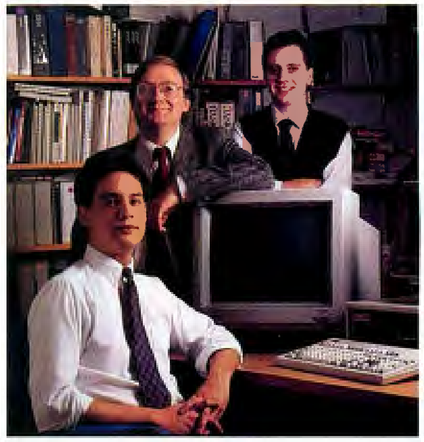
S P O T L I G H T

Rob Mitchell

Stan Wszola

Steve Apiki



FROM MATH CHIP TO TIE CLIP

The trials and tribulations of testing 25-MHz 386-based motherboards

At first, it seemed simple: Set up a standard system configuration that would let us plug in and benchmark 25-MHz 386-based motherboards. We would run both MS-DOS and Unix tests, compare features and price, and assess expandability. In the end, we accomplished our goal: to tell you which motherboards make the best PC clones (see "The Heart and Soul of a PC Compatible" on page 130). Our mistake was thinking that it would be easy.

Technical editor Rob Mitchell and testing editors Steve Apiki and Stan Wszola wrestled with one problem after another. The PC market is changing as fast as the technology. Consequently, several vendors revised their motherboards in the midst of the review, forcing us to duplicate work already done.

Not every vendor supplied a math coprocessor, so the BYTE Lab had to install one 25-MHz 80387 chip into a number of machines. While we placed the math chip in a special carrier to minimize wear and tear, and used special chip-pulling tools, by the end of testing we had somehow cracked the math chip, making it into the most expensive tie clip BYTE has ever purchased.

Assembling and disassembling systems from the ground up was more time-consuming than we had expected and brought more than a few surprises. Several boards failed, some spectacularly, when powered up in the BYTE Lab. One failure trashed the hard disk drive containing our Unix benchmark code.

We wanted to look at motherboards available through dealers and distributors for those of you who want to build or upgrade a machine yourselves. We also wanted products that you can't buy directly, but that you are likely to find in popular PC clones. Sorting out how each company markets its motherboards required a great deal of phone work.

But if you find any part of our effort useful when you shop for your next PC clone, we'll consider it work well done.

—Michael Nadeau

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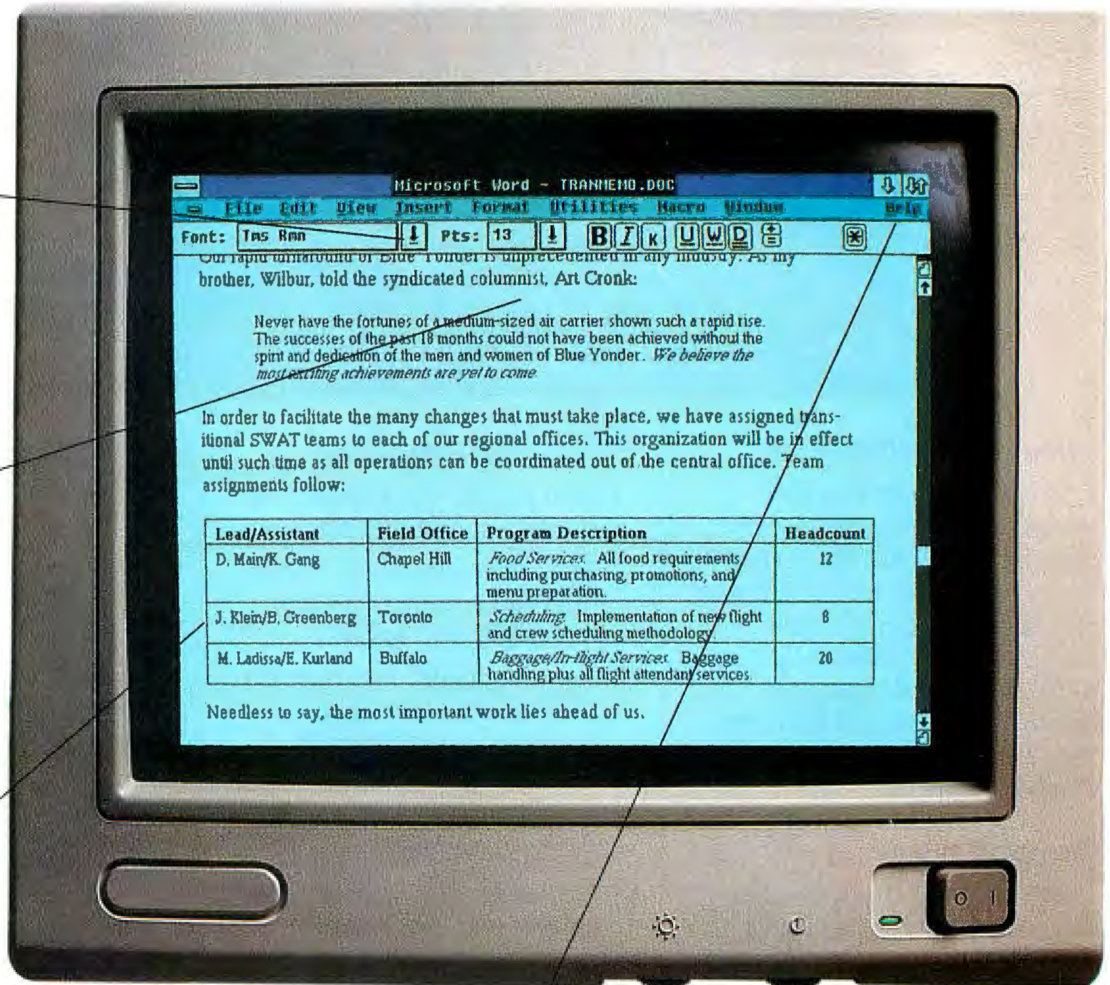

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Intuitive icons on the Ribbon make those everyday tasks, like formatting, as easy as ABC. Or, more precisely, see, point, do.

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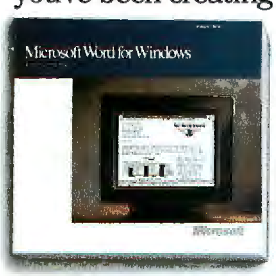

And even if your documents aren't formatted, there's probably someone in your office who wishes they were. You, perhaps.

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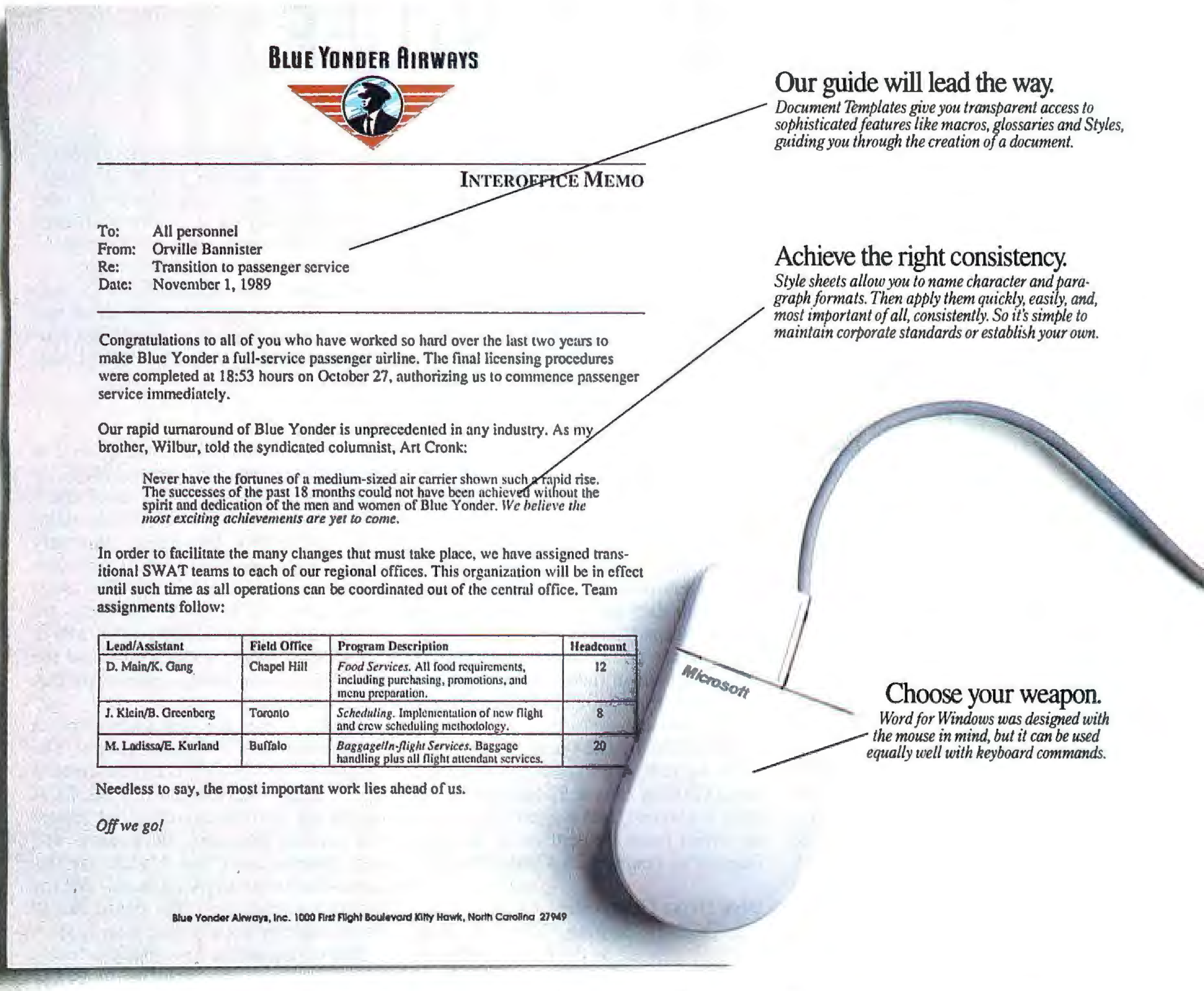

BLUE YONDER AIRWAYS

INTEROFFICE MEMO

To: All personnel
From: Orville Bannister
Re: Transition to passenger service
Date: November 1, 1989

Congratulations to all of you who have worked so hard over the last two years to make Blue Yonder a full-service passenger airline. The final licensing procedures were completed at 18:53 hours on October 27, authorizing us to commence passenger service immediately.

Our rapid turnaround of Blue Yonder is unprecedented in any industry. As my brother, Wilbur, told the syndicated columnist, Art Cronk:

> Never have the fortunes of a medium-sized air carrier shown such a rapid rise. The successes of the past 18 months could not have been achieved without the spirit and dedication of the men and women of Blue Yonder. *We believe the most exciting achievements are yet to come.*

In order to facilitate the many changes that must take place, we have assigned transitional SWAT teams to each of our regional offices. This organization will be in effect until such time as all operations can be coordinated out of the central office. Team assignments follow:

Lead/Assistant	Field Office	Program Description	Headcount
D. Main/K. Gang	Chapel Hill	*Food Services.* All food requirements, including purchasing, promotions, and menu preparation.	12
J. Klein/B. Greenberg	Toronto	*Scheduling.* Implementation of new flight and crew scheduling methodology.	8
M. Ladissa/E. Kurland	Buffalo	*Baggage/In-flight Services.* Baggage handling plus all flight attendant services.	20

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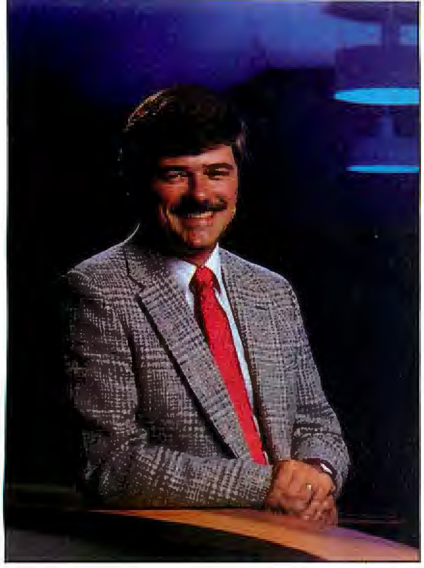

MYLEX STRUTS EISA'S STUFF

The most complete EISA offering to date clearly shows EISA's performance edge

As we were going to press, Mike Nadeau, associate managing editor for reviews, and the BYTE Lab got to test the most complete Extended Industry Standard Architecture (EISA)-based product line to date—an i486-based motherboard, a caching SCSI disk drive controller, an Ethernet adapter, and a prototype Texas Instruments Graphics Architecture (TIGA) graphics coprocessor, all from Mylex.

Mike reports that these EISA products are *fast* and that they suggest that we've just scratched the surface of EISA's power. For example, the disk drive controller is by far the fastest SCSI device that we have seen, approaching the performance of the best ESDI caching controllers. The GXE020A TIGA board—incidentally, it is the first 34020-based board that we have tested—scored as much as 45 percent higher on our low-level benchmark tests than any other TIGA board evaluated: This board could well be the year's TIGA performance leader. The other components in the demonstration system are equally impressive.

Motherboard

The prototype MAE 486-25 motherboard looked like a finished product, except for the firmware (an early Phoenix EISA BIOS), which needed some help from device drivers to configure the EISA boards.

It has six 32-bit EISA slots and two 8-bit slots, a 128K-byte write-back external cache, and a socket for a Weitek 4167 math coprocessor. It will accept up to 32 megabytes of RAM in two single-in-line-memory-module memory banks.

The Mylex scored well on the BYTE CPU and FPU benchmarks, with indexes of 6.21 and 27.44, respectively. Mylex has designed this board for use in file servers, Unix/Xenix systems, and engineering and scientific workstations. This explains why the designers added an external RAM cache and the FPU socket when the i486 already has a small cache and an FPU integrated on the chip.

Graphics

The GXE020A TIGA bus-mastering board was in an earlier stage of development. It had preliminary AutoCAD and TIGA drivers, with X Window System, Presentation Manager, and Windows/386 drivers in the works. The company expects to ship the board sometime during the second quarter, which is noteworthy since no one at this time has yet produced even an Industry Standard Architecture (ISA) 34020 board, much less an EISA version.

With 1280- by 1024-pixel resolution (a 1600- by 1280-pixel version is planned), the GXE020A runs at 32 MHz (up to 40 MHz is planned) and supports 256 colors on-screen from a palette of 16 million. Our test unit came with 4 MB of RAM.

Disk Drive Controller

The DCE376 caching SCSI disk drive controller, based on the Intel 80376 processor, was designed for service in networking or multiuser environments. It comes with drivers for MS-DOS 3.3 and 4.0, OS/2 1.1, Novell NetWare 3.0, and 386/ix V.3.2. Our unit came with 1 MB of cache RAM, expandable to 8 MB. The bus-mastering DCE376 supports up to seven SCSI devices, and you can program it for use with optical disks, scanners, tape drives, or CD-ROM drives.

Ethernet

The Mylex LNE390A Ethernet adapter is not a bus-mastering device. Nevertheless, Mylex claims an impressive host-to-adapter data transfer rate of 32 megabytes per second. The adapter is built around a National Semiconductor DP8390 Network Interface Controller, which takes over data buffer and communications management from the system's CPU. It supports both thick and thin Ethernet interfaces, and Mylex provides software support for Novell NetWare 2.15 and 3.0.

Pricing

The downside to all this is the price: The motherboard lists for a steep $7600, including a 128K-byte RAM cache and 4 MB of memory. The TIGA controller goes for $5100—expensive, but only about $500 more than the most expensive 34010-based TIGA boards. The SCSI controller and Ethernet adapters are more reasonable at $1700 (with 1 MB of RAM) and $500, respectively, and the DCE376 is comparably priced with ISA ESDI controllers.

Mylex is perhaps best known for its high-performance motherboards. The company does not sell complete systems to end users, but you can buy the EISA boards for your own system, and at least one vendor, Samsung Electronics, will sell systems using the Mylex motherboard and other EISA products. All the products except the TIGA board should be available by the time you read this.

EISA proponents have bet that bus's future on early availability of EISA-capable products and compatibility with the ISA standard. Mylex has addressed three key areas where bottlenecks occur: disk I/O, graphics, and network communications. The company will be among the first to actually sell EISA boards to end users. So far, EISA is well ahead of Micro Channel at its early stages, and all indications say that this trend will continue. Stay tuned.

—Fred Langa
Editor in Chief
(BIX name "flanga")

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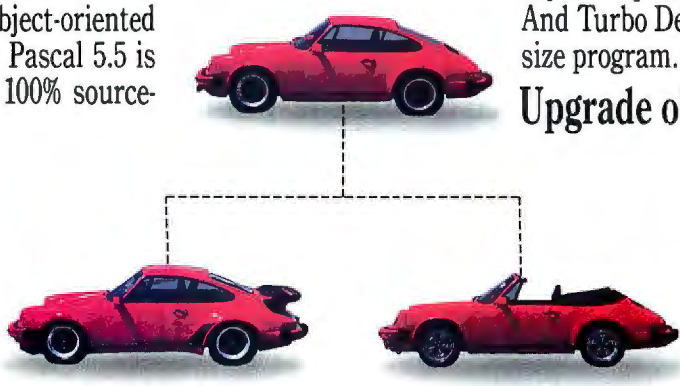

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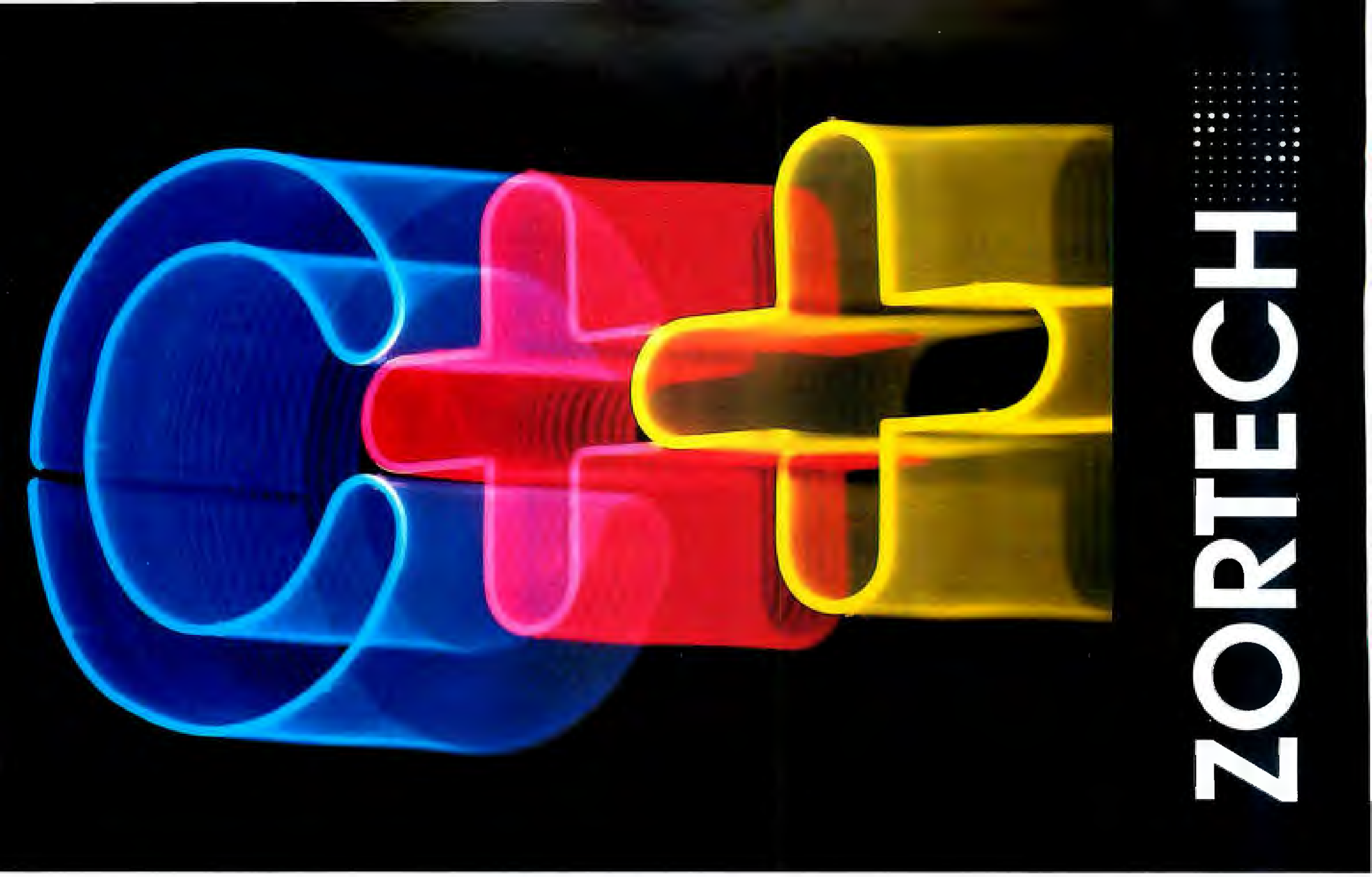
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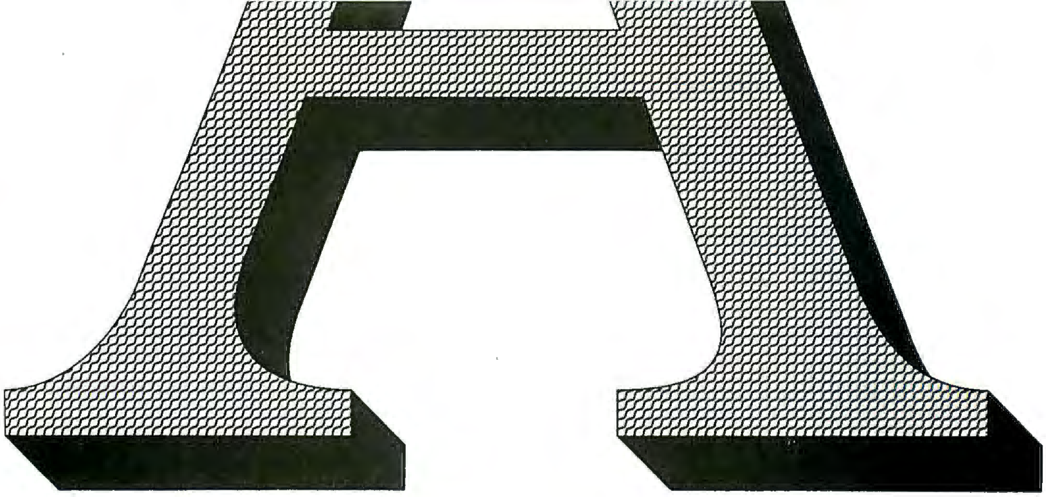

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MICROBYTES

Staff-written highlights of developments in technology and the microcomputer industry, compiled from Microbytes Daily and BYTEWEEK reports.

Edited by D. Barker

Optical Computer No Longer Light Years Away

Researchers at AT&T Bell Labs have successfully demonstrated what they call the world's first digital optical processor, an experimental device that performs calculations using optical switches and beams of light instead of transistors and electricity. The processor holds the promise of future computers that are much faster than current machines and more adept at handling multiple tasks simultaneously.

The tabletop processor bears little resemblance to a silicon chip; in fact, it looks like a Rube Goldberg contraption. Measuring about 2 feet on a side, the processor is made up of lenses, mirrors, prisms, light-sensitive chips, and laser diodes stripped from commercial compact disk players (the scientists hope to someday fit all this into 3 square inches). Four video cameras read the "output" and display a matrix of dots on large TV screens.

At the heart of the processor are tiny optical switches, called S-SEEDs (Symmetric Self-Electro-Optic Effect Devices). Each S-SEED contains two mirrors whose reflectivity to infrared light can be controlled by a separate optical input. The processor contains four arrays of 32 S-SEEDs, and each S-SEED acts as a NOR logic gate. Bell Labs estimates that the area occupied by one conventional electrical path could hold 256 optical gates.

The processor calculates by sending light beams from the laser diodes through a series of lenses and masks to the S-SEEDs, which either reflect or absorb the light, depending on logic. Each array then cascades its output to the next array as input. In this way, the processor is able to count, at an execution speed of about 1 million cycles per second. Since S-SEEDs can switch at up to 1 billion cycles per second, the processor might someday be able to run hundreds of times faster than it does now. Among the impediments to building a speedier version: Researchers can't debug it with conventional computers because they're too slow.

While the optical processor is far from a functional computer, the Bell Labs researchers, led by Alan Huang, hope to challenge skeptics who question whether a completely optical

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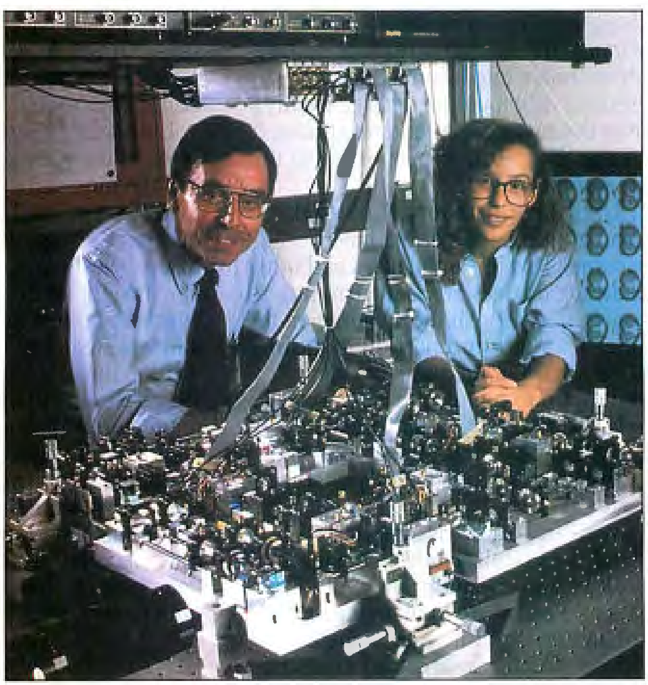

They do it with mirrors. And prisms, lenses, light-sensitive chips, and laser diodes. Bell Labs staff member Maralene Downs and consultant Nicholas Craft with the digital optical processor they helped build. Although the researchers caution that an optical computer is several years away, their experimental device is a major step toward computing at the speed of light.

NANOBYTES

Despite the prospect of tremendous growth for computer companies in **Europe, the main trend will be downsizing**, predicts Vittorio Cassoni, group managing director of Olivetti in Italy and a former AT&T executive. Cassoni said at the recent Personal Computer Forum that all European companies involved in information technology are currently overstaffed and will have to cut back. Some companies that have not reached "critical mass" will not survive, he said. As for the growth potential in Europe, Cassoni stated that Europe is much less penetrated by computer technology than the U.S., so there's more opportunity for selling OS/2, 386-based systems, and other leading-edge technology.

The **Open Software Foundation** (Cambridge, MA) has shipped its first "snapshot," or preliminary source code, of the **OSF/1** operating system to member companies. This version contains elements from Mach, BSD, AIX, and Encore implementations of Unix. Future snapshots will be released on a bimonthly basis, and availability of the final snapshot is slated for November, the company says. One Unix observer pointed out at UniForum, where OSF made its announcement, that it took eight passes through the snapshot process before OSF's Motif user interface was stable.

Meanwhile, AT&T's **Unix System V release 4.0**, Goliath to OSF/1's David, was all over the UniForum show floor. But when will the operating system be commercially released? Good question. A senior staffer for the Unix Software Operation said that **Intel** is in the best position to bring it to market first. Intel says July is most likely. AT&T is allowed to ship only source code, so it's up to other companies to get the new Unix compiled and running.

NANOBYTES

Open Look, AT&T and Sun's answer to the OSF/Motif graphical user environment, has been upgraded. An AT&T representative said that Open Look 2.0 includes bug fixes and performance enhancements, as well as utilities that used to be options.

Intel (Santa Clara, CA) has formed a joint venture with the Japanese company **NMB Semiconductor** to manufacture and market high-speed DRAM chips. The new Intel/NMBS DRAM Fabrication Co. plans to make 1- and 4-megabit chips at NMB's site in Tateyama City, Japan, and eventually in the U.S. NMBS will handle the manufacturing, and Intel, the marketing.

Prometa USA (Gainesville, FL) showed at UniForum a Motorola **88000-based coprocessor** card that plugs into **Micro Channel-based computers**. Using bus-mastering techniques, the board handles its own I/O, freeing the host processor to run DOS or OS/2 applications without additional overhead. The board runs Unix System V release 3.2. Prometa has built extensions to Microsoft Windows and Presentation Manager to allow execution of Unix programs from within DOS and OS/2. Prometa subscribes to the 88open Binary Compatibility Standard, so applications built for other 88000 platforms should run unmodified on Prometa's card.

Graphic Software Systems (Beaverton, OR) now has a version of its XVT (Extensible Virtual Toolkit) graphical interface library that runs under **OSF/Motif**. Previously, XVT allowed programmers to create interface modules in C that can be compiled with minimal changes across Microsoft Windows, Presentation Manager, Macintosh, and nongraphic character displays. GSS has enhanced XVT with color support, dynamic menu modification, text editing, and child windows. A Universal Resource Language specification and compiler allow interface elements to be textually described and transported across various platforms, GSS says.

computer can ever be built. Some computer scientists maintain that optics will be restricted to system I/O and connections between electronic components. And some say that optical gates will never be a practical alternative to transistors.

A fully optical computer is more than five years away, according to the Bell Labs group. The most viable use now for optical technology is in hybrid systems that combine optics and electronics. The researchers are now focusing their work on optical interconnects between chips, which could be practical in as little as three years. Optical interconnections could vastly increase the amount of data moving in and out of chips.

A big problem with electronic chips is their data I/O bottleneck: Signal lines need a critical mass to carry data and must be kept far enough apart to prevent cross talk. By contrast, light is very resistant to interference and has a huge bandwidth. Streams of photons can even cross one another without causing any distortion.

Optics and computers will likely converge gradually. The Bell Labs processor is a significant step toward an optical computer, but there are other hurdles, including developing techniques for programming an optical machine. By 1995, AT&T says, supercomputers and telecommunications computers could contain 20 percent to 30 percent optical components; by the year 2000, as many as half the components could be optical. But it will be quite a while before you'll be running your favorite application program on your desktop optical computer.

—Andy Reinhardt

Have They Been Doing It Wrong? Discovery Could Help Chip Makers, Researcher Says

In the process of designing a device for monitoring peak voltages on silicon surfaces, a Stanford University researcher says that he accidentally made a discovery that could greatly improve manufacturing yields and the reliability of ICs. Contrary to a basic assumption governing silicon chip design and production, Dr. Wieslaw Lukaszek says that he discovered that the process of depositing electrical charge on silicon surfaces (called *doping*, it's used to introduce voltage differentials into a semiconductor) tends to distribute the charge evenly over the surface, rather than concentrating the charge in proportion to the area of the surface.

Until this discovery, Lukaszek says, chip manufacturers have assumed that ion implanters and other charging devices act as a current source and deposit their charge on the silicon wafer in proportion to the size of its area. On the basis of this assumption, manufacturers have believed that they could prevent excessive electrical charge simply by limiting the size of the polysilicon wafer.

With this same assumption in mind, Lukaszek set out to design a peak voltage monitor that could measure and store in memory the voltage levels of a wide range of silicon structures subjected to electrical charge. Lukaszek says he found that "no matter what the size of the polysilicon structure, it sees the same voltage [given the same electrical charge]." In other words, explains Lukaszek, "the ion implanter behaves more like a voltage source than a current source." Or, in still other words, a basic assumption of making semiconductors is wrong, he claims. Until now, there has been no way of verifying the assumption, Lukaszek says. "It was based on looking at the residual damage in chips, sort of like doing an autopsy."

Lukaszek hopes to work with semiconductor companies to refine his voltage monitor so that the manufacturers can gain a better understanding of what's going on. Lukaszek told Microbytes Daily that he thinks this new insight could lead to better control of manufacturing conditions and less electrical "stress" on silicon wafers, thus resulting in higher yields. His finding could possibly enable manufacturers to understand better how silicon wafers behave in response to doping and then to redesign their equipment without worrying about wafer area, but focusing instead on other factors. "Manufacturers have been getting clobbered, and they didn't know about it," he says.

—Nick Baran

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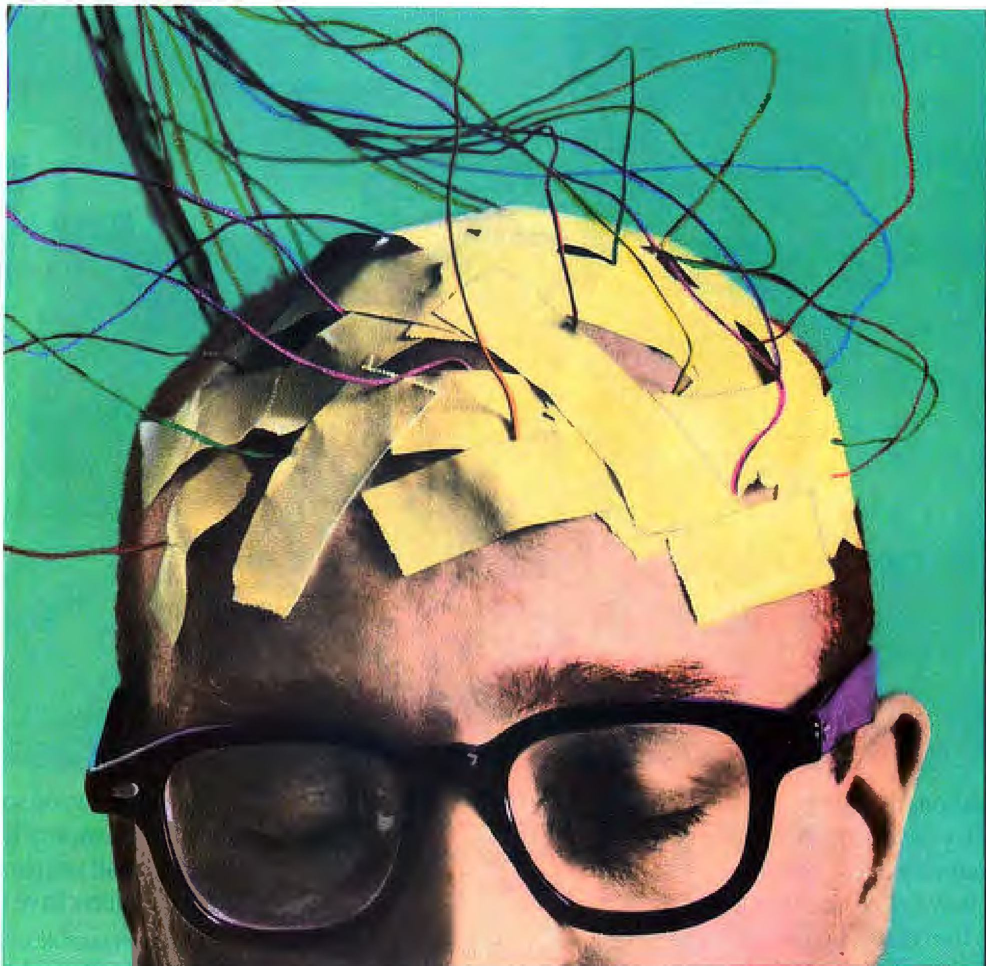
Until now there was only one way to integrate C and Assembler.



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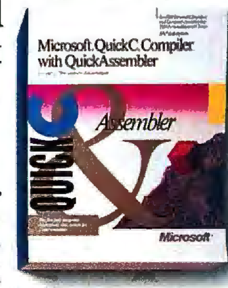

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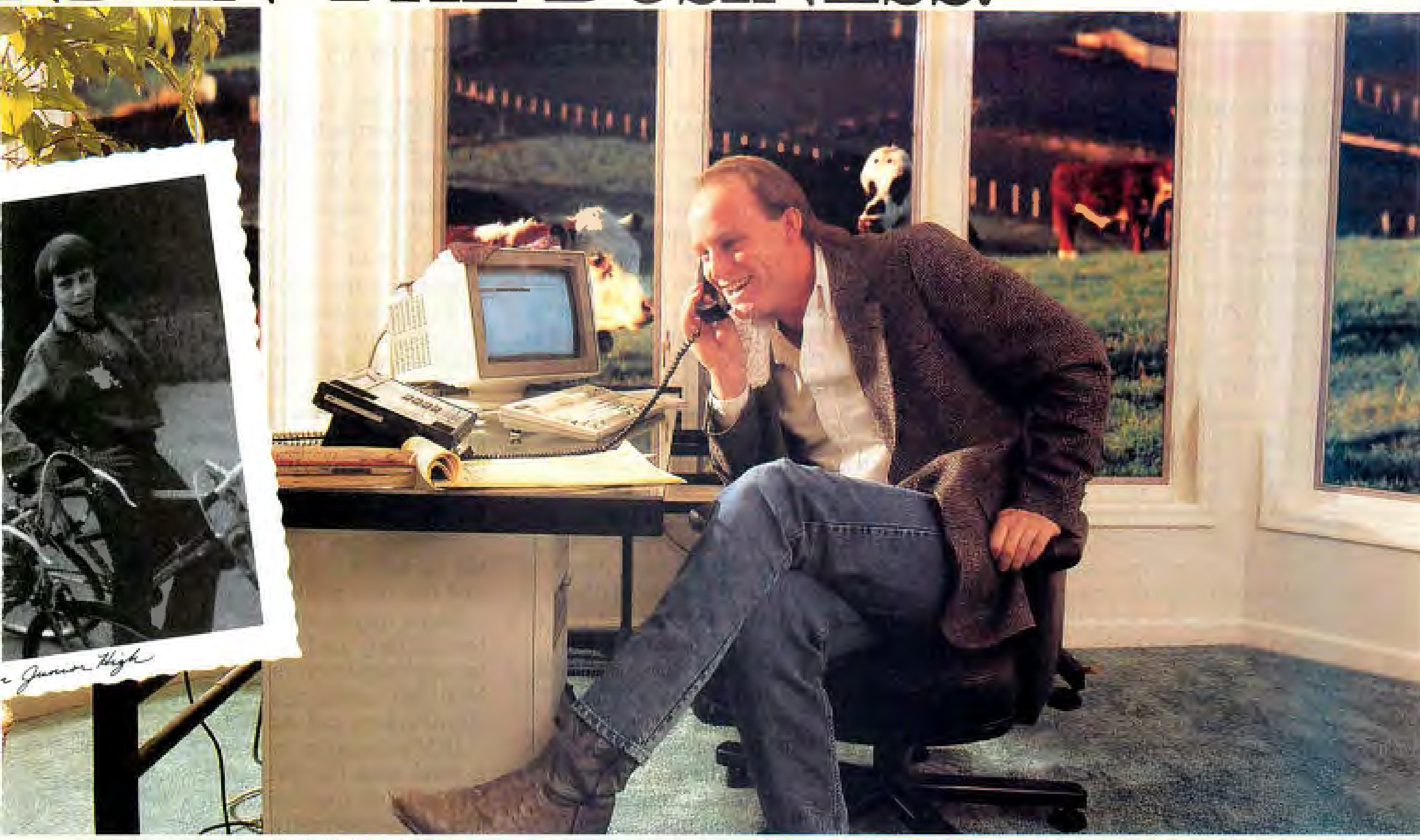

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NANOBYTES

Omron Advanced Systems (Cupertino, CA) is looking for remarketers in the U.S. to sell its Luna workstations. Manufactured in Japan, the Luna systems incorporate advanced performance and features in a small package. The original Luna, based on a 68030/68882 CPU/math coprocessor combination, includes 8 megabytes of RAM, a 150-MB hard disk drive, a 155-MB tape backup system, and a 19-inch monochrome display. The Luna runs Mach 2.5 (the operating system on which OSF/1 is based). Retail pricing is not set, but the product is less than $7000 in OEM quantities. The Luna/88K, a multiprocessing workstation, will incorporate up to four coupled Motorola 88000 chip sets running at 33 MHz.

Frame Technology Corp. (San Jose, CA) has signed with The Santa Cruz Operation (Santa Cruz, CA) to port **FrameMaker** desktop publishing software to **SCO's Open Desktop** graphical environment.

In a move prompted by **Compaq's** debut last November of its SystemPro, **Zenith** plans to offer an **enhanced version of its Z-1000 multiprocessing Unix system** in May. The Z-1000 currently uses two to six 386 processors; they're linked using a special bus configuration that includes standard AT-bus-style connectors and "C-Bus" connectors developed by Corollary. The new version of the Z-1000 will have EISA connectors in place of the AT connectors and will be able to use i486 processors as well as 386s. Zenith says that with six i486s in place, the new system will be capable of over 100 MIPS. Since the Z-1000 uses a passive backplane type of bus, current owners should be able to upgrade to the EISA version easily. As for software, the current Z-1000 can run only a special multiprocessing version of Unix. Zenith said that in the future, it will offer a multiprocessing version of Microsoft's LAN Manager and Novell's NetWare. Compaq has promised a multiprocessing version of LAN Manager (with two processors) for its SystemPro.

IBM Will Offer NeXT Environment to Unix Users

It came as no surprise, but it's good news for NeXT. IBM announced officially that it will offer NeXT's NextStep user interface and development environment on its workstations and PS/2 personal computers running AIX, IBM's version of Unix. IBM licensed NextStep from NeXT in 1988 but then made no public commitment to using it. While it's not yet clear that users of IBM's new RT will want to run NextStep on top of AIX 3, the fact that it's an option gives NeXT's environment the official seal of approval from the world's biggest computer company.

NextStep is a graphical user interface layer for Unix. NeXT uses a version of Unix called Mach, developed primarily at Carnegie Mellon University. IBM's AIX version of Unix is not compatible at the binary level with Mach; therefore, programs developed on NeXT Computers will have to be recompiled to run under AIX, and IBM programs developed with NextStep will have to be recompiled to run on NeXT Computers. While it is likely that little, if any, code modification will be necessary because NextStep uses a consistent graphics model on either NeXT or IBM systems, neither company has publicly demonstrated the portability of NextStep applications.

IBM will also support the Open Software Foundation's Motif interface, which can be considered a competitor of NextStep. NextStep has advantages over OSF in that it offers an excellent development environment for programmers with its Interface Builder and Application Kits, which facilitate software design. NextStep's possible disadvantage is its use of a proprietary windowing system, while most of the Unix market has settled on the the X Window System. While the Window Server doesn't have the acceptance that the X Window System has gained, some NeXT users have said that they think it's superior.

Some major software companies have already said that they're developing applications to run under NextStep, including Lotus, Informix, WordPerfect, and Adobe.

IBM's decision to offer NextStep is good news for developers working on NextStep applications. It gives them the opportunity to market their programs on IBM PS/2s and workstations that run AIX.

—Nick Baran

Group Proposes Decorum for OSF

In an effort to set an industry standard for distributed computer networks that contain software and hardware from different vendors, the Open Software Foundation (Cambridge, MA) has been evaluating responses to its "request for technology." Although the OSF has received 50 proposals for a standard distributed computing environment, observers say that one of the front-runners is Decorum, backed by a group that includes IBM, Microsoft, DEC, Apollo, Locus Computing, and Transarc.

Decorum defines tools that developers can use to more easily create applications for distributed environments. Although obviously aimed primarily at Unix-based environments, the proposal also defines ways of connecting with other operating systems, including DOS and OS/2. Other main components include remote procedure calls using Apollo's Network Computing System protocols; process transparency, provided by the Transparent Computing Facility, jointly developed by IBM and Locus; and a distributed file system, based on Transarc's AFS (formerly the Andrew File System of Carnegie Mellon). These provide support for uniform file systems across networks, as well as for integrating DOS and Unix file systems.

Rounding out the complex proposal are threading facilities based on POSIX, time services using the Network Time Protocol (NTP), distributed access to remote devices, administrative services for managing and monitoring networks, and capabilities for diskless systems.

A spokesperson for the Decorum group says that each of the major components of the proposal are designed as independent layers that can be combined into a complete distributed computing environment.

continued

NANOBYTES

The **Soviet software industry** isn't much of an industry just yet, according to **Alexey Pajitnov**, developer of the popular **Tetris** computer game and probably the USSR's most famous programmer. "We have practically no software products, only programs. We have a very small number of computers, and usually we use them only for scientific or research applications," he said during a recent tour of the U.S. to promote his new game, Welltris (distributed by Spectrum Holobyte). Soviet programmers work "in the same style" as Western ones, Pajitnov said. As for computers in the Soviet Union, Pajitnov doesn't expect to see a PC on every desktop in the near future. He said that his country has "a lot of serious problems" like food shortages and civil unrest that need greater attention.

Meanwhile, **ComputerLand** is opening the first computer store in the Soviet Union. The new **Moscow franchise** will sell systems from IBM, Compaq, AST, Epson, and Hewlett-Packard. The store will not sell Macintoshes yet because Apple is currently developing a Cyrillic keyboard for the Russian market, according to ComputerLand spokesperson Brian Okun. The Moscow store will be owned by Michael Tseytin, a Russian immigrant who owns ComputerLand franchises in Secaucus, New Jersey, and Dresher, Pennsylvania.

Are you lonesome tonight? **UUNET Communications** (Falls Church, VA), an independent company directly connecting 130 Unix sites around the world, has started a telephone-based service through a 900 number. At a rate of 40 cents per minute (telephone toll charges included), users of the 900 number can send E-mail to any machine in the worldwide network of some 100,000 computers and can also pull public files off the UUNET machine, which is the repository for most **free Unix software**, including the source code for the X Window System from MIT and GNU compilers and editors.

Each layer is designed to operate with the others, yet remain independent.

Another prominent proposal comes from Sun Microsystems and involves Sun's Network File System, which is a standard of sorts in the Unix world and is more mature than most of the components in the Decorum model.

Even though Sun is an industry rival of the OSF, the group has shown a remarkable ability to cut through politics and meld technologies from competing companies. A decision on the distributed computing environment could come this month.

—Stan Miastkowski

Ethernet-on-a-Chip Will Save PCs a Slot

Turning an IBM PC or compatible into an "Ethernet-ready" system usually involves plugging a network card into a valuable expansion slot. But now U.S. Sage (Longwood, FL) has developed a chip that incorporates most Ethernet hardware functions. The company hopes that PC makers will use the Ethernet Needing Zero Overhead (ENZO) chip on their motherboards.

ENZO combines most of the Ethernet hardware functions on a single chip, according to U.S. Sage president Alex DuBrow. The LAN controller and Manchester encoding/decoding functions, which often require two chips on Ethernet boards, are included in the chip. ENZO is compatible with the IEEE 802.3 Ethernet network standard and supports both Novell's NetWare and U.S. Sage's MiniLan operating systems, the company says.

Building an Ethernet-ready motherboard really isn't a new concept (witness the NeXT Computer). But it's an idea that hasn't been exploited by manufacturers of IBM compatibles. DuBrow thinks that PC makers (and, in turn, users) can benefit from the LAN-on-a-chip technology; ENZO sells for only $10 to $25 (in OEM quantities), and it frees up a slot. DuBrow claims that U.S. Sage has received "strong inquiries" about ENZO and has sent out about a dozen evaluation kits, some to PC manufacturers.

—Jeffrey Bertolucci

Mike Will Replace Mouse, Apple Exec Says

The "ask and tell" interface will eventually replace the mouse and keyboard for many applications, and the microphone will play an important role in this new interface, says Apple Computer vice president of advanced technology Lawrence Tesler.

Newer, more advanced personal computer applications will require better interfaces, including speech input. "When you're not sure about something, you'll be able to ask, and when your system has some advice about how you can do something better, it will tell you," Tesler says.

Interacting with your personal computer will change to "more of a dialogue, like what you might have with a colleague or assistant," he says. The microphone will become a standard feature of personal computers as speech input technology improves.

Apple says that's two or three years away. "It's pretty easy now to do single-speaker, limited-vocabulary recognition," says marketing director Michael Homer. "It's a lot more difficult to do a larger vocabulary—say, 2000 words of connected speech—where the system isn't trained to the particular speaker."

—Jeffrey Bertolucci

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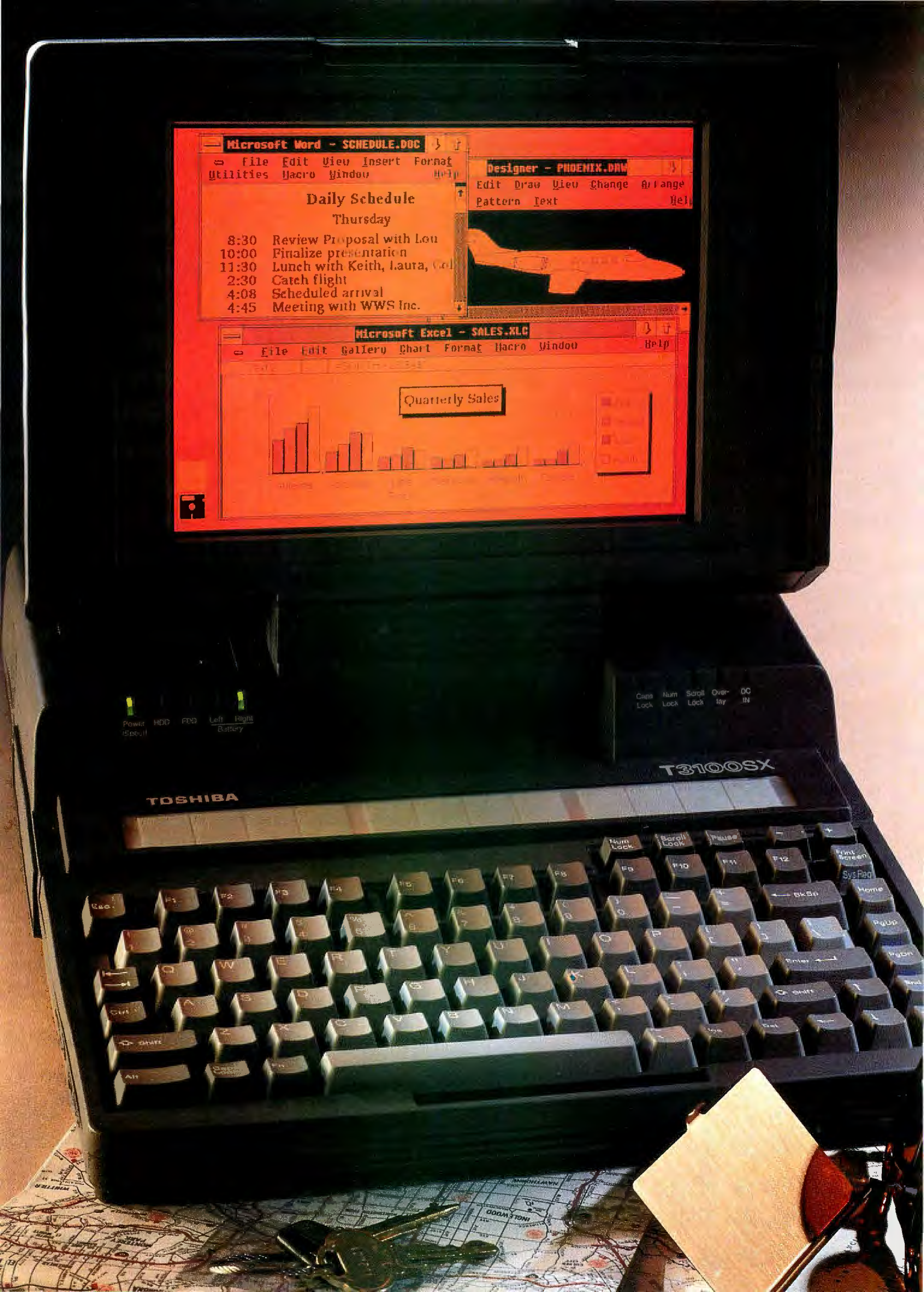
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Utilities Macro Window
Daily Schedule
Thursday
8:30 Review Proposal with Lou
10:00 Finalize presentation
11:30 Lunch with Keith, Laura,
2:30 Catch flight
4:08 Scheduled arrival
4:45 Meeting with WWS Inc.
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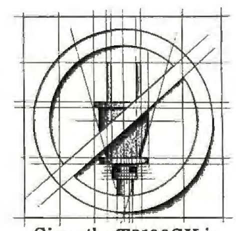

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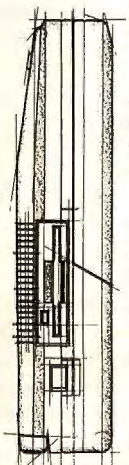

The T3100SX's slim case is only 3.15 inches thick and weighs just 14.9 pounds including its two standard batteries.

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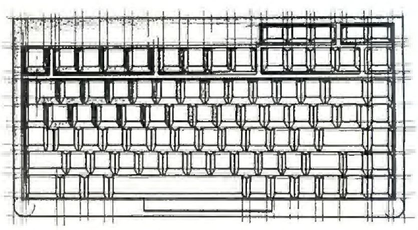

The ergonomically-designed 86-key keyboard features eight dedicated cursor control keys, 12 function keys and a numeric keypad.

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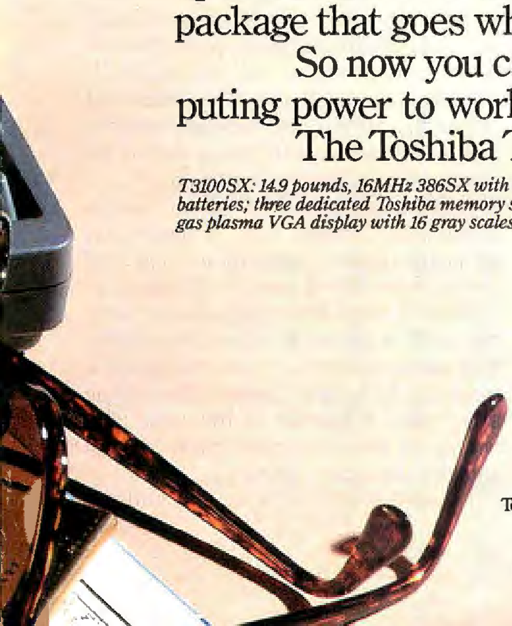

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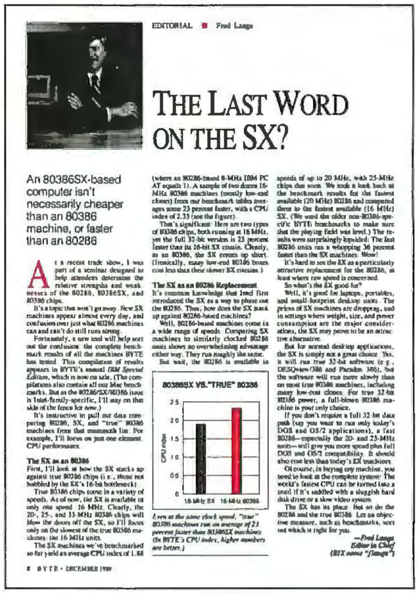

286 vs. 386SX vs. 386

The issue of the 386SX is not one of speed, but one of future compatibility and protecting your investment (Editorial, "The Last Word on the SX?," December 1989). Given a choice between an 8-MHz 386SX and a 25-MHz 286, I would put my money on the 386SX every time, because a fast 286 executes 386 code at precisely 0 MHz.

The 386SX, 386, and i486 CPUs have a common working environment and code that will finally give software a chance to catch up with the hardware, at least for a few years before the i586 hits the scene. While there might not be much 386-specific software now, the installed base is large enough to be worth the effort of developing it.

Bob Keates
Guelph, Ontario, Canada

Until recently, I would have agreed completely with editor in chief Fred Langa about the 386SX chip. As part of my job, I specify a lot of LAN workstations, and the one place where I suddenly find myself choosing the 386SX is for running Microsoft Windows. The reason is memory management. With the 386SX, I can use plain old extended RAM and the Quarterdeck Expanded Memory Manager to get what would otherwise require expensive hardware-enhanced EMS.

The 386SX machines I end up with aren't as fast as similarly priced 286s, but the memory handling makes up for it, at least under Windows. However, I continue to specify 286 systems, too.

Jeff Sloman
Boston, MA

If you substitute 386 for 386SX in your letter, I will agree completely. There are many valid reasons for opting for a 386 over a 286—memory management being one of them. My editorial was not anti-386—not at all. But it was *anti-386SX. If you need 386 capabilities (and it sounds like you do), then a "real" 386 is usually the way to go. The 386SX is a crippled 386. Why buy it, especially when many vendors still charge a premium for it?*

—Fred Langa

Hugh's Reviews Reviewed

Hugh Kenner's column on A. K. Dewdney's *The Turing Omnibus* (Print Queue, December 1989) carries much more punch than that of a review. Kenner offers a historical perspective that could only come from one who has a broad background in both computer science and mathematics.

John M. Ward
Augusta, GA

I'd like to make a few comments on Hugh Kenner's review of *The Turing Omnibus*. First, 3 is not the first prime number. Unfortunately, 2 is. Many theorems begin with, "For all odd primes. . . . ."

Second, G. H. Hardy's use of the word *useless* to describe number theory was a very restrictive use of the term. *Useless*, in Hardy's sense, meant that one couldn't use number theory as a tool of war. How wrong he was.

Finally, I wonder what Kenner meant by the phrase, "what universities fund as 'mathematics.' " Perhaps Kenner works in a department that universities fund as "English."

Wayne Moore
Gaylord, MI

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Don't Forget Amiga

Regarding Don Crabb's "A Tale of Two Operating Systems" (December 1989), I would rewrite the last part of the second sentence to read, "You can pick and choose from a variety of powerful computer systems—IBM PC or Macintosh *or Amiga*—and at prices less than a king's ransom." I would add that if you want high-resolution color graphics, true multitasking, and more than a nickel left in your bank account, you should choose the Amiga. The Mac will display a bazillion colors more than the Amiga 4096, but you'll pay dearly for it. And the Mac does not really perform multitasking. OS/2 does, but, again, you pay a great price for what you get.

Barry E. Holsinger
Sunnyvale, CA

Flap over Kurzweil's Flap

I was surprised by Raymond Kurzweil's use of the term "alveolar flap" in his article on automatic speech recognition (ASR) ("Beyond Pattern Recognition," December 1989). He states that we all have an alveolar flap that turns on and off nasality in human speech.

An alveolar flap is an acoustic event, not a piece of anatomy. An alveolar flap is the sound made by tapping or flapping the tip of the tongue against the alveolar ridge behind the top front teeth while the vocal chords are vibrating, producing the sound represented by "dd" in "ladder."

The anatomical part that opens and closes the air passage between the oral and nasal cavities is the nasal side of the velum (also called the "soft palate").

In addition, phonemes are not speech sounds, as Kurzweil says. A phoneme is an abstraction, a symbol for a category of one or more speech sounds (phonetically similar if more than one) called "allophones." A phoneme represents a minimal sound difference that can signal a meaning difference. Substitution of one allophone for another of the same phoneme may sound peculiar, but it does not signal a change of meaning.

I found Kurzweil's article and the

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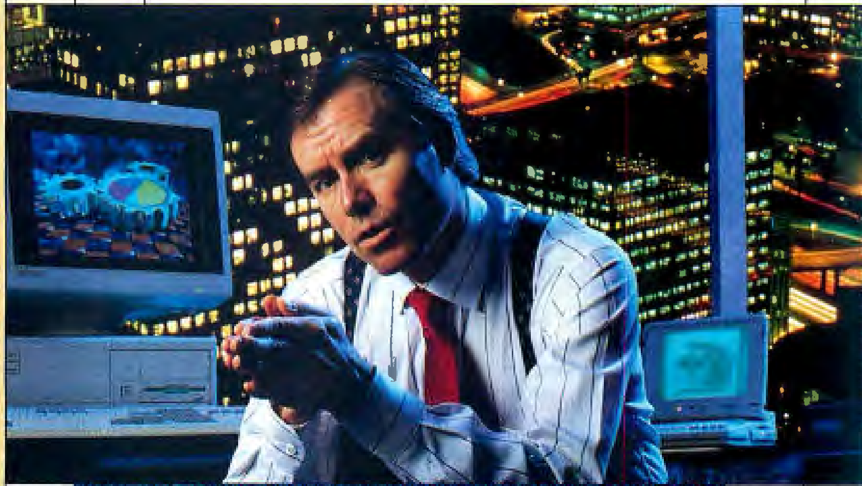

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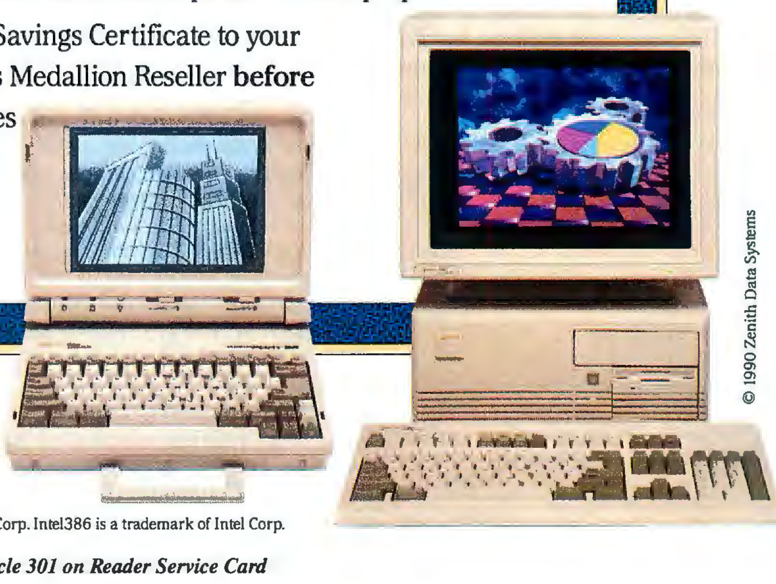

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others in the In Depth section on sound and image processing very interesting. I once predicted that someday we'd reform our spelling in English to accommodate natural language processing (that prediction is as yet unfulfilled, of course). Now that commercial ASR systems require pauses between words, I suggest (but not predict) that we might change our manner of speech, pausing briefly between words, to accommodate ASR.

James L Wyatt, Chairman
Dept. of Modern Languages and Linguistics
Florida State University
Tallahassee, FL

Helping the GUI User

If William Lee ("Heard It Through the Help Line," December 1989) thinks that giving customers advice over a help line is a nightmare with a textual interface, he should appreciate what I heard outside an office that had just installed Macs.

"Just a minute. I'll put you on the speakerphone. I can't balance a headset, type, and run the mouse at the same time!"

Voice on the phone: "Run the little mousey over the thing that looks like a praying mantis that got ironed in your shirt pocket. Go clicky, clicky. Did he turn into a new menu or that old flatiron thing again?"

"Neither. I think it's a shot glass."

"That's just wishful thinking. Could it be a wastebasket? One of those old wire ones?"

"What does a wire wastebasket look like?"

"Are you under 30? Did you ever see an old movie with a reporter's office? They always had one by the desk."

"Yeah, so what? Do you have to be over 40 to work this thing? It took me 15 minutes to figure out that the clockface wasn't a pie. I own a digital watch, like everyone else. Now I gotta know all about old movies to recognize these stupid pictures!"

"Go clicky, clicky on the shot glass and tell me if it turned back into the flatiron thing. If not, look for a real shot glass after work."

Joe Celko
Los Angeles, CA

You're Welcome

Thanks for starting David Fiedler's Unix /bin column. With Unix coming into play more and more in the workplace, it's a much-needed, gentle introduction to the subject. Keep it up.

Louis M. Pecora
Washington, DC

ASK BYTE

Too Much Protection

I am trying to run a program that I received with my Penman plotter almost two years ago, but a special security feature built into it has prevented me from doing so.

The name of the program is PENPLOT.EXE. The documentation failed to mention that I could make only one backup copy. It was clear, however, that the program had to be executed on the original disk. In the process of trying to redeem the situation, I also overwrote the original file (or else it automatically locked itself when I made a second backup copy).

Having looked at the executable file with my PCTOOLS file editor, I know that it is an unpublished work by the Vault Corp. I have been unable to find an address for the company, and Penman has gone out of business. Is it possible for me to defeat the backup security? It displays "Unauthorized Duplicate" any time I run Penplot on the original disk or either of the backups.

Larry D. Elliott
Moscow, ID

You're not the first person to have this problem, and I doubt that you'll be the last. Yes, it's possible to defeat the copy protection on your software, but making pirated copies of software is illegal and a practice that we at BYTE disapprove of. But with Vault's copy protection, it is often unnecessary.

Vault's scheme uses a physical mark on the floppy disk. You can reformat the disk, copy your software back onto it (from your backup), and the disk should be as good as new.

For obvious reasons, I won't tell you how to break Vault's scheme here, but I can tell you that several software utilities are available that will make copies of your disks. Before you spend your money, I suggest that you contact Vault's technical-support department (505 West Olive Ave., Suite 330, Sunnyvale, CA 94086, (408) 737-8474). The people there are very nice, and as long as you're holding a legitimate copy of the software, I'm sure that they'll be glad to help you out.

—H. E.

The Educated Computer

I am studying educational administration, and the theme for my upcoming thesis is "Computer-Assisted and Support Instruction—Its Planning, Implementation, and Evaluation." Could you suggest any source of information on this topic (including any computer software that is available)?

Oralia Eugenia Machuca Vaca
Mexico City, Mexico

First, I suggest that you explore your university library to see if it carries the Journal of Research on Computing in Education. *If not, you may be able to obtain a subscription (either through your department or the library) by contacting the International Association for Computing in Education, 1230 17th Street NW, Washington, DC 20036.*

As far as software goes, the public domain world is filled with educational and educational-support (which I take to mean record-keeping, student tracking, and so on) software. Try the Buyer's Mart at the back of BYTE and order a few catalogs.

Finally, here is a list of some books you can look for that describe specific instances of using computers in upper-level courses: APL Programs for the Mathematics Classroom *by Norman Thompson (Springer-Verlag, New York, 1989);* Calculus and the Computer *by William F. Oberle (Addison-Wesley, Reading, MA, 1986); and* Using Computers in Physics *by John R. Merrill (Houghton Mifflin, Boston, MA, 1976).*—R. G.

Speaking of Speech Recognition

In the December 1989 Ask BYTE, David R. Brammer wrote asking about speech recording and playback hardware for the PC. Shortly afterward, we received a press release describing SoftSpeak, a software product from Quantech Ltd. SoftSpeak allows a 10-MHz PC (or any AT or PS/2) to produce speech through the standard speaker; no additional hardware is required. Mr. Brammer, if you're reading this, contact Quantech Ltd., 2a West View, Forest Hall, Tyne & Wear, NE12 0LJ, UK, 091-266-7007.

—Lab Staff

FIXES

• The mapping algorithm shown in "Configuring Parallel Programs" (December 1989) was developed by Shahid H. Bokhari for the Finite Element Machine, which was an early microprocessor array at the NASA Langley Research Center.

• The correct telephone number for Zenith Data Systems ("Zenith's EISA Does It," February) is (800) 553-0331. ■

A 386SX for Less Than $1000

The generically named 80386SX from Acma Computers includes a 16-MHz CPU, 1 MB of RAM (expandable to 8 MB), an American Megatrends BIOS, a 5¼-inch 1.2-MB or 3½-inch 1.44-MB floppy disk drive, a floppy/hard disk drive controller, and five 16-bit and two 8-bit expansion slots.

The chassis is either the small-footprint or standard AT size, respectively measuring 6½ by 17 by 16½ inches and 6½ by 21 by 16½ inches. The small-footprint version can hold one 3½-inch and three 5¼-inch half-height floppy disk drives. The standard-size system has room for five half-height 5¼-inch drives.

The VGA Executive Package includes color VGA graphics necessities, a printer, and printer accessories. Inside the computer, Acma supplies a 40-MB 28-ms hard disk drive and a 16-bit color VGA card. The package also includes a color VGA monitor and a Panasonic 1191 printer. Printer accessories include a cable, a stand, a surge protector, 10 disks, and computer paper.

Price: $995; VGA Executive Package, $2245.

Contact: Acma Computers, Inc., 117 Fourier Ave., Fremont, CA 94539, (800) 666-8898 or (415) 623-1212.

Inquiry 1121.

Acma's 80386SX has all the basics and is expandable.

386SX Portables Come with Cellular Phones

Intelligence Technology has introduced two 386SX-based portables with removable cellular telephones that you can use for voice communication or for 2400-bps data communications.

The ITC 386 CEL and XCEL (for extra-lightweight cellular) systems both feature a built-in keyboard and monochrome VGA display, an MNP modem, and standard I/O ports. Power on both models comes from a removable 7.2-V rechargeable battery pack or any 12-V connection.

Weighing 9½ pounds (with telephone), the XCEL has 2 MB of RAM and a 20-MB hard disk drive. It measures 2½ by 12 by 11¾ inches.

The 15-pound (with telephone) CEL offers 4 MB of RAM, a 3½-inch 1.44-MB floppy disk drive, a 40-MB hard disk drive, one 16-bit expansion slot, a full-size keyboard with a numeric keypad, and a built-in speakerphone. It measures 3⅓ by 13 by 12 9/10 inches.

Price: XCEL, $7495; CEL, $8695.

Contact: Intelligence Technology Corp., 16526 Westgrove, Dallas, TX 75248, (800) 356-3493 or (214) 250-4277.

Inquiry 1122.

Inexpensive Desktops and a Laptop

Emerson Computer has introduced three inexpensive ATs: two desktops and a laptop.

The 8200 is a 12.5-MHz 286 small-footprint desktop system. It has 640K bytes of RAM (expandable to 4 MB on the motherboard), five 16-bit full-length slots, a CGA controller, two 3½-inch disk drive bays (one internal), an Integrated Drive Electronics (IDE) hard disk drive controller, a 101-key keyboard, a 5¼-inch 1.2-MB floppy disk drive, and bundled software.

The 16-MHz 826ECV desktop ups the ante with 1 MB of RAM and a VGA controller but has only three full-length expansion slots.

The 550LTV laptop has a 12-MHz 286 CPU, a monochrome VGA controller, a 10-inch backlit VGA monitor, 1 MB of RAM (expandable to 4 MB), a socket for an 80287 math coprocessor, a 3½-inch 1.44-MB floppy disk drive, and a 20- or 40-MB hard disk drive. The laptop weighs 14 pounds without the hard disk drive but with the battery (which is good for 3 hours between charges).

Price: 8200, $1349; 8200 with 20-MB hard disk drive, $1669; 8286ECV, $1699; 550LTV with 20-MB drive, $2499; 550LTV with 40-MB drive, $2699.

Contact: Emerson Computer Corp., 5500 East Slauson Ave., Commerce, CA 90040, (213) 722-9800.

Inquiry 1120.

Cellular phones let you talk from your ITC laptops.

The Shape of Monitors to Come

The Finlux ELM 640.350 is a compact flat-panel monitor that gives you yellow-on-black EGA (640- by 350-pixel) graphics and three levels of gray with electroluminescent display technology.

The ELM weighs only 3 pounds, measures $9\frac{4}{5}$ by $7\frac{9}{10}$ by $2\frac{4}{5}$ inches (with a display area of $4\frac{4}{5}$ by $7\frac{1}{10}$ inches), and has a movable arm and table stand. Finlux says that the monitor emits no magnetic or electrical radiation and that it uses only 25 W, which is about one-fourth the power consumption of a normal CRT.

Price: $1595.
Contact: Finlux, Inc., 20395 Pacifica Dr., Suite 190, Cupertino, CA 95014, (408) 725-1972.
Inquiry 1128.

Two-Page Display for a Mac or PC

The Radius TPD/21 is a high-resolution 21-inch two-page monochrome/gray-scale display system for your PC compatible or Mac SE, SE/30, or II.

The flat-screen monitor features a maximum Macintosh resolution of 1152 by 882 pixels (effectively, 74 dpi) and a 71-Hz refresh rate. If you're using a PC, the refresh rate is 65 Hz and resolution is 1280 by 960 pixels.

Included in the price of the monitor is RadiusWare software for menus and drivers for DOS applications and for VGA-compatible applications. The video-controller card is optional.

Price: $1795; TPD/PC controller, $795; TPD/Mac controller, $595; GS/C controller for Mac II, $1895.
Contact: Radius, Inc., 1710 Fortune Dr., San Jose, CA 95131, (408) 434-1010.
Inquiry 1127.

The Finlux ELM 640.350 monitor has a movable arm and table stand.

Epson's New Wide-Carriage 24-pin Printer

The LQ-1010 is an inexpensive 24-pin letter-quality printer with a carriage wide enough for 136-column printing.

Features include print speeds of 180 cps in draft mode and 60 cps in letter-quality mode, bidirectional printing in text mode, a slot for optional font modules, an 8K-byte buffer, built-in push-tractor feed, and automatic single-sheet loading. There's also a SmartPark paper-handling feature and 360- by 360-dpi graphics resolution.

Standard equipment also includes five resident fonts, four print speeds, and six character sets. The printer has a parallel interface, measures $5\frac{2}{3}$ by $23\frac{1}{3}$ by $13\frac{2}{3}$ inches, and weighs 18 pounds.

Price: $699.
Contact: Epson America, Inc., 2780 Lomita Blvd., Torrance, CA 90505, (800) 922-8911.
Inquiry 1129.

SEND US YOUR NEW PRODUCT RELEASE

We'd like to consider your product for publication. Send us full information, including price, ship date, and an address and telephone number where readers can get further information. Send to New Products Editor, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458. Information contained in these items is based on manufacturers' written statements and/or telephone interviews with BYTE reporters. BYTE has not formally reviewed each product mentioned. These items, along with additional new product announcements, are posted regularly on BIX in the microbytes.sw and microbytes.hw conferences.

Mondo Storage for Unix Fans

The MO Floppy drive for Unix systems features rewritable and removable 640-MB magneto-optic cartridges and is implemented on The Santa Cruz Operation's Unix 386/V operating system.

MO Floppy is based on Sony's SMO-S501 magneto-optic drive. You plug it into the host system via the included 1542A 16-bit SCSI controller by Adaptec.

Each MO Floppy includes a SCSI driver and operating software. The user interface has commands for formatting new cartridges and for copying files.

Price: $7999.
Contact: Software Horizons, Inc., 501 McDonald Rd., Aptos, CA 95003, (408) 684-1375.
Inquiry 1130.

This Keyboard Is Designed for 3270 Applications

The 122-key KB 3270 Plus keyboard from Key Tronic has an 8K-byte RAM chip for IBM 3270 terminal emulation. It's plug-compatible with PCs, and an adapter is available for PS/2s.

Two main features are ScanEdit and ScanLoad, with which you can reprogram all 122 keys. Supported applications include Attachmate, Attachmate Extra, IBM 3270 Workstation, IBM 3270 Emulation, IRMA, IRMA/2, IRMAX Multisessions, Novell NetWare 3270, and PCOX.

Price: $349.
Contact: Key Tronic, P.O. Box 14687, Spokane, WA 99214, (509) 928-8000.
Inquiry 1131.

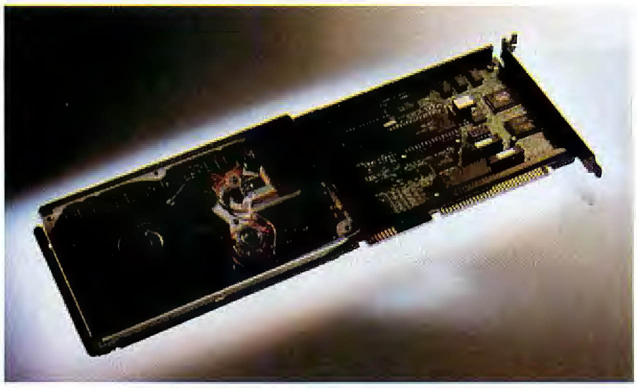
continued

Plus Development's Hardcard II Features 64K-byte Cache

Plus Development has announced a revamped version of its hard-disk-on-a-card product, Hardcard. The company says that the Hardcard II offers better performance but is designed to work only with 286- and 386-based systems.

Hardcard II comes in two models: the Hardcard II 80 and the Hardcard II 40, holding 80 and 40 MB of data, respectively. Both cards are full-length, single-slot cards that do not obscure other slots.

Both cards use 3½-inch hard disk drives and integrate a full 16-bit drive controller on the card. In addition, both use 1-to-1 interleaving and have an on-board 64K-byte cache to give them an effective access time of 19 ms, according to the company.



Each Hardcard II features a hard disk drive.

Hardcard II also features Plus Development's firmware to transparently trap bad sector information and map data elsewhere on the disk to minimize data loss.

Price: Hardcard II 40, $849; Hardcard II 80, $999; the company has also reduced prices of the original Hardcards to $749 (20-MB model) and $849 (40-MB model).

Contact: Plus Development Corp., 1778 McCarthy Blvd., Milpitas, CA 95035, (408) 434-6900.

Inquiry 1132.

Controller Doubles Your Hard Disk Capacity

Perstor says that its new ADRC-9008 hard disk drive controller, a half-length 8-bit card, almost doubles the capacity of modified frequency modulation (MFM) hard disk drives and significantly increases the capacity of run length limited (RLL) drives.

To achieve such dramatic increases in capacity, the controller writes to 32 sectors per track (MFM usually uses 18 sectors, and RLL, 26). To keep errors from occurring more often, Perstor uses a proprietary 56-bit error-correction code that doesn't increase flex reversals.

The ADRC-9008 supports two hard disk drives. Any ST506/ST412 drive type with up to 1024 cylinders and 15 heads will work. For installation, Perstor provides a BIOS-resident autoconfigure setup and low-level formatting program.

The controller supports variable interleaving and operates at 9 Mbps. It has an 8-bit bidirectional bus-host interface but will operate in 286 and 386 systems.

Price: $199.

Contact: Perstor Systems, Inc., 1335 South Park Lane, Tempe, AZ 85281, (602) 894-3494.

Inquiry 1133.

continued

Input and Manipulate Motion Video in Windows

You can now inexpensively input and manipulate full-motion video with your AT in Windows on your standard VGA monitor.

The DVA-4000/ISA works with today's analog technologies, such as videodisk, satellite feed, off-air TV, and video camera, and with digital storage technologies such as Digital Video Interactive (DVI), CD-I, and CD-ROM/XA.

The manipulation of these images requires a wider data path than is available on XT and AT computers. So VideoLogic designed the 32-bit Video Logic Media Bus, which can potentially support daughterboards.

Features of the ISA board include display at 30 frames per second (or, for PAL, 25 frames per second); software-controllable picture content (e.g., hue, saturation, contrast, and brightness); video, audio, and graphics mixing; image capture on magnetic or optical media; two switchable input sources; video windowing, scaling, and positioning; pictures within pictures; and multiple live video windows.

Price: For ISA or Micro Channel, $2495.

Contact: VideoLogic, Inc., 245 First St., Cambridge, MA 02142, (617) 494-0530.

Inquiry 1134.

VideoWindows now integrates full-motion frame grabbing and VGA graphics overlay in Microsoft Windows and HP NewWave environments, according to New Media Graphics.

The AT-compatible board with an 80188 microprocessor continuously digitizes NTSC or PAL video signals in a frame buffer, which you can manipulate or position anywhere on the screen in real time. The full-motion (or still-frame) image that results is then converted back to an analog signal, decoded in RGB, combined with VGA or EGA graphics, and then displayed on your noninterlaced 60-Hz RGB monitor. You can also store images on a disk to be manipulated or displayed later.

Features include overlay with VGA graphics, in any proportion of graphics or video; automatically locking onto VGA with up to 256 colors at 640 by 480 pixels; zoom functions from 65 percent to 200 percent; image compression to one-fourth and one-sixteenth of the screen; image storing in VideoWindows, PCX, or TARGA file formats; cutting and pasting portions of video into graphics screens; panning horizontally and vertically and fading in and out; programmable picture attributes like hue, saturation, intensity, comb filter, coring, and sharpness; and up to two simultaneous inputs (from broadcast TV, videotape, videodisk, still video camera, live video camera, cable, and satellite).

Price: $1795; Microsoft Windows driver, $195.

Contact: New Media Graphics, 780 Boston Rd., Billerica, MA 01821, (508) 663-0666.

Inquiry 1135.

DBMS Case Study:

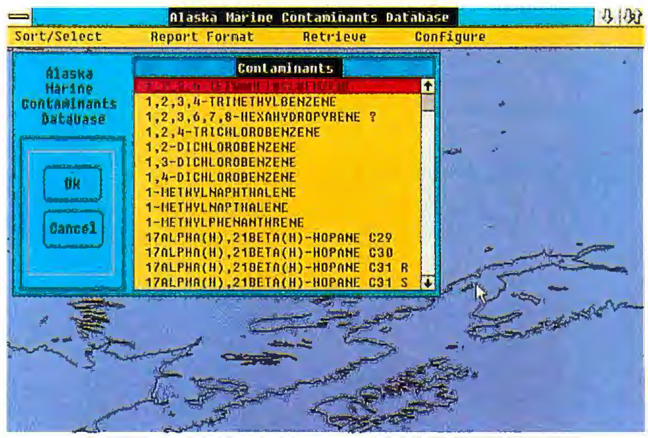
The Exxon Valdez Disaster

March 24, 1989. Exxon VALDEZ tanker runs aground, creating the worst oil spill in U.S. history. 11,000,000 gallons contaminate the pristine waters of Alaska's Prince William Sound.

The Problem Major disasters, like the Exxon Valdez spill, require quick response based on careful data analysis. Fortunately, an easy-to-use database was already being created which would help.

The Application The Alaskan Marine Contaminants Database lets oceanographic chemists easily access 60 megabytes of data covering the past decade. The database is provided free of charge on CD-ROM, and the Windows interface means they can get right to work, assessing damage to the ecosystems of Prince William Sound and other Alaskan waters.

The Solution db_VISTA III is the only DBMS with the features this project required: C language support, Windows compatibility, royalty-free runtime distribution, quick performance in large databases, quality documentation and support. With the Alaskan Marine Contaminants Database, the difficult job of calculating the long-term effects of the Exxon spill is a little easier.*



A Microsoft Windows front end lets chemists select regions from a map to retrieve data. And, db_VISTA III's SQL-based query and report writer lets users perform complex SQL data searches.

Your DBMS problems may not make the headlines, but they are no less important and often no less challenging. If you develop applications for MS-DOS, MS Windows, UNIX, VMS, QNX, OS/2, Macintosh, and other environments, db_VISTA III is your solution.

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* Reprints of the story, as published in PC Week and Data Based Advisor, are available from Raima.

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db_VISTA III DBMS rated number #1

For Performance and Flexibility of DBMS Programming Tools- **PCWEEK** Poll of Corporate Satisfaction, August 28, 1989.

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Circle 243 on Reader Service Card

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For Dell in Canada, call 800-387-5752.

Circle 87 on Reader Service Card

A Mouse in Disguise

The MousePen is a Microsoft Mouse–compatible input device with two input buttons and ballistic control, yet you hold it like a pen and you don't need a mouse pad.

Inside the head of MousePen is a miniature mouse. The buttons are positioned for clicking with your index finger; the bottom button is the "point" or traditional "left" button. Resolution is 50 to 1000 dpi, and tracking speed is 18 inches per second. MousePen measures $\frac{7}{10}$ by $\frac{3}{5}$ by $6\frac{1}{10}$ inches. Without the PS/2 cable or the serial cable for XTs and ATs, MousePen weighs 32 ounces.

Pop-up TSR menus for Lotus 1-2-3, dBASE III, and WordPerfect are included in the 10K- to 30K-byte main program. Also included is TelePaint, a color paint program with VGA support.

Price: $129.

Contact: International Machine Control Systems, Inc., 1332 Vendels Cir., Paso Robles, CA 93446, (800) 448-1184 or (805) 239-8976.

Inquiry 1138.

The Microsoft Mouse-compatible MousePen offers you all the standard features.

Da Vinci Graphics Creates Penless Plotter

Da Vinci Graphics' new RasterPro 720 "penless plotter" looks much like a laser printer and operates eight to 10 times faster than conventional pen plotters. The RasterPro 720 uses a bidirectional print head and a four-color fabric ribbon.

Inside the plotter is a 68000 microprocessor and technology for converting vector-based plotter instructions to a raster printing format. Print resolution is 720 dpi, and the interfaces are parallel and serial.

The RasterPro 720 produces A-size ($8\frac{1}{2}$- by 11-inch) or B-size (11- by 17-inch) images. Unlike conventional plotters, the RasterPro 720 offers a high-speed draft mode at either 180 or 360 dpi in color or monochrome.

The RasterPro 720 weighs 27 pounds and measures $4\frac{3}{4}$ by $22\frac{2}{5}$ by $13\frac{3}{5}$ inches.

Price: With 512K bytes of RAM, $3495; with 2 MB of RAM, $3995.

Contact: Da Vinci Graphics, Inc., 870 Hermosa Dr., Sunnyvale, CA 94086, (408) 737-8800.

Inquiry 1137.

Measure Horizontal Frequencies on CRTs

Scan-Mate is a hand-held device that measures your monitor's horizontal frequency or the horizontal frequency of a video projector, using the magnetic fields that CRTs emit. It can measure monitors with screens as small as 9 inches or as big as 35 inches and display frequencies from 0 to 70 kHz. Power comes from a standard 9-V battery.

Price: $250.

Contact: Inline, Inc., 625 South Palm St., La Habra, CA 90631, (800) 882-7117 or (213) 690-6767.

Inquiry 1142.

continued

Spoken to Your Spreadsheet Lately?

The Voice Master Key System II is a small external box that lets you add voice commands to DOS applications, thus replacing repetitive keystrokes or extensive mouse movements with macro voice commands. The interface is your parallel printer port, and there's a pass-through function that lets you keep your printer attached.

A TSR program is included that occupies about 64K bytes of RAM (or you can order an EMS version that requires only 6K bytes of main memory). It's compatible with such programs as Lotus 1-2-3, AutoCAD, WordPerfect, dBASE III, and SideKick.

You teach it words by saying them twice and typing the prompt and the desired response. Other users can subsequently repeat the list of macros in their own voices and save additional voice templates to memory.

The program is divided into 16 levels, which can correspond to 16 different software packages. You can store up to 16 macros in each level, with a macro as short as one keystroke or as long as 250. Any one of the maximum 64 voice commands can be assigned to activate a macro in any of the 16 levels, so a single voice command can have different meanings in different software applications, for example.

Other features include adjustments for recognition modes and sensitivities, testing sequences to adjust for background noise, display of your macros within applications, and recording and sending voice memos over networks (with Voice Master Systems on each voice-memo workstation).

Also included is developer software for speech and sound recording and editing. Editing software lets you edit sounds for use in software programs or in external EPROMs. It allocates 64K bytes of RAM for input, variable to 576K bytes of RAM with data file links.

Price: $219.95.

Contact: Covox, Inc., 675-D Conger St., Eugene, OR 97402, (503) 342-1271.

Inquiry 1140.

Get the latest Word from SCO.

Microsoft Word 5.0 for UNIX Systems.

You've come to depend on SCO™ for the latest UNIX® System software solutions for PCs. Industry standards such as SCO™ XENIX® 386 and SCO UNIX System V/386 Release 3.2. World-famous applications such as SCO Professional,® the 1-2-3® workalike, and SCO™ FoxBASE+.™

And now Microsoft® Word 5.0, the same full-featured word processing system that has defined power, speed and flexibility for MS-DOS® and OS/2™ users, is also available for SCO XENIX and UNIX Systems!

It's multiuser and multitasking. And it's ready to give you true workgroup benefits while maintaining keystroke and file compatibility with Word for MS-DOS and OS/2, preserving your investments in Word training and data.

With Microsoft Word 5.0 for UNIX Systems, you can share a single copy of Word — on a single PC — with an entire workgroup of 16, 32, or even more users on inexpensive terminals.

And your workgroup can share documents, style sheets, forms, macros, glossaries, and outlines — plus group review and editing features such as annotations and redlining — while sharing expensive printers and other resources as well.

Microsoft Word 5.0 joins SCO's powerful team of multiuser business applications.

Of course, Microsoft Word 5.0 for UNIX Systems still gives you Word's advanced productivity features. Data, text, and graphics integrated in a single document. Text flow around graphics. Side-by-side columns. A vast array of fonts and sizes. Links to spreadsheets and other programs. Line and box drawing. Spell checker and thesaurus. Speedkeys. And a whole lot more.

And since it's compatible with SCO Portfolio,™ Microsoft Word 5.0 for UNIX Systems supports the SCO Portfolio Clipboard, letting you copy and paste data to and from other popular applications such as SCO Professional and SCO FoxBASE+.

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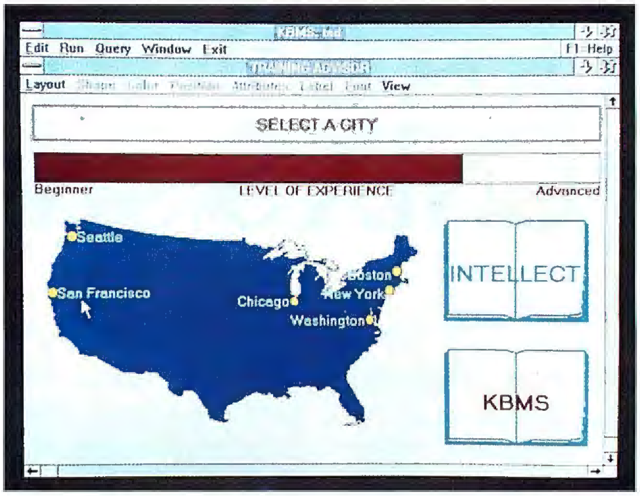
Circle 255 on Reader Service Card

Active Objects and Graphics Added to KBMS for OS/2

Two tools included in AICorp's new version of its Knowledge Base Management System (KBMS) for the OS/2 Presentation Manager let developers use graphics during the application development process and incorporate graphics in the resulting application.

Developer Graphics, a tool for designing, developing, and analyzing KBMS applications, has a graphical editor facility that lets you select an object, see the attributes defined for that object, and view the relationships among objects during the development process, AICorp says.

Active Objects lets you link rules with graphics, building knowledge-base applications with a graphical user interface. For example, you can use Active Objects to develop a course registration application in which users see a map of the U.S., click on a city where they want to take a course, and automatically register and update the underlying database, instead of filling out forms or using a text menu.



With AICorp's Active Objects, an expert system can display information graphically instead of relying on text only.

The Active Objects editor lets you choose shapes, colors, fonts, and other elements. You can also use bit-mapped images from other sources.
Price: $7500.
Contact: AICorp, 100 Fifth Ave., Waltham, MA 02254, (617) 890-8400.
Inquiry 1143.

Better IPC for Unix, OS/2

XIPC (for Extended Interprocess Communications Facilities) is a software library designed to augment the interprocess communications facilities of Unix, OS/2, and VMS. In the area of software engineering, XIPC supports on-line monitoring of all IPC activities of a live system, multiple views of the same system, interactive debugging, and browsing of message queues and shared memory of an active system. It also lets you configure and use multiple instances of XIPC without modifying the operating-system kernel, Momentum says.

The package adds a message queue facility that offers atomic multiple-queue operations by multiple processes, individual queue slicing, automatic overflow spooling, and many other functions.

XIPC provides for automatic portability of source code among operating systems, while supporting a superset of the functionality of all supported operating systems.

The package will be available for OS/2, SCO Xenix, Unix System V, AIX, SunOS, Ultrix, and VAX/VMS.
Price: $1495 and up.
Contact: Momentum Software Corp., 602 Fair Lawn Pkwy., Saddle Brook, NJ 07662, (201) 794-1462.
Inquiry 1146.

Spelling Checker for Programmers

SpellCode, a customizable spelling checker for programmers, can check both the text that end users will see and the contents of program files. SpellCode checks variable and constant names, reducing the number of compiler or interpreter errors, says Geller Software.

SpellCode comes with an English dictionary and a dictionary of computer terms. The program knows the keywords used in dBASE languages and can check Ada, COBOL, PL/1, FORTRAN, and other languages. It can check the contents of character and memo fields in DBF data files or Lotus 1-2-3 worksheets.

SpellCode runs on the IBM PC with 256K bytes of RAM and DOS 2.0.
Price: $99.95.
Contact: Geller Software Laboratories, Inc., 35 Stephen St., Montclair, NJ 07042, (201) 746-7402.
Inquiry 1144.

FORTRAN Subroutines for the Mac

IMSL has released three FORTRAN libraries for the Macintosh that provide more than 800 subroutines for solving mathematical problems, analyzing statistics, and special functions.

Features of the libraries include standard calling sequences, sophisticated error handling, and automatic allocation of workspace.

The libraries require a Mac II or SE/30 running Language Systems' FORTRAN compiler 1.2.1 and System 6.0.3.
Price: $3250.
Contact: IMSL, 2500 Park-West Tower One, 2500 City-West Blvd., Houston, TX 77042, (800) 222-4675 or (713) 782-6060.
Inquiry 1145.

CUA Compliance for DOS

With Layout/CUA for DOS, a software development tool that works with Interactive Images' Easel/DOS graphical development tools, you can create applications that automatically comply with IBM's Common User Access guidelines. With Layout/CUA, you can add action bars and scroll bars, pull-down menus, and secondary windows to your DOS application.

Layout/CUA for DOS runs as an application under the OS/2 Presentation Manager. Once you've defined how the application will look, Layout/CUA automatically generates the necessary DOS code.

To run the system, you need an IBM PC with at least 640K bytes of RAM.
Price: $1900; Easel/DOS Development System, $7500.
Contact: Interactive Images, Inc., 600 West Cummings Park, Woburn, MA 01801, (617) 938-8440.
Inquiry 1147.

continued

SAGE SOFTWARE

NEW, the next generation editor at Programmer's Paradise

DEVELOPMENT POLYTRON TOOLS

Announcing the Sage Professional Editor - the editing environment for the 90's. The product of two years work by one of the most talented programming teams in the business. Right out of the box you'll be more productive with this editor than any you use today.

Announcing the Sage Professional Editor

The instant installation, elegant mouse support, advanced user interface, and point-and-shoot help get you running immediately. If you prefer the commands and keystrokes of a popular editor, the turnkey emulations duplicate them precisely, and you still gain the Sage Professional Editor's advanced features, windowing capabilities and powerful engine.

Later you'll make this editor truly yours by configuring the interface as you prefer. Every feature can be turned on or off as you like - from a clean screen, to tiled windows, to overlapping windows in various colors, pulldown menus, rulers, scroll bars, and line numbers - choose any or all and place them as you like.

Works with or without a mouse.
Packaged with or without a Microsoft® Mouse.

Use the editor with or without a mouse - all functions are available without lifting your fingers from the keyboard.

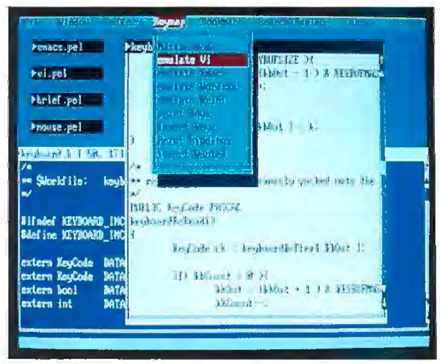
Pop open the DOS window and the editor shrinks to just 4K. So you can back-task to compilers and other tools without leaving the editor.

This package is stuffed with value. It includes MS-DOS, OS/2 and Dual Mode versions, templates for popular languages, and you can buy it with or without a bundled Microsoft® Mouse.

The core of the Sage Professional Editor is a powerhouse virtual memory system that allows you to edit huge files (up to 100MEG) in as many as 256 windows - over two billion lines. It makes maximum use of all available memory. All higher level services use this powerful VM scheme. Consequently, there are no size constraints on the macro library and no limit to Undo/Redo. You can have 1000 bookmarks, anchors and saved positions per buffer.

And then there's the extension language. The Sage Professional Editor uses a C-like extension language and compiler/ debugger that programmers find immediately intuitive. You can build the environment you want with the editor as the front end to your favorite tools. The seamless integration of the Polytron Version Control System (PVCS) is a sterling example of how cleanly you can hook external programs.

Emulations of Vi, Brief, EMACS, and WordStar, were written with the extension language. The source code for emualtion is included. Enter a new generation today by calling Programmer's Paradise.



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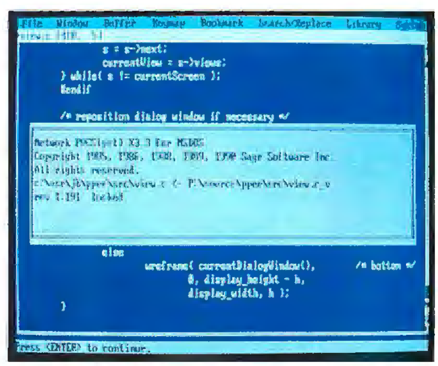

The editor environment provides seamless integration to the Polytron Version Control System (PVCS) or any other tool you care to connect.

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Both packages include: MS-DOS, OS/2 and Dual Mode versions on 3 1/2" and 5 1/4" disks.

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VM/386 Multi-User	895	819

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Lahey F77L-EM/32 (w/ OS/386)	1090	975
Novell C Network Compiler/386	995	779
Paradox/386	895	629
WATCOM C 7.0/386	895	799

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ASMFlow	99	89
ASMTool	90	80
MS Macro Assembler	150	105
OPTASM	125	109
Re:Source	150	129
Sourcer w/ Pre-Processor	140	125
Turbo Assembler/Debugger	150	105
Visible Computer: 80286	100	89

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MS BASIC Prof. Devel. System	495	349
Power Basic	110	99
QuickBASIC	99	69
True BASIC	100	69

BASIC LIBS/UTILITIES	LIST	OURS
db/LIB	139	121
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GraphPak	79	70
GraphPak Professional	149	125
LaserPak	79	70
P.D.Q.	99	89
ProBas	135	125
ProBas HyperHelp Toolkit	99	94
ProBas Telecomm. Toolkit	75	70
ProBas Toolkit	99	94
ProMath	99	94
ProScreen	99	89
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QuickComm	139	125
QuickMenu	59	55
QuickPak	79	70
QuickPak Professional	149	125
QuickPak Scientific	79	70
QuickScreen	79	70
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QuickWindows Advanced Corp.	500	445

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Lattice C 6.0	250	155
Microsoft C 6.0	CALL	CALL
MS Quick C	99	69
MS QuickC w/ QuickAssembler	199	139
Top Speed C	199	179
DOS Professional	399	359
OS/2 Professional	495	445
Turbo C	150	99
Turbo C Professional	250	159
WATCOM C 7.0	395	319

C++	LIST	OURS
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NDP C++	495	479
Zortech C++ Debugger	150	129
Zortech C++	200	165
Developer's Edition	450	399
Zortech C++ Tools	150	129
Zortech C++ Video Course	500	449

C-COMMUNICATIONS	LIST	OURS
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Essential Communications	329	259
Greenleaf Comm. Library	299	215
Greenleaf ViewComm	559	475
SilverComm C Async Library	249	209
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Btrieve for DOS 3.1 Networks	595	449
C-Index Plus	195	175
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c-tree	395	315
dBC III	250	219
dBC III Plus	500	439
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Essential B-Tree w/ source	199	149
FairCom Toolbox - Prof. Edition	1095	789
FairCom Toolbox - Special	695	509
Informix Products	CALL	CALL
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Greenleaf SuperFunctions	299	209
Power Search	149	99
Turbo C TOOLS/2.0	149	109

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Greenleaf DataWindows	395	309
Hi-Screen XL	149	129
JAM	595	529
Panel Plus	495	395
Power Screen	149	109
Vermont Views	CALL	CALL
Vitamin C	225	165
VC Screen	149	115

C-UTILITIES/OTHER	LIST	OURS
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C-Terp	300	219
Code Runner	149	135
Heap Expander	80	70
HyperWindows	99	90
Norton Guides for C	100	65
PC-lint	139	109
PCYACC Professional	495	469
TimeSlicer	295	279
w/ source	1000	899

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COBOL/2 w/ Toolset	1800	1499
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MS COBOL	900	629
Realia COBOL	995	849
SCREENIO	400	375

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C Source	395	299
Logic Gem	99	89
Matrix Layout 2.0	200	169
PRO-C	399	339

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Clipper 5.0	695	519
dBASE IV	795	489
dBFast/PLUS	249	219
dGE	195	179
FlashTools!	89	79
FoxPro	795	635
Magic PC	299	249
R&R Report Writer	150	129
R&R Code Generator	150	129
Say What?!	50	45
SilverComm Library 2.0	189	165
Tom Rettig's Library	100	80
UI2 Version Two	595	479

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Interactive Easyflow	150	125
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FORTRAN LANGUAGE	LIST	OURS
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Lahey Personal FORTRAN 77	95	89
MS FORTRAN	450	299
Plotmatic	135	119
RM/FORTRAN	595	499

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Graphics-MENU	195	175
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MetaWindow	250	209
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PCX Programmer's Toolkit	195	175
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.RTLink	295	265
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TopSpeed Modula-2:		
B-Tree Toolkit	149	135
Communications Toolkit	149	135
Compiler Kit	100	89
DOS 3-Pack	200	179

NETWORK PROGRAMMING	LIST	OURS
Above LAN	495	395
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dBASE IV LAN Pack	995	645
FoxBASE +/ LAN	595	479
NetWare SQL	595	459
Paradox LAN Pack	995	697
Remote Procedure Calls	950	829

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Btrieve	595	449
CASE:PM	CALL	CALL
Epsilon	195	159
Greenleaf DataWindows	395	330
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MKS Toolkit (DOS & OS/2)	399	339
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MS OS/2 Pres. Mgr. Toolkit	500	349
MultiScope	299	229
Panel Plus	495	395
PC-lint	139	101
PCYACC	395	359
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Turbo-Plus 5.5	199	159
Turbo Professional 5.0	125	99

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Dan Bricklin's Demo II	195	159
Instant Replay III	150	135
ProtoFinish	300	269
Show Partner F/X	350	319
Soft Demo	80	70

TRANSLATORS	LIST	OURS
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dBx Translator	550	467
FOR_C	575	519
PROMULA.FORTRAN	450	399

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Actor 2.0	699	559
Case:W	795	759
C-Talk/Views	450	375
dBFast/Windows	249	229
DialogCoder	499	479
MS Windows Development Kit	500	349
RFFlow	79	69
Whitewater Resource Toolkit	195	169
WinTrieve	395	339

ADDITIONAL LANGUAGES	LIST	OURS
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Janus Ada/Compiler System	300	269
Lattice RPG	1600	1469
Meridian AdaStudent	50	45
Meridian Ada Developer's Kit	1095	985
MKS AWK	99	85
Personal Rexx	150	139
Smalltalk-80 (386)	595	535
Smalltalk/V	100	85
Smalltalk/V 286	200	169

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Speedy, reliable and easy to use. Reads the hard disk and writes to a floppy simultaneously. Norton Backup can restore from severely damaged disks. Saving and restoring can be done quickly by pointing and shooting through organized pop-up windows.
List: $149 **Ours: $99**

Actor 2.0 *by The Whitewater Group*
Create windows applications in significantly less time than it takes in C. Actor 2.0 adds three new features: ancestor binding, class variables and class initialization.
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Turbo C 2.0	150	99
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PC Anywhere III	145	99
Procomm Plus	75	50
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Gem Desktop Publisher	299	183
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Lattice HighStyle	375	319
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Mathematica 386	695	625
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MACE GOLD	149	129
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Smalltalk/V PM	495	395
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MS OS/2 Present. Mgr. Toolkit	500	349
MS OS/2 Softset	150	105
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MS QuickPASCAL	99	69
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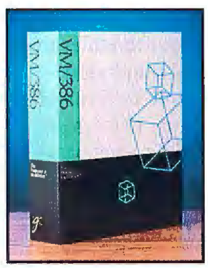
Pocket Soft Inc.

VM/386 & VM/386 NetPak



If you've ever had to wait for your computer to finish processing a task, you need VM/386. It lets you create lots of DOS sessions on your 386 PC, each running a different application on a full screen. All background sessions will continue to process whether you work in an application on your computer or go off to lunch. And with the addition of NetPak, each DOS session can interact with network files and peripherals. This is the only way you can multitask large programs without having to exit and re-enter the network.

IGC

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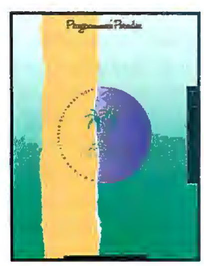

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Programmer's Paradise

A Division of Voyager Software Corp
1163 Shrewsbury Ave., Shrewsbury, NJ 07702

Circle 227 on Reader Service Card

Accounting with Database Orientation

A low-end accounting program called AXS (pronounced "access") Accounting Solutions features a database orientation that lets you work with accounting data interactively. The program's database structure lets you enter, edit, scroll, find, select, and take action on a data file, all from the same form, Computer Trends says.

When you write a check or make a deposit, you can use the payee, vendor, or customer name. If you're not sure of the exact name, you can enter the first few letters and scroll through the companies in the database that match.

AXS updates reports as you enter transactions without requiring batching. The real-time system updates accounts instantly, so you can generate period-to-date financial statements at any time. You can also prepare activity reports (e.g., income statements, profit and loss statements, and balance sheets).

AXS Level 2 includes general ledger, accounts payable, accounts receivable, a check writer, and a mail manager. AXS Level 1 includes only general ledger (with a check-writing facility). AXS Accounting Solutions Level 2 version 2.0, scheduled for release this summer, will include payroll, inventory, job costing, and time billing modules. New features will include budgeting, comparative financial statements, exporting, and recurring transactions.

Price: Level 1, $59.95; Level 2, $139.95.
Contact: Computer Trends, 116 East Washington St., Ann Arbor, MI 48104, (800) 544-2597 or (313) 662-4430.
Inquiry 1148.

The AXS Accounting Solutions' database structure lets you perform a number of operations on a data file from the same form.

Four Accounting Modules for the Mac

Pro Plus Accounting consists of four modules that you can use as stand-alone programs or link to form an integrated system. The system features multiple-level password protection and can export reports in ASCII text, SYLK, and Excel format, its developer reports. The four modules are general ledger, accounts receivable, accounts payable, and inventory control.

To run the program, you need a Mac II or higher with a hard disk drive.

Price: $995; each module, $350.
Contact: Pro Plus Software, Inc., 2150 East Brown Rd., Mesa, AZ 85203, (602) 461-3296.
Inquiry 1149.

Forms Software Does More Than Create Blanks

In addition to its ability to create fill-in-the-blank forms, a forms completion and management program called Blankity Blank works with your word processor's mail-merge capabilities to create hundreds of forms and documents from databases and questionnaires. When used with the separate Blankity Blank DB-Link, you can import information needed to complete forms from up to five other external databases created by Blankity Blank or another DBMS.

The latest version, 3.0, features point-and-shoot screens, multiple simultaneous document and form completion, and one-pass laser printing, where a form and its associated data are printed at the same time.

Blankity Blank's math capabilities let you do addition, subtraction, rounding, and other basic mathematical operations automatically in a form. It can also convert the numeric form of a number to text.

The program runs on the IBM PC with 640K bytes of RAM.

Price: $99.50; four-user network version, $249.50; DB-Link, $199.50 and $449.50, respectively.
Contact: Softstream Technologies, Inc., 2740 Hollywood Blvd., Hollywood, FL 33020, (800) 888-9292 or (305) 920-9292.
Inquiry 1151.

continued

Streamline Organizational Writing with One Voice

Scandinavian PC Systems, publisher of the style-checking program Readability Plus, has released a new program that lets businesses create their own style models. An organization can thus establish and enforce writing standards based on its own best-written products. With Corporate Voice, you identify your company's stellar proposals, briefs, reports, and other documents; the program then uses these documents to create corporate style models that help staff writers replicate outstanding written products.

Corporate Voice uses the style models to evaluate similar documents. It identifies inappropriate sentences and determines the percentage of sentences that fit the selected style model. In addition, the program guides the writer through the revision process, after which the document will closely resemble its original style model.

Corporate Voice works directly with WordPerfect (including version 5.1), Microsoft Word, and WordStar. It can also read ASCII files. The program requires 256K bytes of RAM and will run on any DOS 3.0-compatible LAN.

Price: $119.95.
Contact: Scandinavian PC Systems, Inc., 51 Monroe St., Suite 1101, Rockville, MD 20850, (800) 288-7226 or (301) 294-7450.
Inquiry 1150.


BUY A RACEHORSE...
GET A WORKHORSE!

Engineering Database for the Earth Sciences

Techbase, a relational DBMS for earth science engineering projects, combines graphics, modeling, and statistics with the ability to handle the large numeric data sets often encountered in mining, petroleum, and similar industries.

You can add or delete database fields at any time; files and tables within a database can vary in size; and you can store data in flat, polygon, cell, layer, or block format.

All Techbase modules have filtering capability to selectively retrieve data or regroup it in subsets for further analysis and graphing. The program can calculate common statistics such as mean and standard deviation, plus chi-squared and two-tailed t-distribution hypothesis statistics. It can also calculate correlation coefficients.

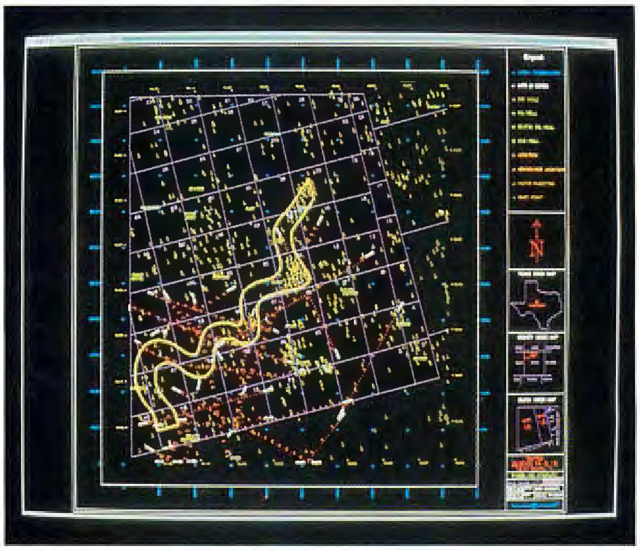
Techbase can generate four kinds of statistical plots: cumulative frequency plots, scatter plots, histograms, and ternary diagrams. You can annotate the graphs with text, lines, and graphics. Graphics capabilities include contouring, cross sections, digitizing, plotting, three-dimensional perspective, and vector. You can include up to 128 customized markers on a graph or plot.

Techbase runs on PCs and workstations from IBM, Sun, DEC, Hewlett-Packard, Silicon Graphics, and others. It requires a minimum of 640K bytes of RAM and a hard disk drive.

Price: Single-user, $2840 and up; multiuser, $5190 and up.

Contact: MINEsoft Ltd., 1801 Broadway, Suite 910, Denver, CO 80202, (303) 292-6449.

Inquiry 1160.



A map of blocks 19 and 18 in Taylor County, Texas, made with Techbase. In addition to the legend on the right, the base map includes state index, county index, and block index maps.

Data Acquisition with Graphing, OOP Language

LabOBJX combines data acquisition with math, statistics, and graphing. According to Scientific Software Tools, LabOBJX's programming language combines the object-oriented capabilities of Smalltalk with syntax similar to that of Pascal and Modula-2, letting you modify routines to fit your requirements in the laboratory.

The compiler, linker, editor, analysis, and interface tools are integrated in the run-time application environment, and at any time during execution you can create and integrate new commands or displays of data.

The program lets users work from the command line (for advanced lab personnel) or with pull-down menus (for novices). LabOBJX supports three-dimensional axonometric and mesh plots and several other types of graphs, including real-time display of signal traces.

To run LabOBJX, you need an IBM PC with 640K bytes of RAM; a math coprocessor is recommended.

Price: $1995.

Contact: Scientific Software Tools, Inc., Penn State Technology Development Center, 30 East Swedesford Rd., Malvern, PA 19355, (215) 889-1354.

Inquiry 1161.

Nonlinear Curve Fitting Added to Plotting Program

SigmaPlot 4.0, a scientific graphing program, lets you define almost any equation, or sets of equations, with up to 25 parameters and 10 independent variables, and fit the equation to your own data. In addition to the nonlinear curve-fitting capability, the company has added a pull-down menu interface and more graph types and has increased the program's worksheet capabilities.

Jandel Scientific says that it has expanded the SigmaPlot worksheet to 16,000 columns by 65,000 rows. The program directly supports Lotus spreadsheet files, including named ranges. It also supports DIF files and ASCII.

SigmaPlot 4.0 runs on the IBM PC with 640K bytes of RAM and a hard disk drive.

Price: $495.

Contact: Jandel Scientific, 65 Koch Rd., Corte Madera, CA 94925, (800) 874-1888 or (415) 924-8640.

Inquiry 1164.

Electromagnetic Analysis Added to FEA Program

A new version of Cosmos/M, a finite-element analysis system for IBM PCs, Mac IIs, and Unix workstations, includes a module for performing FEA of electromagnetic problems. Called Estar, the new module features nonlinear analysis and includes B-H material and permanent magnet demagnetization curves, its developer reports. (A B-H material curve refers to the magnetic flux density [B] versus magnetic field intensity [H] curve that's used to solve nonlinear material curve design problems.) The module can handle force calculations on ferromagnetic objects under externally applied fields and supports two- and three-dimensional magnetostatic modeling while including the current effects for the 2-D and axisymmetric cases under study.

In all, the program has 11 modules, including fluid, nonlinear static, heat transfer, linear dynamic, and linear static analysis. Cosmos/M 1.60 can solve problems of up to 15,000 nodes and 60,000 degrees of freedom. It requires a hard disk drive with at least 10 MB.

Price: $995 and up.

Contact: Structural Research and Analysis Corp., 1661 Lincoln Blvd., Suite 200, Santa Monica, CA 90404, (213) 452-2158.

Inquiry 1163.

continued

Open Server. Closed Server.

Open Server	Closed Server
Runs on every vendor's operating system: OS/2,™ VINES,® UNIX,™ VAX® VMS, IBM® MVS, etc.	Runs only on OS/2.
Supports every vendor's local area network protocol: Novell's® SPX/IPX,™ NetBIOS, Named Pipes,™ etc.	Supports only Named Pipes.
Transparent access to data in other vendor's databases: IBM's DB2™ and SQL/DS, and Digital's RMS.	Does not provide access to any other database.
Transparent data sharing between all your computers: PCs, minis and mainframes.	Can't even transparently share data between two PCs running Ashton-Tate SQL Server.
Lotus 1-2-3® spreadsheets and dBASE® applications work with ORACLE Server today.	Doesn't work with either Lotus 1-2-3 or dBASE just yet.
Developers have a complete and integrated family of portable tools for CASE, applications generation, report writing, etc.	Supports only Focus.
Programmers can use interfaces from C, COBOL, and FORTRAN.	Supports only C.
Certified by Codd and Date to run at 11.0 TP1 transactions per second.	Ashton-Tate SQL Server's published benchmarks show it to be slower.

Oracle Client/Server Forums
1990 Schedule

Tuesday, April 3	Boston
Thursday, April 5	Philadelphia
Tuesday, April 10	Cincinnati
Thursday, April 12	Toronto
Tuesday, April 17	Newport Beach
Thursday, April 19	San Francisco

Call to register for the Oracle Client/Server Forum nearest you. Or order ORACLE Server for OS/2 for only $2499 and get six months of phone support and upgrades for free (a $500 value). Or try our Developer's Version (limited to 3 users) for only $699.

ORACLE®

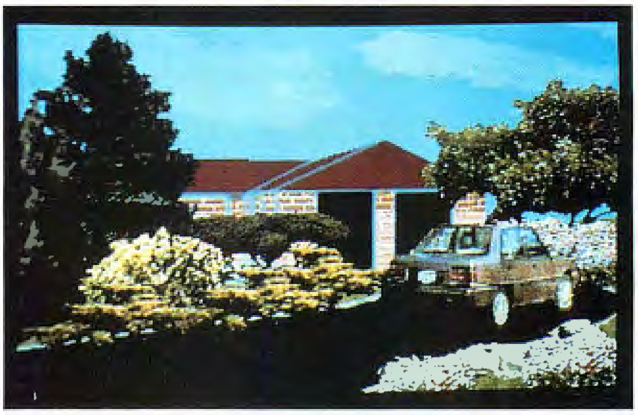
Call 1-800-ORACLE1, ext. 4965. We're always open.

Animate Building Sites with VideoScapes

A video library for land planning professionals that works with Autodesk's Animator lets you take an image of a planned building site that's bereft of buildings, trees, people, and cars and create a full-color, animated presentation that shows how the proposed site will look upon completion.

Called VideoScapes, the library encompasses hundreds of images, including people, trees, plants, cars, and other objects, that you can size to fit a CAD drawing or insert into an Animator video image. VideoScapes includes building-face patterns such as brick, cedar, and other textures.

Using the animation capabilities of Animator, VideoScapes' cars can move across the screen, trees can grow, and people can walk through the site. With a video capture board, you can import a video of the proposed site, render a three-dimensional CAD drawing of the building with Animator and VideoScapes, and combine those separate elements into an animated presentation for a client.



With the VideoScapes library and Animator, cars can move, trees can grow, and people can walk through a building site.

VideoScapes comes in Animator and Targa formats.
Price: $495.
Contact: LandCADD, Inc., 7519 East Highway 86, Franktown, CO 80116, (303) 688-8160.
Inquiry 1152.

Access COGO Reference Points Through Database

The AutoCAD release 10 add-in E.S. (for expert system) COGO lets you access COGO reference points through an external database instead of having to select the point on-screen. According to Applications Publishing, this feature is useful for engineers who need the hidden data and attributes of many reference points in a large drawing. You can use more than 100 commands while working on the external database to retrieve information such as the distance between two reference points.

A new Universal Data Collector converts raw field data into a representative drawing, and the Master Symbol Library performs symbol insertion for each COGO reference point that you've entered via a description code.

E.S. COGO and E.S. COGO Contour (for contour mapping, plan and profile modeling, and other representations of data) each require extended AutoLisp and AutoCAD running on an IBM AT with 640K bytes of RAM and a hard disk drive.
Price: $2500; E.S. COGO Contour, $1000.
Contact: Applications Publishing, Inc., One Harbor Dr., Suite 103, Sausalito, CA 94965, (415) 332-1111.
Inquiry 1159.

Autodesk Ships PM Version of AutoCAD

Autodesk's version of AutoCAD release 10 for OS/2 Presentation Manager (PM) is the latest in the company's introductions of AutoCAD for high-end platforms, including one for Unix (specifically, the SCO Xenix and SCO Unix System V/386 operating systems), and a DOS-extended, 386-specific version.

Autodesk says that the multitasking capabilities of OS/2 make it a natural platform for AutoCAD. As is the case with other DOS programs ported to OS/2, many new features of AutoCAD for OS/2 are OS/2 features, such as multitasking, the PM graphical user interface, and Dynamic Data Exchange. Another feature is the ability to port AutoCAD files for OS/2 to any other platform running AutoCAD release 10, without file conversion. (However, this is a standard feature of all versions of AutoCAD release 10.)

AutoCAD for OS/2 requires at least 4 MB of memory and an 80287 or 80387 coprocessor. It is compatible with either the Standard or Extended Edition of OS/2.
Price: AutoCAD for OS/2 and Unix, $3000; for extended DOS, $3300.
Contact: Autodesk, Inc., 2320 Marinship Way, Sausalito, CA 94965, (415) 332-2344.
Inquiry 1153.

Ad Hoc Reporting, New Attributes Added to EASIMAP

EASIMAP (Equipment and Systems Installation Management and Planning) 3.0, a data-center facility-planning add-in for AutoCAD, features true ad hoc reporting capabilities and more than 60 new attributes per symbol. New attributes include leasing and maintenance, square footage of each machine, airflow in cubic feet per minute, operating temperature and relative humidity tolerances for each machine, and more.

With the ad hoc capabilities, you can sort up to three attributes and search up to four attributes concurrently. Some of the other EASIMAP attributes include British Thermal Units to air and water, weight, machine type, and serial number.

EASIMAP comes standard with three-dimensional symbol libraries for IBM, multilayered/multicolored symbol libraries, and a DXF file translator. Additional symbol libraries are available for DEC, Cray, and other systems.

EASIMAP runs on the IBM AT, Mac II, and Sun and Apollo systems with AutoCAD release 9 or higher, a math coprocessor, and a hard disk drive with 3 MB of available space.
Price: $2750 and up; additional libraries, $275 each.
Contact: 21st Century Innovations, Inc., 23861 El Toro Rd., Suite 611, El Toro, CA 92630, (800) 327-4627 or (714) 768-8060.
Inquiry 1158.

Where's more power and speed when you need it?

Introducing the IBM RISC System/6000™

With the ultimate desktop

Whatever job you're setting off to conquer, from pioneering new electrical circuitry to getting a new airplane design off the ground, if you're always wishing your workstation could help you do it better and faster, you're a Power Seeker. And the new IBM RISC System/6000 family of POWERstations and POWERservers is for you.

Take our new POWERstation 320. It puts more than 7 MFLOPS of double-precision performance and over 27 MIPS right on your desk—more power than most floor-standing workstations. And those numbers soar as high as 13 MFLOPS and 41 MIPS in other models.

RISC System/6000	MIPS	MFLOPS (DP)	3D Vectors (K/SEC)
POWERstation 320	27.5	7.4	90

A processor that's ages ahead of its time. What makes all this possible? POWER Architecture—Performance Optimization With Enhanced RISC—IBM's second family.

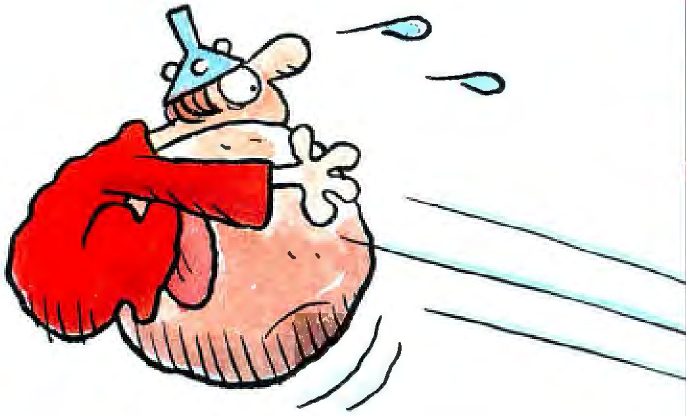
workstation for the power seeker.

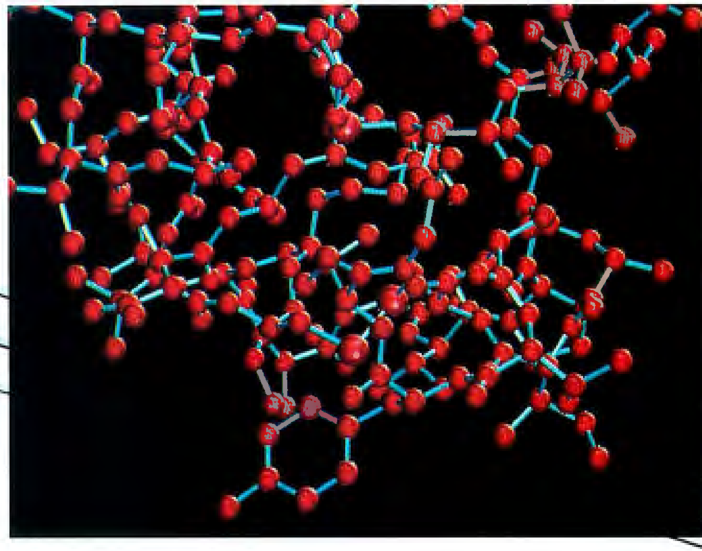
generation of RISC technology, and the heart of the RISC System/6000 family. POWER Architecture gives you up to four instructions per cycle, and it has a CMOS microprocessor built right in that leaves others in the dust. Plus, there's massive memory (up to 256MB) linked to the processor by high-speed internal bandwidth that handles data up to 480MB per second—so the POWER processor is free to attack larger tasks. All of which means solving a complex problem doesn't mean a long wait anymore.

Micro Channel™ conquers throughput barriers. This much raw processing power needs lots of data transfer muscle, too. So we gave all these systems a new implementation of the Micro Channel bus with I/O throughput of up to 40 megabytes per second. And that's just the beginning. There'll be future implementations of Micro Channel that can double and even quadruple that data transfer capability, making the traditional, nonexpandable architectures seem primitive by comparison.

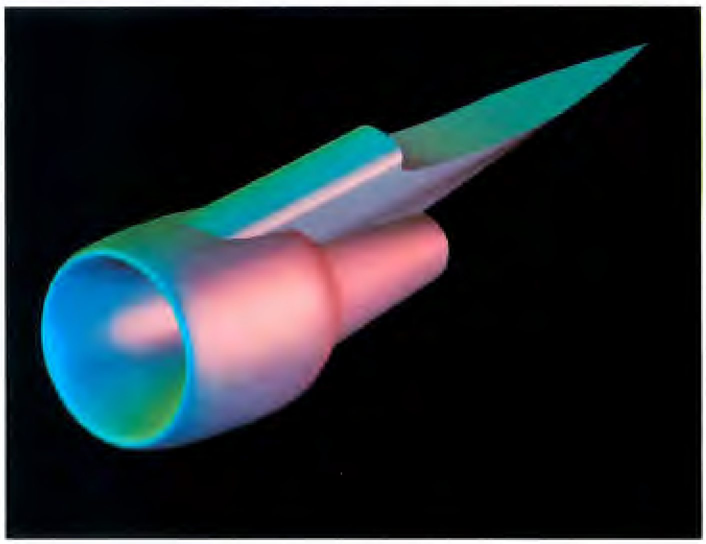
Add to all this the ability to take advantage of Micro Channel cards and adapters, IBM's new 320MB and 857MB high-performance disk drives and high-speed POWER processing, and throughput bottlenecks are ancient history.

3D graphics performance



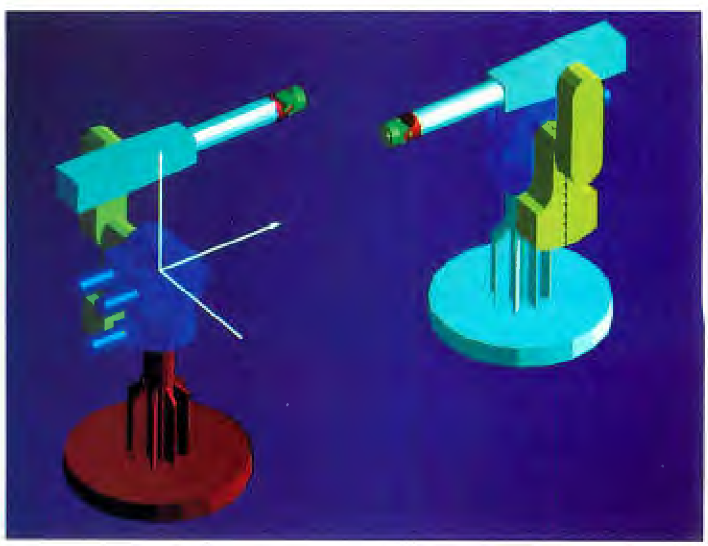


Rock-solid support for all UNIX® applications. All members of the RISC System/6000 family are industry-standard UNIX operating system processors all the way, with the AIX™ system, IBM's version of the UNIX operating system. And they'll run hundreds of applications in such diverse fields as engineering design, fluid dynamics, molecular modeling, structural analysis, securities trading, technical publishing and geophysical modeling, plus a wide selection of commercial applications.



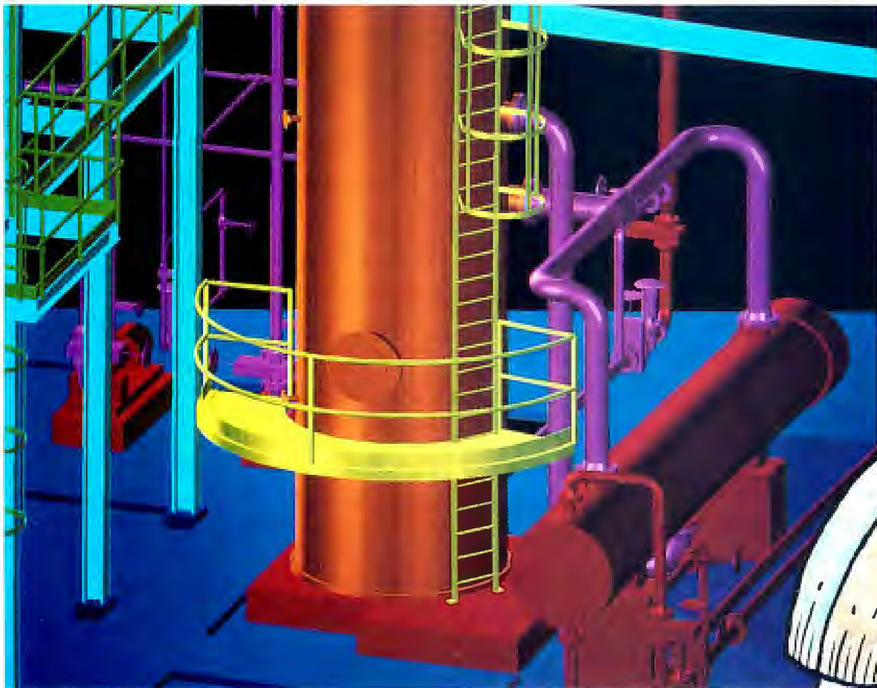
Your complete graphics arsenal. Every POWERstation in the family is built to give you high-speed, high-resolution graphics. Each can come complete with its own graphics processor, freeing up the driving speed of the POWER processor to rapidly create and analyze your designs. And all have screen resolution of 1,280 x 1,024 pixels for sharp, crisp, detailed images.

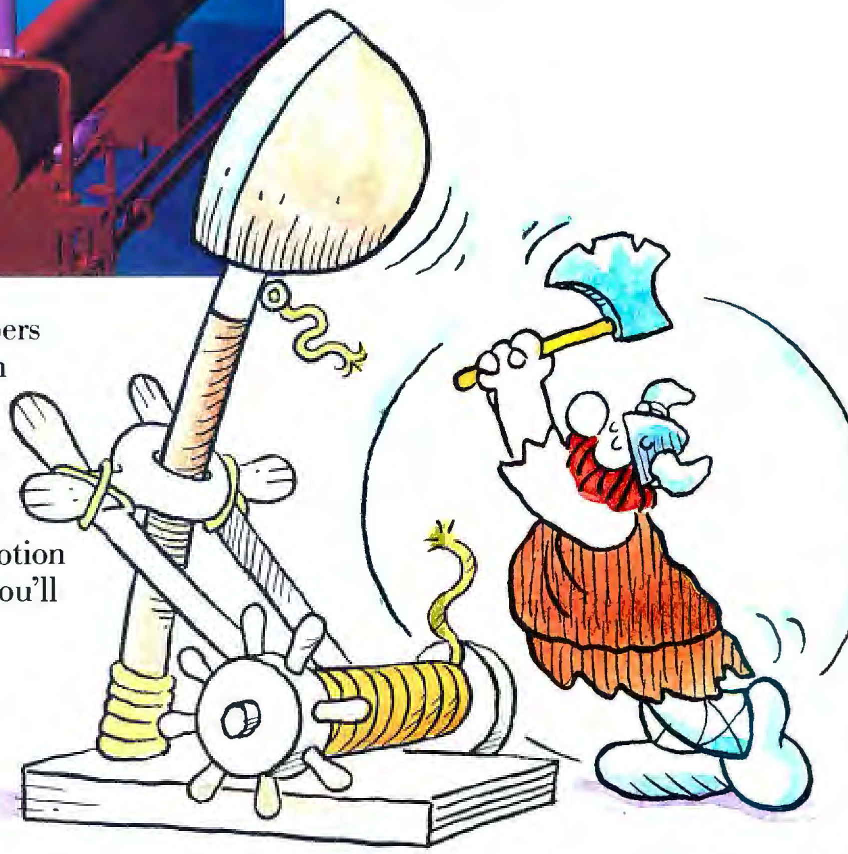
When it's time to call in the heavy artillery, there's our new Supergraphics POWERstation 730. It features IBM's new Supergraphics Processor Subsystem that's a lot of processors in one: a graphics control processor, a drawing processor and a shading processor, to let you smoothly shade and rotate complex 3D images.



with tremendous impact.

The POWERstation 730 is an awesome combination of speed and performance. It can do nearly one million 3D vector transformations and 120,000 Gouraud Shaded Triangles per second, for realistic shading effects done amazingly fast. Great news for Power Seekers who work on animation, scientific visualization, medical imaging, applications using IBM graPHIGS™ and CAD applications like CADAM™ and CATIA.™





All these beautiful performance numbers yield even more beautiful results. You get an almost unimaginable palette of 16 million colors to work with, which gives you 3D images so realistic, they fairly leap off the screen. And POWER processing lets you view even complex creations in fast, fluid motion from any angle. With any POWERstation, you'll be catapulted into a whole new arena of graphics performance.

...and a whole lot more.

AIX brings different worlds together. Hardware this powerful deserves an operating system to match. So every system in the family can come preloaded with AIX, IBM's version of the UNIX operating system, which runs across the broadest range of platforms in the industry. And it supports major industry standards, as well as the programming languages C, FORTRAN, COBOL and PASCAL. And AIX has additional enhancements, like Advanced Optimizing Compilers, that give you the maximum benefits of POWER Architecture, enriched file system capabilities and support for real-time processing. To make things even easier, we've included on-line publications with hypertext search capabilities. Plus, you get leading industry graphical user interfaces: AIXwindows™—based on the popular X Windows System™ and OSF/MOTIF™—and NextStep.™ AIX lets the RISC System/6000 family fit right into your installed UNIX base as well as your IBM SAA™ environments, giving you, quite literally, the best of both worlds.

A lot more power for a lot less loot. Power Seekers will be pleased with the surprisingly low price of our entry desktop POWERstation 320—with over 27 MIPS and 7 MFLOPS—as well as our floor-standing POWERservers. And the booty doesn't stop there. Included in the price of every system are software service and a full one-year warranty, plus the best documentation in the business. It's enough to satisfy even the most demanding.

A network with power to spare. And to share. The RISC System/6000 family is designed to connect to everything from big IBM mainframes to PS/2®s, as well as the full range of non-IBM systems. That means great connectivity and more open systems, so all users have the full power of the network at their command.

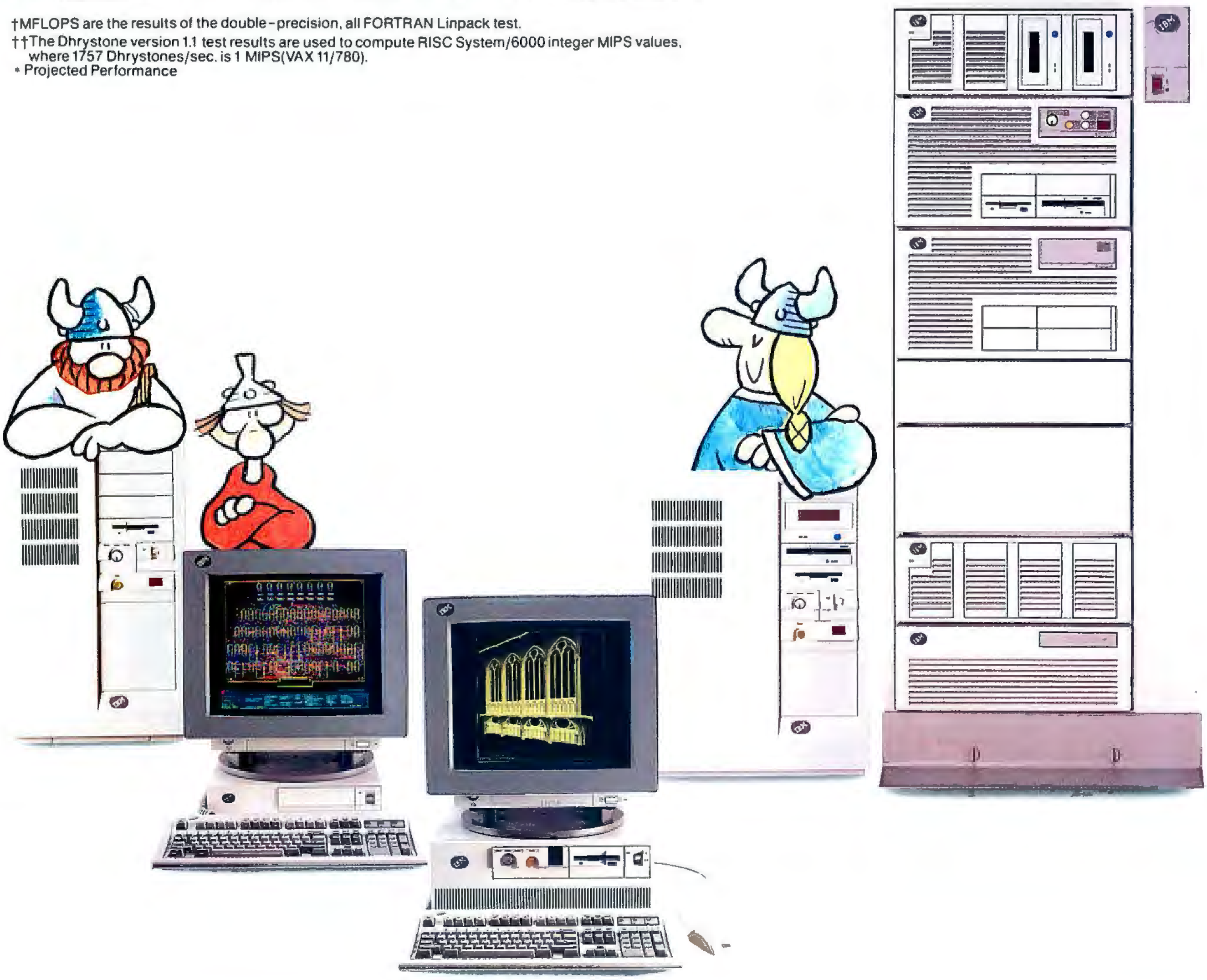
The RISC System/6000 family. Choose your weapon.

There's a RISC System/6000 POWERstation or POWERserver to conquer any need, from a single user's desktop requirements to the demands of an army of concurrent users. Each member of the family comes in a wide variety of configurations, so you can choose among display sizes and disk storage and graphics processing capabilities. For low cost-per-user LAN solutions, there's even a new, high-performance IBM Xstation 120.

	RISC System/6000 POWERstations			
	320	520	530	730
Package	Desktop	Deskside	Deskside	Deskside
MFLOPS (DP)†	7.4	7.4	10.9	10.9
MIPS††	27.5	27.5	34.5	34.5
Maximum Memory	32MB	128MB	128MB	128MB
Internal DASD Capacity	640MB	2.5GB	2.5GB	2.5GB
Total Memory Slots	2	8	8	8
Total Micro Channel I/O Slots	4	8	8	8
Graphics 3D Vectors (K/sec)	90	90	90	990•
Graphics Shaded Polygons (K/sec)	10	10	10	120

	RISC System/6000 POWERservers				
	320	520	530	540	930
Package	Deskside	Deskside	Deskside	Deskside	Rack
MFLOPS (DP)†	7.4	7.4	10.9	13	10.9
MIPS††	27.5	27.5	34.5	41.1	34.5
Maximum Memory	32MB	128MB	128MB	256MB	128MB
Internal DASD Capacity	640MB	2.5GB	2.5GB	2.5GB	12GB
Total Memory Slots	2	8	8	8	8
Total Micro Channel I/O Slots	4	8	8	8	8

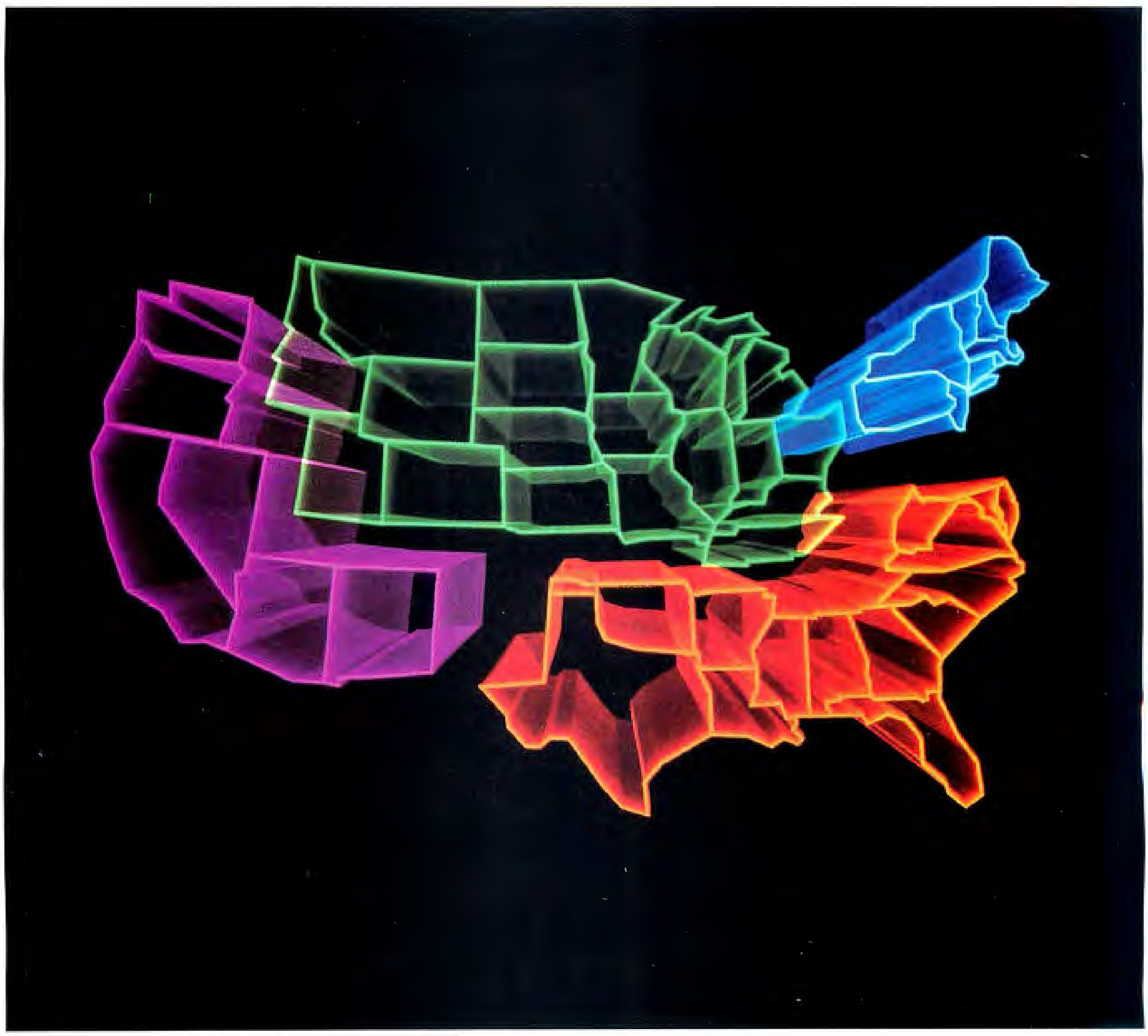
†MFLOPS are the results of the double-precision, all FORTRAN Linpack test.
††The Dhrystone version 1.1 test results are used to compute RISC System/6000 integer MIPS values, where 1757 Dhrystones/sec. is 1 MIPS(VAX 11/780).
• Projected Performance



BYTE

REGIONAL

MIDWEST



PHOTOGRAPHIC IMAGE: ALEX PIETERSEN © 1989

Chicago Group Sponsors Computer Show

The Chicago Computer Society (CCS) is sponsoring the first of what the group hopes will become an annual computer show in the Chicago area. The event, to be held from 9:00 a.m. to 4:00 p.m. on March 31 at the Rosemont O'Hare Exposition Center in Rosemont, Illinois, will feature workshops, vendor expositions, seminars, and raffles.

CCS now has six chapters and 18 special-interest groups (new SIGs include graphics and communications). The group mails about 2500 copies of its newsletter each month and runs its own BBS.

Contact: The Chicago Computer Society, P.O. Box 8681, Chicago, IL 60680, (312) 794-7737; BBS: (312) 942-0706. For show information, call (312) 942-1265.

Denver Group to See Quattro Pro

The Mile High Computer Resource Organization (MICRO) will feature Quattro Pro, Borland's latest spreadsheet, at its general meeting in April. The group is also scheduled to see Act, the contact management program from Contact Software International.

In May, the general meeting will focus on Autodesk's Animator. Tentatively scheduled for May or June is Lotus 1-2-3/G.

MICRO holds its general meetings on the last Thursday of the month at the Glendale Community Center on 999 South Clermont, near Mississippi and South Colorado Blvds. February's general meeting covered the IBM Micro Channel architecture.

Contact: Mile High Computer Resource Organization, 3311 West 92nd Place, Westminster, CO 80030, (303) 286-7455, (303) 426-6669, or (303) 798-5435.

Smalltalk/V Users Groups

Two users groups that support Smalltalk/V, Digitalk's version of the object-oriented programming language, are forming in the Midwest, one in Columbus, Ohio, and the other in Chicago.

Contact: Ron Schultz, Network Solutions, 7450 Horizon Dr., Columbus, OH 43235, (614) 841-4103; or Aubrey Jackson, Commonwealth Edison, 72 West Adams St., Room 922, Chicago, IL 60690, (312) 294-2945.

Computer Show in Lexington, Kentucky

On April 14, the Central Kentucky Computer Society will sponsor the CKCS Computer Show and Seminars at the Lexington Hilton Inn Convention Center. The group expects to hold two sets of

continued

MYODA

MYODA computers are manufactured by PAO-KU Group, a highly respected, public-held corporation. The MYODA product line includes a full selection of desktop and laptop computers. Myoda is the one source supplier for costumer looking for quality, service & price.

LT3500 $2299

- INTEL 80286-12cpu
- 0 wait state
- 80287 coprocessor socket
- 1MB on board (expand able to 4MB)
- Gas Plasma 640 x 480 EGA mode, • 4 Gray scale
- 40M HDD (28 ms)
- 1.44MB FDD
- 2 serial, 1 parallel port
- 1 EGA/CGA /MGA CRT port

LT3200 $1899

- INTEL 80286-12cpu
- 1 wait state
- 80287 coprocessor socket
- 640 KB on board (expand able to 2.6MB)
- Gas Plasma 640 x 400 CGA mode, * 4 Gray scale
- 40M HDD (28 ms)
- 1.44MB FDD
- 1 serial, 1 parallel port
- 1 CGA/MGA CRT port

NEW!

$3799 LT5200CD

- INTEL 80386-25cpu
- 0 wait state
- 80387 coprocessor socket
- 1MB on board(expandable to 8MB)
- 32KB CACHE memory
- Gas Plasma640/480
- VGA mode, 16 gray scale
- 40M HDD(28ms)
- 1.44MB Floppy Drive
- 2 serial, 1parallel port
- 1VGA/EGA CRT port
- 2 full size expansion slots
- 90-260V auto switch power supply

LT5200NV $2599

- INTEL 80286-16 cup/0 wait state
- 80287 coprocessor socket
- 1MB on board (expandable to 8MB
- Other configrations are same as LT5200CD (no CACHE memory)

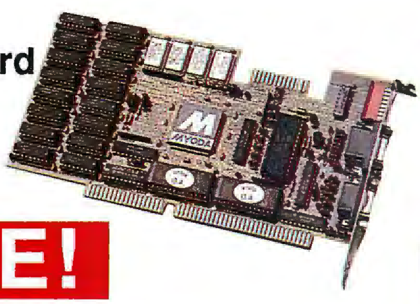
Options:

Memory expansion board(2MB/3MB/4BM)	External FDD(360KB/1,2MB)
Expansion chassis(4 external expansion slots)	33Key keypad
coverter(12V-110V) for use in car	5hr external battery

MYODA 16Bit VGA Card

512K, Res. 800/600

$149



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QUANTITY DISCOUNT PRICE

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SPECIAL ON MOTHERBOARD

SUNTAC/VLSI 286-12
AMI 386-25/64 cache
MYODA 386SX-16

Vertical Case

Large, medium & small

MD3410 $685

- INTEL 80286-12cpu
- 0 wait state
- 80287 coprocessor socket
- 1MB on board (expanable to 4MB on motherboard)
- 101 key enhanced keyboard
- 1.2 MB Floppy Drive
- 1serial, 1parallel, 1 game port
- 8 expansion slots
- 1:1 interleave HFDC
- 180W power supply
- Baby AT case

MD2000 $319

- 8088-1(10MHZ) Micropro cessor
- 4.77/10 MHZ Clock Speed
- 256KB installed, Expand able to 640KB on Board
- One 360 KB Floppy Drive with Controller
- Four 1/2 Height Drive Bays
- Turbo Switch & LED
- Reset Switch
- Hard Drive Access LED
- 150W Power Supply
- 101 key enhanced Keyboard

Options:

Hard Drive	20MB(65ms) $219	40MB(28ms)$339	80MB(28ms)$559	120MB(28ms)$659
MYODA 14"/VGA Monitor $339	12" Monochrome Monitor $75	MGP $41		

$859 MD5030

- INTEL 80386SX-16cpu
- 80387 coprocessor socket
- 1MB on board (expand able to 8MB on mother board)
- 101 key enhanced keyboard
- 1.2 MB Floppy Drive
- 1serial,1parallel, 1game port
- 8 expansion slots
- 200W power supply
- 1:1 erleave HFDC

MD7240 $2399

- INTEL 80386-25cpu
- 0 wait state
- 80387 coprocessor socket
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seminars each hour during the show, which will also include product demonstrations.

CKCS recently moved the location of its general meetings to the Lexington Community College on Cooper Dr. General meetings are held on the third Monday of the month.
Contact: Central Kentucky Computer Society, Inc., 2050 Idle Hour Center, Suite 160, Lexington, KY 40502, (606) 266-7446; BBS: (606) 293-0154.

Technology Conference Nanobytes

On April 9–12, Chicago's McCormick Place East will be the site of the 1990 AIIM Show and Conference. Sponsored by the Association for Information and Image Management, the show will cover the latest in technologies for document imaging.
Contact: Association for Information and Image Management, 1100 Wayne Ave., Suite 1100, Silver Spring, MD 20910, (301) 587-8202.

Columbus, Ohio, will be the site of the sixth annual Academic Microcomputing Conference. The conference deals with all aspects of microcomputing and workstation use in the academic setting.
Contact: John Schar, Instruction and Research Computer Center, The Ohio State University, 1971 Neil Ave., Columbus, OH 43210, (614) 292-4843.

The 1990 IEEE International Conference on Robotics and Automation, including exhibits, will be held at the Hyatt Regency Cincinnati on May 13–18.
Contact: IEEE Robotics and Automation Society, P.O. Box 3216, Silver Spring, MD 20901, (407) 483-3037.

St. Paul, Minnesota, will host the Midwest Electronics Exposition. The show addresses management and technical issues in electronics, including design, production, and test engineering. The exposition will be held at the St. Paul Civic Center on May 15–17.
Contact: MG Expositions Group, 1050 Commonwealth Ave., Boston, MA 02215, (800) 223-7126 or (617) 232-3976.

Wisconsin Group to Sponsor MacWorld Talk

For those Wisconsinites who can't make it to San Francisco for MacWorld, the Madison Macintosh Users Group is sponsoring a report by Dan Neesley, owner of North Shore Computers in Milwaukee, on the convention. Neesley will speak at the Edgewood High School on April 17.

The group usually holds its general meetings at the high school, located at 2219 Monroe St., on the third Wednesday of the month.
Contact: Madison Macintosh Users Group, P.O. Box 1522, Madison, WI 53701, (608) 251-2885.

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Create Expert Systems with DBMS

A program for application developers called Guru FirstStep combines a relational DBMS, a fourth-generation programming language, and Structured Query Language support with the ability to create expert systems.

The program, developed by Micro Data Base Systems (mdbs), combines all the capabilities of KnowledgeMan/2 2.6, the company's information management system, with an expert-system development platform that supports up to 30 rules with one level of nesting.

Other features of the program include a forms manager, natural-language interface, custom report generator, color graphics, text processor, remote communications, and spreadsheet. A debugger lets you view source code through pop-up windows.

Guru FirstStep runs on the IBM PC with 640K bytes of RAM and a hard disk drive.
Price: $895.
Contact: mdbs, Inc., KG Software Division, P.O. Box 248, Lafayette, IN 47902, (800) 344-5832 or (317) 463-2581.
Inquiry 1020.

NCR's PC486/MC Exploits Micro Channel

A bus-mastering SCSI controller and 128K bytes of cache memory are just two of the high-performance features of NCR's new top performer, the PC486/MC.

The heart is an Intel i486 CPU. The motherboard can accept up to 16 MB of RAM and offers four Micro Channel architecture slots. The cache is contained in a pair of custom application-specific IC cache chips that permit read-and-write-back operation.

NCR will offer an optional bus-mastering graphics coprocessor board made by GSS (and based on a Texas Instruments 34010) that provides high-speed 1024- by 768-pixel graphics independently of the CPU. The PC486/MC comes standard with Super VGA (800- by 600-pixel) graphics.

NCR will deliver the PC486/MC in four configurations. The base system has 1 MB of RAM, a 3½-inch 1.44-MB floppy disk drive, and the Super VGA. The most powerful system has 8 MB of RAM and a 200-MB SCSI hard disk drive.
Price: $9995 to $16,995.
Contact: NCR Corp., 1700 South Patterson Blvd., Dayton, OH 45479, (800) 225-5627 or (513) 445-5000.
Inquiry 1022.

Image Manipulation Times Three on the Mac

Enhance, an image-enhancement program that offers 256 levels of gray support for filtering operations, lets you create up to three versions of the same image so that you can experiment with image filters without corrupting the original image. MicroFrontier says that the program offers real-time filters for brightness/contrast, gamma, gray-scale toning, and color/gray-scale thresholding.

With the program's cut-and-paste function, you can copy among the different versions of an image. Once you cut from one image, you can align it automatically or display it as a semitransparent overlay. An undo feature lets you convert an altered image to its original state.

The program supports 256 colors for painting and drawing, offering airbrush, pencil, smudge, and smooth tools.

Enhance runs on the Mac II with 2 MB of RAM, an 8-bit video card, and a gray or color monitor. It supports TIFF, EPS, and PICT image formats.
Price: $375.
Contact: MicroFrontier, Inc., 7650 Hickman Rd., Des Moines, IA 50322, (515) 270-8109.
Inquiry 1021.

Price Drop from Eighty/20

The Eighty/20 family of contact-management software just got less expensive: In addition to announcing an international version, the company reduced the price of the single-user, advanced, and network versions of its programs.

With Eighty/20, you can organize time, track activities, process mass mailings, record and report expenses, dial customers automatically, and generate reports. Eighty/20 Expeed 1.0 is the entry-level package. It requires 460K bytes of RAM.

Eighty/20 International has customizable formats for international dates, times, and sorts, including international address and phone fields.

The German version is now available; French and Spanish versions should be available shortly, the company says.
Price: Expeed, $189; Advanced, $395; network version, $995; international version, $495.
Contact: Eighty/20 Software, 555 Third Ave. NE, Hutchinson, MN 55350, (800) 635-8020 or (507) 345-8020.
Inquiry 1019.

Retrieve BBS Documents with Graphics

With BulletFax, you can access documents from a DOS-based BBS and have those documents sent to any fax machine, Nuntius reports. The program works on any BBS that has drop to DOS (doorway) capability. Callers to the BBS can search, scan, tag, and fax out documents. If the BBS is single-line, the document is faxed as soon as you hang up; dual-line BBSes can fax documents while you're still on-line.

With BulletFax, a BBS can transmit a document created using desktop scanning equipment, Aldus PageMaker, or Ventura Publisher with graphics intact (the program also supports ASCII). BulletFax supports batch processing, the ability to create documents from existing databases. For example, while you're on-line, you can create an inventory list with the most up-to-date information and then transmit it to any fax machine immediately.

BulletFax works with single-line versions of TBBS, FIDO, OPUS, RBBS, Wildcat, and WWIV, and it supports BBSes that run under the DESQview/DoubleDOS environment. It requires an IBM PC with DOS 3.0 or higher and a 40-MB hard disk drive. If an Intel Connection CoProcessor 2400-bps modem is used, the BBS can receive faxes as well.
Price: BulletFax only, $249; with Intel board, $950.
Contact: Nuntius Corp., 1904 Merrill Dr., St. Charles, MO 63301, (314) 768-0109.
Inquiry 1018.

continued

SHEBRO IBM Compatible Computers assembled by a highhly experienced team of top quality engineers since mid '87 in USA now introduces ***RACER*** series for the nineties.

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Page Interleave & Shadow RAM support within BIOS on 286-16MHz & 386sx Systems

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Additional 1.2 or 1.44 Floppy Drive ....add ....$ 85

RACER 386 SYSTEMS

BASIC FEATURES OF *RACER* 386 SYSTEMS: INTEL 80386-25 MHz CPU (Landmark 34 MHz on 0 wait) • AMI-BIOS with built-in Setup & Diagnostic • 1mb RAM expandable to 8mb on 6-layer Motherboard + 8mb on 32-bit Card • 0 or 1 wait state setting • 8 expansion slots Realtime Clock/Calendar • 1 Parallel, 2 Serial & Game I/O • Math Co-Processor socket • 101 Enhanced Keyboard • 200 watts • Power Supply (220W/33MHz) Barebone Systems include Motherboard with manual, Case/PS & 1mb RAM only, nothing else.

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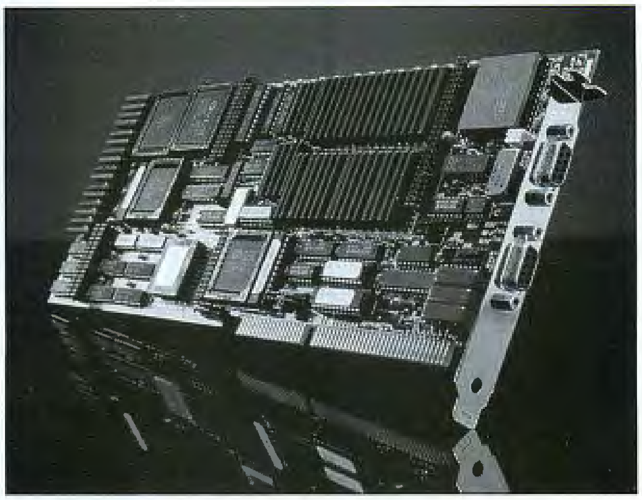
CAD Display Controller Zooms Four Times Faster

Nth Graphics' Nth Engine/550 display controller zooms and pans up to four times faster than the company's previous Nth Engines and comes with 4 MB of onboard display list RAM, expandable to 8 MB.

The AT-bus-compatible board comes with Hydra, the company's visualization software that reads in three-dimensional wire frames produced in AutoCAD directly from your hard disk drive, the company reports. It then uses the controller's 20 MIPS and 3 MFLOPS of processing capability to shade and rotate models. You can use Hydra to "walk through" wire-frame and surface-shaded models.

The board is also bundled with Nth View, a stand-alone program that lets you view, plot, and save two-dimensional and wire-frame drawings without having the CAD software that created the drawing (for distribution of drawings across networks and via modem). Some of the other free software includes a GIF file-exchange utility, an interactive palette editor, and enhanced display list drivers.
Price: 1024- by 768-pixel, $4995; 1280- by 1024-pixel, $5995; extra RAM, $350 per MB.
Contact: Nth Graphics, Ltd., 1807-S West Braker Lane, Austin, TX 78758, (800) 624-7552 or (512) 832-1944.
Inquiry 1013.



The Nth Engine/550 displays 256 colors from a palette of 16.7 million and supports extended DOS and AutoCAD Xenix.

Hypertext Word Processor

Hyper-Word, a hypertext word processor for the IBM PC, contains a number of features that may interest programmers. In addition to the program's ability to interconnect documents by linking a calendar, memos, contracts, and outlines, it can link related source files to display a function or subroutine from any reference.

Zaron Software says that Hyper-Word can use its hypertext ability to make quick work of a program mock-up or a set of interrelated screens that show how a proposed program will look and flow. First, individual screens are drawn and then interlinked using Hyper-Word's link function. You can jump to a screen that shows the next logical display in program operation.

Of course, Hyper-Word is not just for programmers. Other features include a readability index and an integrated spelling checker. You can search multiple files with one command, and the program can function as a personal information manager, linking the calendar, daily log, and documents. The program prints multiple columns, labels, and form letters.

Hyper-Word runs on the IBM PC with 512K bytes of RAM and a hard disk drive.
Price: $249.95.
Contact: Zaron Software, 13100 Dulaney Valley Rd., Glen Arm, MD 21057, (301) 592-3334.
Inquiry 1016.

Property-Mapping Software

LAN/SCAN's L-Plot 5.0 is a property-mapping program for title attorneys, real estate companies, and anyone else involved with property descriptions. It lets you automatically generate a map of a property by typing in a description of the land. You can plot any legal description by metes and bounds, township and range, or a combination of both, LAN/SCAN reports.

Each file can include up to 250 closed tracts. The program includes a library of mapping symbols; automatic labeling of calls; copy, move, and rotate functions; and a font editor. Area and error-of-closure are automatically calculated, the company says. Maps are automatically updated when you change data.

L-Plot 5.0 runs on the IBM PC and requires 640K bytes of RAM. The stand-alone program can export files in DXF format.
Price: $299.
Contact: LAN/SCAN, Inc., P.O. Box 6863, Abilene, TX 79608, (915) 672-2901.
Inquiry 1014.

Canvas Adds Enhanced Bézier Curves

A new version of Canvas, the drawing program for the Macintosh Plus or higher, features enhanced Bézier curve editing, the ability to create four-color separations, and a 100,000-word spelling checker.

New editing features of the Bézier curve tool include adding control points anywhere on the curve, creating sharp edges without adding control points by manipulating the control handles independently, and splitting curves at any location.
Price: $299.95.
Contact: Deneba Software, 3305 Northwest 74th Ave., Miami, FL 33122, (305) 594-6965.
Inquiry 1015.

Dynamic String Handling for C

For programmers who want to build dynamic strings in C, KBM Communications has released the bStrings Library, which provides dynamic string-handling capabilities similar to BASIC, without the difficulties of heap management and without fragmenting memory, the company says.

The library provides more than 130 string-manipulation routines that KBM says duplicate almost every string function available in BASIC.
Price: $89.95.
Contact: KBM Communications, 2401 Lake Park Dr. NW, Suite 160, Atlanta, GA 30080, (800) 227-0303 or (404) 333-0303.
Inquiry 1017.

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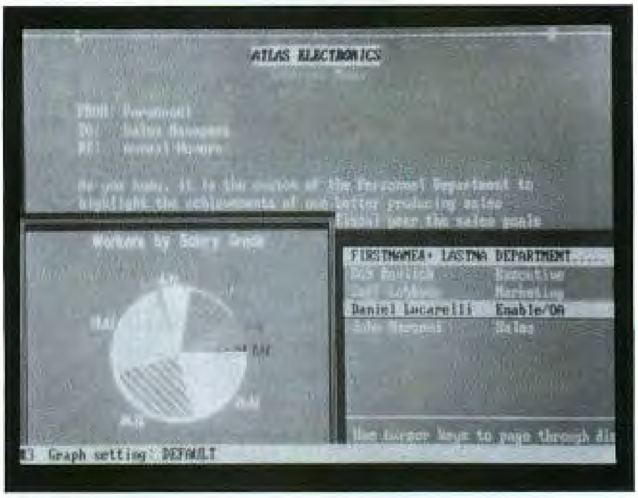
Integrated Software for Small Businesses

Enable/BP integrates word processing, a spreadsheet, a relational database, business graphics, and telecommunications with the ability to open up to eight windows at once, Enable Software reports. The program, available in single-user and LAN versions, lets you copy data and graphics among windows and supports more than 20 formats for importing and exporting files.

The 65,000-cell spreadsheet, compatible with Lotus 1-2-3, includes a macro facility. You can update and display graphs and spreadsheets simultaneously. The word processor supports mail merge and graphics and includes an 80,000-word spelling checker.

Enable/BP requires 384K bytes of RAM for DOS 2.1 and 448K bytes for DOS 3.0 and higher.
Price: Enable/BP, $199; Enable/BP LAN (four-user version), $495.
Contact: Enable Software, Northway Ten Executive Park, Ballston Lake, NY 12019, (518) 877-8600.
Inquiry 1007.



With Enable/BP, you can open up to eight windows at once.

Desktop Publishing for Under $60

Spinnaker Software has released version 5.0 of its BetterWorking Word Publisher. It lets you work in text or graphics mode, allowing you to edit text in a WYSIWYG environment. The program combines word processing with the ability to create documents using fonts, columns, boxes, lines, and clip-art images.

Other enhancements include the ability to scale documents to large, distorted, normal, reduced, and other sizes. You can also pick any column height and the program automatically reformats the text, the company says. The program includes a spelling checker, outliner, and cut-and-paste capabilities. To run the program, you'll need an IBM PC with 512K bytes of RAM and a hard disk drive.
Price: $59.95.
Contact: Spinnaker Software Corp., One Kendall Sq., Cambridge, MA 02139, (617) 494-1200.
Inquiry 1008.

Create 32 Graphs and Charts

With QuickGraph, you can create 32 types of charts and graphs from data you've imported from Lotus 1-2-3, dBASE III, ASCII, and ASCII delimited files. QuickGraph lets you chart up to 2250 data points (up to 15 columns wide and 150 rows deep) in one chart. You can hot-link a chart to data, and once you create a chart, you can export it directly to a word processor.

The program supports standard bar, column, line, and other charts. Variations include clustered, overlapped, stacked, and unstacked. Chart styles include pie-column, scatter, table, pie-pie, and others. You can also create comparative charts with dual y-axes.

Other features include text annotation, automatic scaling, and a variety of line styles and colors.

QuickGraph consumes about 415K bytes of RAM and runs on the IBM PC.
Price: $99.95.
Contact: Sumak Enterprises, 39 Dawson Dr., Sudbury, MA 01776, (508) 443-0205.
Inquiry 1012.

Graph-in-the-Box for Executives

New England Software's newest version of Graph-in-the-Box supports 15 different types of charts and uses disk swapping, so that the program requires only 10K bytes of RAM when not activated. The Executive version, a TSR program that captures data and text directly from the screen, lets you manipulate, display, and print it as a graph or chart.

In addition to three-dimensional effects and nine fonts, the program offers 57 data manipulation functions and 16 statistics. The program automatically detects the graphics standard in your IBM PC and supports the EMS specification. When active, Graph-in-the-Box requires about 300K bytes of RAM on a PC.
Price: $299.95.
Contact: New England Software, Inc., Greenwich Office Park 3, Greenwich, CT 06831, (203) 625-0062.
Inquiry 1011.

Accelerate AutoCAD VGA Performance

A new display list driver for AutoCAD release 10 accelerates the performance of AutoCAD, when used with a VGA board, by an average of two to 10 times over that of the driver that is supplied by Autodesk, Panacea reports. DLD-VGA uses Panacea's proprietary display list technology to let you quickly pan, zoom, and redraw your AutoCAD drawings.

DLD-VGA supports all 100 percent IBM-compatible VGA boards at the 640- by 480-pixel resolution. In addition, it supports the VESA Standard 800- by 600-pixel VGA resolution and Super VGA boards from Video Seven, Paradise, ATI, Tecmar, Orchid, STB, and Willow.

DLD-VGA is compatible with AutoSketch, AutoShade, and AutoCAD, supporting pull-down menus, multiple viewports, and transparent commands. The driver can use expanded and extended memory and the disk for storing the display list information while accelerating AutoCAD.
Price: $99.
Contact: Panacea, Inc., Londonderry Sq., 50 Nashua Rd., Suite 305, Londonderry, NH 03053, (800) 729-7420 or (603) 437-5022.
Inquiry 1010.

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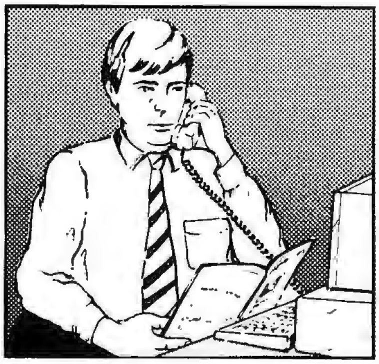

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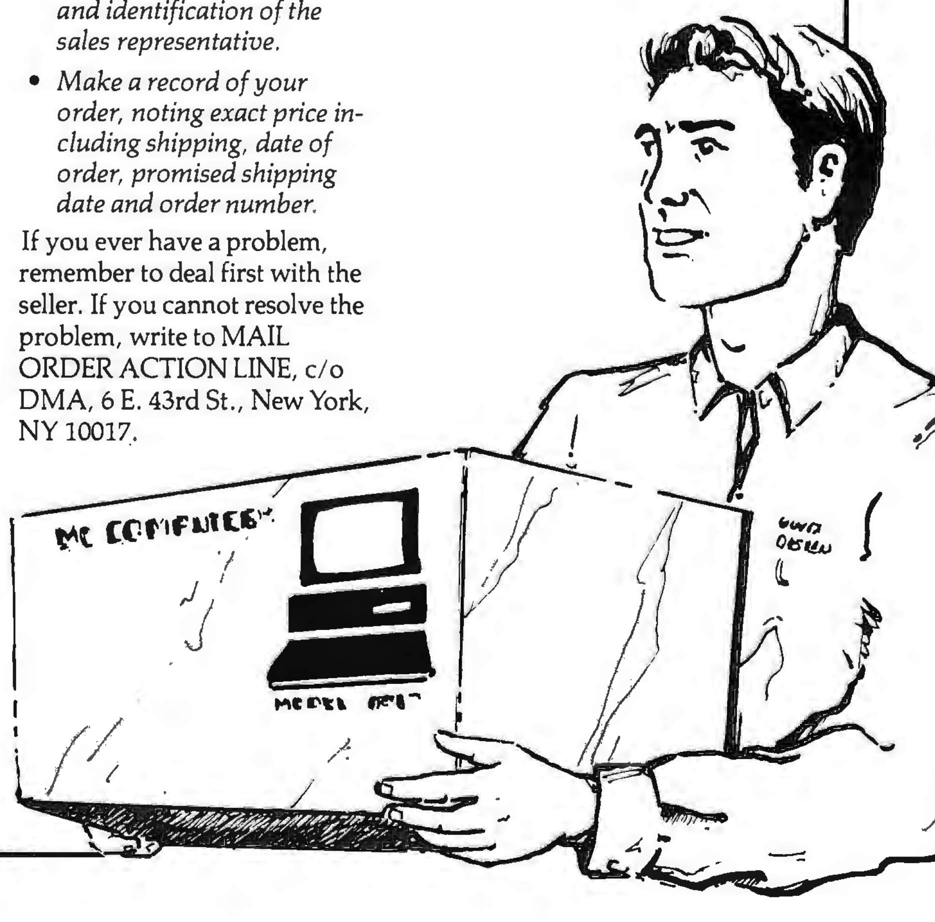


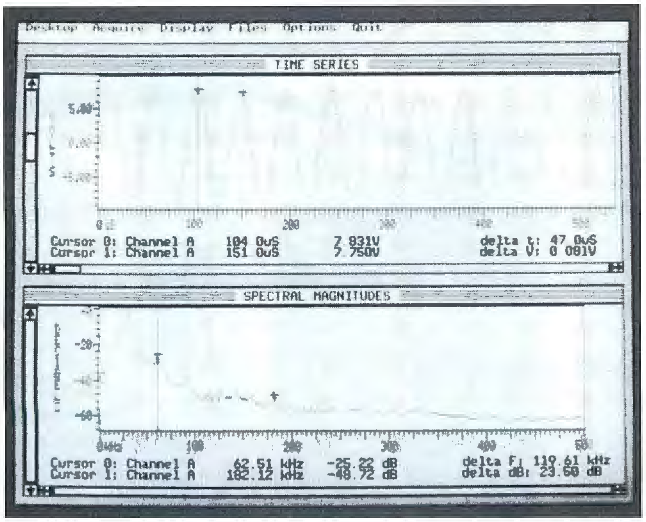
Rapid Systems' Waveform-Averaging Software

With Rapid Systems' R2 software and multichannel waveform digitizers, you can display up to 16 channels at once and average from two to 1000 waveforms per channel, the company says.

Digitizers that R2 supports can handle one to 16 independent channels, sample rates from 0.01 Hz to 20 Hz, data buffers of 128K bytes per channel, and 8 or 12 bits of A/D resolution.

Some of the features of R2 include digital scope display and the ability to display amplitude in engineering units of your choice. You can control acquisition and display parameters from pull-down menus.

R2 runs on the IBM XT or higher with 640K bytes of RAM. It is included with a Rapid Systems digitizer.
Price: $1995 to $6495, depending on the hardware.
Contact: Rapid Systems, Inc., 433 North 34th St., Seattle, WA 98103, (206) 547-8311.
Inquiry 1023.



R2 showing its split-screen capabilities: The top shows the time information associated with an electrical waveform, while the bottom shows the same waveform's frequency information.

Flat-File Database for Under $100

Ultra:Base is a flat-file DBMS designed for the novice user or someone who doesn't want to spend too much time reading manuals, the company says. You set up the database in folder format, with each folder containing up to 32,200 records.

Features of the program include a memo pad and an alarm clock, a calculator, global update, an amortization program, and an automatic phone list.

Ultra:Base runs on the IBM PC with 384K bytes of RAM.
Price: $79.95.
Contact: International Distributors & Marketing, 24 North Hibbert St., Suite 6, Mesa, AZ 85201, (602) 644-1067.
Inquiry 1025.

Front-Line Security for the Mac

Magna's scaled-down version of Empower II, a security system for the Macintosh, limits access to your machine by accepting registered users only. Unlike its predecessor, however, Empower I doesn't provide for levels of access privileges.

Once inside the system, you can open any folder, but you still need a password to get into the system (that's what Magna means by "front line"). Empower I can optionally prevent start-up of the Mac from a floppy disk and control the use of floppy disks after start-up.

Security administrators are the only users who can add or delete registered users and change security options, the company says. A key icon can immediately blank the screen from prying eyes when you're dealing with sensitive data, and a timed lockout feature lets you blank the screen after a period of inactivity. The program can also log activity.

Empower I runs on the Mac Plus or higher.
Price: $169.
Contact: Magna, 2540 North First St., Suite 302, San Jose, CA 95131, (408) 433-5467.
Inquiry 1024.

Manage PROM Programming on the PC

The PROM Master Support Program 1.10, an interface between the IBM PC and a PROM programmer unit, lets you edit and display PROM images in terms of the addresses the target machine sees, so that you don't have to do manual address conversions.

The program allows direct serial data transfers between Data I/O and Bytek PROM programmers of 19,200 bps and 9600 bps and the PC.

PROM Master Support Program 1.10 can automatically program PROMs for multiple PROM word widths of any multiple of 8 bits. The program verifies PROMs end to end. It directly loads Intel object files produced by Intel (Santa Clara, CA) or Systems and Software (Costa Mesa, CA) locaters.
Price: $99.95.
Contact: Roth Enterprises, 925 H Kirsten Court, Rohnert Park, CA 94928, (707) 586-9237 or (707) 762-2703.
Inquiry 1026.

Better Function Testing Through Talis

Auto Function Tester is a structured testing tool for C that Talis Computer Service says is designed to eliminate random testing and throwaway test cases. AFT supports relative timing, regression testing, and any function that takes parameters, the company says. With the tool, you can run hundreds of tests on your function with only one compile/link cycle. The program is self-documenting, saving all test data, output, and code. Test case coverage reports help you design better test cases, Talis says.

With the Source Code Catalog (SCAT), you can organize your functions in a database so that you can find functions by category, external reference, or description. The database is language-independent and supports Auto-Add functions in batch or interactive modes from C or dBASE source code and Microsoft-compatible libraries. The program comes with stand-alone and TSR versions. You can also search or view any file and paste function calls and paths.
Price: AFT, $199; SCAT, $99; SCAT network version, $199.
Contact: Talis Computer Service, Inc., P.O. Box 1539, Nevada City, CA 95959, (916) 265-5777.
Inquiry 1027.

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* BYTE Editors, "Megahertz Madness," *BYTE IBM Special Edition* (Fall 1989): p. 13.

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Chaos Manor Awards

Jerry presents his annual awards for the best products of 1989

Well, it's year's end and time for the annual Chaos Manor Awards. Of course, this is the April issue, but there's no help for that; by me, a year ends in December when I write this column.

First the ground rules: these are *my* awards. This year for the first time we'll be giving out certificates—the basic design was done by Mrs. Pournelle with considerable help from the BYTE editorial staff—that bear the BYTE logo; what that means is that BYTE approves of my giving awards; however, they remain *my* choices, not those of the BYTE staff.

There are two award categories: the Chaos Manor Best of the Year User's Awards, which go to products that I consider the best in their respective categories *and that are in use at Chaos Manor*, and the Chaos Manor User's Choice Awards. In both cases, the awards go to products I use myself.

In addition to the awards, there's the Chaos Manor Orchid and Onion Parade for products, companies, and deeds that I think deserve praise or opprobrium.

Languages

I have for years said that small computers will come of age when programming languages are at the point where programming skill, per se, isn't as important as the ability to think up things for the machines to do. I tend to look for developments that move us in that direction.

One of those is object-oriented programming, of which a prime example is Borland's Turbo Pascal 5.5, which provides the simplest introduction to OOP that I know of. I've said enough about Turbo Pascal that I needn't repeat it here; I really had no trouble deciding that Turbo Pascal 5.5 has earned the Language of the Year User's Choice Award.

I have to add that it was not the only significant user-oriented language development last year. It had two very serious competitors. One of them, Microsoft BASIC 7.0 Professional Development System, didn't get here until mid-December, and while that's technically in 1989, it hasn't been around long enough to be in this year's running. However, I have had it long enough to know I like it.

BASIC 7.0 is revised BASCOM with a world of new features. It's thoroughly integrated with CodeView, the Microsoft debugger. My late mad friend Dan MacLean really hated BASIC as a programming language because of its lack of structure, but I'm sure he'd share my enthusiasm for the new BASIC 7.0. He would, however, insist that it isn't really BASIC. BASIC in his day required line numbers, had few control structures and no declarations, and generally required liberal use of GOTO statements to build useful programs. Now, not one of those criticisms applies.

Microsoft's BASIC 7.0 compiler has a lot of interesting features. For one thing, it breaks the 64K-byte string space limit. For another, it can automatically use EMS memory, which means that on a 386 with a memory manager such as Quarterdeck's QEMM-386, you can have very large programs without kludges. There are already several commercial games that are written in compiled BASIC; now there will be even more. Microsoft BASIC 7.0 looks very good indeed as a language for developing large and complex programs quickly and easily.

There's a significant development in the other direction, as well. I described Crescent's P.D.Q. library for Microsoft QuickBASIC 4.5 in the February column: with P.D.Q., you can build small, fast programs in BASIC, including TSR programs; P.D.Q. has already earned its User's Choice Award. Equally important, Crescent is revising their entire line of professional BASIC tools and routines to work with the new Microsoft BASIC 7.0; those should be out by the time you read this. The result is a truly professional capability that provides a highly friendly and productive environment.

Microsoft and Crescent have taken several giant steps toward the world I envisioned 10 years ago, in which anyone could write and debug decent programs. A world in which you concentrate on what you want the computer to do, rather than how to persuade it to do it. True, behind that kind of "user programming" there have to be some very sophisticated people writing software tools in assembly language—which is fine by me. I don't really know how my books are printed and bound, either.

Follow the Dots...

When I got old Ezekial, my first computer, about half the cost was for a Diablo daisy-wheel printer. Later I upgraded to an NEC Spinwriter. It's faster than the Diablo and uses a thimble rather than a daisy wheel, but otherwise it's not a lot different from the old Diablo: big, clunky, loud, and pretty slow.

I solved the whole problem by going to the Hewlett-Packard LaserJet; I got one of the very first ones, and I loved it. I'm told my raving about the thing helped HP's sales a lot, and I sure hope so. Incidentally, I still have it and still use it. It was upgraded to a LaserJet Plus, but that's the only service or maintenance it ever got, and it will be used to print out this column when I'm done.

I do use the old NEC Spinwriter once a month: when it comes time for the ritual known as The Paying of the Bills. I have an accounting program (I wrote it) that lets me enter the checks and credit-card expenditures and such into my General Journal; after which another program reads the Journal and writes the checks. The checks themselves come printed on

continued

tractor-feed paper, so there's no way they can be fed into the LaserJet. As a consequence, every month I drag the Spinwriter out of a closet and fire it up for the half hour it takes to write checks, and then I stuff it away again.

Then last fall I met someone from the printer division of Seikosha. "I need a little printer," I said. "The smallest tractor-feed printer you have."

"That's no problem," he said, making a note, "but don't you want a *real* dot-matrix printer as well?"

I'd never thought about it; what I really wanted was freedom from the Spinwriter. Still, Don Hawthorne, our writer apprentice at Chaos Manor, lives out back in the old apartment suite, and when he needs to print, he has to bring in a disk. That sounded like a fair test to Seikosha, and a few days later there arrived two Seikosha printers: a perfectly wee little thing called the SP-2000, which weighs under 8 pounds and is about as small as anything incorporating a tractor feed could be, and the SL-230AI, which is about 25 pounds and fully as large as the NEC Spinwriter.

These arrived when I was about to go off on a trip. I didn't even open the SL-230AI; I just pointed Don Hawthorne at it, handed him a printer cable, and told him to see if he could get it running with his Tandon AT compatible. It seemed a fair test: Don has much experience as a copy editor and proofreader, and he knows a good bit about typography and typesetting; but his hands-on experience with small computers is almost nil.

Don has used that printer to print out and sell enough stories that it's not really accurate to call him an apprentice any longer. He got the printer to work with Q&A and a roll of Avery labels to make up the labels for our Christmas greetings list; he does a good bit of my correspondence with it; and in general, he uses the printer daily. No glitches.

Dot-matrix printers have come a long way in the past few years. The SL-230AI is fast and relatively quiet, and best of all, the output doesn't look like dot matrix. Italic is *italic*, boldface comes out **boldface**, and so forth. They're quieter, too, not much louder than most office equipment.

I still prefer laser printers for both speed and print quality, but I have to say, modern dot-matrix printers are plenty good enough. Incidentally, hooking up the SP-2000 so it would do the NEC Spinwriter's job took about 5 minutes; and it sure takes up a lot less room. Now my only problem is, what do I do with an old NEC Spinwriter?

Clearly, the Seikosha dot-matrix printers have earned their User's Choice Award.

UPS of the Year

Ever since the Great Power Spike (see my August 1989 column), I have been sensitized to the need for power conditioning; in fact, not only have I had all my systems connected to surge protectors, but my major systems are connected to uninterruptible power supplies, usually called UPSes.

I have come to the conclusion that if you are serious about the value of the work you do on your small computer, you simply must get a UPS; it's as important as backing up your hard disk. If you run Unix, it's even more important, because Unix talks to the disk from time to time even if you're not around, and if

continued

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there's a power glitch while Unix is doing whatever mysterious things it does, you can lose *everything*.

Anyway, we've been collecting and testing UPS systems for several months now. Naturally, the only kind I'd even consider testing do power conditioning as well as provide emergency power. That eliminated several. Some we tried didn't work properly. I'd plug the Zenith Z-248 (286) computer into the UPS, get Q&A Write going, and yank the UPS power cord. If the computer had any problems at all, that UPS went back to its manufacturer. Then I plugged the UPS into a Variac and ran the voltage down; if the UPS didn't kick in before the computer noticed, we got rid of it. That got rid of a *lot* more UPS boxes.

Eventually we were down to just two brands of UPS. Both had come through the initial tests all right.

One surviving UPS is a small desktop unit, a cute little thing with convenient switches and flashing lights, a lot prettier than its Clary competition. It's also quieter; the Clary desktop UPS has a fan sound squarely in a frequency I'm sensitive to. Mind you, that's not a real flaw for most people; I have a condition commonly known as "artillery man's ear," which means serious hearing losses in scattered frequencies, no losses at all in others. The result is that I don't hear my own voice very well, and many conclude I'm deaf as a post; but in fact I hear high frequencies better than most people, so that things that sound normal or quiet to my friends are sometimes loud to me.

In any event, I chose the Brand X UPS (I don't name it for reasons I'll give later) to sit on my desk, and Don Hawthorne got the little desktop Clary, which, incidentally, he loves, but that's getting ahead of the story.

I plugged Big Cheetah, a 386/387 with a Distributed Processing Technology disk drive controller, a Priam 330-megabyte hard disk drive, and 4 MB of memory, into the UPS. I plugged in the Zenith Flat Technology Monitor (FTM). Then into the outlet labeled "printer" I plugged in a four-outlet box, into which I plugged the USRobotics modem, a CD-ROM drive, and the Maximum Storage WORM (write once, read many times) drive. That's three items, leaving the fourth outlet on the strip empty. The UPS fired up, and everything seemed to be working properly.

It was that way for weeks; then one day the housekeeper plugged a vacuum cleaner into that empty fourth outlet on the power strip. For about 2 minutes nothing happened; then, Whammo!, the system sounded horrible warnings, and everything shut down. Clearly, overloading that UPS was *not* the thing to do. I unplugged the vacuum cleaner and restarted. Nothing. A glass cartridge fuse had blown, and until it was replaced, the UPS was dead. Once the fuse was replaced, everything seemed all right—

Until a couple of weeks ago. We've been having rain in Los Angeles. Rain does odd things here. Power spikes. Miniblackouts in which lights flicker. And every time the lights flickered, Big Cheetah reset. He came right back up OK, but he had *reset*. Fortunately, my habit is to save early and often, so nothing was lost; but this clearly was not why you want a UPS!

Time for some investigation. I had Don Hawthorne bring the little Clary UPS from his room and plugged Big Cheetah into it.

The Clary UPS has fewer switches and

continued

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80410/710	200.00	150.00	600.00	250.00
80451	200.00	150.00	600.00	250.00
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controls than the other one does; but it also has one thing the others lack, a line of lights, first green, then red. As you draw more current from the UPS, more and more of the green lights come on, until you overload it, and you get one green and one red; then, no green and two red, at which point it simply cuts things off and tells you in no uncertain terms that you can't overload it this way.

It did that with Big Cheetah. The interesting part is that it is rated for as much power as the UPS I'd been using on Big Cheetah—which *let me use it* but wasn't reliable. The Clary UPS, in other words, knew it was overloaded and was not about to fool me into thinking it was doing its job when it wasn't.

"You've had your Tandon 286 plugged into this Clary during the bad weather, haven't you?" I asked Hawthorne.

"Sure have. Never noticed a thing."

"Even when the lights blinked?"

"Nothing. I remember once I was writing and I'd just finished something and was saving it when the lights blinked. The Clary box screamed for a second, but then the lights came on, and no problem. I just went on working."

He just went on working, while Big Cheetah, supposedly protected by the other UPS, reset itself.

So, as I write this it's raining outside, and I have a lash-up. Big Cheetah is still plugged into the other UPS, but *that* is plugged into a big, hairy extension cord, which runs across the Great Hall to the soundproofed electronics closet; and in that closet the big extension cord is plugged into the *big* Clary UPS, their 1.25-kVA OnGuard system. As I wrote this, I deliberately did *not* save the last paragraph.

I walked over to that closet and yanked the cord that plugs the Clary UPS into the wall. It howled. I waited a moment and plugged it back in. Then I stood there and *jiggled* the plug, plugging it in and out as fast as I could about nine times. Came back here. As you see, the paragraph remains intact. Things plugged into a Clary UPS never know that you're torturing the poor thing.

The Clary 1.25-kVA UPS is in a closet because it is much louder than its little brother; it puts out a high-pitched sound that even my wife finds too much to be close to. That's all right. It doesn't need attending, and we'll never hear it in the cable closet. It would be all right in almost any kind of cabinet for that matter, but it's pretty big, and it's convenient to have it remotely located. Tomorrow, I'll string a power cable under the floor.

continued

As to why the other UPS is still on my desk, I have deadlines and it's a perfectly good power-distribution box. Besides, the monitor is sitting on it and I like the height. I'll change that tomorrow, too. I don't name this box because it's a perfectly good UPS if you don't overload it. After all, it did pass my preliminary tests. Its only real problem is that it doesn't tell you when it's overloaded.

But the clear winner of the Chaos Manor UPS of the Year User's Award is Clary. I have no hesitation in trusting my work to Clary.

Dance of the Planets

There isn't much science education software, and a lot of it isn't very good, which is surprising, since computers are getting faster and their graphics better. Once in a while, though, comes a program that will simply blow you away.

Dance of the Planets is like that. It has an infuriating user interface that's hard to learn unless you know a lot about astronomy. The view it gives you when you first fire it up isn't very intuitive. Even after you use it for a while, it will do things you didn't expect, and you'll have vexing problems trying to get it to do something simple. But none of that matters at all.

Dance of the Planets simulates the solar system. Once you've mastered it, you can move around from one viewpoint to another. Stand well back and watch all the planets go about the Sun. Set a date, past or future, to see where the planets are. Add the asteroids, and look again. This part of the program alone makes it an absolute *must* for me: I have several science fiction stories set in the asteroid belt, and it used to drive me nuts calculating where the various flying mountains were relative to each other and to the major planets. Now I just crank up Dance of the Planets.

Once you've looked at the solar system, zoom in on a planet, Jupiter, for instance, and see all the moons, plus the great bands on Jupiter itself. Now go look at Saturn as it appeared from *Voyager*. And on. It's not the easiest program to learn, but it's sure worth learning it.

Dance of the Planets works on EGA systems, but it's prettier on VGA. We've had it up on a Tecmar VGA card with a Zenith FTM, and a Samna VGA card with the 19-inch Electrohome monitor; you haven't lived until you've seen Saturn's rings on a 19-inch color monitor! A fast 386 with no coprocessor will run it fairly well, but a slower 286 with an 80287 math chip will be faster: this is a simulation program, and it has to calculate where all those objects are. A 33-MHz 386 with an 80387 really screams.

If you have the slightest interest in astronomy and the solar system, get this program, which I'm giving the Best Science Education Program of the Year User's Choice Award. Try it. You will love it.

Games

There are two kinds of games: those that you think you *ought* to enjoy, and those you just plain like. Chess falls in class 1 for me: I used to be a good chess player and even played successfully for money when I was in the army. I still follow the tournaments, and I guess I still think of myself as a chess player; but the fact is that I haven't played much in the past few years. I'm not sure why.

But, if I do play chess against a computer, the game to beat is Chessmaster 2100 from The Software Toolworks,

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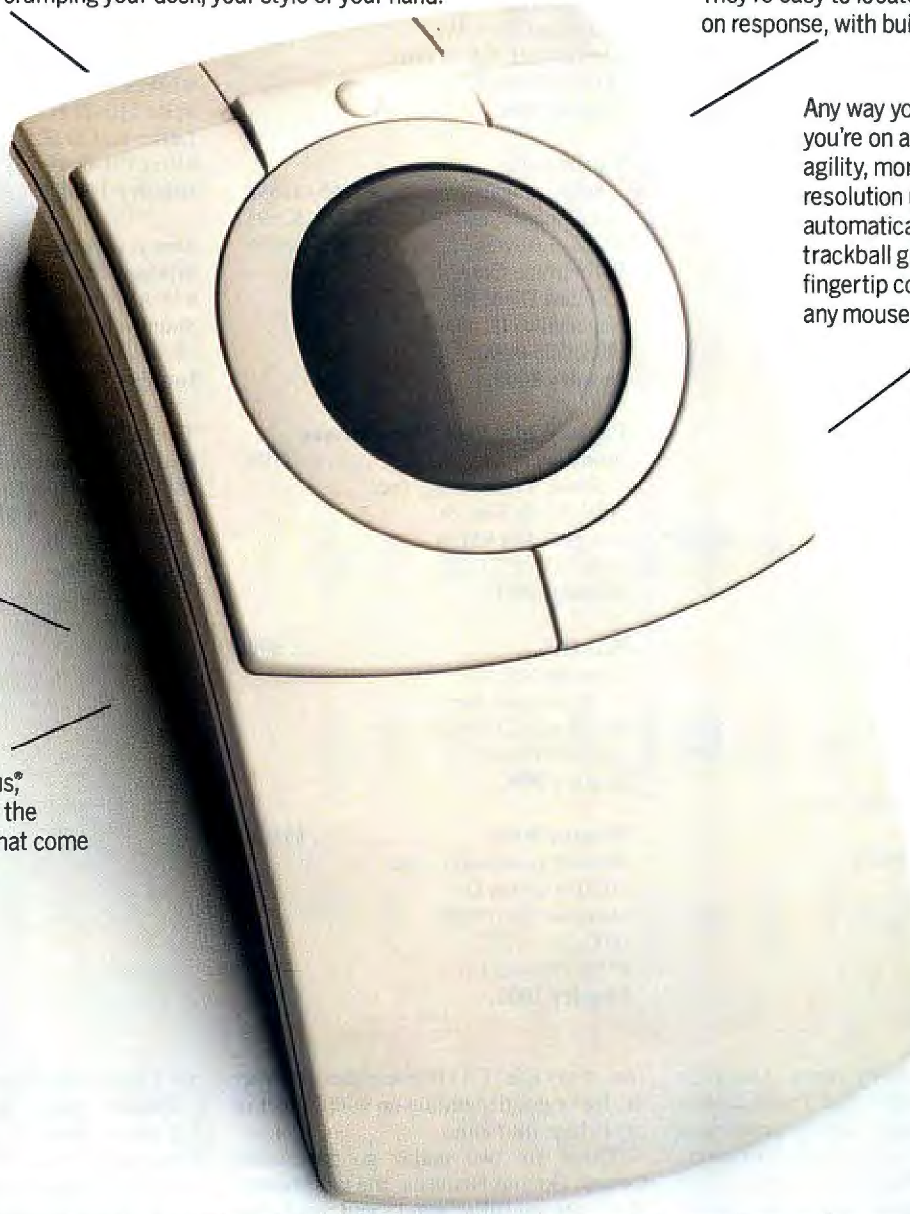

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only I don't win very often. Old-time readers will remember that The Software Toolworks was Walt Bilofsky's company distributing really nifty utility programs in ZipLoc bags back in S-100 CP/M days. The company has gotten a bit larger, and the packaging is slicker nowadays. There's been no drop in quality of products, either. Chessmaster 2100 is as good as chess programs come.

Go is intermediate between the games I think I ought to like and the games I like. I play more go than I play chess, and I like it more; indeed, if I were condemned to play only one game for the rest of my life, I'd choose either contract bridge or go, depending on who I'd get in my bridge foursome.

There are two major go programs: Cosmo Go and Nemesis, the Go Master. Both are awfully good, and each has beaten the other in a computer go tournament. I believe that Nemesis is ahead this month. Overall it's hard to choose between them, but I find that when I play go against a computer, I almost always choose Nemesis, which tells me something. There are versions for both the Macintosh and the PC. I generally play on the Mac, but I keep the PC version on my Zenith 286 SupersPort laptop.

Finally, there's a game of no redeeming social value at all; it was just plain *fun*, and I played a lot of it last year: Sword of Aragon from Strategic Simulations. This is a game of medieval fantasy. The fantasy elements are good, but that's not what I really liked about this game. What I really liked was that you could quite realistically simulate medieval warfare, build combined-arms armies and use them properly, and win the game without letting magic dominate it at all.

Anyway, on reflection, I'm giving

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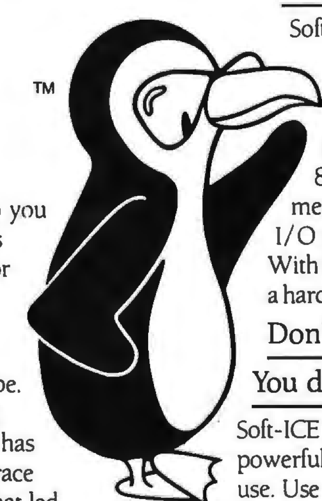

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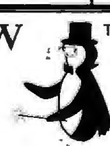

CodeView is a great integrated debugger, but it uses over 200K of conventional memory. MagicCV uses advanced features of the 80386 to load CodeView and symbols in extended memory. This allows MagicCV to run CodeView in less than 8K of conventional memory on your 80386 PC.

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Chaos Manor User's Choice Awards to Chessmaster 2100 and Nemesis, the Go Master; but the 1989 Chaos Manor Game of the Year User's Award goes to Sword of Aragon.

Monitors

The all-around best monitor in the business is Zenith's FTM, which has already got plenty of awards, including mine as monitor of the year two years running. It's crisp and clean and has no flicker. You can see it in all conditions of ambient light, from late night with other lights in the room to a bright, sunny afternoon with a window behind you. It's the monitor of choice for VGA systems.

However, it's also big, bulky, and comparatively expensive. Moreover, some people don't need color. I'll argue that if you can possibly afford it, the Zenith FTM is worth the money in what it saves you in eyestrain, even if you use it only as a monochrome monitor; but I also know that some won't agree.

We've looked into a lot of low-cost monitors this year, and one was outstanding: the Goldstar Paper White VGA Monochrome Monitor. It's about as low in cost as you'll find for anything of decent quality. It has crisp, clear images and no flicker. It's light in weight and cool-running. I used monochrome for years before I thought color was sharp enough to stare at all day; and the monitor I had then wasn't anywhere near as good as the Goldstar Paper White VGA monitor, which gets a Chaos Manor User's Choice Award.

Backup System

A lot of people seem to think that when I say something is "good enough" I am damning it with faint praise. Not so. In my judgment, "good enough" is high praise: it means I can use it without worrying about it; that it has all the features I need to get the job done.

There's one problem with starting off with hardware or software systems that are good enough: there's little incentive to experiment with anything else. This is fine when I'm thinking like a user, but it's not so hot when I'm looking for something new to write about. It's even worse for the people trying to get me to look at something new.

Most of you know that I'm partial to WORM drives in general, and the Maximum Storage WORM drive in particular. I've had a Maximum Storage WORM drive for a couple of years now, and it's more than good enough. I'll recommend the Maximum Storage WORM drive to anyone; and I've often said that if you're serious about the value of what you do on your computer, you'll get a UPS and a WORM drive, because anything less is gambling in ways you'll regret. The Maximum Storage WORM drive got a year's best award last year, and it has improved considerably since; it more than deserves its User's Choice.

A WORM drive is great for a single user. It's pretty good when a couple of users share it, for instance through an Applied Creative Technology Systematizer. As the number of users goes up, though, while it's important to have at least one WORM drive—it's still the absolutely best way to be sure you have kept and can retrieve every version of your work—using a single WORM drive to back up the work of many people becomes difficult, while setting up and enforcing a centralized plan for ensuring that all valuable work is saved and cataloged becomes nearly impossible.

Last year was supposed to be the Year of the LAN. I don't think it was, and I don't think this year will be, either, but it does seem clear that networked microcomputers are getting more important as time goes by, and they already are stealing large portions of a market that used to be the private preserve of the minicomputers, including VAXen. Now, one of the strengths of VAX systems was the ability of the MIS to set up and enforce backup plans whereby, like it or not, *everyone's* work was systematically copied off and archived. It was something you couldn't do with linked microcomputers.

That's no longer true. Comes now Palindrome, a network-archiving system for Novell and Novell-compatible LANs, which will do just about everything a VAX backup system can do. Palindrome is software and firmware to run an automated 2.2-gigabyte Exabyte tape cartridge backup system.

Palindrome first goes out and backs up everything; depending on the size of the network, this could take all night the first time you run it. Once it has done that, Palindrome then works iteratively, copying anything that changed since the last backup. It uses a sophisticated tape-changing scheme so there's no chance of losing everything; and, of course, you can periodically send tape cartridges off-site so that you have a chance to revive your company even if the place burns to the ground. It also records what it has done and catalogs the files it has archived.

Palindrome comes as a complete system with an Exabyte tape drive, or, if you already have an Exabyte tape drive but

continued

don't have software as good as Palindrome—and I don't know of any that is—you can get the firmware and software alone. Either way, if you are running a Novell network system or contemplating one, I strongly recommend Palindrome, the Chaos Manor Data Backup System of the Year User's Choice.

MNP and ARQ

Sometimes I think I have the noisiest telephone lines in the U.S.; at least when it rains in Los Angeles, I get world-class line noise. There is, however, a remedy. Not all communications networks have it. Tymnet doesn't, for instance, and BIX has it on only a few direct-dial lines. MCI Mail has it, though, as does GE's GEnie. I refer to a hardware error-correcting protocol system called MNP and ARQ. I confess I haven't the remotest idea of what those stand for, and what, if any, is the difference between them.

What I do know is that the new USRobotics modems can be set to use these protocols automatically. Once properly set, the modem sends a special signal to any modem it connects with. If it gets the proper return, the two go into communications in error-correcting mode—and you are not bothered by line noise no matter how bad the lines are. Moreover, when the lines are not noisy, the data transmission is much faster.

I don't have space for the technical details. But as a user, I find that MNP and ARQ pretty well solve the line-noise problems and speed up data transmission as well; and the USRobotics Courier HST Dual Standard modem wins hands down the Chaos Manor Modem of the Year User's Award. I love this thing.

Gadgets

I love gadgets; there's even a "gadgets" topic in the new technology conference that's part of my new exchange on BIX. There were a lot of really neat gadgets last year: the Atari Portfolio, a pocket-size DOS computer that I really like except that I can't get mine away from my son Alex; the Sharp Wizard; the Casio Boss; the Selectronics Word Finder; and a number of other dedicated special-purpose computers developed by Mike Weiner at Microlytics.

On reflection, though, one stands out: the Spectre GCR. Add this to an Atari ST, and you have, for all practical purposes, a Mac Plus. Add it to Atari's neat full-function portable ST, and you have a low-cost portable Mac Plus. The Chaos Manor Gadget of the Year User's Choice Award goes to Dave Small of Gadgets by Small for the Spectre GCR.

Mice

Like it or not, a good pointing device is becoming a necessity. I make no secret that I keep searching for new substitutes for the mouse. One product I mightily wanted to support was Logitech's TrackMan trackball system. Alas, for me it didn't quite make it. It was a good step in the right direction, but I find that the pointing device I prefer, and use at Chaos Manor, is not the TrackMan but Microsoft's "Dove-bar-shaped" Mouse. It fits the hand, looks nice, is easy to use, and gets this year's Chaos Manor User's Choice Award.

Orchids

Every year on BIX I ask for nominations for the Chaos Manor Orchids and Onions Parade: people, events, and things re-

continued

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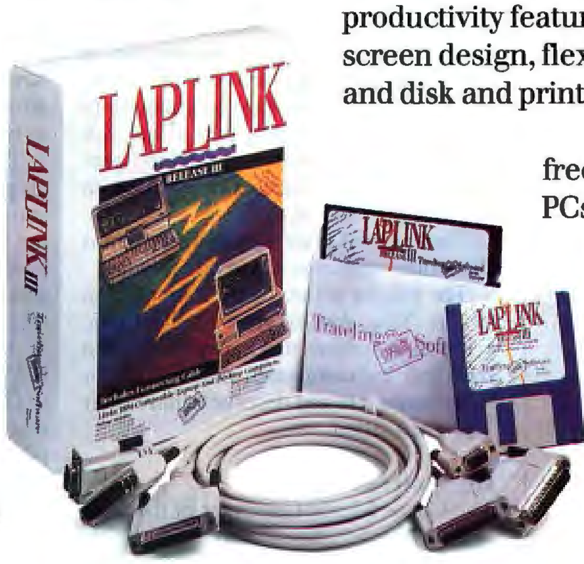

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lated to the computer community that made us happier and deserve orchids—and of course the stuff that deserves recognition for causing us problems.

A lot of good things happened last year. My orchid list includes:

Bill Gates, for his support of CD-ROMs. He has almost single-handedly built the market for this product; without his support, it certainly would not be where it is now and might not even exist.

American Express for their customer service: not just the AI programs that help their people make *fast* decisions on credit approval, but the whole card member privilege and support services they provide.

Tymnet, which, for all its problems, does listen and works on fixing things.

All of the above deserve orchids; but the Chaos Manor Orchid of the Year goes to Nolo Press, which is doing as much as anyone to help deliver the nation from its plague of lawyers.

Onions

The onion list is long, too; enough so that I'm going to omit the minor irritations and get right down to the real baddies:

Gould of Seattle, which makes disk mailers that are almost impossible to open; and once you have opened them, they have a horrible glue guaranteed to adhere on contact to any part of the disk that the container was supposed to "protect." I have lost three floppy disks to this outfit's mailers.

Those awful voice-synthesizer gizmos that allow magazine ads to talk to you.

The winner of the Chaos Manor Onion of the Year Award goes to electronic voice-mail systems that have clearly been installed by companies that no longer want customers and deserve to have their wishes fulfilled.

Computer of the Year

The Chaos Manor Computer of the Year is the machine I have found most useful; and that's always a tough choice, because I always have a whole bunch of computers that are more than good enough. I do tend to use the best and fastest machine I have, but I don't lightly switch from one to another.

I am still using Big Cheetah, the 386; but that's almost a fluke. The truth is, I would have changed to the Premier 9000, a 33-MHz 386, if I hadn't been promised a 486 machine in the very near future. The Premier 9000 is the fastest and cleanest-running machine at present in Chaos Manor, and by a good bit. It has been used as the primary test machine for odd software; it was used as a network server for a while; it has had OS/2 installed and taken off again; it was used to test Quarterdeck's *wonderful* new version of QEMM-386 and Manifest—if you have a 386, run, don't walk to get these—and in between times the Premier 9000 was put to use as the general-purpose workhorse for everything except writing books.

It's only fair, then, that the Premier 9000 is designated the 1989 Chaos Manor User's Choice DOS machine.

However: I give my awards for utility; and while I write all my books on DOS machines, I do an awful lot of my other work on Macs, which puts me in a genuine dilemma. I know I could do my books on the Mac. I'm not at all sure I could do my briefing charts and maps on a PC. Therefore, the Premier 9000 has to share the Computer of the Year Award with the Mac IIx, which generated the briefing charts we took to the White House; and I can honestly say that I'm glad I don't have to choose one or the other machine. They're both useful for the kind of work I do.

Winding Down

I've made a dent in the list of worthy software, but I see there's a lot more than I have space for. I don't know what I can do about that except rejoice that there's so much good stuff to work with.

The shareware of the month is Hieroglyphics for the Atari ST; this will let you write your name and history in genuine hieroglyphics that could have been understood by the pharaohs. It's available from the author, William Bentley (P.O. Box 2203, Santa Ana, CA 92707), or in the "tojerry/listings" section on BIX. The book of the month is *Nowhere to Go: The Tragic Odyssey of the Homeless Mentally Ill* by E. Fuller Torrey (Harper Torchbooks, 1989). It will tell you a lot you need to know about that problem.

Next month the mixture as before: a lot of good stuff came in yesterday. I sure love these little machines. ■

Jerry Pournelle holds a doctorate in psychology and is a science fiction writer who also earns a comfortable living writing about computers present and future. Jerry welcomes readers' comments and opinions. Send a self-addressed, stamped envelope to Jerry Pournelle, c/o BYTE, One Phoenix Mill Lane, Peterborough, NH 03458. Please put your address on the letter as well as on the envelope. Due to the high volume of letters, Jerry cannot guarantee a personal reply. You can also contact him on BIX as "jerryp."

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Byte Magazine, May 1989

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GETTING UUCP RUNNING, AND OTHER STORIES

The details of setting up Unix communications can be overwhelming without a little direction

There's a good reason for the wry title of this month's column. Trying to set up UUCP (Unix-to-Unix copy) has gotten many people running—as far away as they can get from even the *thought* of Unix!

Luckily, things are better these days. Many systems have automatic UUCP setup scripts or menus that make the process a lot easier. But without automatic setup, it's still an intricate mechanism of tables and daemons (background programs).

This month, I'll go over some of the inner workings of the UUCP subsystems, with particular reference to the mundane aspects of setting it up and getting it running. I will assume, for this column, that a setup script is *not* available; it doesn't often do what you want, anyway.

Hard Facts

The first hurdle to clear in your race for intersystem communications is hooking up your modem. While most modems will work (at a minimal level) with factory configurations on most computers, this is not what you want, except perhaps when you initially test the modem.

On single-tasking operating systems, you generally operate the modem manually by dialing out, using a telecommunications program. This gives you direct control over what the modem is doing. But a Unix system will place and receive its own calls whether you're there or not. So the full complement of modem-control signals must be used, especially Data Terminal Ready (DTR) and Data Set Ready. These correspond to pins 20 and 6, respectively, on a standard DB-25 connector. If this is not done, your modem may stay on-line for hours after a call has failed, running your phone bill way up.

Generally, the pins that should be connected (straight through from one end to the other) are pins 1 through 8, and pin 20. Some modem/computer combinations have to be cross-wired: 2 on one side to 3 on the other, 4 crossed with 5, and 6 with 20. This is known as a "null-modem" cable and can be used to connect two computers directly, back-to-back. But test your regular cable first.

If all this talk of pins confuses you, just make sure you use a modem-to-computer cable with at least nine internal wires. Test the connection as described below; if your modem operates satisfactorily, all is well.

Talking to the Modem

You need both read and write permission on the modem port to test the connection. On some systems, you may have two different names for the same physical port: one with the modem-control signals and one without. If so, test both, but use the modem-control device for "real" work whenever possible.

In the following examples, I've used the actual entries from my own SCO-based system; be sure to substitute the correct port names and data transfer rates for your machine.

On my system, I've found through trial and error that the only way to get my modem to operate correctly with all my communications programs is to allow dial-ins on the modem-control port (`/dev/tty1A`) and to perform dial-outs on the non-modem-control port (`/dev/tty1a`). The `uudemon.hour` shell script (the one that performs UUCP dial-outs) disables log-ins until UUCP is done and then reenables them. It may not be standard, but it works on my machine!

continued

Getting to Know cu

It's time to edit some files in the /usr/lib/uucp directory. In the current HoneyDanBer (HDB) version of UUCP, the file that describes what port to use for dial-outs is called Devices (previous UUCP versions called it L-devices). A typical entry in this file might be `Direct tty1a - 2400 direct`. This lets you talk directly to the modem port via the cu program. Except for the port number and data transfer rate, it should look the same on your machine. If you want to talk to the modem at different speeds, make similar entries at different speeds.

Test your Devices entry by typing `$ cu -l /dev/tty1a`. You should get a `Connected` message from cu, indicating only that you've reached the modem port. Now type AT (it may not echo), and if all goes well, you should receive an OK from the modem if it's been set up to respond with status messages (and it should have been).

You can now type ATDT5551234 (replace the digits with the telephone number of an operating, answering computer) to connect to another machine. Once you connect, you're acting as a remote terminal to that computer. When you're done, type ~. (a tilde followed by a period) to end the cu session. The modem should hang up, and its DTR light should go out, showing that your modem control (at least from the DTR side) is working.

For UUCP, as well as dialing by name from cu, you will have to make another entry in the Devices file to tell the system about dialing capabilities. Mine looks like this:

```
ACU tty1a - 300-19200 dialTBIT \\D
```

This signifies that I have an automatic calling unit (ACU) on port /dev/tty1a. The first dash takes up space for a field naming a separate dialer port (an antiquated method). The usable data transfer rate (or range, in this case) follows.

The next field, `dialTBIT`, references the name of the modem for dialing purposes. This can be a separate program but is usually an entry in the Dialers file, which describes the protocol involved in getting a phone number to the dialer. The `\\D` simply means, "Use the system phone number exactly as found in the Systems file." A `\\T` would mean to translate the number passed to the dialer, using information found in the Dialcodes file (I've never personally had any luck using Dialcodes files).

Now, you should be able to dial another computer by simply typing `$ cu 5551234`.

Finally, We're Getting Somewhere

From here to full UUCP capabilities is only a short step. The Systems file (L.sys in previous versions of UUCP, with a slightly different format) tells UUCP the names of the systems you can call, plus their phone numbers and log-in information. A typical entry looks like this:

```
lizard Any2300-0700 ACU 2400
    19165551234 \\
"" \\d\\r gin:--gin:-BREAK-gin:
    nuucp sword: foolyou
```

This lets my system call the "lizard" system on any day from 11 p.m. to 7 a.m. (when the phone rates are lowest); that it dials out (ACU) at 2400 bps; and that lizard's phone number is 1-916-555-1234.

continued

The rest of the line is a so-called "chat script" that alternates between strings to be expected from the other system and strings sent to the other system. The chat script begins executing once connection is made to the remote system. When you call a system using `cu`, the chat script is ignored.

The null string (i.e., the pair of quotes) means to initially expect nothing. It serves as a placeholder. The `\\d\\r`, meaning "Delay one second, then carriage return," is then sent out to the remote system. This expect/send pair is useful for goading systems that would otherwise wait too long to send their log-in prompt.

The next string, `gin:--gin:-BREAK-gin:`, anticipates the last characters of the log-in prompt from the remote machine. The double dashes request that another null string (actually a linefeed) be sent out if the first `login:` is not received within a few seconds. If this fails to produce the prompt, a BREAK goes out on the assumption that the other system is prompting at a different data transfer rate (sending a break at log-in time will generally cycle data transfer rates on Unix). If these three tries fail, then the chat script fails.

However, if the other system is running properly, one of these combinations should elicit the desired `login:` prompt, at which time the script knows to send out the UUCP log-in name of your computer (in this case, `nuucp`). Then, you expect to get a `Password:` prompt (again, you just look for the last few characters), at which time your system sends the message `foolyou`.

Then the fun begins, as UUCP connects to the other system and begins exchanging any mail and news that each system may have queued up for the other. To watch all this happen, run `/usr/lib/uucp/uutry lizard` or `/usr/lib/uucp/uucico -r1 -Slizard -x9`. You won't want to do this all the time, but it's essential for debugging chat scripts, and it's interesting when you're just getting started.

UUCP will block calls to systems if certain lock or status files exist, so you should remove them before testing. In HDB, these are `/usr/spool/uucp/LCK*` and `/usr/spool/uucp/.Status/system` (where `system` is the name of the system you're trying to call). Status files in earlier versions of UUCP are named `/usr/spool/uucp/STST.system`.

Finally, to make sure pending mail, news, and UUCP requests get processed, you must ensure that the `uucico` program executes once or twice an hour. The shell script `/usr/lib/uucp/uudemon.hour` should run from the `cron` task scheduler by the user `uucp`. Either `/usr/lib/uucp/uusched` or `/usr/lib/uucp/uucico -r1` should be in the `uudemon.hour` script.

Next month, I will finish up the UUCP discussion with some more hints and tricks, and delve into some public domain programs that help make E-mail and UUCP a bit more interesting, if not easier. ■

David Fiedler is publisher of the Unix Video Quarterly *and the journal* Root, *as well as coauthor of the book* Unix System Administration. *He can be reached on BIX as "fiedler."*

Your questions and comments are welcome. Write to: Editor, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458.

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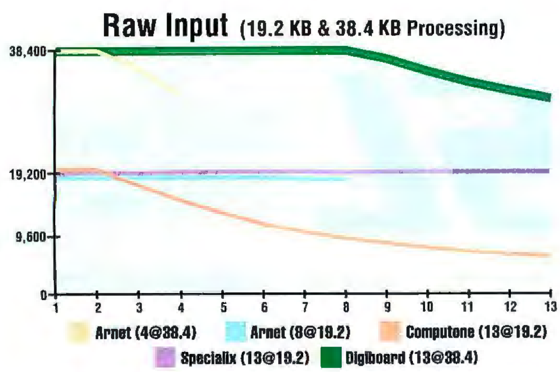
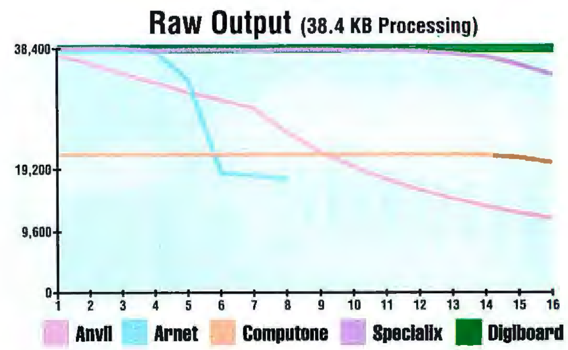


Raw Input: Primarily data received via host-to-host communications. The higher the better.



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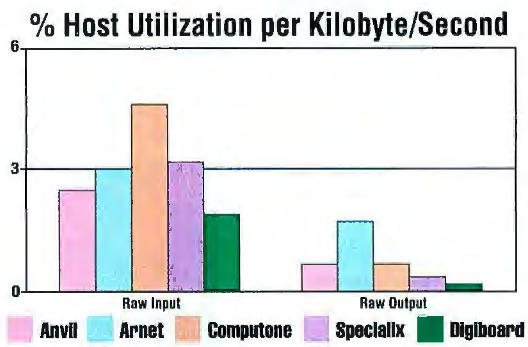

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CD-ROM TO THE RESCUE

If your business needs complete and accurate information in a hurry, databases on CD-ROM may fill the bill

Jim had a problem. A new client wanted to talk to his boss about a project that was being relocated to a remote site in the Pennsylvania mountains. Unfortunately, his boss was in a small hotel in Zambales in the Philippines, and it was now 3 a.m. there. Jim knew that overseas telephone calls are not always reliable and are not always answered in the wee hours. He also knew that his boss was leaving soon to see the new client, but at the old site.

Fortunately, Jim also knew that the international telex networks are quite reliable and immune to the interruptions that plague voice telephone traffic overseas. He knew that nearly every hotel in the world that caters to business travelers has a telex number. All he had to do was find the telex number for the hotel in the Philippines and send a message.

Unfortunately, this is easier said than done. While telex directories do exist, they are expensive; they normally cover only a few of the many networks in any area; and the thorough, accurate ones are massive, due to the hundreds of thousands of listings they must contain. Few businesses want to deal with the bulk, the expense, and the uncertain coverage of paper telex directories.

Jim's boss, of course, had no idea his client had a new site or where it was located. Thus, Jim knew he would have to find a source that would tell him about Pennsylvania and locate the new site's proper county and town.

Jim grabbed a copy of Time-Space Research's Supermap disk, inserted it into the CD-ROM drive on his PC clone, and loaded a list of the counties in Pennsylvania. This source provides information on localities and the demographic business and physical information about them. When he found the correct county, he looked at a map of the state, which had the county highlighted. It was clear from the map that the site had to be near Pittsburgh. With that in mind, Jim turned to the problem of the telex number.

Finding the telex number was even easier. Jim used the Jaeger+Waldmann worldwide CommDisc package, which provides every telex and teletex number and many fax numbers. Despite the vast quantity of information it contains—it takes two CD-ROMs to hold it all—the J+W CommDisc allows speedy search and retrieval. You can search by the name of the telex subscriber (or a portion of the name), its address, or its city or country. If you know only part of the information (e.g., the hotel name but not the city), you can search on what you do know. You will have to look at a few more entries, but it can be surprisingly few if you're careful what you ask for.

The CD-ROM telex directory includes the capability to display company logos, advertisements, and information beyond the telex number. Many companies also include a fax number, for example. The telex number listing includes the name of the telex network as well as the subscriber's answerback.

Within minutes, Jim was able to compose a message to his boss explaining the change in plans. With the information he had obtained from the CD-ROM, Jim gave his boss particulars about the new site, the name and location of the airport he needed to fly into, and the specifics of the meeting arrangements. Without the information on the disk, Jim's task would have been difficult, if not impossible.

Not every business needs a listing of

continued

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CDU-510 .... $895
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Day-Timers Quick Trip Carryall $135
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or

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668 Burwood Rd.
Hawthorn, East Victoria, 3123
Australia
61 3813-3211
Inquiry 1106.

all the telex numbers in the world. Likewise, not all of them need access to maps and demographic information like that provided in Supermap. The fact remains, though, that as businesses learn to meet the challenges of international growth, the need for information of all types has grown dramatically.

Once, all the information that most businesses needed was printed on paper. Most of it still is. Unfortunately, the amount of information has grown, while staffs have shrunk and the necessity for rapid response has increased. You no longer have the luxury of looking up information at your leisure, unless you want the competition to get there first.

One answer to this need for immediate access to great quantities of information is the CD-ROM. The demand for more and more information has resulted in significant growth in the quantity and variety of information available in this format. Where once reference material was limited to Microsoft Bookshelf, CD-ROMs are now available with contents ranging from the CIA's World Factbook to facts about additives in fast food. Many of these items are public domain information that has been packaged on CD, so the cost is surprisingly low.

Horizontal and Vertical Markets

The CD-ROM marketplace contains a great deal of vertical-market software and information. For reasons that I'll cover next month, this area of information is becoming very attractive to companies that need to provide large quantities of information for their customers.

Information for the horizontal market is aimed at a variety of businesses. Companies that publish horizontal-market packages on CD-ROM try to provide information that many types of businesses will use, and then they try to sell it to businesses in general. A CD-ROM reader similar to the Sony unit I looked at for this column now costs about $600. If you think that your business needs this type of resource more than a few times a year, you can probably justify the cost in terms of the staff time you will save and the accuracy you will achieve.

CD-ROMs intended for business use normally include search software optimized for the data on the CD-ROM. Frequently, this is in the form of a full-text database package that supports flexible queries with partial information. These packages are usually based on menus and are quite easy to use.

Are They for You?

Whether your business needs CD-ROMs depends on several factors. Some packages are quite expensive, although usually less so than their paper counterparts would be. They do require the installation of an additional drive and the addition of another internal circuit card. Most CD-ROM drives can play music and include a headphone jack and volume control. This is handy for long nights in the office, but it's more important as a way to include audio information as a part of the CD-ROM. This is especially useful in applications such as training. The Sony CDU-510 that I used for this column didn't have that capability, although Sony says it can be added.

One way to realize a greater return on your investment is to use CD-ROMs as a centralized resource, such as on a network. One company, CBIS (Norcross, GA), makes a CD-ROM server, although I haven't had a chance to use one yet.

The kind of business you have will determine the merits of moving to CD-ROMs for reference support. The economic feasibility of such a move depends on the equipment you already have—including existing computers that could be outfitted with a CD-ROM drive—and whether you're likely to use the information that is available. Once you have answered these questions, you can take the next step, which is to decide whether immediate access to this kind of information is important to your business.

Travel Update

In my September 1989 column, I wrote about some changes that were on the horizon for users who traveled with their computers. Since that time, some of those changes have happened, but some haven't. The most important is that the FAA didn't ban laptop computers from being carried on airplanes. What it did do, however, is begin enforcing the two-item limit for carry-on luggage. This means that you can no longer carry your computer along with your briefcase and an overnight bag. One of those has to be checked or left at home.

Fortunately, Day-Timers has introduced its new Quick Trip Carryall, a fabric briefcase that will hold a laptop computer, as well as a full complement of briefcase junk, a few spy novels, and the like. I was able to carry either Roberta Pournelle's Zenith SupersPort or the Zenith MinisPort that I took to Comdex. Each one fit with room to spare. Since notebook-size computers don't seem to come with rugged carrying cases and they don't leave much room for anything else in a standard briefcase, the Day-Timers Quick Trip Carryall, or something like it, is a must. ■

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Your questions and comments are welcome. Write to: Editor, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458.

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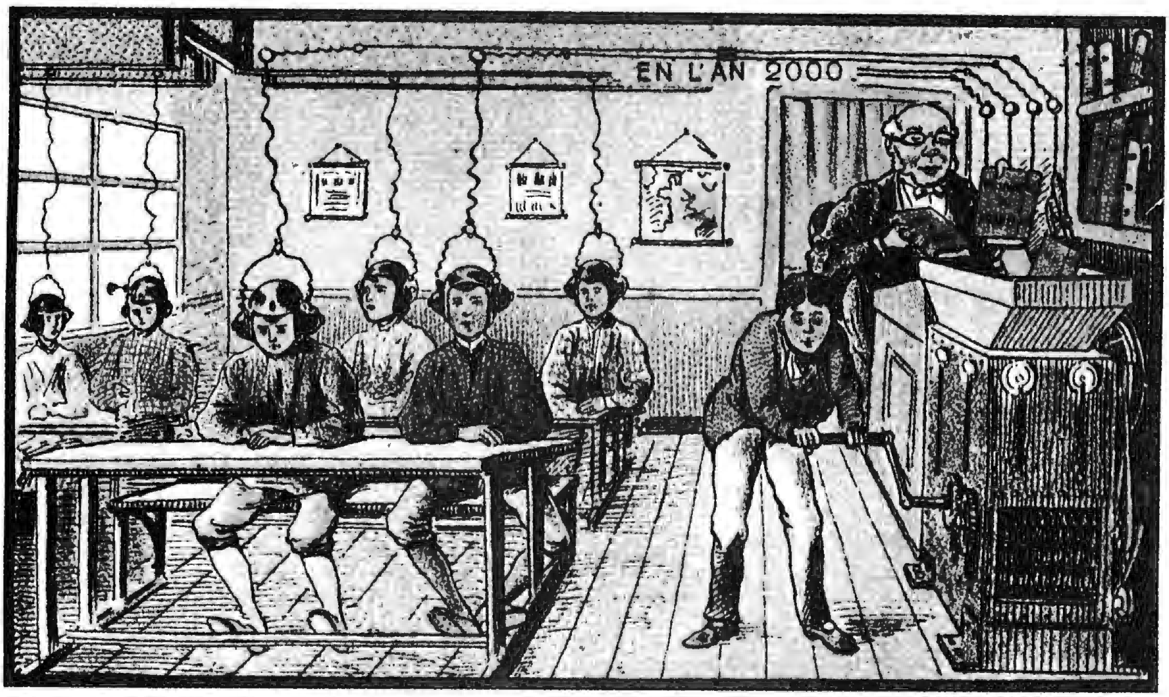

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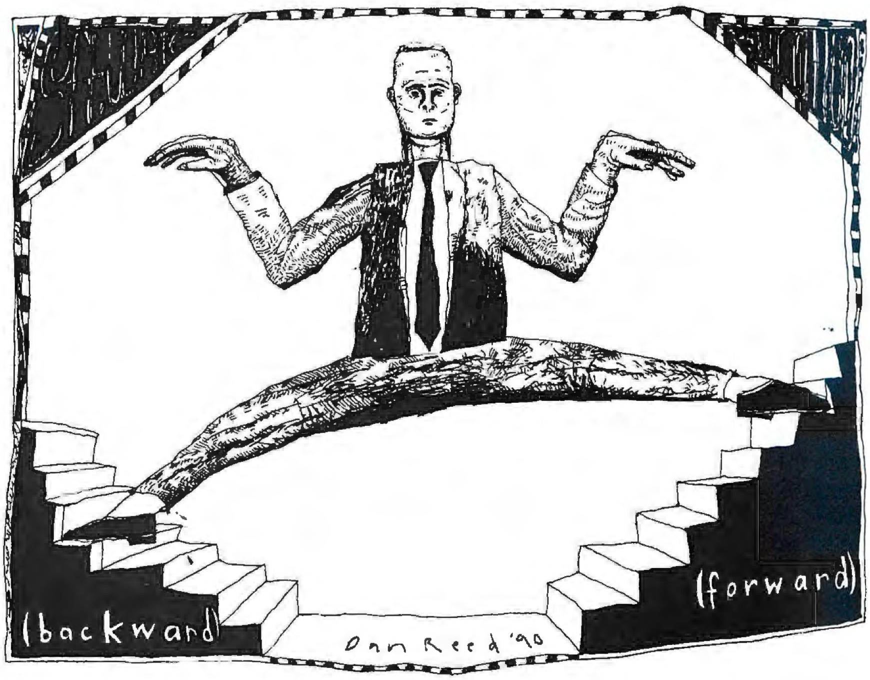

I work closely with Apple. Some of you have suggested that I work too closely and sometimes am too critical of Apple, because I feel for this company. I plead guilty to that charge. I know this company well, probably better than any other technology company I deal with. While I count many of its employees as my close friends, I do tend to take things that Apple does with at least some personal grain of salt. If I sometimes lose sight of Apple and its role in the bigger picture of commercial computing technology, I apologize. It's hard to watch a close friend make an error without spouting off about it.

But I also know when to praise Apple. This is one of those times. Most large hardware vendors have some kind of programs in place to encourage education, especially higher education. Most of these programs are simple grant or extended loan programs, where the vendor donates hardware to a school for use in its classes or research, sometimes with topical areas targeted for the grants. Thus, we've seen grants for developing courseware, teaching English, research in software engineering, and others.

While these programs are certainly worthwhile, they're really not much more than thinly disguised soft-sell marketing efforts. If a vendor can get faculty, staff, and especially students exposed to its machines on campus, the marketing theory says that they'll be enamored of that equipment and want to buy more (or buy it for their companies after graduation).

There's certainly nothing wrong with these tit-for-tat grant programs, but they don't go far toward helping schools in the business of teaching and research. Also, they don't build strong long-term buying constituencies for the computer companies. Apple has been a tit-for-tat company with its education grants for years, but recently it has branched out with new programs that don't have equipment donation as their primary interaction with the schools.

The Bright Side

One of these programs, Apple's Academic Marketing Competition, is two years old. The idea behind AAMC is to create a program within a group of targeted universities where students develop and execute their own marketing program. Not surprisingly, the marketing program has to be about Apple products generally, and the Macintosh specifically. And to keep that focus in mind, Apple donates two Mac SEs to each participating school and provides a fully equipped Mac lab to the winners (after all, this is a competition).

The way AAMC has worked so far is that Apple has identified some universities with a large or growing Mac presence and others where the Mac is just beginning to emerge as the machine of choice. Once these are identified, Apple uses its higher education marketing people already working with those schools to find a group of students on each campus willing to take part. Uniformly, this has meant working with a class of marketing students and their instructor (and other allied faculty). Significantly, not all the classes Apple has worked with in AAMC are business school marketing classes. Others have been journalism classes, graphics design classes, and those studying the sociological implications of technology marketing.

continued

The rules for AAMC are fairly clear and reasonably flexible. Each team works with its Apple higher education representative and has a $2000 budget (also supplied by Apple, and separate from the donated hardware). The team plans, puts together, and executes a specific marketing plan at its school. Each team uses the budget as it sees fit to buy advertising. Similarly, the teams can use the Mac SEs any way they choose. Most teams use the computers to design ads, plan schedules, write ad copy, produce radio commercials, and create storyboards for TV ads. Some choose to give away one or both of the SEs as part of the plan; others barter or sell one or more of the SEs to increase their budget.

Results of the competition are judged in a single-day presentation in front of a group of 10 judges selected from the computer industry. Each team spends 20 minutes presenting its campaign in any way it chooses, trying to convince the judges that its plan has been created and executed to perfection, and relying on Mac-generated multimedia to enhance the presentations. I recently spent a very enjoyable two days judging an AAMC in Chicago, so my memories of the whole process are clear.

The winner of the Chicago competition, the University of Missouri–Columbia, blew away the judges with the completeness of its campaign, how well it integrated the Mac into its campaign, and its preparation. On top of that, this team was a wonder at its presentation. In short, it was the only team to convince me and the other judges that we should hire it as our ad agency. And it did so by subtly influencing us with the technology of the Mac, its interface, and the ease with which the team pulled the whole thing off.

These kinds of competition change the way that personal computers are thought about and used in a broader range of careers. Apple deserves kudos for this, as well as our encouragement for future AAMC-style programs. If personal computing is ever going to live up to the promises made for it, such programs will have to become the standard, not the exception.

Personal computing is not about making a lot of money, nor about buying and using all the latest gear. Personal computing is about people using a malleable machine that can fit their work patterns theoretically better than any Swiss Army knife ever made. Apple has begun something significant with the Mac that goes way beyond user interfaces. Its revolutionary view of how personal computing is conceived is just now starting to take off and spread to others in the industry with a parallel vision. With programs such as AAMC, Apple has proven that it still maintains the conceptual lead over its competitors.

ITEMS DISCUSSED

Prograph 1.2.....................$195
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A Darker Side

Having said all that, you still can't lose sight of the building blocks that make up the revolution. The personal computing revolution started by the Mac and fostered by Apple each year (much better this year than in previous years) is based on the Mac's user interface. Without that now-familiar Mac Desktop, we wouldn't be worrying about stuff like Motif, X Window System, Presentation Manager, Open Look, NewWave, and others.

The problem with the Mac has always been the paradox of software development. While the Mac user interface can be seen as the first ease-of-use win for personal computing users, it has been a royal pain for software developers. People who have been developing for the Mac since 1984 still complain about twiddling with the Mac's esoteric Toolbox ROM calls (which get more complex with each new CPU), its complex development system (MPW), and its arcane user-interface guidelines (which Apple regularly violates while nearly terrorizing developers into adhering to).

The problem of software development on the Mac is going to get worse. As System 7.0 rolls out this year, and Apple gets close to a CPU with 1 megabyte of ROM code, developers will be screaming for help. Apple should take a serious look at overhauling its developers' tools, probably by scrapping MPW (or rewriting it) and refining its MacApp object-oriented programming (OOP) tools.

Apple also needs to produce a lower-level developers' system that could be built on the ideas popularized in HyperCard and announced in AppleScript. It should include some of the nice prototyping features of Plus and Supercard, with structure and language editors on a par with Prograph and QUED. It wouldn't even have to be all Apple. The company could license parts of other systems for both the lower-level system (I call it the Mac User's Software Kit [MUSK]) and the professional system (I'll call it the Mac Professional Developer's Software Kit [MPDSK]).

Regardless of how Apple breaks these out and how it puts them together, the need is certainly there. Apple must make it easier for pros, semipros, and power users to roll their own applications and to distribute them to other Mac aficionados. Apple also needs to give MPDSK users the ability to cross-develop their software for other platforms. The "not invented here" syndrome won't do at all. Other graphical user interfaces (GUIs) are here to stay, no matter how many lawsuits get filed. Applications need to be developed with more than one computer in mind, and the translation between environments needs to be made as transparent as possible for developers.

Here is another one of those golden opportunities for Apple to take the lead in the personal computing revolution that it started. Just as it has recaptured the higher education market with innovative cooperative programs like AAMC, an Apple-developed cross-GUI programming system would set the pace for others to follow.

Tip of the Month

Speaking of development systems, I've been using a new one lately, called Prograph, from TGS Systems. So far, this graphically oriented OOP system lacks a compiler, but that should be completed by the time you read this. The Prograph system combines an OOP environment with a GUI programming environment that relies on visual programming metaphors (e.g., HyperCard). To this interesting mix, TGS Systems adds familiar data-flow diagrams.

While Prograph 1.2 won't replace MPW or even Symantec's Think compilers, it's an important new kind of development system. If you've toyed with the idea of Mac software development before, but you were put off by the weaknesses of HyperCard and the complexities of MPW, look at Prograph. ■

Don Crabb is the director of laboratories and a senior lecturer for the computer science department at the University of Chicago. He is also a contributing editor for BYTE. He can be reached on BIX as "decrabb."

Your questions and comments are welcome. Write to: Editor, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458.

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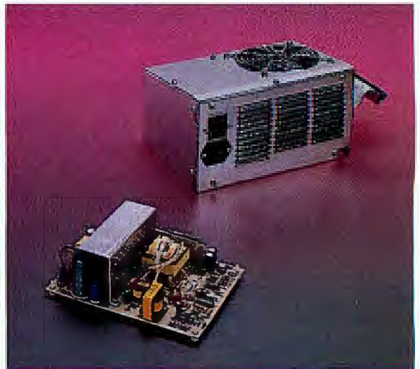

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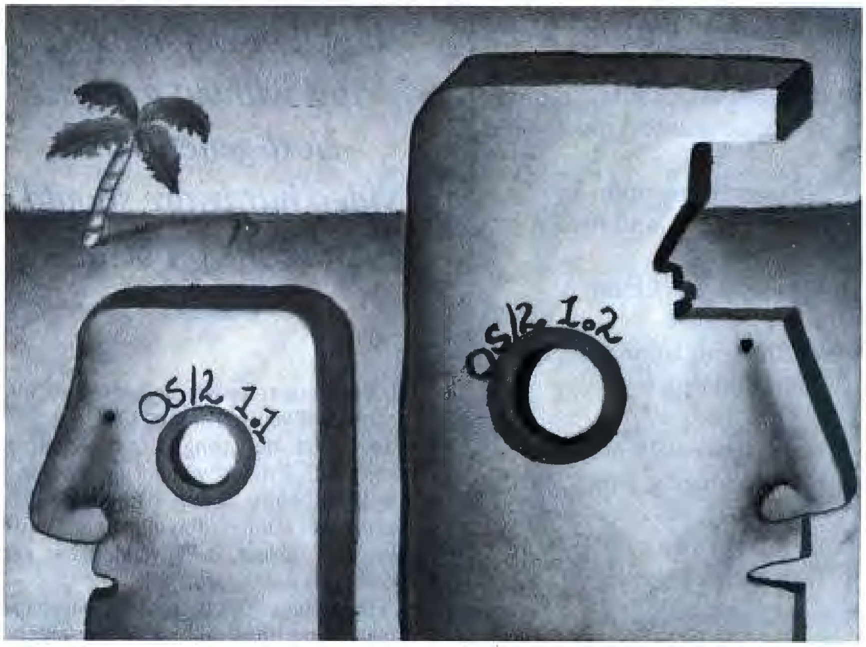
LIVING WITH OS/2 1.2

Incremental improvements are a sign that OS/2 is maturing



I told you about using the High Performance File System (HPFS) last month. Now I'll look at OS/2 1.2 in general. I've been living with this new version for a while, and for those of you who are still thinking of taking the plunge, here are some of the things you'll find.

Compatibility

It appears that just about anything that ran version 1.1 will run version 1.2. As before, one of my OS/2 workstations has a DTK motherboard with the Phoenix BIOS 3.06 (you may recall that the DTK BIOS doesn't seem to work with OS/2). My Micronics 386 motherboard, as before, will not boot version 1.2. That's probably because this early Micronics motherboard required a daughterboard to use an 80387, and something about the daughterboard upsets OS/2, or so I am told.

I don't have a later motherboard to test this claim on because Trillian Computer, the company I bought the system from, has washed its hands of this particular computer—you see, the company doesn't sell Micronics motherboards anymore. Micronics has no suggestions, either, alas, so for now I've got to advise caution when buying Micronics motherboards for use with OS/2.

Of course, 1.2 runs on the IBM machines that I've tested it on, although running it on either the PS/2 Model 30 286 or the 50 Z is a joke: version 1.2 takes about 10 megabytes of disk space, about the same as 1.1, and both computers ship with 20-MB drives. I suppose that means that the official low-end IBM OS/2 machine will be the Model 50 Z, but most folks I know who are doing real work on OS/2 end up with the 386SX-based PS/2 Model 55 SX or the 386-based PS/2 Model 70.

If you're a Big Blue–only person, I'd suggest (reluctantly, as it's expensive) that you look at the PS/2 Model 80. It is built around a 386, can be gotten with the large hard disk drives that OS/2 really needs, and has numerous slots. You'll want the slots for the 8-plus MB of RAM that is needed for the Extended Edition or some other communications/database product.

Performance

I hate to say it, because I love the features that I get from OS/2 (e.g., large memory and multitasking), but it's *still* slow. For example, I do a lot of work with three object-oriented graphics packages: Generic CADD, a regular DOS application that creates its own graphical environment; Micrografx Designer, one of the best (if not *the* best) Windows-based object-oriented drawing programs; and Designer/PM, a beta version of Micrografx Designer for use with the Presentation Manager (PM).

The difference in speed of screen handling is remarkable and instructive. Because it does its own screen management, Generic CADD runs respectably on an 8-MHz 8088 machine. Designer, requiring Windows, needs at least a 10-MHz 286 to look decent. This isn't the fault of Micrografx: I've run many Windows programs, and they're *all* slower than their non-Windows counterparts. For another example, compare PC Paintbrush with PC Paintbrush for Windows. Both were written by ZSoft, but the non-Windows version is much faster.

The benefits of Windows are counterbalanced by its overhead. That's why

continued

ILLUSTRATION: NURIT BOCHNER © 1990

Windows was renamed Windows/286; you can certainly run Windows/286 on an 8088 machine, but you really don't want to. However, Windows looks positively snappy compared to PM: Everything takes forever on a 286. PM's overhead must be tremendous. And 1.2 has not solved the problem. I suppose it's another argument for not buying below 386 machines if you're running OS/2.

I just wonder how long it will be before OS/2 runs without delays. Next-generation video hardware should solve the problem.

Don't get me wrong, I'm not beating up on OS/2. I'm just wondering how long it will be before it runs without delays. Next-generation video hardware will solve the problem, if PC vendors can get together on a standard.

The problem stems from the basic approach to putting graphics on the screen. Suppose a program wants to put a circle on the screen. With the popular graphics boards (i.e., CGA, Hercules, EGA, and VGA), the program describes the circle as a series of commands to place dots, or pixels, on the screen. Basically, it does a pile of calculations that are familiar to students of trigonometry: sines, cosines, and the like. (That's why a numeric coprocessor improves the performance of most graphics programs.)

This pixel-by-pixel approach is, as you'd imagine, quite compute-intensive. It's also video-board-type-specific: You have to know how many pixels exist on a VGA to write a VGA driver, how many on an EGA for an EGA driver, and so on.

The newest video boards take high-level graphics commands independent of board resolution. The width and height of the screen are defined as 1.0, and a point can be placed anywhere from (0.0, 0.0) to (1.0, 1.0). For example, the center of the screen would be (0.5, 0.5).

Nor must the program direct the board to place pixels in order to define a circle. Instead, the program just tells the video board to place a circle on the screen, centered on a given point and extending for a given radius. It's a more efficient system because the video board has a microprocessor on-board that's been optimized for this kind of work.

Texas Instruments and Intel make chips that are intended for just this kind of thing; the problem is that no big PC vendor has popularized the idea enough to make it cheap. The TI34010 graphics chip isn't exactly new and untried at this point. Why not embrace it? Perhaps someday soon. If the slowness of the PM's screen handling isn't enough to spur the development of such products, I don't know what is.

Needed Fixes: Fonts and the Spooler

Two really annoying features of 1.1 were the buggy spooler and the hidden fonts. The spooler, as I've mentioned in previous columns, was pretty useless under 1.1. Version 1.2's spooler seems better, and now there are printer drivers for PostScript and Epson printers, Hewlett-Packard plotters, and a number of IBM printers.

The Times Roman and Helvetica fonts are now also preloaded into the PM, so there is no more wandering through the Control Panel. With 1.1, you got (in addition to the usual monospace Courier font and the proportional Helvetica-like System font) those ever-popular mainstays of desktop publishing, Times Roman and Helvetica.

Unfortunately, the fonts were *copied* to the hard disk by the automatic installation procedure, but not *installed*—the two actions are separate under both Windows and PM, and it takes some digging in the manuals to figure out what must be done and how to do it. You probably needn't worry about it here, however, as 1.2 preloads the fonts—a nice touch, and a needed one.

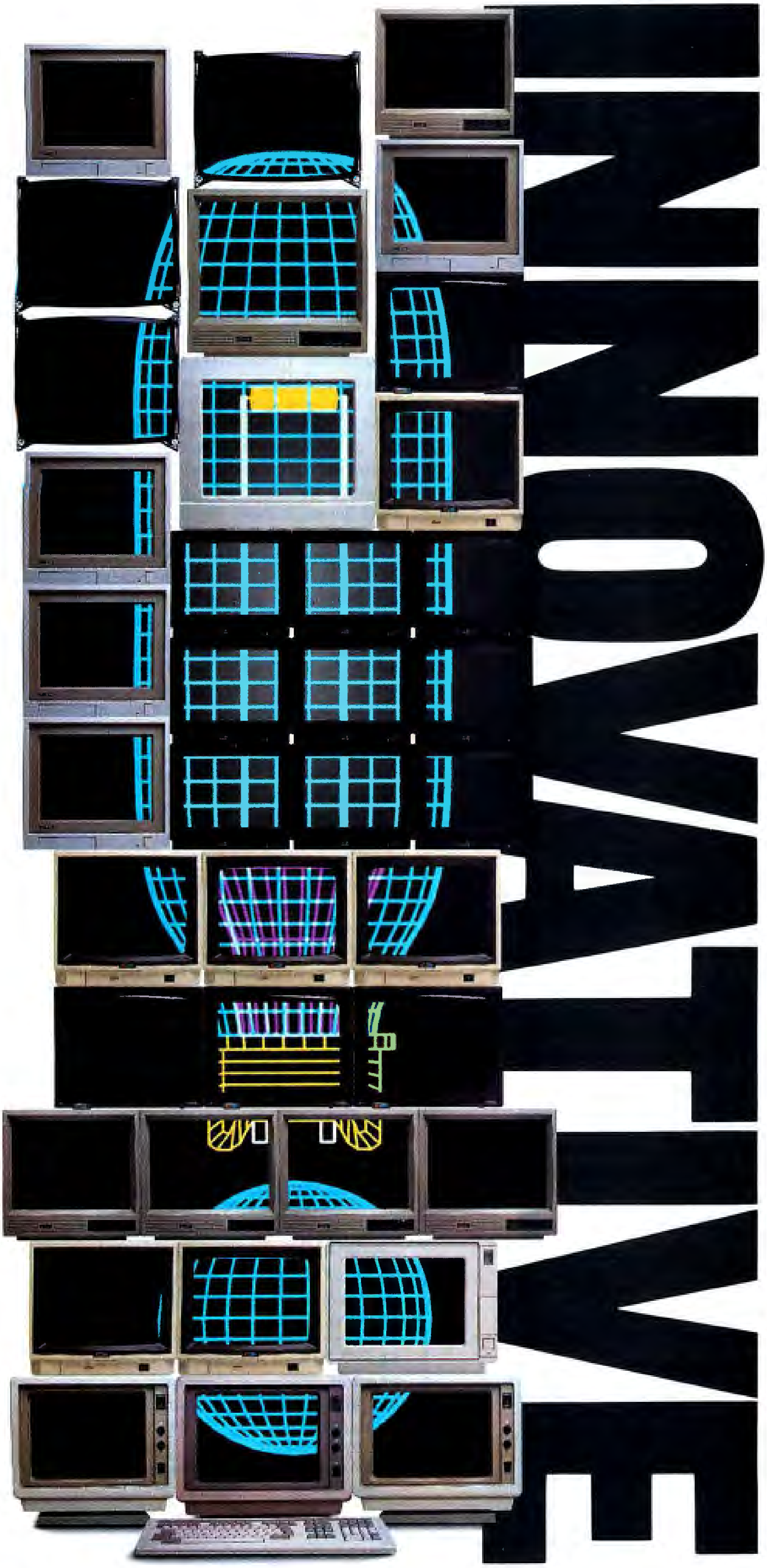
Improvements

Here are some more welcome changes that I found in version 1.2.

Command history. Many of you no doubt use a program like DOSEDIT or CED under DOS to remember previous commands. Such a program lets you recall the last 20 or so commands, edit any command, and reissue it just as if you'd typed the whole line.

For those who don't use something like that now, let me tell you, it's indispensable, because it saves retyping lines entered in error and simplifies repetitive tasks. A public domain "command

continued


INNOVATIVE

history" program for OS/2 named Alias has been around for a while, but it's nice not having to hunt around for Alias every time I set up a system. Thanks, Microsoft and IBM. How about putting this feature in DOS?

On-line documentation. Rather than having to hunt around for the manual to look up some obscure syntax, there is now an on-line command reference that is installed (optionally) by the Install program. Take my advice and install it. You see, you don't get a manual with IBM OS/2 1.2 that completely describes the commands. You must install the command reference on-line or buy the separate command reference book from IBM (lesson number 457,199 in "how to annoy customers").

The command reference is as complete as the old OS/2 manuals. Since there are new options for several commands, take a look at the on-line reference before going too far with OS/2. Oh, and a hint on using the reference: You'll see a command syntax tree showing each option, but no description of what each option does. What you must do to get more information is to click, hypertext-like, on the option itself—you'll get the whole story then.

No more unnecessary disk checks. Version 1.1's file manager had an incredibly annoying habit. When it started up, it checked each floppy disk drive to see if there was a disk in the drive. As there generally is *not* a disk in the drive, the file manager waited a minute or two for each drive to time-out, and believe me, that minute got longer every time you loaded the file manager. No more.

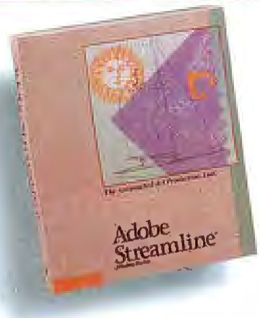
Dual boot. Dual boot has been needed for some time, and it's a welcome addition. One problem with dual boot was setting up the directories for both DOS and OS/2: OS/2 left the root directory a real mess, with some basic system device drivers required to be in the root directory. But that's all fixed.

The change from 1.1 to 1.2 was more evolutionary than revolutionary (save, of course, for the HPFS), but perhaps that's because OS/2 is starting to mature. We'll see just *how* mature when the 386 version appears. ■

Mark J. Minasi is a managing partner at Moulton, Minasi & Company, a Columbia, Maryland, firm specializing in technical seminars. He can be reached on BIX as "mjminasi."

Your questions and comments are welcome. Write to: Editor, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458.

April 1st is funny.



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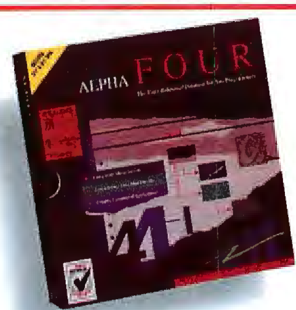

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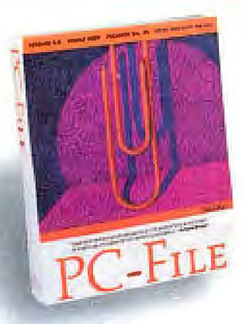

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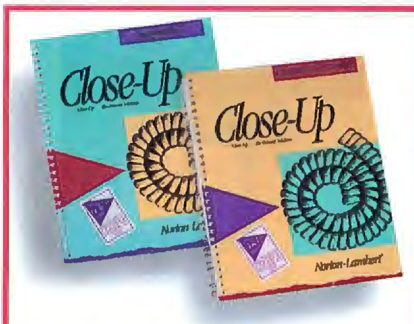

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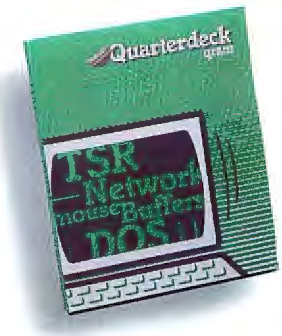

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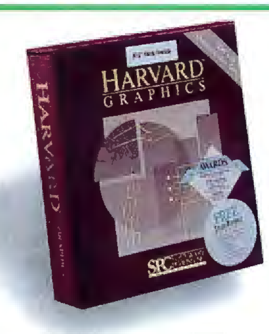

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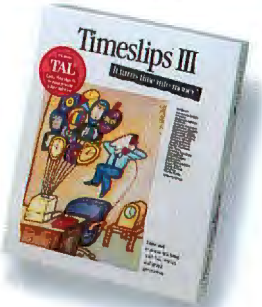

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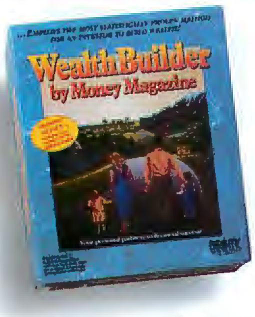

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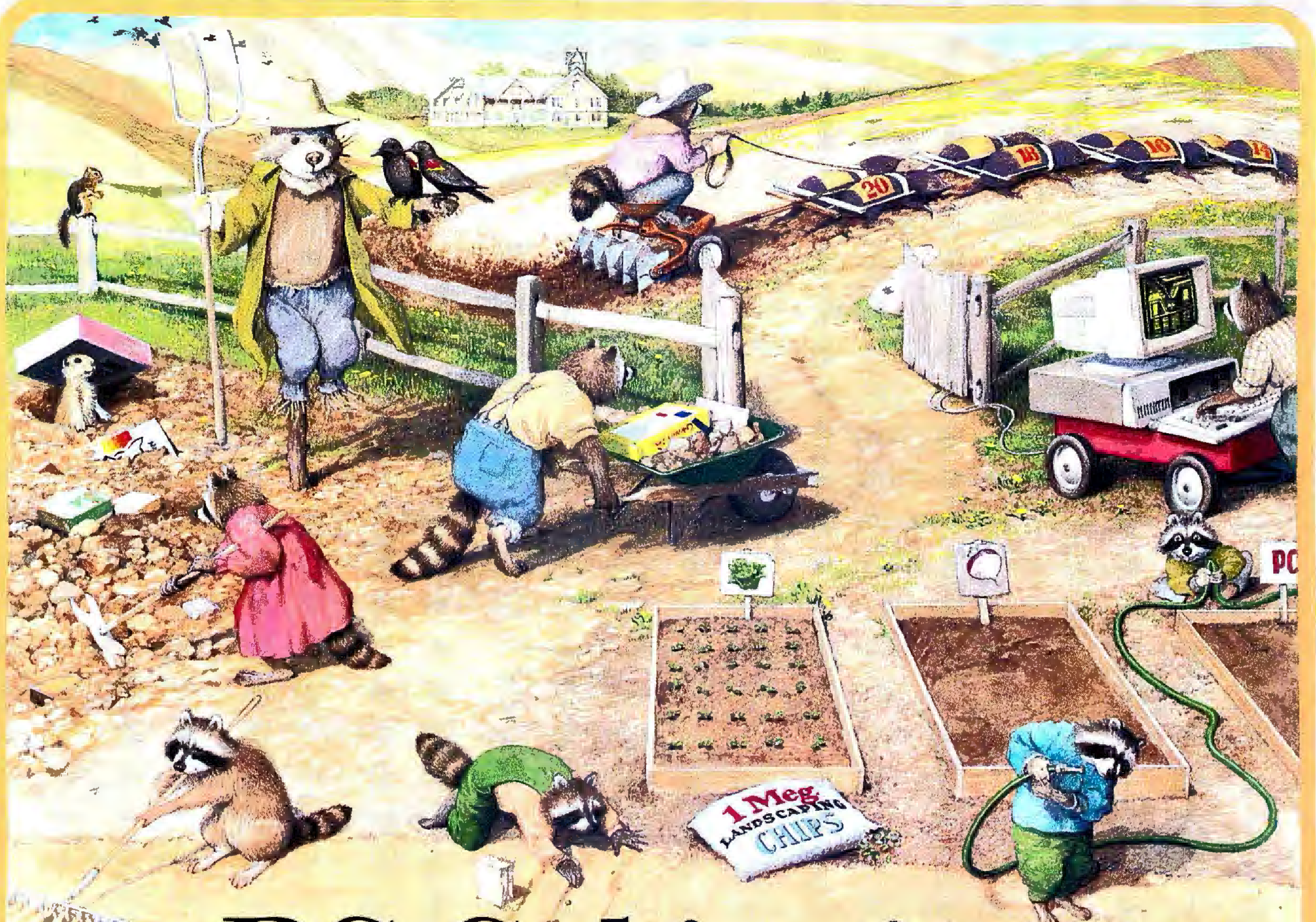

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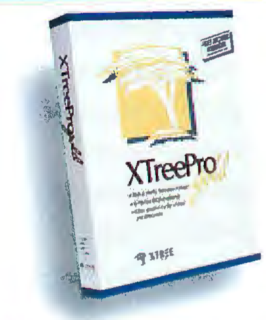

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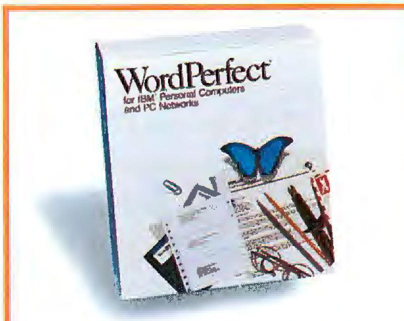

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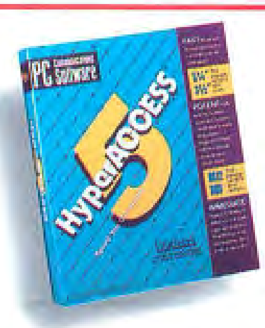

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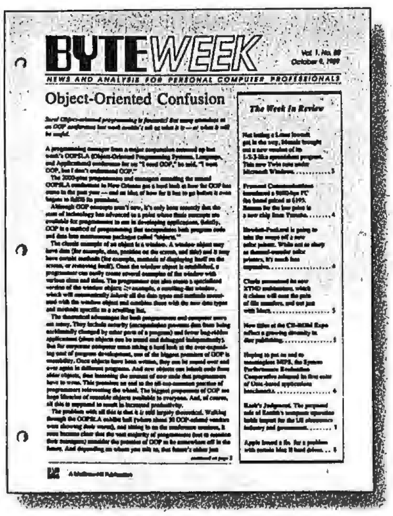

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FARAWAY LANs

LAN remote-access schemes are the next-best thing to being there

ILLUSTRATION: BONO MITCHELL © 1990

The last few years have tugged many of you in two directions at once. LANs have drawn you to central locations, while the growing use of portable computers and the move toward people working at home have pushed you geographically apart.

We're suffering from this dilemma ourselves. Our main LAN, with its crucial data and applications, is in our lab at Mark's house. We currently run NetWare on that LAN because it lets us link the 20 or so Macintoshes and PCs in the lab to the same servers. The problem is that, while we often work together in the lab, Bill also often works in his home office. We also spend a lot of time traveling, usually armed with one of the eight or so Mac and PC portables in the lab.

A recent bout of travel, coupled with some bad weather, forced us to consider ways to get to the lab's LAN from other locations. While our situation is admittedly unusual (few organizations have a 10-to-1 computer-to-employee ratio), the solutions that we found will work for any group that needs to provide remote access to its LANs.

Move the Mountain

The most obvious solution is to move any LAN data you need to a remote system. Just run a communications program and a modem on a machine on the LAN, and use that machine to transfer files. All you need is a reasonable file transfer protocol, such as ZMODEM, XMODEM, or Kermit. Until fairly recently, this was our answer: Kermit in server mode on a PC.

But this approach has several drawbacks. It ties up a PC, it doesn't let the remote user run important LAN applications like E-mail, and it abandons the whole notion of sharing live LAN data.

Create Two Mountains

The disadvantages of moving data to a remote system suggest another obvious solution: Make the remote computer a full participant in the LAN, so that it can share LAN data in the usual ways. Basically, you extend the LAN over telephone lines by using a LAN spanning product such as a bridge or router. Then neither the remote system nor any of the other machines on the LAN, including the server, are aware that the LAN is not all in one location.

On the remote side, you connect a PC to a null Ethernet (or another network), which in turn connects to the bridge or router. On the LAN side, you connect another bridge or router to the Ethernet. Many vendors now offer remote bridges and routers for both PCs and Macs.

Unfortunately, these products are impractical for single PCs, because they require a pair of bridges and high-speed modems, as well as a leased line or its equivalent. That will cost from $5000 to $10,000 up front and hundreds of dollars a month in line charges.

Bridges become cost-effective when you need to connect a remote group of PCs to a central LAN because you can spread the cost over all the remote PCs. Bridges work best when most of the LAN traffic is on the two separate LAN segments, with only occasional messages passing between them.

Move Mohammed

The final solution is to leave the data where it is. You just dedicate a local PC to the remote user and run a remote-access program on that PC. Those programs run the LAN applications on the

continued

ITEMS DISCUSSED

NETremote+ ....$350 per server
Brightwork Development, Inc.
766 Shrewsbury Ave.
Jerral Center West
Tinton Falls, NJ 07724
(800) 552-9876
(201) 530-0440
Inquiry 1071.

QL 1002 (for the PC)...........$645
QL 2201A (for the AT).......$1125
Cubix Corp.
2800 Lockheed Way
Carson City, NV 89706
(702) 883-7611
Inquiry 1072.

Timbuktu/Remote ..$195 per Mac
Farallon Computing, Inc.
2000 Powell St.,
Suite 600
Emeryville, CA 94608
(415) 596-9000
Inquiry 1073.

local PC and send to the remote PC only the screen output of those applications. The idea of transferring only screen information is not new to LANs; PC and Mac remote-access programs have been around for years.

One interesting LAN remote-access product is NETremote+ from Brightwork Development of Tinton Falls, New Jersey. NETremote+ adds LAN capabilities to Co/Session, a PC remote-access package from Triton Technologies of Red Bank, New Jersey.

NETremote+ runs as a TSR program on the slave PC on the LAN. It detects screen changes as they happen and sends them to the remote PC. The remote PC runs a special, complementary terminal emulator that uses those changes to update the screen. That emulator also sends any keystrokes from the remote PC to the LAN slave PC, making it appear as if you had typed them in on the slave. The program can even send graphics screens, albeit slowly.

Co/Session provides most of these features. NETremote+ goes a step beyond normal remote access by letting the slave PC control any other PC on the LAN.

The result of running NETremote+ is that the remote PC acts as if it were the slave PC on the LAN.

While fewer remote-access products exist for the Mac than for the PC, the Mac products work in basically the same way. Timbuktu/Remote, from Farallon Computing of Emeryville, California, is a popular Mac remote-access program. Because it works with Macs, Timbuktu/Remote sends mouse commands as well as keystrokes to the slave Mac. It transfers screen images as QuickDraw commands; this approach speeds graphics transfers and lets the remote and slave Macs use different-size monitors.

One More Wrinkle

The above approach still requires a dedicated PC or Mac, with a modem, to handle the telephone connection. That's fine for folks who need to get to their office systems from a home computer or a laptop on the road, but it means buying another whole system if the remote user doesn't normally have an office PC. That additional slave PC costs extra money and consumes precious space.

Cubix Corp. addresses this problem by putting a dedicated PC into a PC-based server. The firm's PC-on-a-card product requires only a standard AT slot and is available in both NEC V40 and 286 versions. It lets you put up to four PCs on a card and up to four such cards in one server—so you can have as many as 16 PCs hiding in your server. This approach can save a lot of desk space.

We put one of Cubix's QL 1002 cards, which contains two V40 processors, in our Samsung NetWare server. (The card will also work with Network OS.) The server's standard AT bus acts as the "network" between the server's CPU and the CPU on the card. The QL 1002 includes NetWare drivers for this "bus" network, so neither the server nor the PC can tell that it's not just another system on the LAN. (The server sees the bus as just another LAN medium, much as a single NetWare server can contain and work with both Ethernet and Token Ring cards.)

The PCs on the card use a NetWare shell that also comes with the card. You also have to create a boot-image file for these PCs, such as we described in our December 1989 column "When One Drive Is Enough." You then boot the PC-on-a-card from the server. By attaching a terminal to it, you can operate that PC just as if it were a diskless workstation.

You also can use the PC-on-a-card to solve our problem by running a remote-access package on it. You can make the entire process automatic by starting that program in the PC-on-a-card's AUTOEXEC.BAT file in the boot image. Attach an external modem to the card (which has the necessary serial ports), and you can access the PC-on-a-card

continued

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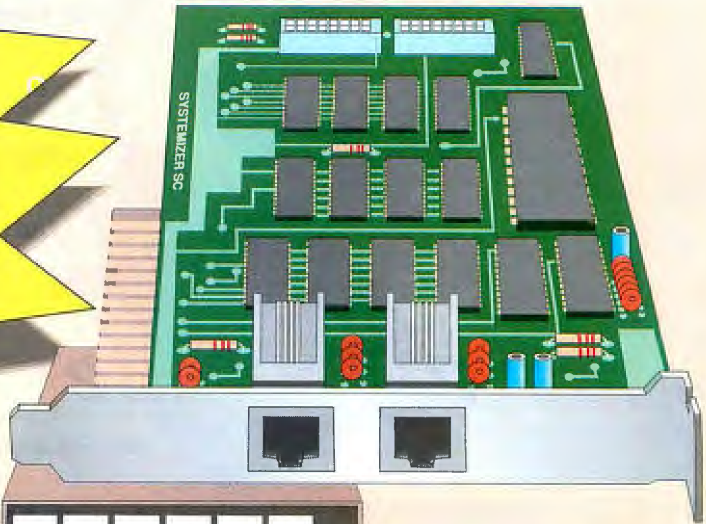

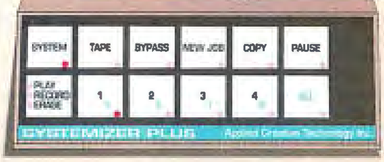

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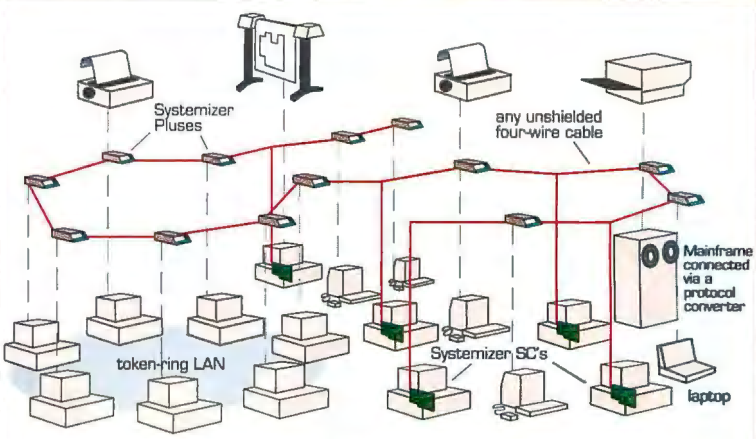

Example: 17 micros, of various brands, *plus* a mainframe, all sharing printers, data and E-Mail via Systemizing. Note how some PC's on a token-ring LAN are also part of the Systemizer LAN.

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from a remote PC just as if you were using a regular PC on the LAN.

The PC-on-a-card approach saves both physical space and network bandwidth. You can use it whenever you would use a dedicated PC on the LAN; for example, it makes a nice asynchronous modem pool server. But there are some drawbacks to using a PC-on-a-card. These cards can't work with any other boards in the server because they see the server's bus as a network, not a normal bus. These boards cannot, therefore, work with such important server resources as 3270 gateways. The PC-on-a-card also isn't particularly cheaper than a dedicated inexpensive PC clone—Cubix's AT-on-a-card lists for more than $1100.

Line Problems

The solutions that we have described should sound familiar: We've just reinvented the minicomputer, complete with terminals (graphics terminals for Macs).

It shouldn't be surprising, then, that these techniques also suffer from the biggest problem plaguing minicomputer terminals—the speed of telephone lines. If you've ever used a minicomputer or an on-line service like BIX, you know that 2400 bps is slow. The problem is even worse for PCs and Macs, where applications update the screen constantly.

Higher-speed 9600-bps modems help quite a bit. CCITT V.32-class modems with V.42 data compression are even better. Still, even the best modem yields screen performance far below what you have come to expect from PCs. The 65,536-bps speed of ISDN will help even more, but remote access will probably never be as nice as being there.

The bottom line is that you sacrifice PC responsiveness to gain remote LAN access. As a result, for the foreseeable future, remote LAN access is best for occasional use for applications such as E-mail and data exchange. Save the heavy database work until you're in the office and can either sit down at your desktop LAN system or plug your laptop into a Xircom external Ethernet adapter or an AppleTalk connector. ■

Mark L. Van Name and Bill Catchings are BYTE contributing editors. Both are also independent computer consultants and freelance writers based in Raleigh, North Carolina. You can reach them on BIX as "mvanname" and "wbc3," respectively.

Your questions and comments are welcome. Write to: Editor, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458.

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The No-Compromise Notebook Computer

For laptop systems—perhaps the most personal of personal computers—everybody seems to have strong opinions on what features ought to be included. We all have our own notions of the ideal display type, processor, hard disk size, weight, and, of course, price. In the past, the small size and weight required that you make some significant compromises. This has been particularly true for the lightweight notebook computers that have appeared recently. But fortunately, as time goes on, new systems exhibit fewer and fewer compromises. And the new Toshiba **T1200XE** is perhaps the first notebook system that frees you from any major compromise.

At first glance, it looks as if Toshiba has crammed all the goodies of its T1600 laptop into a notebook format. This is quite a feat, since the T1600 weighs almost 12 pounds, and the new T1200XE weighs in at less than 8 pounds, including a battery pack. Despite this rather low weight, the system includes a 12-MHz 286 processor, a 20-megabyte hard disk drive, a 3½-inch floppy disk drive, and a high-contrast LCD screen. There is even room inside for up to 5 MB of memory (1 MB is standard); this is important for OS/2 users. And while most companies charge more for their smaller systems, Toshiba has bestowed upon the T1200XE a price that is significantly lower than that of its older, larger relative, the T1600.

Of course, the new Toshiba computer does not set any records for low weight. Lighter laptops are available, notably the impressive Compaq LTE/286, which has the same features as the Toshiba system but weighs in at a full pound less.

Nevertheless, the T1200-XE has a larger screen, a more comfortable key-board, and a lower price tag.

In my test of a prototype T1200XE, the system performed quite well. Its large 640- by 400-pixel CGA-style backlit LCD is almost exactly like that of the T1600 and is a real pleasure to view. Likewise, the keyboard is almost an exact copy of that on the T1600 and is very easy to become accustomed to. The many T1000 users out there—including myself—should have no trouble at all easing into this system.

A somewhat hidden feature of the new system is a 100-pin connector on the back panel. Toshiba has stated that it will soon offer a "base station" for the T1200XE that will include, among other things, room for two full-size expansion slots.

Another nice feature of the back panel is an RGB monitor connector—important for those who need to make presentations or demonstrations.

Other hidden features of the system include Toshiba's traditional assortment of laptop frills. These include AutoResume, a feature that lets you turn the system on and immediately resume what you were doing when you last powered the computer down.

Toshiba has a number of interesting new laptops available. The new T1000SE and the T1000XE (with a hard disk drive) deserve particular note. I found these systems to be excellent, but some users may prefer a bit more power.

Eventually, we will probably see notebook systems based on the 386SX microprocessor. But until then, if you're going to hit the road and can't compromise on power—or anything else, for that matter—the T1200XE seems to be an excellent choice.

—Rich Malloy

THE FACTS

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Computer Systems
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Inquiry 987.

R:base Goes for the Gold

Ever since its first appearance, R:base's forte has been ease of use coupled with power. In its newest incarnation, **R:base 3.0** from Microrim, it is even easier to use and more powerful and comes with a raft of new features.

It's nearly impossible to list even a small fraction of the features available in an application package as sophisticated as R:base 3.0. Its menu interface is improved and now looks like those in other database packages. But overall, the software makes creating, editing, and doing real work with data much less of a chore than other database managers I've used.

While QBE (Query By Example) is a customary (and necessary) feature in all relational databases, R:base 3.0 adds a number of handy bells and whistles to it. In competing high-end packages, the all-too-necessary ability to browse through existing data—to mark, edit, or print needed information—isn't always easy. But R:base 3.0 has made browsing chores easy to do with just a few keystrokes.

Another time saver is R:base's ability to do global search and replace. By way of comparison, in Borland's Paradox 3.0, the only way to do a search and replace is by writing a custom utility using the package's proprietary language.

Most of the people who actually use databases in their day-to-day work aren't technically sophisticated. So in order to be truly powerful, a database manager must provide the ability for the resident database expert to create easy-to-use finished applications with custom forms and menus. R:base 3.0's application-generation facilities are some of the

continued

BYTE editors' hands-on views of new and developing products

Hewlett-Packard's Laser Counterattack

With the introduction of the **LaserJet III**, Hewlett-Packard has thrown down the gauntlet, making it clear to competitors that it's not about to sit back and give others the advantage in the hot battle for laser-printer market share. The long-awaited successor to the venerable LaserJet Series II, the LaserJet III brings new meaning to the term "more for less," and it's sure to make users sit up and take notice. I certainly did.

HP claims that the LaserJet III is completely compatible with the Series II. So what's the big deal, besides a sleek new look? Well, there's plenty of cutting-edge technology under the hood.

If you've purchased a laser printer recently, you've probably found that few are very useful without a bunch of options. It's like buying a stripped-down car.

But HP has packed enough standard features into the LaserJet III to make it immediately useful. With a megabyte of RAM, I could print out a full page of graphics. Even more useful is the LaserJet III's selection of fonts. The 14 internal bit-mapped fonts are just the beginning. It also comes with CG Times and CG Univers typefaces from AGFA Compugraphic. Both typefaces come in regular, boldface, italic, and boldface italic. You can scale these eight fonts from ¼ point (too small to read) to 999.75 points (larger than a standard sheet of paper).

Thanks to the III's new PCL (Printer Control Language) 5, which incorporates vector graphics, those fonts can be stretched, rotated, and overlaid in addition to being scaled. All these features are impressive, but what places the LaserJet III in a solitary spotlight is a proprietary feature called *resolution enhancement.* Yes, it is still a 300- by 300-dot-per-inch printer, but HP has put a patented circuit before the print engine that makes all the difference. Resolution enhancement performs the tricky task of modulating the laser beam in the print engine, varying both the size and placement of the individual dots. It works strictly on the edges of graphics and characters, and it does a superb job of eliminating jaggies, the stair-step edges that are particularly noticeable on graphics and large fonts.

I noticed the difference on the first sheet I printed; the III's output has a pronounced crispness that's lacking on the output from other laser printers. Since resolution enhancement is also switchable (in case you're using add-in cards that depend on an unmodified print engine), I turned it off and printed a page of unenhanced graphics. The difference is striking, and, under a magnifying glass, the III's ability to produce what's effectively the look and feel of typeset quality is even more discernible.

While many laser printers are rated at 8 ppm, that's a theoretical maximum for plain text. The reality—especially for printing graphics—is often considerably less. But in the LaserJet III, HP has tweaked the hardware and software to make the data really move. The company claims overall I/O performance has been increased by nearly 50 percent. And although I didn't use any formal benchmarks, my subjective impression is that the LaserJet III gave my computer back to me (and started printing) considerably faster than the Series II. It was very noticeable when I printed graphics.

At $300 less than the LaserJet II, the LaserJet III's price is impressive.

You can use all the add-ons designed for the Series II plus some new ones. Add a 2-MB memory board, a PostScript-emulation cartridge, and an AppleTalk interface, and for $4355, you have a full-fledged Macintosh laser printer for considerably less than Apple's own. In addition, you get resolution enhancement.

I was disappointed that the LaserJet III lacks a second paperfeed tray. But when you couple the printer's standard features, resolution enhancement, and rock-bottom price, the LaserJet III comes out as not only an unbeatable deal, but a truly trailblazing product. And since other laser-printer manufacturers will be burning the midnight oil to answer HP's challenge, the LaserJet III's ultimate feature may turn out to be "competition enhancement."

—*Stan Miastkowski*

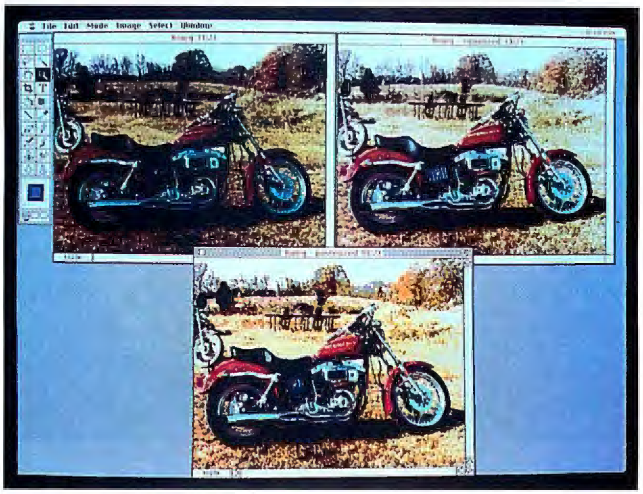
THE FACTS

LaserJet III
$2395

Options:
1-MB memory board, $495;
2-MB memory board, $990;
PostScript cartridge, $695;
AppleTalk interface, $275.

Hewlett-Packard Co.
19319 Pruneridge Ave.
Cupertino, CA 95014
(800) 752-0900
Inquiry 985.

Photoshop Is Picture-Perfect



With the advent of 32-Bit QuickDraw and a variety of 24-bit color boards, Macintoshes can view and work with large images that contain millions of colors. This opens the door for Mac applications like Adobe's new **Photoshop**, which can perform the electronic equivalent of darkroom image manipulation on your Desktop.

Photoshop comes well-equipped to import, process, and export images from various computers. It reads PICT2, TIFF, MacPaint, PixelPaint, and the preview image in EPS files. Other files that it can handle are TGA (TARGA format), GIF, PIXAR, and Amiga IFF/ILBM files. For the hard cases, there's also a "Raw" option that lets you specify certain file characteristics so that Photoshop attempts to generate an image from the data. And Photoshop's list of image-saving formats is equally exhaustive. It has its own Photoshop format, plus PICT2, PICT2 resource, TIFF, EPS, Amiga IFF/ILBM, GIF, MacPaint, and PIXAR formats.

Photoshop supports black-and-white bit-mapped, gray-scale, RGB, HSL (hue, saturation, and lightness), HSB (hue, saturation, and brightness), and CMYK (cyan, magenta, yellow, and black) images. You can convert images between each image type, within limits.

A variety of tools on a floating palette window provides all sorts of ways to work with an image. There are painting, viewing, editing, and selecting tools. You can also make color corrections to an image by adjusting its brightness, contrast, and color balance. You can flip, rotate, and skew images. There's a host of filtering functions that blur or sharpen an image, apply high-pass filtering, diffuse and despeckle it, or add noise. These changes are applied to the entire image or just the portion that you select with one of the selection tools.

Photoshop can print an image using CMYK-process colors or Color PostScript, or as a halftone, where you can specify the screen frequency, dot shape, and screen angle. Images can be printed as composites (all the colors together) or as separations. Photoshop can send the pixel data either as ASCII hexadecimal (the standard PostScript method) or in binary form for speed.

I used a beta version of Photoshop 1.0b6 on a Mac II equipped with 4 megabytes of RAM, a Rodime Cobra 210e 210-MB hard disk drive, and a 19-inch SuperMac monitor and Spectrum/24 Series III video board. I worked with an assortment of scanned images, ranging from 8 to 24 bits deep and 75 to 300 dots per inch, that I acquired from either Howtek or Sharp color scanners.

Photoshop's user interface is very slick and clean: Adobe used Apple's MacApp object-oriented libraries to implement it. You can have multiple windows open, and each window's title descriptively names the image's source file, size ratio, and memory usage. Unlike some other image editors, Photoshop didn't care what the Mac's screen depth was: Whether it was 4 or 24 bits deep, Photoshop drew the images. Better still, with a 24-bit-deep display, you can open windows to the same image and place them side by side to compare the effects of color corrections—a very nice feature that I've yet to see elsewhere.

Photoshop is fast. It does not take long to open 24-bit PICT2 images. And it applies color modifications and rotations rapidly to an image; there was none of the dawdling that I've come to expect with PhotoMac 1.1. Photoshop had no problems importing a TIFF file from a NeXT Computer, and it accepted Amiga IFF and HAM files that I downloaded from BIX. For the HAM file, a dialog box informed me that the original image's pixels were rectangular and asked if it should rescale the image for the Mac's square pixels. It's small but significant touches such as these that save designers and illustrators headaches and that makes Photoshop a superior product.

I used Apple's LaserWriter 6.0 driver with a LaserWriter and a QMS-PS 810 Turbo laser printer to print images, with good results. Printing with binary encoding reduced the printing times by a third. Certain networks and printers choke on binary PostScript data, in which case you'll have to check ASCII encod-ing in the printer dialog box. Photoshop also implements its own virtual memory system so that you can work with files larger than physical memory.

This version of Photoshop looks excellent. The tools worked smoothly, and the virtual memory let me work on 6-MB files easily. If your work runs to heavy-duty image processing or color prepress, then Photoshop promises to be a must buy for the job.

—Tom Thompson

THE FACTS

Photoshop
$895

Requirements:
Mac Plus, SE, SE/30, or II with 2 MB of RAM, System 6.0.3 or higher, and a hard disk drive.

Adobe Systems, Inc.
1585 Charleston Rd.
P.O. Box 7900
Mountain View, CA 94039
(800) 922-3623
Inquiry 986.

continued

The No-Compromise Notebook Computer

For laptop systems—perhaps the most personal of personal computers—everybody seems to have strong opinions on what features ought to be included. We all have our own notions of the ideal display type, processor, hard disk size, weight, and, of course, price. In the past, the small size and weight required that you make some significant compromises. This has been particularly true for the lightweight notebook computers that have appeared recently. But fortunately, as time goes on, new systems exhibit fewer and fewer compromises. And the new Toshiba **T1200XE** is perhaps the first notebook system that frees you from any major compromise.

At first glance, it looks as if Toshiba has crammed all the goodies of its T1600 laptop into a notebook format. This is quite a feat, since the T1600 weighs almost 12 pounds, and the new T1200XE weighs in at less than 8 pounds, including a battery pack. Despite this rather low weight, the system includes a 12-MHz 286 processor, a 20-megabyte hard disk drive, a 3½-inch floppy disk drive, and a high-contrast LCD screen. There is even room inside for up to 5 MB of memory (1 MB is standard); this is important for OS/2 users. And while most companies charge more for their smaller systems, Toshiba has bestowed upon the T1200XE a price that is significantly lower than that of its older, larger relative, the T1600.

Of course, the new Toshiba computer does not set any records for low weight. Lighter laptops are available, notably the impressive Compaq LTE/286, which has the same features as the Toshiba system but weighs in at a full pound less.

Nevertheless, the T1200-XE has a larger screen, a more comfortable key-board, and a lower price tag.

In my test of a prototype T1200XE, the system performed quite well. Its large 640- by 400-pixel CGA-style backlit LCD is almost exactly like that of the T1600 and is a real pleasure to view. Likewise, the keyboard is almost an exact copy of that on the T1600 and is very easy to become accustomed to. The many T1000 users out there—including myself—should have no trouble at all easing into this system.

A somewhat hidden feature of the new system is a 100-pin connector on the back panel. Toshiba has stated that it will soon offer a "base station" for the T1200XE that will include, among other things, room for two full-size expansion slots.

Another nice feature of the back panel is an RGB monitor connector—important for those who need to make presentations or demonstrations.

Other hidden features of the system include Toshiba's traditional assortment of laptop frills. These include AutoResume, a feature that lets you turn the system on and immediately resume what you were doing when you last powered the computer down.

Toshiba has a number of interesting new laptops available. The new T1000SE and the T1000XE (with a hard disk drive) deserve particular note. I found these systems to be excellent, but some users may prefer a bit more power.

Eventually, we will probably see notebook systems based on the 386SX microprocessor. But until then, if you're going to hit the road and can't compromise on power—or anything else, for that matter—the T1200XE seems to be an excellent choice.

—Rich Malloy

THE FACTS

Toshiba T1200XE
$3999

Toshiba America
Information Systems
Computer Systems
Division
9740 Irvine Blvd.
Irvine, CA 92718
(714) 583-3000
Inquiry 987.

R:base Goes for the Gold

Ever since its first appearance, R:base's forte has been ease of use coupled with power. In its newest incarnation, **R:base 3.0** from Microrim, it is even easier to use and more powerful and comes with a raft of new features.

It's nearly impossible to list even a small fraction of the features available in an application package as sophisticated as R:base 3.0. Its menu interface is improved and now looks like those in other database packages. But overall, the software makes creating, editing, and doing real work with data much less of a chore than other database managers I've used.

While QBE (Query By Example) is a customary (and necessary) feature in all relational databases, R:base 3.0 adds a number of handy bells and whistles to it. In competing high-end packages, the all-too-necessary ability to browse through existing data—to mark, edit, or print needed information—isn't always easy. But R:base 3.0 has made browsing chores easy to do with just a few keystrokes.

Another time saver is R:base's ability to do global search and replace. By way of comparison, in Borland's Paradox 3.0, the only way to do a search and replace is by writing a custom utility using the package's proprietary language.

Most of the people who actually use databases in their day-to-day work aren't technically sophisticated. So in order to be truly powerful, a database manager must provide the ability for the resident database expert to create easy-to-use finished applications with custom forms and menus. R:base 3.0's application-generation facilities are some of the

continued

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5. Custom Optimization: You can optimize compiler output for your application because *you* control the sizes of C types, including pointers, *floats*, and all integral types.

6. Register Optimization: Ten registers are reserved for your register variables, and there's an option to automatically declare all stack variables as *register*, so you can instantly optimize programs that were written without registers in mind.

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8. No Limitations: No matter how large your program is, **CrossCode** C will compile it. There are no limits on the number of symbols in your program, the size of your input file, or the size of a C function.

9. 68030 Support: If you're using the 68030, **CrossCode** C will use its extra instructions and addressing modes.

10. Floating Point Support: If you're using the 68881, the compiler performs floating point operations through the coprocessor, and floating point register variables are stored in 68881 registers.

11. Position Independence: Both position independent code and data can be generated if needed.

12. ANSI Standards: CrossCode C tracks the ANSI C standard, so *your* code will always be standard, too.

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DEPARTMENT 23
4248 BELLE AIRE LANE
DOWNERS GROVE, ILLINOIS 60515 USA

neatest I've seen. I was able to design a custom mailing-list application in a little over a half hour. (It took nearly a full day's work with Paradox.) R:base 3.0 also supports a mouse. And that made the job even easier.

For everyday applications, R:base's powerful built-in ability to handle a large variety of labels is particularly handy. And once I had designed the mailing-list application to my liking, I used the CodeLock utility to convert the application into a stand-alone executable file.

Of course, the R:base 3.0 developers haven't forgotten the needs of dyed-in-the-wool database aficionados. The package's command language has been extended and enhanced with a number of new features. Most notable is a selection of ANSI Level II Structured Query Language commands. And for those of us for whom SQL is still an inscrutable mystery, I found R:base 3.0's extensive on-line help (called Prompt by Example) an invaluable learning tool that saved me considerable time and effort.

While R:base users are an enthusiastic lot, the package has never managed to make much of a dent against the heavyweights in the heavily competitive RDBMS market. In many ways, R:base 3.0 has taken a giant leap ahead of its competition, but it's still going to be a tough horse race for Microrim.

—Stan Miastkowski

THE FACTS

R:base 3.0
$725 (Network Six-Pack, $995; unlimited network license, $2695)

Requirements:
IBM PC, AT, PS/2, or compatible with 640K bytes of RAM, DOS 3.0 or higher, and a hard disk drive (with at least 4 megabytes of available space).

Microrim
3925 159th Ave. NE
P.O. Box 97022
Redmond, WA 98073
(206) 885-2000
Inquiry 988.

Lotus Goes Graphical

Lotus's snazzy new three-dimensional **Lotus 1-2-3/G** spreadsheet for Presentation Manager (PM) takes full advantage of OS/2's power, yet manages to retain compatibility with earlier character-based versions of 1-2-3. It also upholds an OS/2 truism: If you want multitasking, large memory, and the ease of use of a graphical user interface (GUI), you must be prepared to pay a price in hardware and performance.

Many of the program's advantages (i.e., WYSIWYG screens and live links to external files) accrue from OS/2 and PM. To make the transition to OS/2 even more appealing, Lotus greatly improved graphics and added 20 levels of undo. A utility called the Solver lets you model equations for optimal results based on a defined set of inputs and criteria.

Lotus 1-2-3/G is based on the feature set and 3-D model used in 1-2-3 release 3.0. A single spreadsheet file can contain up to 256 layers, and normal @ functions and ranges can stretch along the z-axis.

In addition, you can open up to 16 spreadsheet and graphics windows on the desktop at the same time. Because OS/2 is multitasking, you can recalculate a spreadsheet in one window while printing from another and editing in a third.

One of 1-2-3/G's strengths is that it conforms to PM standards while preserving the keystroke sequences that are familiar to current 1-2-3 users. To mimic 1-2-3's hierarchical menu in the GUI environment, Lotus devised enhancements to PM, including cascading menus and multiple-choice dialog boxes.

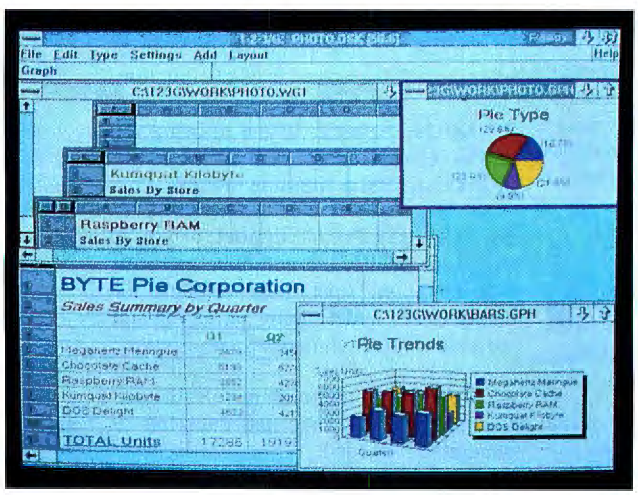
Among the new graphics features are 3-D bar graphs and the user's ability to directly manipulate graphs with the mouse. Most of the new features are in the Graph Tool, a separate part of the program from the main menu.

With the powerful Solver utility, you can model problems backward to obtain a desired output. Instead of trying repeated what-if scenarios, you enter variables and constraints into the spreadsheet and let the 1-2-3/G Solver feature optimize an output like profit or resource utilization.

I was very impressed with most capabilities of 1-2-3/G. My only reservation concerned a conceptual clash between the 3-D model of release 3.0 and the windowing model of PM. In maintaining file and keystroke compatibility, I don't think 1-2-3/G makes the best use of the mouse. This is clearest when a window contains stacked sheets in the style of release 3.0.

While PM lets you click between windows, resize them, and so forth, sheets within a window don't follow the same rules—in fact, you can't even zoom in on them as you can in release 3.0. As a result, you spend more time with the keyboard than the mouse, but for 1-2-3 traditionalists, this is probably preferable anyway. ■

—Andrew Reinhardt



THE FACTS

Lotus 1-2-3/G
(price not available)

Requirements:
A 386 computer with 4 megabytes of RAM, OS/2 1.1 or 1.2 Standard or Extended Edition, a hard disk drive with at least 10 MB of free space, and EGA, VGA, or 8514/A graphics.

Lotus Development Corp.
55 Cambridge Pkwy.
Cambridge, MA 02142
(617) 577-8500
Inquiry 989.

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Apple's Special fx

The 40-MHz IIfx sets new Macintosh speed records

■ Nick Baran

The code name for Apple's new Mac IIfx was "F19," which sounds like a name for a jet fighter plane or rocket. Indeed, the Mac IIfx is one "wicked fast" computer, as the machine's product manager, Frank Casanova, describes it. Powered by a 68030 CPU and a 68882 math coprocessor operating at a clock speed of 40 MHz, this new Mac leaves its predecessors in the dust.

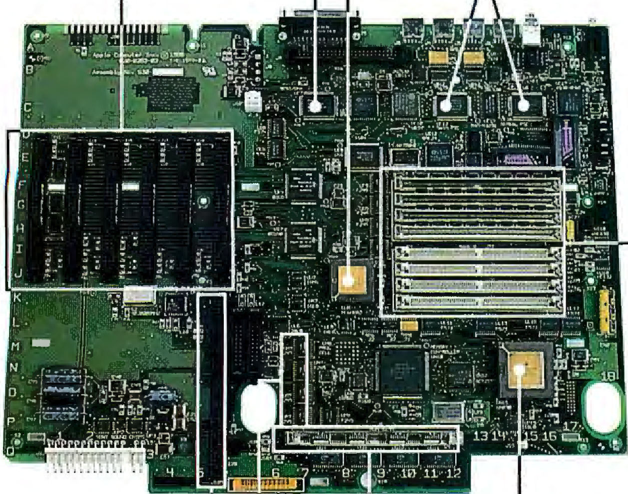
Apple's two most recent machines in the Mac II product line, the IIcx and IIci, were compact models with only three NuBus slots. The Mac IIfx, however, is a six-slot machine like the Mac II and Mac IIx. In addition, the Mac IIfx includes a Processor Direct Slot that is similar to the slot used in the Mac SE/30, which operates independently of NuBus and therefore offers a direct and higher-performance interface for third-party peripherals such as graphics and network controllers. The 120-pin PDS is a superset of the Mac SE/30 PDS and accepts add-in cards designed for the SE/30. Use of the PDS disables one of the six NuBus slots on the logic board, so six slots remain.

Not only does the Mac IIfx have a much faster clock speed than its Mac II cohorts, it has new features specifically designed to boost performance. To help minimize main memory and disk accesses, the Mac IIfx comes with a cache memory consisting of 32K bytes of 25-nanosecond static RAM. To ease the burden of the main processor, the IIfx has a new controller for DMA to SCSI devices like the hard disk drive, and two Peripheral Interface Controllers (PICs) for controlling the floppy disk drives, the Apple Desktop Bus, and the system's two serial ports.

Each PIC controller consists of a 10-MHz 6502 processor surface-mounted to the logic board. You might recall that the 6502 is the CPU of the Apple IIe. In this new machine, two of those IIe processors are used as peripheral controllers. The photo on page 112 shows the new logic board of the IIfx.

The purpose of the SCSI DMA and PIC controllers is to take over tasks that previously were performed by the central processor. Coupled with these I/O and SCSI controllers, the increased clock speed and cache memory of the machine result in a dramatic improvement in system performance, with faster disk access and processing during serial and floppy disk drive operations. Based on some benchmarks that I ran on a preproduction machine, the Mac IIfx is two to four

continued



The Mac IIfx's logic board represents a new design. Although it has new functions such as cache memory and peripheral controllers, the IIfx board has the same chip count as the IIci logic board. Note the empty real estate on the board, suggesting that a compact model with fewer slots could also be produced.

PRELIMINARY BYTE BENCHMARK RESULTS

Preliminary benchmark results reveal the speed advantage offered by Apple's new Mac IIfx.

Low-level test	Mac IIx	Mac IIcx	Mac IIci	Mac IIfx
CPU				
Matrix	17.1	16.2	10.4	6.4
String move				
Byte-wide	82.1	81.7	51.3	31.9
Word-wide	42.1	42.1	26.5	16.1
Doubleword-wide	22.8	22.9	14.2	8.2
Sieve	31.3	31.4	19.6	12.1
FPU				
Math	151.5	149.9	93.2	45.0
Sine(*x*)	72.7	73.9	45.2	21.6
e^x	96.6	98.7	60.8	29.1
Disk I/O				
Sub-Finder seek				
1-sector read	13.9	14.2	14.7	14.3
32-sector read	35.6	27.1	25.4	24.7
Video				
Text				
TextEdit	4.7	4.6	3.3	2.5
DrawString	1.6	1.6	1.1	1.2
Graphics				
Slow test	52.8	52.5	18.5	9.9
QuickDraw	0.3	0.3	0.2	0.1

times faster than the Mac SE/30 or Mac IIx, depending on the operation. On the average, the Mac IIfx is about 60 percent faster than the Mac IIci (see the table). With the SCSI DMA controller, disk seeks of 32 blocks are about seven times faster on the Mac IIfx than on the Mac SE/30. In a briefing at Apple, the IIfx executed a complicated spreadsheet and graphics routine, involving recalc and cut-and-paste operations and scrolling graphics, almost twice as fast as the Mac IIcx did.

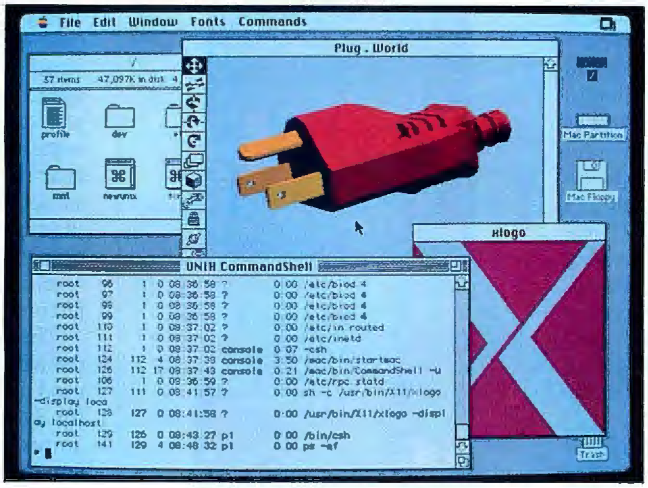
Along with its new superfast Macintosh, Apple announced a new version of its flavor of Unix, A/UX 2.0 (see the text box "A/UX 2.0: Unix with Mac Interface Not Ready Yet" on page 113), and a new series of 24-bit color graphics boards (see the text box "24-bit Graphics with a Bang" on page 114). Clearly, Apple planned these announcements together with the rollout of the Mac IIfx to position the machine as its main platform for the high-end engineering and CAD workstation markets, where the two key components are Unix and high-speed graphics.

The Mac IIfx comes with either 4 or 8 megabytes of RAM. However, these are nonstandard 80-ns, 1-megabit single inline memory modules. Rather than standard off-the-shelf 32-pin SIMMs, the Mac IIfx uses 64-pin-wide SIMMs, which are designed to support a memory-access technique called *latched read/write*. Basically, the phrase means that read and write accesses to memory can overlap, with a "holding area" in the form of 64-bit words for managing the overlapping read/write operations. According to Casanova, Apple is patenting its latched read/write technique. While the technique was designed to improve performance, the drawback is that users who wish to upgrade their systems will have to buy these 64-pin SIMMs from Apple at Apple's premium prices. Perhaps worse, current Mac IIx or IIci users will not be able to reuse their memory if they decide to upgrade their machines to the IIfx logic board. But that's the price of high performance, I guess. It should also be noted that Apple will eventually offer 4- and 16-Mb SIMMs, allowing memory expansion of up to 16 and 32 MB, respectively.

While the logic board has been completely redesigned (it has the same chip count as the Mac IIci in spite of new cache chips, the I/O and DMA processors, and some new custom application-specific ICs), the IIfx looks just like the Mac IIx or the Mac II, and many of its

continued

A/UX 2.0:
Unix with Mac Interface Not Ready Yet



A/UX 2.0, as demonstrated at an Apple press briefing. Note the familiar Mac interface controlling Unix, and the simultaneous display of both Unix and Macintosh applications on the screen.

Although Unix is one of the oldest of the operating systems in use today, there is little doubt as we enter the 1990s that it is the operating system of choice for scientific and engineering applications. Any computer manufacturer who wants to compete in the federal and technical markets has to offer a version of Unix—one that has a good graphical interface.

Apple sees an opportunity to make major inroads into the Unix market by offering a version of Unix that looks to the user just like the Macintosh interface, which is probably still the premier graphical interface on the market today. Except for the NeXT computer's NextStep interface, no full-fledged, Unix-based graphical interface exists that is completely integrated with the operating system like the Macintosh interface. The Open Software Foundation's Motif and Sun's Open Look are the other major Unix graphical interface contenders, but neither of them is a complete end-user interface at this point. They are still developers' tools that will lead to end-user interfaces in the next year or two.

In conjunction with the introduction of the Mac IIfx, Apple has introduced A/UX 2.0, which is indeed a version of Unix (System V release 2 with BSD 4.3 extensions) with the Mac desktop interface. As you can see from the photo, A/UX 2.0 lets you run Unix and Macintosh applications simultaneously and exchange data between them from the Clipboard. You can configure the hard disk drive with two partitions—one for Unix and one for the Macintosh System—and applications are transparently accessed from either partition. Note, however, that multiple tasks under MultiFinder will not run reliably in conjunction with A/UX. According to Apple's product managers for A/UX, the Unix preemptive scheduler can "bring down MultiFinder."

You use the Macintosh Chooser to select printers and file servers. A dialog box called the Commando provides a point-and-click interface for issuing Unix commands, which are automatically routed to the Unix console window. The Apple menu is used to hide running applications that you can recall with a simple mouse-click. In addition, A/UX comes with a mouse-driven text editor and support for TCP/IP networking protocols and the X Window System. Using the Macintosh Toolbox, programmers can develop "hybrid applications" that run under Unix but take advantage of Macintosh desktop features. It's all very elegant.

Nonetheless, A/UX 2.0 isn't ready. According to A/UX product managers, it won't be ready until mid-1990. The version that was demonstrated at the press briefing looked like early alpha software, and it crashed repeatedly. Although Apple demonstrated A/UX 2.0 on a 4-megabyte Mac, it was clear that you need 8 MB of memory to run any significant applications simultaneously.

There are other concerns. While it is undoubtedly an elegant interface that lets you execute Unix and Macintosh applications simultaneously, A/UX 2.0 needs third-party applications. Some off-the-shelf Unix character-based applications may run under A/UX, but Apple supports only the QuickDraw screen-imaging model. Although the X Window System is supported in A/UX 2.0 and can run in a separate window, Unix software developers will still have to port graphics-based applications to run under QuickDraw. At this time, Apple does not support any three-dimensional graphics standards, such as PHIGS, GKS, or RenderMan. As a result, third-party developers can't write three-dimensional applications for A/UX using those standards.

On the other hand, the major appeal of A/UX 2.0 is that you can run both Unix and all the third-party Mac-based applications at the same time. An obvious use of A/UX 2.0 would be for a Unix network such as NFS (Network File System) with simultaneous access to Macintosh software, or for the development of vertical-market Unix-based applications with links to standard Mac software.

Another question is price. At the time of this writing, Apple declined to disclose its price for A/UX 2.0; but A/UX 1.0 costs about $400, and Product Manager Carol Clettenberg stated, "We have lots of additional value in this." That implies that it will cost substantially more than $400. And the price of the software is only the beginning. A/UX takes up most of an 80-MB hard disk drive. That means that you need at least an additional 80-MB hard disk drive or, preferably, an even larger hard disk drive, to store your applications and data. Add to that the cost of a fully configured 68030-based Mac II with high-resolution graphics and 8 MB of RAM, and you're looking at a very expensive system, probably in the neighborhood of $15,000 or more.

Although it's expensive when you add it all up, A/UX 2.0 looks very impressive. Now, the question is whether Apple can deliver a working product and whether software developers will write applications for A/UX 2.0

24-bit Graphics with a Bang

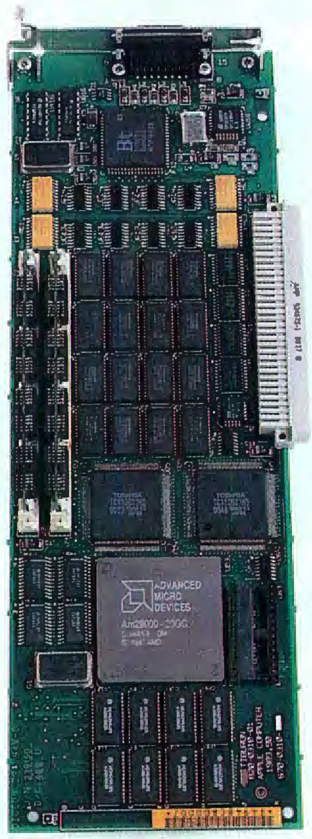
If you're going after the workstation markets, you need Unix and high-speed graphics. A/UX 2.0 is one side of the equation. The other side is Apple's new 24-bit graphics accelerator board (see the photo). Called the Macintosh Display Card 8/24 GC, the board is powered by an AMD29000 RISC processor running at 30 MHz. The accelerated version is part of a new family of color cards based on Apple's new "custom color chip," which is a single-chip replacement of the series of digital-to-analog converter chips that were used in previous Apple color boards. The board requires one NuBus slot, 2 megabytes of main memory, and version 6.0.5 of the Mac OS.

The 8/24 GC board comes with 2 MB of video memory and can be expanded to 4 MB of RAM. In color mode, the board can display images with 8 or 24 bits per pixel and has a screen resolution of 640 by 480 pixels. In gray-scale mode, the board supports 1, 2, 4, or 8 bits per pixel at a resolution of 1152 by 870 pixels. The board supports a refresh rate of 66.7 to 75 Hz depending on the resolution of the display. It also supports the RS-170 timing standard for interlaced video devices such as TVs and VCRs. However, the 8/24 GC does not have a video input port. The board automatically configures its display mode and resolution according to the display to which it is connected.

With the AMD 29000 processor, which is rated at about 20 million instructions per second at the 30-MHz clock speed, the 8/24 GC provides excellent performance for complex and colorful graphics applications. In a demonstration at an Apple press briefing, the board offered blazing speed for everything from text scrolling to movement and refreshing of 24-bit images on the screen. Apple claims that the 8/24 GC accelerates color display from five to 30 times the normal speed of color applications. The company declined to give a definite price for the 8/24 GC but said that it would cost approximately $2100.

In addition to the 8/24 GC, Apple announced less powerful color boards called the Display Card 4/8 and the Display Card 8/24. The 4/8 version is an 8-bit color board that you can upgrade to a 24-bit 8/24 card by adding video memory to it. These cards have essentially the same features as the 8/24 GC but without the accelerator board. The boards will be priced at about $700 and $1000 for the 8-bit and 24-bit versions, respectively.

The 8/24 GC is an impressive top-of-the line graphics board; the other new entries are more conventional color cards, although they support 24-bit color. However, Apple faces stiff competition from such third-party graphics board suppliers as Radius, RasterOps, and SuperMac, all of which offer 24-bit color graphics accelerators at very competitive prices.



The 8/24 GC graphics accelerator board. Note the AMD29000 RISC processor, which operates at 30 MHz. The board comes standard with 2 MB of video RAM and includes a 64K-byte static RAM instruction cache.

components are the same. The AppleTalk speed is still 230 kilobits per second. The Apple sound chip is still the same 8-bit 44.1-kHz chip. And the system has the same floppy and hard disk drive options as the other Mac II models.

One improvement worth mentioning is a larger, but much quieter, cooling fan (whose diameter is 92 millimeters instead of 80 mm), which has a variable speed controller, allowing the fan to adjust speeds according to the cooling load required by the system. You can barely hear the fan with two NuBus boards installed in the machine, according to Casanova. (This was hard to tell in the briefing room, which had seven or eight machines running, along with video projectors.)

The new 512K-byte ROM SIMMs in the Mac IIfx are a superset of the ROM used in the IIci. The new ROM has hooks for System 7.0, says Casanova, and it requires a new version of the operating system (System 6.0.5) to handle the new I/O controllers.

At the time of this writing, Apple had not established a price for the Mac IIfx. Needless to say, it won't be cheap. The Mac IIfx will be offered in 4- and 8-MB configurations with only one SuperDrive floppy disk drive or with 80- or 160-MB hard disk drives. Casanova says a base system would start at between $10,000 and $12,000. In addition, Apple will be offering logic board upgrades to current Mac II and IIx users. As mentioned earlier, the upgrade will be costly because you won't be able to use the same memory modules as the earlier Mac II/IIx models use. Apple did not disclose prices for the logic board upgrade.

The Mac IIfx is built for speed, pure and simple. It looks like the machine of choice to run advanced graphics, network-server, and A/UX applications. It's the latest top-of-the-line product in an increasingly crowded Mac II product line. We now have the IIfx, the IIci, the IIcx, the IIx, and the good old Mac II. But if you're looking for the fastest Macintosh on the market, the IIfx is the one. ■

COMPANY INFORMATION

Apple Computer, Inc.
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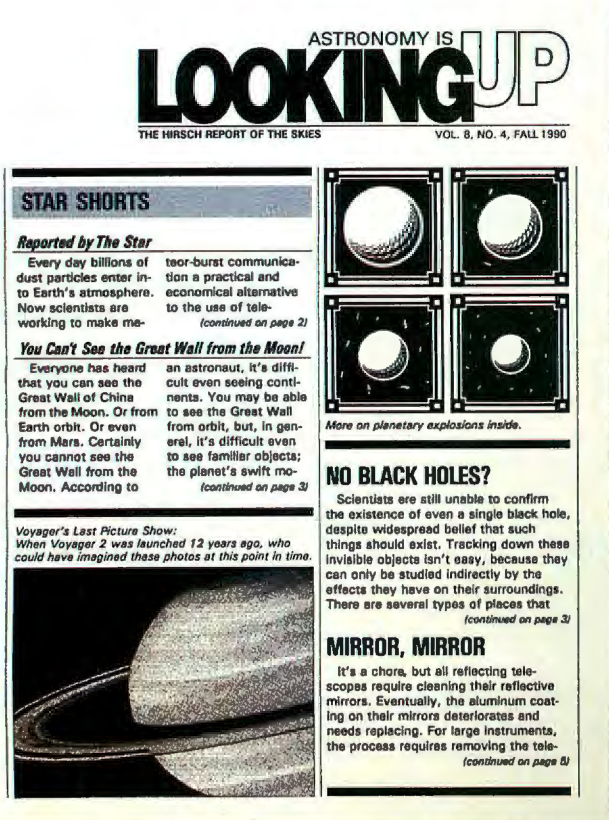

ASTRONOMY IS LOOKING UP

THE HIRSCH REPORT OF THE SKIES — VOL. 8, NO. 4, FALL 1990

STAR SHORTS

Reported by The Star

Every day billions of dust particles enter into Earth's atmosphere. Now scientists are working to make meteor-burst communication a practical and economical alternative to the use of tele- *(continued on page 2)*

You Can't See the Great Wall from the Moon!

Everyone has heard that you can see the Great Wall of China from the Moon. Or from Earth orbit. Or even from Mars. Certainly you cannot see the Great Wall from the Moon. According to an astronaut, it's difficult even seeing continents. You may be able to see the Great Wall from orbit, but, in general, it's difficult even to see familiar objects; the planet's swift mo- *(continued on page 3)*

More on planetary explosions inside.

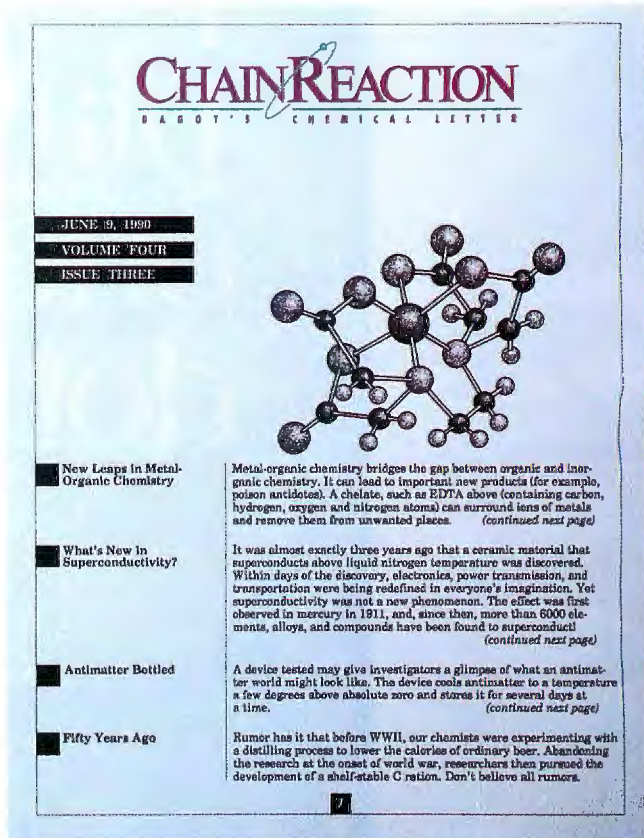
Voyager's Last Picture Show: When Voyager 2 was launched 12 years ago, who could have imagined these photos at this point in time.

NO BLACK HOLES?

Scientists are still unable to confirm the existence of even a single black hole, despite widespread belief that such things should exist. Tracking down these invisible objects isn't easy, because they can only be studied indirectly by the effects they have on their surroundings. There are several types of places that *(continued on page 3)*

MIRROR, MIRROR

It's a chore, but all reflecting telescopes require cleaning their reflective mirrors. Eventually, the aluminum coating on their mirrors deteriorates and needs replacing. For large instruments, the process requires removing the tele- *(continued on page 6)*


CHAIN REACTION

BAGOT'S CHEMICAL LETTER

JUNE 9, 1990
VOLUME FOUR
ISSUE THREE

New Leaps in Metal-Organic Chemistry

Metal-organic chemistry bridges the gap between organic and inorganic chemistry. It can lead to important new products (for example, poison antidotes). A chelate, such as EDTA above (containing carbon, hydrogen, oxygen and nitrogen atoms) can surround ions of metals and remove them from unwanted places. *(continued next page)*

What's New in Superconductivity?

It was almost exactly three years ago that a ceramic material that superconducts above liquid nitrogen temperature was discovered. Within days of the discovery, electronics, power transmission, and transportation were being redefined in everyone's imagination. Yet superconductivity was not a new phenomenon. The effect was first observed in mercury in 1911, and, since then, more than 6000 elements, alloys, and compounds have been found to superconduct! *(continued next page)*

Antimatter Bottled

A device tested may give investigators a glimpse of what an antimatter world might look like. The device cools antimatter to a temperature a few degrees above absolute zero and stores it for several days at a time. *(continued next page)*

Fifty Years Ago

Rumor has it that before WWII, our chemists were experimenting with a distilling process to lower the calories of ordinary beer. Abandoning the research at the onset of world war, researchers then pursued the development of a shelf-stable C ration. Don't believe all rumors.

1

Introducing the new HP LaserJet III printer with Resolution Enhancement technology.

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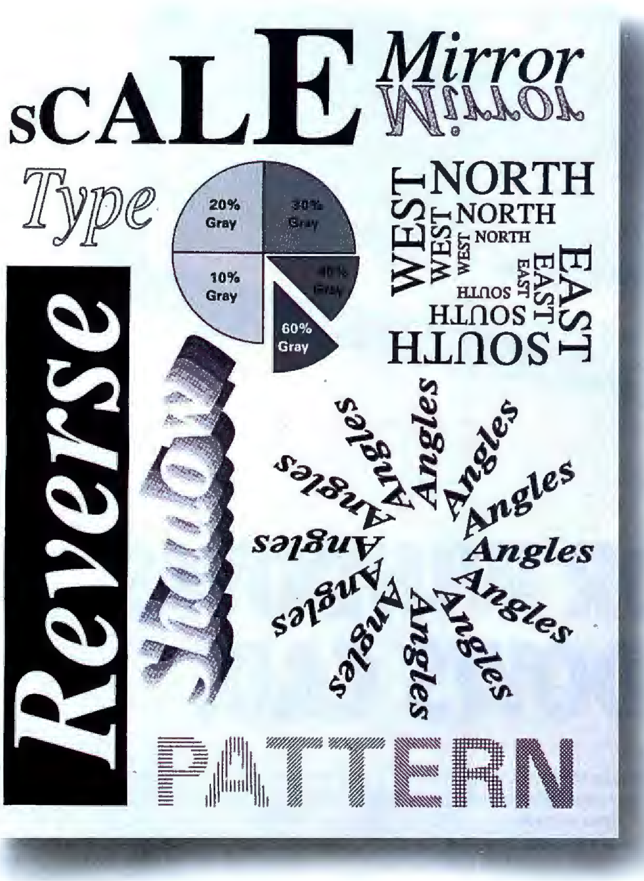
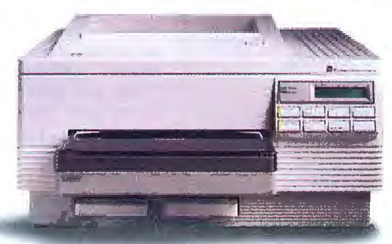
Resolution Enhancement technology shrinks dots to fit in curves and diagonals where they've never gone before.

whole new ball game.



But there's more than better print quality. 14 bit-mapped fonts and 8 internal scalable typefaces provide thousands of options. And enhancements to our PCL5 printer language, including our HP-GL/2 graphics language, let you print portrait and landscape on the same page. Reverse and angled type. Spirals. Even shaded text. You can also plug in Adobe PostScript® software.

For all its new features, the $2,395* list price of the HP LaserJet III is a good deal less than the HP LaserJet



Series II printer it replaces. With the same hardware compatibility, wide range of applications, 8 ppm print speed, and software compatibility, including WordPerfect 5.1 and WordStar® 5.5. And the same reliability as the rest of the HP printer family.

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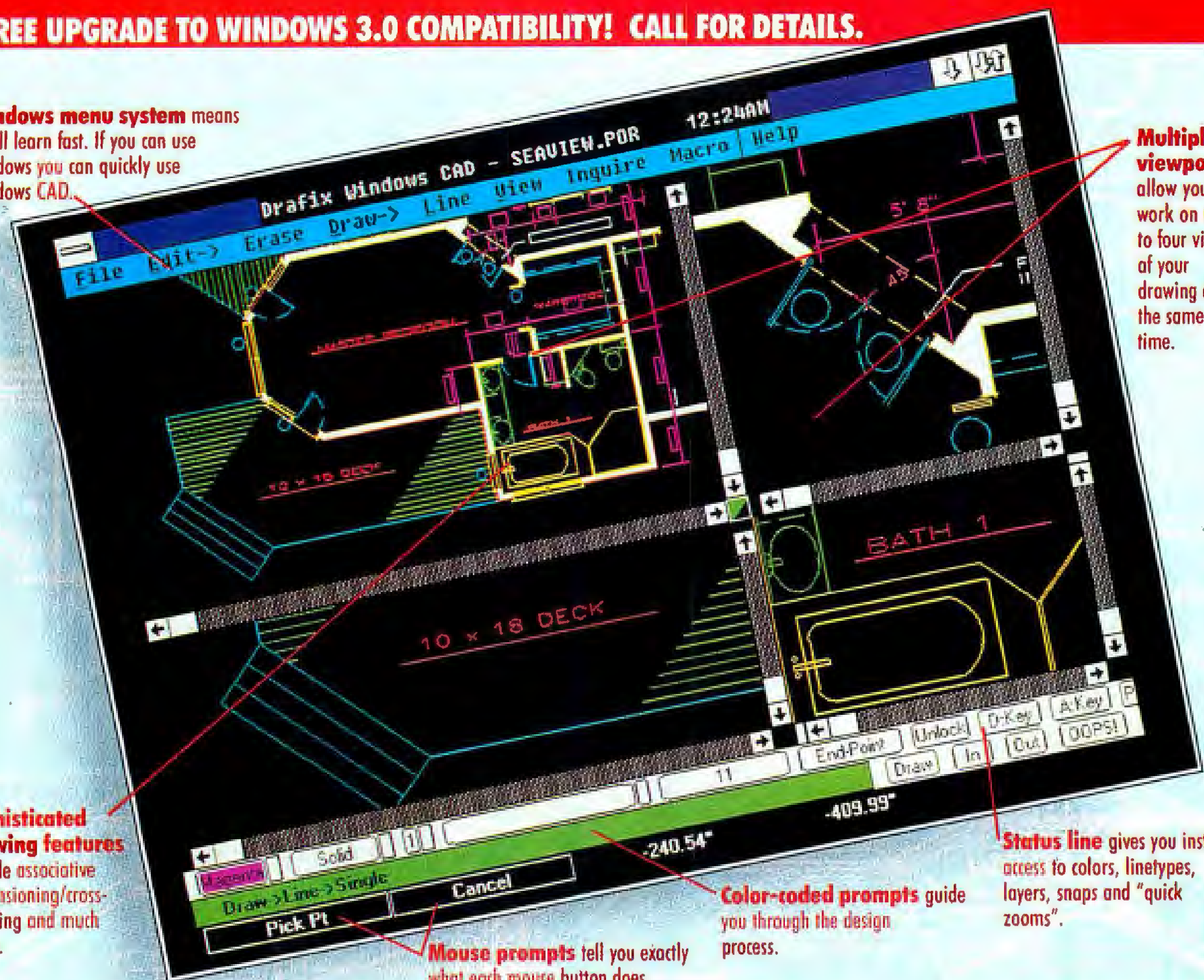

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Macro Programming Language

System Requirements ☐ '286 or '386 processor ☐ Microsoft Windows 2.1 or later ☐ 1 Mb internal memory or greater ☐ Windows-supported mouse

File Compatibility ☐ Autocad DXF ☐ Drafix CAD ☐ HPGL ☐ CDF, SDF for database information

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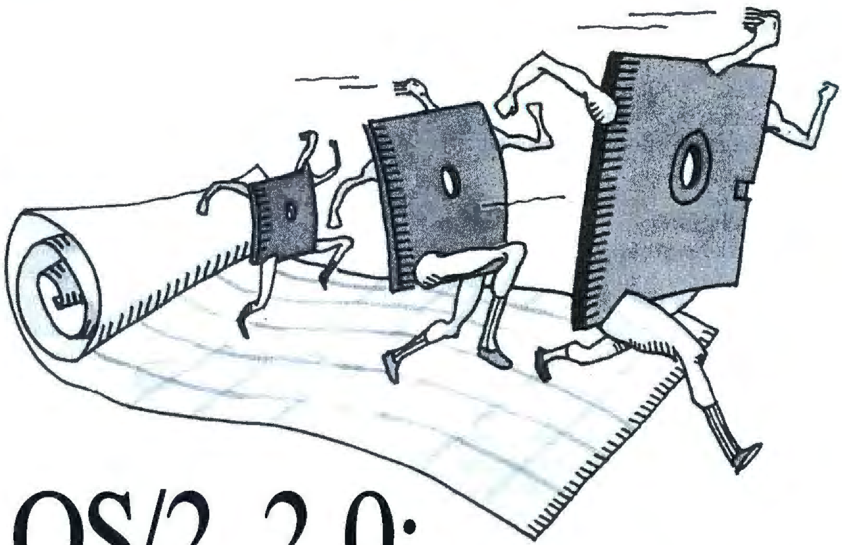
32-bit OS/2 forges ahead, with DOS and Windows in tow



OS/2 2.0: It's a Family Affair

■ Jon Udell

It's going to be a flat world after all. Microsoft's long-awaited 32-bit OS/2 2.0 joins the list of 386 operating systems—Unix, NetWare 386, 386|DOS-Extender—that have abandoned segments in favor of the flat model. Of course it isn't a flat world yet. Thirty-odd million DOS systems, several million Windows systems, and a few hundred thousand OS/2 systems run segmented programs today and will continue to do so for a long time to come.

Can OS/2 2.0 inherit the features of its three 16-bit predecessors and still realize its 32-bit destiny? I don't see why not. OS/2 2.0 runs 1.x binaries and offers both 16- and 32-bit application programming interfaces (APIs). More important, it features DOS support that far outperforms the 1.x compatibility box. OS/2 2.0 can multitask DOS and even Windows sessions, each in an OS/2 screen group or Presentation Manager (PM) window and scheduled as a normal OS/2 process.

The Unix-style memory model and DOS multitasking add up to a "hit 'em high, hit 'em low" strategy. At the high end, OS/2 can now compete strongly as a server platform. LAN Manager 2.0's HPFS-386 (High Performance File System) is a crucial ingredient, but OS/2 2.0's ability to run 32-bit applications on the server with paged virtual memory completes the picture. Microsoft can't realistically expect to dominate the server market. Today, nearly half of the server-class machines that cost between $15,000 and $350,000 run Unix; the other half run IBM, DEC, or other proprietary operating systems; less than 1 percent run OS/2. Still, an OS/2 freed from its 16-bit shackles should be able to carve out a significantly bigger piece of the midrange pie.

Farewell to Segments

In view of that goal, Microsoft's choice of the flat memory model is a strategic decision, not merely a technical one. Segments, per se, aren't evil. What gave them a bad name was that, on the 286 with its 16-bit registers, segments were too small—just 64K bytes. On the 386, with 32-bit registers, a segment can span 4 gigabytes. An operating system can organize kernel and process-address spaces as one or several of those segments. That choice determines whether segment-oriented or just page-oriented mechanisms can protect the kernel from user processes, and processes from one another.

Experts differ on what's best, but segments have advantages, notably limit-checking, that OS/2 2.0 forgoes. Why toss them completely? Technically, they're inconvenient. Even with fewer, larger segments, there's inefficiency associated with loading selectors. Programmers are just plain tired of them, but strategically, they're a disaster. Competitive Intel-based operating systems don't use the segmentation hardware, and most other 32-bit processors don't even have segments. Although the flat model won't make OS/2 applications portable to other operating systems and processors, at least it will make them less nonportable. It makes reverse migration feasible as well. The prophesied union of OS/2 and the FORTRAN/COBOL code base may yet come to pass.

Battle for the Desktop

At the low end, it's a different story. Here, OS/2 contends for desktop supremacy in a market that Microsoft already dominates. Although the Macintosh finds wide favor, and the romance between Unix and 386 PCs continues to heat up, these systems, like OS/2 itself, compete mainly with DOS and Windows. To judge OS/2 a failure because users still cling to DOS, or because there aren't more OS/2 applications, begs the question. The DOS desktop market is huge; its inevitable upward migration will be glacially slow. As users do move, they'll have to make a choice. OS/2 2.0's competitive 32-bit capabilities and strong DOS support will make it a likely candidate. Microsoft wins to the extent that users will choose OS/2.

The imminent Windows 3.0, which Microsoft acknowledges will run Windows applications in protected mode and so give them access to large memory, clearly complicates matters. Those who have used OS/2 know that memory management is just one of its advantages over Windows. Windows rests on a shaky foundation, namely DOS, and it won't ever match the multitasking, multithreaded capabilities of OS/2. Nevertheless, users who don't yet see OS/2's superiority will, in the short term, almost

continued

certainly make Windows 3.0 a successful applications platform. More trouble for OS/2? Again, only if users, when they migrate, don't choose it.

OS/2 and Windows: An Applications Strategy

Although OS/2 2.0 won't run Windows binaries, its ability to run Windows in a DOS session will help keep users in the family. Even more helpful would be a way to simplify porting Windows applications to PM. Despite their conceptual similarity, the two programming environments differ radically in their implementation. Today, a port from Windows to PM can be a painful exercise. Microsoft is therefore at work on a "mapping layer," analogous but unrelated to Micrografx's Mirrors, designed to ease the Windows-to-PM transition. Microsoft hopes to add the still-unnamed tool to a future release of the 2.0 Software Development Kit (SDK). It's not version-specific, though; Microsoft expects it to work for current and future versions of Windows and OS/2.

Developers will, in theory, be able to port Windows applications in gradual stages. Minimally, they'll have to touch perhaps 10 percent of their code in order to meet the requirements of the mapping layer's interface. Mainly, that means converting interrupts to system calls. The emulator would then enable OS/2 to run the Windows application, with an estimated 5 percent to 10 percent performance penalty. The Windows program could even exploit features of the kernel—threads, interprocess communication, scalable fonts, and HPFS. Ultimately, of course, a full PM port is best, but the emulator should lower the threshold of resistance and help OS/2 capture the still-burgeoning Windows applications market.

The 2.0 SDK

Microsoft announced shipment of the 2.0 SDK on the last day of last year and began filling orders in quantity about six weeks later. It's the usual deal. This time, developers will have to pony up $2600 to get the series of releases leading up to the final 2.0. What are they paying for? In Microsoft's view, tools, on-line support, and a head start on building 32-bit applications. In the eyes of some developers who have already invested thousands of dollars in previous OS/2 SDKs, the opportunity to alpha-test yet another new operating system. Obviously, the big players won't blink. To what extent this policy alienates the "little guy," and so impedes the flow of OS/2's lifeblood applications, we may never know. In any event, when a final version of 2.0 ships sometime this year, everyone can join the party—for the price of a compiler upgrade and an OS/2 toolkit.

The SDK version of the operating system, fat with debugging instrumentation, wants 6 megabytes of RAM. Microsoft expects the final version to run in 4 MB, and, given that 2.0's more efficient paged virtual memory system will make more of the kernel swappable, that seems attainable. In its current incarnation, the system looks and feels just like OS/2 1.2. The SDK includes 32-bit versions of Microsoft C and MASM (Microsoft Macro Assembler). The C compiler, called Microsoft C 5.2, isn't the new 6.0 compiler that was in beta test at the time of this writing, but rather a 32-bit adaptation of Microsoft C 5.1. However, the SDK does include a prerelease version of CodeView 3.0, the debugger that's bundled with Microsoft C 6.0. Eventually, 6.0 and its Programmer's Workbench should work with OS/2 2.0, but Microsoft hasn't yet committed to a release date.

In other respects, the SDK is a typical OS/2 toolkit. It includes the resource and help compilers; icon, dialog box, and font editors; and sample code. Like the 1.2 toolkit, which began shipping around the time of the 2.0 announcement, it will also include the Dialog Manager, which supports COBOL- and FORTRAN-generated screens in the PM environment, and IBM's CUA (Common User Access) style guide. These components testify to OS/2's key role in IBM's plan to integrate applications across platforms, which is known as SAA (Systems Application Architecture).

The New Memory Model

OS/2 2.0 accomplishes the shift to a 32-bit programming model gracefully. Developers familiar with version 1.x needn't worry about API shock. The vast majority of kernel and PM function calls don't change. Dual 16- and 32-bit support takes the form of 16- and 32-bit dynamic link libraries (DLLs) and header files that control parallel name spaces. You will still write `DosOpen` and `DosCreateThread`; when compiling for 32-bit mode, those names will become `Dos32Open` and `Dos32CreateThread`. Those functions that manipulate segment selectors, such as `DosAllocSeg` and `DosAllocHuge`, are gone. But few programmers will shed many tears for them.

The new unit of memory allocation is called a "memory object" and is simply a contiguous set of 4K-byte pages in the linear address space. Flags to the allocation routines specify access permissions: read, write, execute, or guard. Guard pages facilitate the use of "sparse memory objects." OS/2 2.0 distinguishes between *allocating* and *committing* memory. To allocate memory means to reserve linear address space; to commit it means to map physical pages into that reserved space and possibly trigger page swapping. Guard pages enable the system (or the programmer) to commit memory dynamically to an allocated region; stacks are the most obvious use for the technique. When there's a reference to a guard page, the processor generates a guard-page fault; a system- or user-defined exception handler can then commit a physical page and make the next page a guard page.

Since there's no way to defragment the linear address space or reallocate memory, sparse memory lets programmers allocate ridiculously large chunks—limited only by the backing store—without involving the virtual memory subsystem until it is actually needed.

> **O**S/2 *threads, or "lightweight processes," offer huge advantages to the applications that use them; they also support multitasking.*

Threads, Semaphores, and Other Enhancements

OS/2 threads, or "lightweight processes," offer huge advantages to the applications that use them. Threads support multitasking not only between, but within, applications. Unfortunately, in version 1.x, threads proved notoriously tricky to use. Programmers had to allocate stack memory for threads. Because threads share process memory, programmers relied heavily on semaphores to coordinate access to that shared memory, and these were in short supply. Semaphore semantics were confusing, and the behavior of semaphores was unreliable in some cases. However, OS/2 2.0 should help to improve matters.

continued

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The system now dynamically allocates stack memory for threads using the guard-page feature. The semaphore functions are new and are incompatible with the 1.x functions. Semaphores in 2.0 come in three flavors: event, mutual exclusion (`mutex`), and multiple wait (`muxwait`). Event semaphores provide a basic interthread signaling mechanism. The `mutex` semaphores work similarly but are designed for serializing critical sections of code in multiple threads. The `muxwait` semaphores permit a thread to wait on multiple semaphores, all of which must be of either the event or `mutex` variety. All semaphores are now handle-based and reside outside an application's address space.

Other enhancements include built-in floating-point emulation (a DLL that's not loaded on an i486 or if an 80387 is present), improved exception-handling capabilities that language extensions can make available to users, new device helpers (`DevHlps`) to enable device drivers to communicate with the linear address space, and a general relaxation of system limits. OS/2 2.0 supports more threads (4000, versus 1.2's 512 and 1.1's 256), and vastly more semaphores—64,000 per process.

There's one major omission. OS/2 2.0 does not support the VIO/KBD/MOU packages, which bypassed PM to give 1.x developers direct control of the keyboard, screen, and mouse. So there's no middle ground anymore. It's either PM or `printf` (primitive teletype-style I/O).

MVDM: Multiple Virtual DOS Machines

There's no shortage of 386 DOS multitaskers these days. DESQview, VM|386, and VP/ix are notable examples of programs that use the V86 mode of the 386 to good effect. But OS/2's MVDM facility exploits an advantage that is uniquely Microsoft's. Other DOS multitaskers run off-the-shelf MS-DOS. MVDM's designers grabbed the DOS 4.0 source code, threw away the file system and other nonessentials, and ended up with an OS/2 2.0-specific version of DOS that leaves more than 620K bytes of RAM free for real-mode applications.

It's eerie to see DOS programs like Lotus 1-2-3, WordPerfect, and even Flight Simulator running in overlapped PM windows, side by side with PM applications. A DOS program can run in the background as an icon. DOS programs can even use the PM clipboard. For example, you can cut a block of numbers out of 1-2-3 using PM's mouse and paste the numbers into WordPerfect or the PM version of Excel. MVDM will allow a full-screen DOS program to write straight to the display. And it supports EMS memory. Tunable parameters, such as task priority and idle detection, aren't in the first SDK version of OS/2 but will be made available.

MVDM comes with "virtual device drivers" for the standard character devices: video, keyboard, printer, and communications port. There won't be VDDs for block devices (at least initially), so DOS programs won't be able to talk directly to network adapters, CD-ROM readers, tape drives, and the like. You'll have to depend on OS/2's support for such devices—and that's been a sore point with OS/2 thus far. There aren't many OS/2 network drivers available yet, and, despite Microsoft's commitment to CD-ROM publishing, there's no OS/2 CD-ROM driver yet.

You won't be able to run DOS-extended programs, such as the DOS versions of Lotus 1-2-3 release 3.0, AutoCAD 386, Mathematica, and IBM Interleaf Publisher, under 2.0's MVDM. OS/2 2.0 doesn't, and won't, support VCPI (Virtual Control Program Interface). Options are to use dual-boot or wait for PM versions of these programs—which, in the case of 1-2-3 and AutoCAD, have already appeared. Although Microsoft acknowledges a need for DOS programs under MVDM to use extended memory better than EMS memory allows, there's no announcement yet of a plan to accomplish that.

Royal Fonts

Although Royal fonts aren't included in the first SDK release of 2.0, Microsoft has demonstrated the technology. Apple licensed the Royal font format to Microsoft. In the near term, this means that OS/2 2.0 and the forthcoming Macintosh System 7.0 will be able to exchange and use identical, high-quality, scalable display fonts. When Royal printers appear, both operating systems will be able to operate with them as well.

COMPANY INFORMATION

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Inquiry 880.

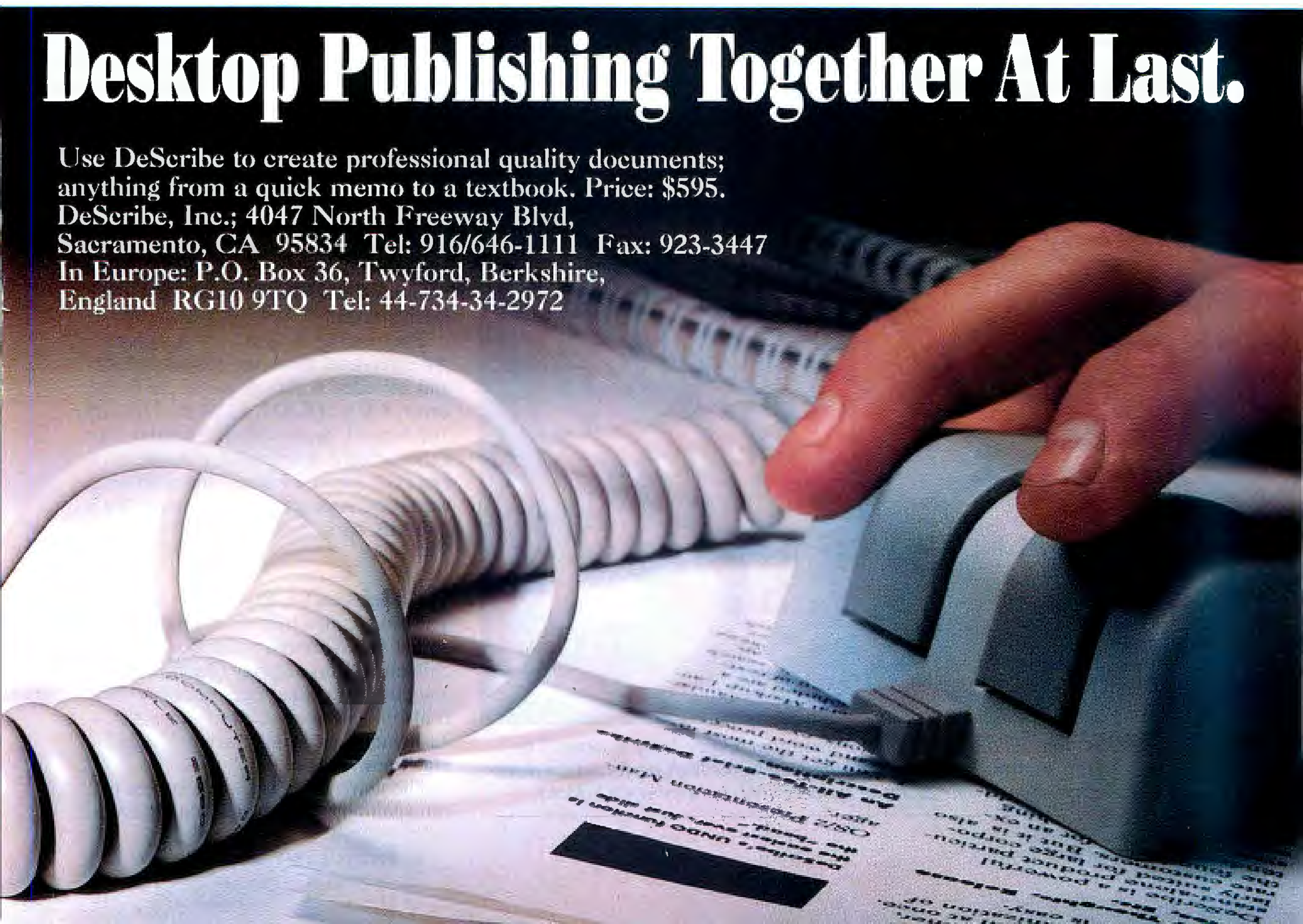
Royal is especially well suited to OS/2's GPI (Graphics Programming Interface). OS/2 defines its own vector-font API, which need not change to accommodate Royal. OS/2 features a unified imaging model that makes virtually no distinctions between screen and printer graphics. OS/2 2.0 defines no new APIs for Royal, because it doesn't need to. From an application writer's perspective, the necessary tools are already in place.

It's (Almost) the Real Thing

OS/2 is finally growing up. Flat addressing, paged virtual memory, an extremely powerful and flexible file system, an excellent graphical user interface, DOS multitasking, and a unified imaging model: It all adds up to certain success in the long run. How long? That may not matter; Microsoft can afford to wait. So long as there isn't a mass exodus to alternate platforms—and the next couple of years admittedly will be critical—2.0 will be there to greet users who grow weary of wrestling with DOS and its extensions.

But the picture isn't completely rosy. OS/2 2.0 is still wobbly; a final release is many months away. OS/2 device driver support remains spotty—in some cases, such as printer control langauage and CD-ROM, unconscionably so. Applications are few. Development tools aren't what they should be. And the proliferation of Microsoft systems—DOS, Windows, 16-bit OS/2, and now 32-bit OS/2—fragments the finite pool of programming talent to an alarming degree. We'll see how it all plays out. But I've seen the system that I want to install on my 386 PC. It's OS/2 2.0. ■

Jon Udell is a BYTE senior technical editor at large. You can reach him on BIX as "judell."



Sizzling RISC Systems from IBM

■ Andy Reinhardt and Ben Smith

IBM's POWERstation 320 desktop and POWERstation 530 deskside systems. The desktop unit (left) is showing a ray tracing generated by the high-performance three-dimensional graphics board. The deskside system (right) is running OSF/Motif.

Last year saw an explosion of interest in Unix workstation computing, but IBM's position in the market remained a big question. How would the company upgrade its lackluster RT system? In December, BYTE was invited to preview the answer, the RISC System/6000 family of high-performance workstations and servers. Codeveloped by IBM's Yorktown, New York, and Austin, Texas, research labs under the code name "RIOS," these machines are IBM's new Unix flagships.

The RISC System/6000 sets a new performance standard, boasting speeds of 28 million instructions per second on the desktop and over 40 MIPS in the fastest models. Preliminary benchmarks for the entry-level system appear to show performance 2.5 times that of the Sun SPARCStation 1; the machines have enough power to emulate an Intel 8086 *in software* and still run DOS applications faster than an AT. Most important, the RISC machines are designed not just for technical users but also for multiuser commercial applications, which speaks volumes about IBM's commitment to the Unix market.

The pricing is also very aggressive. An entry-level machine sells for $12,995 and includes a 120-megabyte hard disk drive, 8 MB of RAM, a 19-inch 1280- by 1024-pixel monochrome display, an Ethernet card, a keyboard, a mouse, AIX and OSF/Motif software, and a one-year warranty. A desktop server model has a 240-MB hard disk drive and sells for $14,945.

Variations on a CPU

The product line includes nine RISC machines based around a common CPU architecture, plus an array of add-ins and a low-cost X terminal (see the table). IBM is also releasing a new version of AIX—its home-grown Unix variant—with the machines.

The new AIX 3 has a file system that can span physical devices and change in

IBM's new family of RISC-based Unix systems offers tremendous power

size while the system is being used. It also includes PC-Simulator, an IBM product that allows the RISC machines to run DOS programs.

The systems are packaged in three basic models: desktop, deskside (or tower), and rack-mount. The desktop and deskside units are available as workstations or servers, while the cabinet-size rack-mount model is a server only. Many subsystems, including memory boards, mass storage, and graphics and communications cards, are common across the product family. In this article, we will focus on the entry-level platforms.

The 32-bit superscalar CPU is constructed of seven to nine CMOS chips containing more than 6 million transistors. Its architecture, which IBM calls "second-generation RISC," includes separate fixed-point, floating-point, and instruction/branch units that operate in parallel, for a total execution rate of up to five operations per cycle. In addition, the chip set includes separate data cache, storage control, and I/O control units. Depending on the model, the CPU operates at 20, 25, or 30 MHz. (See the figure.)

The new processor can access a vast amount of memory. Full 32-bit memory addressing allows it to directly address up to 4 gigabytes of real memory, and 52-bit virtual address generation permits access to a whopping 4 petabytes (i.e., 4 million gigabytes) of virtual memory. Real memory is located on a special high-speed synchronous bus that passes data to the cache on a 64- or 128-bit-wide path, depending on the model, at speeds of between 160 and 480 megabytes per second.

All the systems include an enhanced version of IBM's Micro Channel bus that uses data streaming to allow burst-mode transfers at up to 40 MBps, twice the speed of the bus in the PS/2s. The sustained throughput is 25 to 30 MBps. The new Micro Channel also specifies a 77 percent larger card size to allow more complex designs, and it performs parity checking on all data; however, it still accepts the smaller boards engineered for PS/2s. All the new high data-rate cards available for the systems, such as graphics, SCSI, and network interfaces, have on-board I/O processors and are bus-mastering.

To boost system reliability, all members of the family include error-detection and correction capabilities unprecedented in workstations, including a suite of 80 to 100 power-on self tests, parity checking on all buses and boards, bad-bit-swapping, and memory scrubbing.

The RISC CPU is a uniprocessor and isn't designed to allow closely coupled multiprocessing like many minicomputers. However, with an eye to distributed computing, IBM has built-in support for a 20-MBps optical link that lets systems share data in clusters. This technology will be implemented in the future.

Desktop POWERhouse

The entry-level RISC systems are called the POWERstation 320 and POWERserver 320. (POWER is an acronym for performance optimization with enhanced RISC.) Both use the same polycarbonate

continued

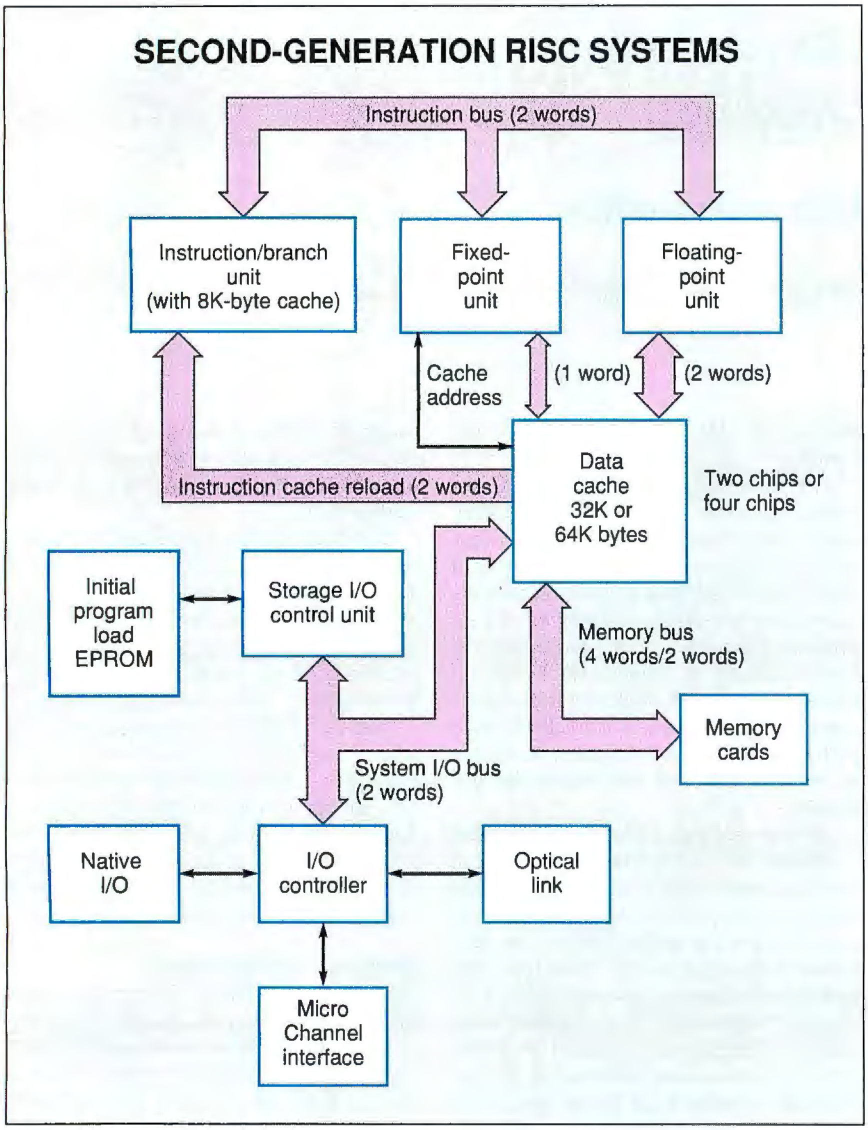
SYSTEM CONFIGURATIONS FOR THE RISC SYSTEM/6000 FAMILY

IBM's new RISC System/6000 consists of six models, all of which use essentially the same proprietary RISC CPU.

Model	Packaging	CPU/cache	Memory slots	Standard RAM	Maximum RAM (1-Mb/4-Mb SIMMs)	Micro Channel slots available	Storage bays (full-/half-height)	Standard storage[1]
320	Desktop	20 MHz/32 KB	2	8 MB	32/128 MB	4	0/2	120 MB
520	Deskside	20 MHz/32 KB	8	8 MB	128/512 MB	7	3/6	355 MB
530	Deskside	25 MHz/64 KB	8	16 MB	128/512 MB	7	3/6	355 MB
540[2]	Deskside	30 MHz/64 KB	8	64 MB	128/512 MB	7	3/6	640 MB
730[3]	Deskside	25 MHz/64 KB	8	16 MB	128/512 MB	6	3/6	355 MB
930[2]	Rack-mount	25 MHz/64 KB	8	16 MB	128/512 MB	6	4/8 per drawer	670 MB

[1]Storage, internal hard disk drives: 120-MB (desktop only), 320-MB (3½-inch); 355-MB, 670-MB, and 857-MB (5¼-inch); backup: 8-millimeter digital audio tape-recording system (internal/external), and ¼-inch and ½-inch tape (external); other: External 5¼-inch floppy disk drive and internal CD-ROM drive.
[2]POWERserver only.
[3]POWERstation only.

Notes: All systems include one 3½-inch 1.44-MB floppy disk drive and the following ports: keyboard, mouse, tablet, external floppy disk drive, parallel, and two serial. Deskside systems include one 4-MBps SCSI adapter; the 930 has two. The 730 includes a two-slot graphics card.



Block diagram of RISC CPU architecture. Note the separate units for fixed-point, floating-point, and instruction/branch operations. All memory access flows through the data-cache unit, while the storage I/O control unit and I/O "combo" chip control Micro Channel and bus access.

plastic enclosure, but the server version will sport more storage.

The desktop unit is a little larger than an IBM AT: It measures 6⅔ inches tall, 18 inches wide, and 20⅗ inches deep, and it weighs between 28 and 34 pounds. Inside the unit are a *system planar* (the motherboard [see photo 1]) and a *CPU planar* (see photo 2) that plugs into the unit perpendicularly. Both boards use an advanced eight-layer construction, with four signal and four power/ground layers; the CPU board is practically devoid of passive components.

The desktop CPU uses a seven-chip complex that operates at 20 MHz and includes two 16K-byte data-cache chips, or 32K bytes of cache. (Larger systems use a nine-chip set that has 64K bytes of data cache.) In addition to the CPU slot, the system planar has two memory slots, four Micro Channel slots, a "direct attach" hard disk drive connector, 192K bytes of self-test and boot EPROM, and an assortment of I/O ports. Rounding out the interior are a quiet cooling fan and a 265-watt, auto-sensing power supply with its own fan.

The standard memory allotment is 8 MB of 80-nanosecond RAM, configured as eight 1-MB single in-line memory modules on a single memory board. Double-sided 2-MB SIMMs are also available that would allow each memory board to hold 16 MB, for a total system memory of up to 32 MB. When 4-megabit DRAM chips become available in the future, the desktop unit will be able to hold 128 MB of real memory. For mass storage, the desktop includes two 3½-inch 120-MB hard disk drives mounted in a special carrier and plugged into the hard disk drive slot, and a 3½-inch 1.44-MB floppy disk drive.

For commercial installations, IBM provides a range of multiport asynchronous cards to connect ASCII terminals. For graphics applications, IBM offers four cards: gray-scale and color two-dimensional boards and two three-dimensional color options, which will be discussed later in the article. You can choose from 13 displays that range from a 12-inch, 640- by 480-pixel monochrome model to a 23-inch, 1280- by 1024-color unit, or you can use previously purchased displays.

The deskside systems, which look like small minicomputers, share similar packaging and internal design, but they vary in performance and configuration. In these models, the system and CPU boards are on the same plane, attached end to end (see the table for specifications).

Reestablishing the Lead in RISC

IBM invented RISC in 1975 with the 801 processor. The 801 was almost used as the heart of the IBM DisplayWriter, but, instead, it evolved into the CPU for the IBM RT, which was introduced in 1986.

The RT's anemic floating-point and graphics performance prompted IBM to design a new-generation CPU. The RIOS project had a major design objective: to achieve an execution rate of less than one cycle per instruction. Hand-in-hand were commitments to use 1-micron VLSI CMOS technology for low-power and cooling requirements, to offer large virtual memory and real-time interrupt handling, to develop optimized Unix compilers, to use industry standards, and to provide the best price/performance ratio on the market.

IBM's definition of RISC relies less on a small instruction set—there are 184 instructions, comparable to some complex-instruction-set computer architectures—than on optimizing them to execute in a single cycle or less. To achieve this, the RISC CPU uses parallelism and pipelining. At the heart of the CPU are three separate processor chips: the instruction/branch unit (ICU), the fixed-point unit (FXU), and the floating-point unit (FPU).

The ICU is responsible for doling out

instructions to the FXU and FPU and for resolving branch conditions. Instructions are pulled from an 8K-byte cache located on the same chip, which is in turn fed from memory through the data cache in 64-bit increments. The ICU can execute two operations internally while at the same time issuing orders to the FXU and FPU.

The ICU has two particularly powerful capabilities. First, it contains a special 32-bit register that is used to track the status of up to eight branch conditions. Using this register and instruction look-ahead, the ICU can *presolve* branches and execute them as soon as conditions permit. This so-called "zero-cycle" branching is more efficient than the methods that are used in other RISC architectures.

Second, the ICU contains special registers into which the complete machine state is stored in the event of an interrupt. This permits the system to vector quickly to an interrupt service routine without using a time-consuming stack operation that would involve FXU address generation and memory access.

The FXU is less remarkable in its design, but it plays an important role in generating and translating addresses and controlling the data cache. What is significant is that these tasks have been offloaded from the usual RISC CPU. The FXU performs all integer arithmetic and logical operations and contains the segment registers for memory addressing. One unusual feature for a RISC system is that the FXU supports special string instructions for handling null-terminated strings (used in C) or length-specified strings (used in Pascal) with minimal overhead.

The key to RISC performance is that the FPU receives instructions concurrently with the FXU and executes them at the same rate. The FPU has a 64-bit path from the data cache and conforms to IEEE floating-point standards. A pipelined design lets it spit out a double-precision result every cycle with only a two-cycle latency.

The FPU also has one special instruction (multiply/add) that executes in the same time required for simple adding or multiplying. This single instruction permits the system to execute the equivalent of five operations per cycle, even though only four are dispatched at a time.

All the chips in the CPU are implemented in VLSI CMOS using 1-micron technology. The packages, roughly 1 inch on a side, have between 184 and 293 pins each and are socketed for easy replacement. For reliable cooling, each chip is topped with an aluminum heat sink. Most of the rest of the components in the system are surface-mounted.

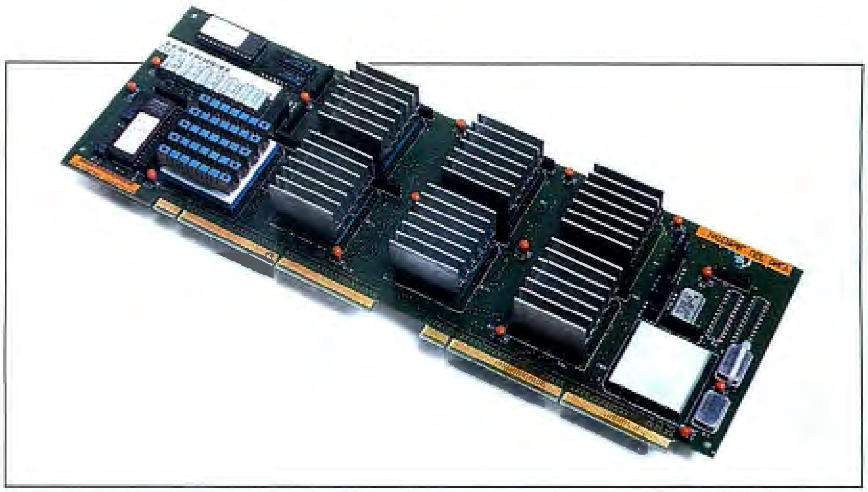


Photo 1: *The 20-MHz CPU planar for the desktop. The CPU plugs into the slot on the system planar. Note the heat sinks on top of the chips.*

Data Paths

The cache is the interface to the main memory, and it feeds instructions to the ICU and data to the FXU and FPU. Instead of off-the-shelf static RAM components, IBM uses a custom cache design that is two- or four-way associative. The company claims that this design permits a hit rate that is equal to a direct-mapped static RAM cache two times as large.

The entry-level desktop and deskside

continued

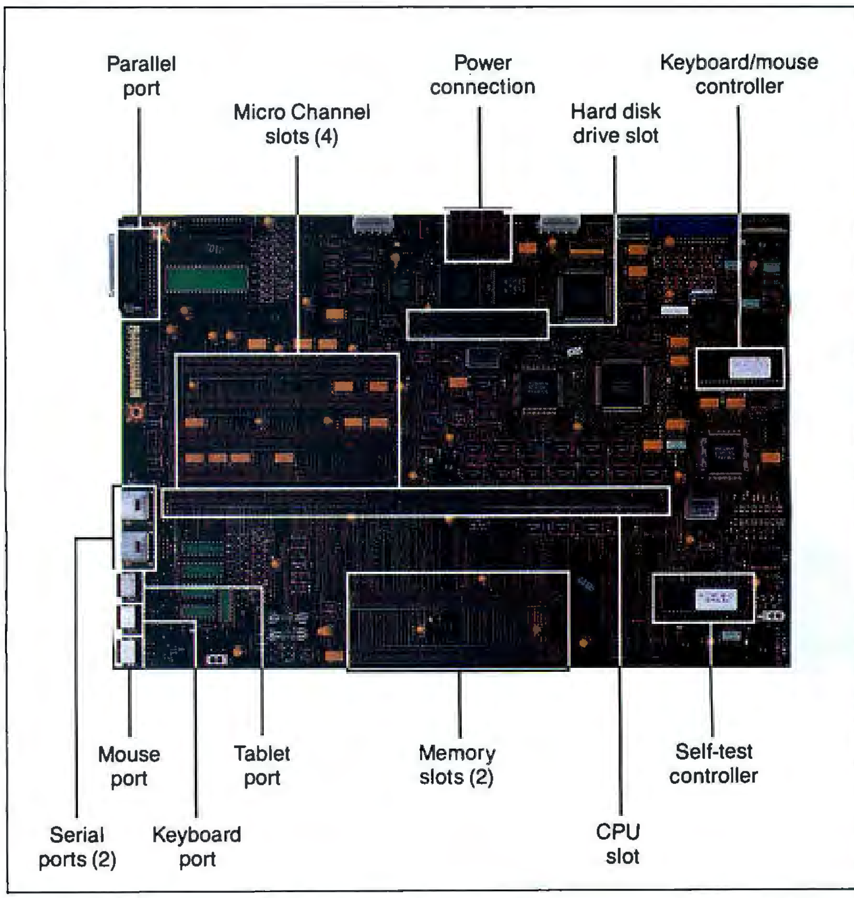


Photo 2: *The desktop system planar. The system planar has slots for the CPU, memory, hard disk drive, and Micro Channel cards, plus a host of I/O connectors.*

COMPANY INFORMATION

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systems have 32K bytes of two-way associative cache and a 2-word, or 64-bit, path width from main memory. (The actual data bit width from each memory card is 80 bits—including error-correction and redundant bit lines—while there are 50 lines for 32-bit addresses plus control and parity.) With a CPU speed of 20 MHz, the memory bus bandwidth is 160 MBps.

The nine-chip systems have a 64K-byte four-way associative cache and a memory path width of 128 bits, or 210 bits including addressing and error-correction. The 25-MHz models have a memory bandwidth of 400 MBps, and the 30-MHz model transfers at 480 MBps.

The systems use a segmented memory architecture and support memory locking to prevent processes from interfering with one another. Physically, memory is four-way interleaved and scattered so that no more than 1 bit of each word is located in a single DRAM chip. Logically, memory is split into 4K-byte pages, and real addresses are calculated using a translation look-aside buffer and a page-frame table.

Graphic Evidence

Any of the systems can accept one of several 2-D and 3-D graphics adapters announced with the RISC family. The "entry-level" board is available in two flavors: 4-bit gray-scale (16 shades) or 8-bit color (256 colors from a palette of 16 million). This card uses a single frame buffer and can draw 75,000 2-D vectors per second.

The High-Performance 3-D Color Graphics Processor, codeveloped by IBM and Silicon Graphics, uses technology from the Personal Iris system. The two-slot card is available in 8-bit or 24-bit color versions to allow, respectively, 256 or 16 million colors from a palette of 16 million. It can draw 90,000 2-D vectors and 90,000 3-D vectors per second, and with an optional daughtercard, it can draw 10,000 Gouraud-shaded triangles per second. A second daughtercard option provides z-buffering.

Impressions

To go from the back of the Unix pack to being a leader requires more than snappy hardware. Users want standards, and they need applications. IBM has poured a vast effort into the compiler technology that lets applications take advantage of the RISC CPU. But the company has also chosen to sidestep the popular movement toward a common Unix by enhancing its nonstandard AIX.

To encourage wary third-party developers to port applications to the RISC System/6000, IBM has set up a special porting lab in Austin and will establish others in the U.S. and all over the world. The laboratories are staffed by trained engineers dedicated to each port, and developers are given ample equipment and security. Hundreds of Unix applications have already been ported. The costs of running the centers is no doubt staggering, but they are indicative of IBM's commitment to this product line and to the Unix market.

IBM's previous venture in workstations was unsuccessful, and the company knows it is at least two years behind in the marketplace. To catch up, IBM has thrown everything into the RISC System/6000, including years of engineering, extensive training, and what promises to be a major marketing effort. From our early look, we think the RISC System/6000 stands a good chance of success.

Our technical reservations are few. Will the Micro Channel, even with its improvements, be fast enough for large multiuser applications or very data-intensive graphics? Will AIX suffer in the market for its incompatibility with Unix System V release 4 and lack of multiprocessing support? Will there be enough applications available soon enough? The main concern is whether IBM will be sufficiently nimble to succeed in the fast-paced workstation market. The RIOS project has been marked from the beginning by vacillation and delays. To compete in the RISC market against Sun, Hewlett-Packard, MIPS, and Digital Equipment, IBM can't afford to be risk-averse.

IBM has bested the SPARCStation's price/performance ratio by 2 to 1. Since IBM has hinted at less-expensive members of the RISC System/6000 family in the future, the price/performance ratio will continue to challenge not only competing workstations but high-end PCs as well. ■

Andy Reinhardt is a BYTE associate news editor. Ben Smith is a BYTE technical editor. You can contact them on BIX as "areinhardt" and "bensmith," respectively.

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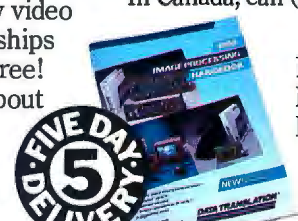

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DT2861 Frame Grabber	IBM PC AT	512x512	256	Yes	Yes	0–12 MHz	8*	Yes	Yes	16 buffers 512x512x8 each (4 Mbytes)	Yes	DT-IRIS IRIStutor Image-Pro	$4995
DT2862 Frame Grabber	I8M PC AT	512x512	256	Yes	Yes	0–12MHz	8*	Yes	Yes	4 buffers 512x512x8 each (1 Mbyte)	Yes	DT-IRIS IRIStutor Image-Pro	$2995

*With DT2859 ½ size multiplexer board ($399).

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Circle 83 on Reader Service Card

The Heart and Soul

The right motherboard provides the foundation for high-performance, 25-MHz 386 systems

Steve Apiki, Rob Mitchell, and Stan Wszola

With all the emphasis these days on high-performance storage and video subsystems, it's easy to forget that the ultimate performance enhancement is a new system board. The fastest SCSI drive won't give your applications the boost you expect if the real culprit is a slow CPU or memory architecture.

Virtually all 386 motherboards are designed to run at or close to zero wait states. But the presence of cache memory, or support for interleaving or fast-page-mode DRAM chips, can make a big difference in how a motherboard performs. Of course, performance isn't the only factor separating 386 motherboards. Other features, such as pricing and expandability, vary considerably.

How do the different 386 motherboard designs stack up? To find out, we examined 23 motherboards from 16 different vendors (see tables 1 and 2). All the motherboards support a 25-MHz CPU and include a 25-MHz Intel 80387 math coprocessor. Last year's cutting-edge performers, systems built around the 25-MHz 386, have dropped in price to become an attractive high-performance 386 platform.

Why Test Motherboards?

Replacement motherboards are an appealing alternative to budget-conscious users of XT- and AT-class machines who are looking for an inexpensive way to move up to a 386. Depending on your existing hardware, you could save substantially over the cost of a new system. But you might have some problems integrating the new motherboard into a system with components that are designed for older, slower systems.

If you plan to build a system from the ground up, the savings will probably be disappointing. Major PC clone vendors buy components by the truckload and can offer assembled systems for less than the retail cost of all the parts. The main advantage of assembling your own system isn't monetary; it's an intimate understanding of what's in your machine and how it fits together. You can build your system to your exact specifications using the components that will produce the best performance or greatest economy.

But the relative merits of 386 motherboards aren't just topics for the do-it-yourselfer. If you're thinking of buying a system, you will find that third-party motherboards offer an excellent basis of comparison among clone machines. Many PC clone vendors pride themselves on using name-brand graphics adapters, monitors, and hard disk drives. But the motherboard isn't as likely to be from a well-known manufacturer—and even when it is, information about a given motherboard is often hard to find.

We tested both cached and noncached designs and both XT- and AT-size motherboards. You won't find all these motherboards at the corner computer store, or even in the back pages of BYTE. Intel and Mylex, for example, sell only to value-added resellers (VARs). But other vendors, such as Jameco and JDR Microdevices, sell both directly to end users and through dealers.

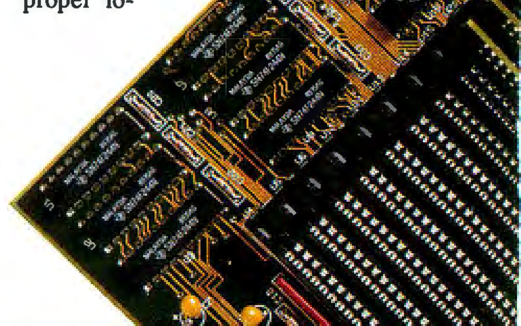
Most vendors offer a bare-bones motherboard configuration that includes a 25-MHz Intel 386 CPU and no DRAM. If the motherboard includes a cached-memory system, it includes at least 32K bytes of static RAM.

List prices vary, depending on configuration, vendor reputation, and distribution channel. Cache motherboards cost more than noncached models, and name-brand motherboards like Mylex's MWS 386-25 and Jameco's JE3026 (which is actually made by American Megatrends, Inc. and is identical to 25-MHz AMI motherboards found in many compatibles) cost substantially more than lesser-known brands. Motherboards sold through dealers and VARs have higher list prices than boards available directly from the manufacturer, but they generally sell at a discount.

To make comparisons easier, we've made two features tables: table 1 for caching motherboards, and table 2 for noncaching motherboards. Most of those with a cache ranged in price from $1100 to $2000 with no RAM. The least-expensive cached product was Nascent's NT-386-25 ($1049), and the most expensive was Intel's Model 302 ($4091), which included 2 megabytes of RAM. Noncaching boards started at $765 and went up to $2095 for the Seattle STD 386XT, which comes standard with 1 MB of RAM.

The Proving Ground

We tested each motherboard for two things: performance and physical compatibility. Determining the latter merely meant installing each motherboard in a generic AT-size case to check for correct size and proper lo-



# of a PC Compatible

cation of the holes for mounting standoffs and screws. Every board fit into the case, although some just squeaked by our AT's disk drive housing.

To test performance, we set up a test system consisting of the following peripherals: a 250-watt power supply, a Western Digital WD1006V-MM1 hard disk drive controller card, a Seagate ST-251-1 40-MB hard disk drive, a Jameco JE1077 floppy disk drive controller/serial/parallel card, a TEAC FD-55GFR 5¼-inch 1.2-MB floppy disk drive, an AST VGA Plus video card, a Key Tronic KB 101 keyboard, and one of several color VGA monitors.

We hooked each motherboard into this test-bed in turn. We tested each board under DOS 3.3 with an Intel 80387 coprocessor and at least 2 MB of memory installed. If the minimum interleaved configuration required 4 MB, we installed 4 MB. The BYTE benchmark results in table 3 show the CPU, FPU, and video benchmark indexes and ratings from the conventional Dhrystone and Livermore Loops tests.

To gauge the effectiveness of these boards when running large, protected-mode applications, we also put them through a run of the BYTE Unix benchmarks. We installed 8 MB of memory in each board to provide a realistic Unix environment and then ran the benchmarks using Interactive's 386/ix 3.2. The indexed results of these benchmarks and of our standard CPU, FPU, and video benchmarks are graphed in the figure.

Cache Machines

Motherboard designers use several tricks to improve performance. While a few techniques (e.g., video-BIOS shadowing or increasing the bus speed) affect peripherals, most are aimed at shortening the time that the CPU spends exchanging data with system memory. Over the last few years, as PC processors began outrunning available DRAM, cached memory has proved the

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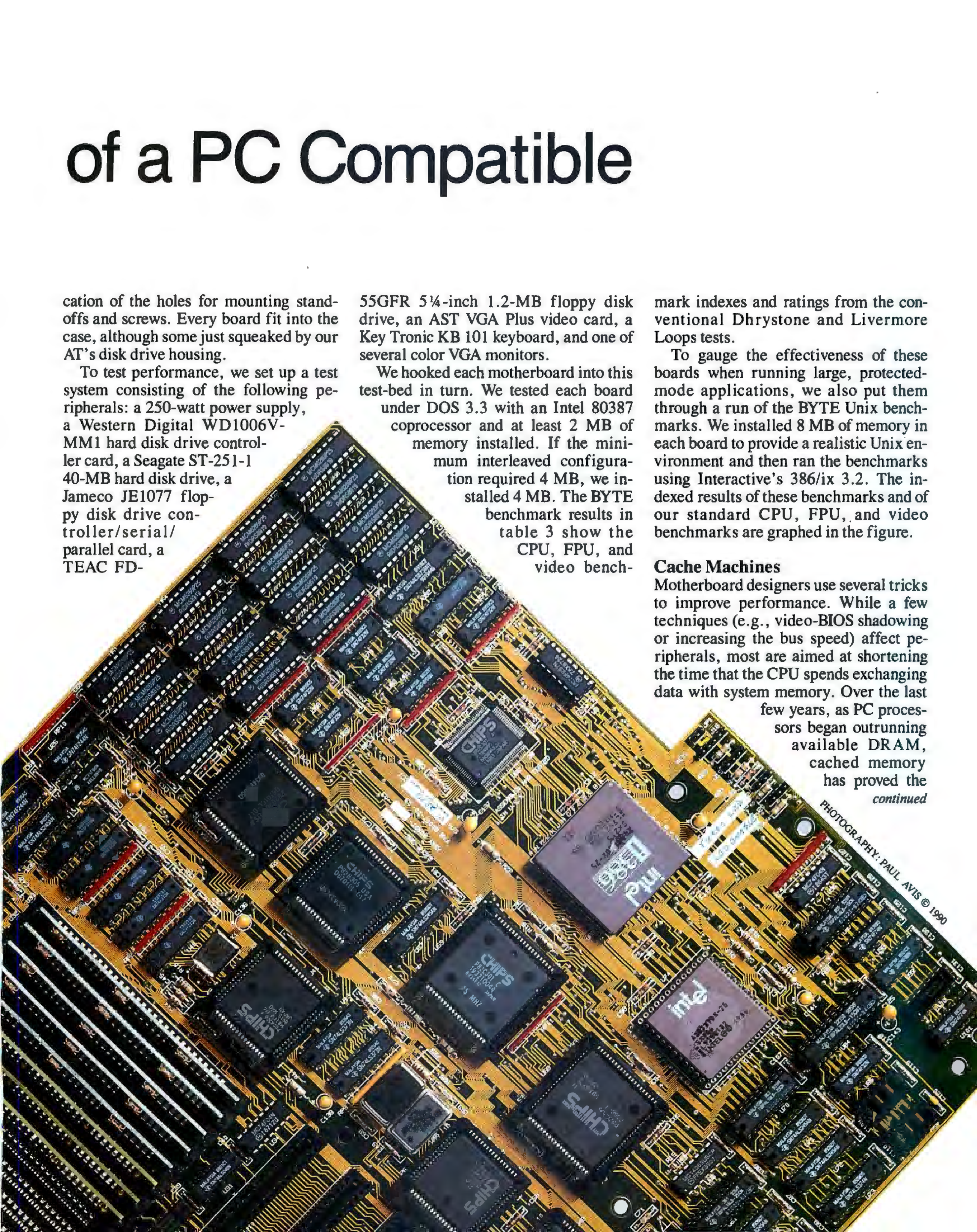

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CACHING 25-MHz 386 MOTHERBOARDS

Table 1: Features of caching 25-MHz 386 motherboards. Boards are differentiated by nonperformance features (e.g., expandability and flexibility of configuration) as well as by performance-enhancing features (● = yes; ○ = no).

Motherboard	Manufacturer	List price	Board size (inches)	CPU speeds (MHz)	System bus speed (MHz)	Expansion slots	Math coprocessors[1]	ROM BIOS (date)	BIOS Shadow RAM	Video Shadow RAM	386 chip set
Atronics ATI-386/B	Atronics International	$1295[3]	18½ × 12	8, 25	8	2 8-bit, 6 16-bit, 1 32-bit	80387-25, 1167-25, 80287-10	AMI EC&T 5286 (4-20-88)	●	○	ATI
C² M-386-25	C² Micro Systems	$1300	12 × 13¾	6, 8, 25	8	2 8-bit, 5 16-bit, 1 8-/32-bit	80387-25,[4] 1167-25	Award M386-25/33 (8-25-89)	●	●	'Discrete logic
Cache 386-25	Cache Computers	$1100	12 × 13¾	8, 25	8, 8.3, 12.5	1 8-bit, 7 16-bit	80387-25, 3167-25	AMI E307 6063 (9-15-89)	●	●	C&T
DTK Cache 386-25	DTK Computer	$1649[5] $2149[6]	12 × 13¾	10, 25	6, 12	1 8-bit, 6 16-bit, 1 8-/32-bit	80387-25, 3167-25	DTK 4.25 (6-12-89)	○	○	Discrete logic
Intel Model 302	Intel	$4091[7]	12 × 13 2/6	8, 25	8	1 8-bit, 5 16-bit, 2 8-/16-/32-bit	80387-25, 3167-25	Phoenix 1.10 04.C1 (1-15-88)	●	●	Discrete logic
Jameco JE3026	AMI	$1900	12 × 13¾	8, 25	8	1 8-bit, 6 16-bit, 1 8-/32-bit	80387-25, 3167-25	AMI DAMI 3607 (4-25-89)	●	●	Discrete logic
Jameco JE3525	Elite Group	$1200	8½ × 13	8, 25	8	1 8-bit, 4 16-bit, 1 32-bit	80387-25, 3167-25	AMI EC&T 1131 (8-30-89)	●	●	C&T
JCS 386c	JC Information Systems	$1100	8½ × 13	8, 25	8	1 8-bit, 5 16-bit, 1 8-/32-bit, 1 16-/32-bit	80387-25, 3167-25	Phoenix 1.10.02 (1-15-88)	●	●	C&T
JDR C386-25	Modular Circuit Technology	$1199[9]	8½ × 13	16, 25	8	3 8-bit, 4 16-bit, 1 32-bit	80387-25, 3167-25	AMI EC&T 1131 (2-25-89)	●	●	C&T
Micronics 80386-I Cache	Micronics Computers	$1500	12 × 13¾	6, 8, 25	8.3, 12.5	2 8-bit, 5 16-bit, 1 32-bit	80387-25, 3167-25[10]	Phoenix 1.10.10A (1-15-88)	●	● (EGA only)	Discrete logic
Monolithic MicroFrame 386CT	Monolithic Systems	$1945	8½ × 13	10, 25	8.3, 10, 12.5	6 16-bit, 2 8-/16-/32-bit	80387-25, 3167-25	Quadtel CS8231 3.03.03 (8-09-89)	●	●	C&T
Mylex MWS 386-25	Mylex	$2100	12 × 13¾	8, 25	6.25, 8.33, 12.5	1 8-bit, 6 16-bit, 1 8-/32-bit	80387-25, 3167-25[10]	Phoenix 1.10.10 (11-15-88)	○	○	Discrete logic
Nascent NT-386-25	Nascent Technology	$1049	12 × 13¾	8, 25	8	1 8-bit, 6 16-bit, 1 8-/32-bit	80387-25, 3167-25	AMI 1400 (8-15-88)	○	○	Discrete logic
OEM 386-25MX	OEM	$1295	12 × 13¾	8, 25	8, 10	1 8-bit, 6 16-bit, 1 8-/32-bit	80387-25, 1167-25	AMI 5301 (12-15-88)	●	●	C&T
Orchid Privilege 386/Cache	Orchid Technology	$1398	12 × 13¾	8, 25	8	2 8-bit, 5 16-bit	80387-25, 3167-25	AMI DC&T 5025 (4-30-89)	●	●	C&T

Note: Base price includes CPU.
[1]All motherboards support only one math coprocessor at a time unless footnoted.
[2]Tested type listed first.
[3]Base price includes 1 MB of RAM.
[4]Supports both coprocessors simultaneously.
[5]64K-byte-cache version.
[6]256K-byte-cache version.

most effective method for enhancing high-speed board performance.

Not surprisingly, cached boards in our tests decidedly outperformed their non-cached counterparts. On both DOS and Unix CPU tests, the 16 caching models finished well ahead of the seven that did not use caches. The trend continued for our Dhrystone tests as well.

While some cache is always better than no cache, a clear winner among caching schemes is not easy to find. The boards that we benchmarked employed a handful of common caching methods, and different tests favored different methods.

All caches work by keeping frequently accessed data in a small amount of very fast static RAM. They are effective because, statistically, programs tend to spend most of their time within a small range of memory addresses. Cache implementations differ, however, in how they organize data, when they write to main memory, and how large a cache they require.

About one-half of the cached boards (nine) used a direct-mapped cached organization; the remainder used two-way set-associative caches. Although other types exist, these two are by far the most common in current PCs.

Direct-mapped caches assign a dis-

Memory							Cache memory					Warranty (years)	Source
Geometry	Package	Speed (ns)	RAM types[2]	Interleave	Maximum on-board RAM (MB)	Maximum 32-bit RAM (MB)	Controller	Cache organization	SRAM speed (ns)	Tested size (bytes)	Other size (bytes)		
256K × 9 1Mb × 9	SIMM	80	RAS/CAS, page-mode, static-column	○	8	16	Proprietary	Direct-mapped write-through	25	64K	32K	1	Dealers, VARs
1Mb × 1	DIP	100	Page-mode, RAS/CAS	○	4	16	Intel 82385	Two-way set-associative write-through	25	32K	None	1	Direct, VARs
256K × 9 1Mb × 9	SIMM	80	RAS/CAS, static-column	○	16	16	C&T 82C307	Two-way set-associative posted-write	25	32K	None	1	Dealers, VARs
256K × 1 256K × 4 1 Mb × 1 256K × 9 1Mb × 9	DIP SIP	80	RAS/CAS, page-mode, static-column	○	8	16	Proprietary	Direct-mapped write-back	25	64K, 256K	None	1	Direct, dealers, VARs
256K × 9 1Mb × 9	SIMM	100	Page-mode, RAS/CAS, static-column	○	8	40	Proprietary	Direct-mapped posted-write	35	64K	None	1	VARs
1Mb × 1 256K × 1 256K × 9 1Mb × 9[8]	DIP SIMM	70	RAS/CAS, page-mode, static-column	●	8	24	Proprietary	Direct-mapped write-through	25	64K	None	1	Direct
256K × 9 1Mb × 9	SIP	80	RAS/CAS	●	0	16	Intel 82385	Two-way set-associative write-through	35	32K	None	1	Direct
256K × 4 1Mb × 1 1Mb × 9	DIP	100	Page-mode	○	0	32	C&T 82C307	Two-way set-associative write-through	25	32K	None	1	Direct, dealers, VARs
256K × 1 1Mb × 1	DIP	60	RAS/CAS	●	0	16	Intel 82385	Two-way set-associative write-through	25	32K	None	1	Direct
256K × 1 1Mb × 1	DIP	80	RAS/CAS, page-mode, static-column	○	0	16	Intel 82385	Direct-mapped posted-write[11]	35	32K	64	1	Direct, dealers, VARs
256K × 9 1Mb × 9	SIP	100	Page-mode	○	8	24	C&T 82C307	Two-way set-associative posted-write	25	32K	None	5	Direct, dealers, VARs
256K × 9 1Mb × 9	SIMM	80	RAS/CAS	○	8	16	Proprietary	Direct-mapped write-through	25	64K	None	1	Dealers, VARs
256K × 9 1Mb × 9	SIMM	80	RAS/CAS	○	8	16	Proprietary	Direct-mapped write-back	25	64K	256K	2	Dealers, VARs
256K × 4 256K × 1[8]	DIP	70[12]	Page-mode	●	8	16	Intel 82385	Two-way set-associative write-through	25	32K	None	1	Direct
256K × 9 1Mb × 9	SIMM	80	RAS/CAS	●	16	16	Intel 82385	Two-way set-associative posted-write	35	32K	None	2	Dealers, VARs

[7]Base price includes 2 MB of RAM.
[8]Motherboard will support 4-megabit chips when available.
[9]Memory board required, not included ($99).
[10]Optional daughtercard supports both Intel 80387 and Weitek 3167 coprocessors.
[11]Can be configured as two-way set-associative with additional static RAM.
[12]80-ns chips are standard.

tinct set of memory locations to each cache *line* (a line is 4 bytes long for these boards). The main memory locations mapped to each cache slot are grouped by the least significant part of their addresses; the effect is that each cache location can contain data only from each *n*th memory address, where *n* is the length of the cache in lines. Each memory location, therefore, has only one corresponding cache slot; the processor need only check one location to determine if a hit or a miss has occurred. This fast hit/miss determination is the strength of the direct-mapped method. Unfortunately, because each memory location must share a cache slot with several other main memory addresses, it's possible that some useful data will get bumped out, forcing the CPU to access main memory.

Two-way set-associative cache designs reduce the likelihood of this problem by having two slots available for each memory location. A cache of this kind is like two direct-mapped caches in parallel. This system has two disadvantages: First, each set is only half the size of an equivalent direct-mapped cache; and second, the processor must look in two places to determine whether a hit or a miss has occurred.

Memory-write methods also affect

continued

NON-CACHING 25-MHz 386 MOTHERBOARDS

Table 2: Features of noncaching 25-MHz 386 motherboards. As with table 1, boards are often differentiated by nonperformance features (●=yes; ○=no).

Motherboard	Manufacturer	List price	Board size (inches)	CPU speeds (MHz)	System bus speed (MHz)	Expansion slots	Math coprocessors[1]	ROM BIOS (date)	BIOS Shadow RAM	Video Shadow RAM	386 chip set
C² MBI386A+	C² Micro Systems	$765	12 × 13¾	16, 25	8.3, 10.3	1 8-bit, 6 16-bit, 1 32-bit	80387-25, 1167-25 with 80287-8 socket[3]	AMI EC&T 1164 (3-03-89)	●	●	C&T
C² Baby 386 Mainboard	C² Micro Systems	$775	8½ × 12¾	20, 25	8.3, 6.7	3 8-bit, 4 16-bit, 1 16-/32-bit	80387-20	AMI EC&T 1030 (3-03-89)	●	●	C&T
JCS 386I	JC Information Systems	$850	8½ × 13	8, 25	8	2 8-bit, 5 16-bit, 1 16-/32-bit	80387-25, 1167-25	Phoenix 1.10.02B (1-15-88)	●	●	C&T
JDR M386-25	Modular Circuit Technology	$799	8½ × 13	16, 25	8	2 8-bit, 5 16-bit, 1 32-bit	80387-25	AMI EC&T 1131 (3-03-89)	●	●	C&T
JDR 386-MB-25S	Modular Circuit Technology	$799	12 × 13¾	16, 25	8.3, 12	3 8-bit, 5 16-bit	80287-8, 80387-25, 3167-25	AMI EC&T 1102 (3-03-89)	●	●	C&T
Pioneer VMB-386/25	Pioneer Computer	$789	8¾ × 12	8, 25	8	2 8-bit, 5 16-bit	80387-25, 3167-25	AMI 6802 (9-15-89)	●	●	C&T
Seattle STD 386XT	Seattle Telecomm and Data	$2095[4]	8½ × 12	8, 25	8	3 8-bit, 4 16-bit, 1 8-/32-bit	80387-25[5]	Quadtel CS2386 3.04.01 (9-20-89)	●	●	C&T

[1]All motherboards support only one math coprocessor at a time unless footnoted.
[2]Tested type listed first.
[3]Motherboard will support 4-megabit chips when available.
[4]Base price includes 1 MB of RAM.
[5]80387 and 386 in daughtercard plugged into 386 socket. 80287 socket is an option.

cache performance. A cache can follow a simple write-through policy, in which each write operation is carried out to both cache and main memory. A more sophisticated approach, *posted write-through*, frees the main processor after the cache write; the main memory write is carried out independently by the cache controller. Write-back, the most complex scheme, updates main memory only when a modified entry is dumped from the cache.

Cache size is the last critical factor. Large caches mean better performance, but there is a very steep diminishing-returns curve after a certain size. That critical size differs for each application, but several manufacturers statistically estimate a 95 percent cache hit rate for 32K-byte caches.

Six of the boards that we tested used Intel's 82385 cache controller. Although the 82385 can be configured for either direct-mapped or two-way set-associative operation, only the Micronics board ran the unit in direct-mapped mode. Micronics lets you set the cache organization as an option, but you must double the standard static RAM to 64K bytes to use a two-way set-associative cache.

JC Information Systems' JCS 386c, the Monolithic MicroFrame, and the Cache 386-25 used Chips & Technologies' 82C307 cache/memory controller instead. The 82C307 also allows two-way set-associative cache control of up to 32K bytes.

The other boards went with proprietary cache designs, all of which were direct-mapped. Intel, ironically, passed over its 82385 in favor of a proprietary cache controller design for the Model 302. DTK's board lets you install a cache of up to 256K bytes, and it and the Nascent are the only models to implement a write-back cache.

Our benchmarks show some correlation between cache type and effectiveness, but the presence or absence of a cache is still a much stronger indicator of performance. DOS tests, which are relatively small programs, reacted more favorably to the smaller, two-way set-associative caches than to the large direct-mapped designs. The top six finishers on our DOS benchmarks (the top six in table 3) all used this design.

Jameco's JE3525 and the Mylex MWS 386-25 performed significantly poorer in the DOS benchmarks than other cached boards. The aberration is surprising, considering that their basic memory configuration is similar to that of boards that outperformed them. These two suffered the most on low-level string move operations, but they handled algorithms like the Sieve of Eratosthenes almost as well as other cached boards.

The Dhrystone test showed more of an affinity for cache size than for cache type. DTK's 256K-byte board finished on top, and the two next highest performers had 64K-byte caches. These three also shared a write-back cache.

Under Unix, large, direct-mapped caches seemed to fare better than they did under DOS. All the cached boards clustered very tightly on these tests, however, and the difference in scores between the best and the worst cached boards is far less than the gap between the slowest caching unit (the Mylex MWS 386-25) and the best noncached board (the JDR 386-MB-25S).

The Interleave Alternative

Noncached boards are an attractive alternative to the pricier cached models, if top performance isn't your driving requirement. The least expensive of these boards can be had for $765, and, of course, any of these boards will still run rings around an AT.

The seven noncached boards that we tested all make use of memory-bank interleaving to strengthen memory performance. Several of the cached boards also use interleaving to back the cache.

One of the critical delays in accessing DRAM is recharge time, which must occur between successive accesses to the same chip. The interleave solution puts

Memory							Warranty (years)	Source
Geometry	Package	Speed (ns)	RAM types[2]	Interleave	Maximum on-board RAM (MB)	Maximum 32-bit RAM (MB)		
256K × 4 256K × 1 1 Mb × 1	DIP	80	RAS/CAS, page-mode, static-column	●	10	16	1	Direct, VARs
256K × 9 1Mb × 9	SIP	80	RAS/CAS, page-mode	●	8	16	1	Direct, VARs
256K × 4 1Mb × 4 256K × 9 1Mb × 9	DIP SIMM	80	Page-mode	●	8	16	1	Direct, dealers, VARs
256K × 9 1Mb × 9	SIP	80	RAS/CAS	●	8	16	1	Direct
256K × 9 1Mb × 9 1Mb × 1	SIP DIP	80	RAS/CAS	●	16	16	1	Direct
256K × 9 1Mb × 9	SIMM	60	Page-mode	●	8	8	2	Dealers, VARs
256K × 9 1Mb × 9	SIP	60	Page-mode	●	8	16	1	Direct

one-half of the addresses (even) in one bank and the other half (odd) in another; if reads or writes occur sequentially, one bank can be recharging while the other is being accessed. Unfortunately, boards that use this scheme require that you fill the memory banks in pairs. On many boards, this means that you must have either 2 or 8 MB of memory to get reasonable performance. In some preliminary tests, we found that the difference between interleaved and noninterleaved performance was 15 percent to 20 percent.

Pioneer's VMB 386/25, Seattle Telecomm's STD 386XT, and the JCS 386i use *page-mode* DRAMs for added speed. Normal (row address strobe/column address strobe, or RAS/CAS) DRAM chips require that both row and column select lines be strobed for each access. Page-mode DRAMs can skip the RAS precharge time when making successive reads or writes to memory locations with the same row address (i.e., in the same "page"). Pages are 2K bytes in size for 256K-byte DRAMs; this gives you a 2K-byte range of consecutive addresses that can be accessed much more quickly than with normal DRAMs. Boards that interleave page-mode DRAMs interleave not addresses but entire pages, for a much higher probability of fast access.

Some of the cached boards also use, or can also accept, page-mode DRAMs. C^2's MBI386A+ board and several cached models will also accept *static-column* RAM, which is like page-mode memory but doesn't require a column address strobe between successive reads. Intel claims a 7 percent improvement for static-column over page-mode DRAM and a 7 percent performance difference between page-mode and normal DRAM.

Our benchmarks show little correlation between use of page-mode DRAMs and superior performance. The seven noncaching boards, page-mode or not, performed very much alike under Unix. Under DOS, five of the motherboards were nearly identical, while the (page-mode) STD 386XT and (standard) C^2 MBI386A+ boards were disappointingly slow.

Beyond the CPU

Fast memory architecture could not make as much of a contribution to our floating-point and video benchmarks. As a result, the cached/noncached distinction is not nearly as severe.

DOS FPU benchmarks showed a smooth transition between cached and noncached units, with cached models still somewhat faster. The two results that stand apart are negative: Atronics' ATI-386/B was surprisingly weak for a cached board, and the noncaching C^2 Baby 386 Mainboard, which could run its 80387 at only 20 MHz, finished dismally far behind the rest of the pack. Unix Float benchmark results confirmed the DOS numbers.

The Livermore Loops test, which doesn't concentrate on pure 80387 instructions quite as much as our FPU benchmark does, showed a similar but slightly broader spread. Again, C^2's Baby 386 Mainboard lagged.

Our final test was BYTE's video suite. Originally, we intended it to be a measure of bus throughput, but instead it pointed out the effectiveness of video BIOS shadowing.

The graphics portions of our test ran similarly on all the boards. Since all buses were configured at or near 8 MHz, there was little room for variation.

But our text tests, which rely heavily on the BIOS, showed drastic differences from board to board. The benchmark uses cursor-positioning BIOS calls to move the cursor around the screen; on this test, the difference between shadowed and not-shadowed performance was on the order of 2 or 3 to 1.

Installation Basics

All the motherboards that we tested came preconfigured with each vendor's recommended memory configuration. But since most boards don't include any memory as standard, you'll face a variety of memory options. A 25-MHz motherboard requires fast RAM, typically with access times of 60 to 100 nanoseconds. Your best bet is to stick with the vendor's recommendations here. You can use slower, less expensive RAM chips, but that adds CPU wait states, which defeats the purpose of buying a fast computer. If you're upgrading to a board that will accept dual-in-line package (DIP) DRAMs, don't give in to the temptation to reuse 150-ns RAM from that old AT—the cost savings isn't worth the performance penalty that you will pay.

A few motherboards, such as C^2's M-386-25 and the JCS 386c, require page-mode DRAMs. Other motherboards accept standard RAS/CAS or page-mode DRAMs, but the slight increase in performance that you'll get by buying page-mode DRAMs probably isn't worth the extra cost. Several vendors also support even faster—and more expensive—static-column DRAMs as an option.

Most of the motherboards that we tested support 16 MB of 32-bit memory through a combination of on-board RAM and 32-bit memory boards. That is no coincidence. Most manufacturers used

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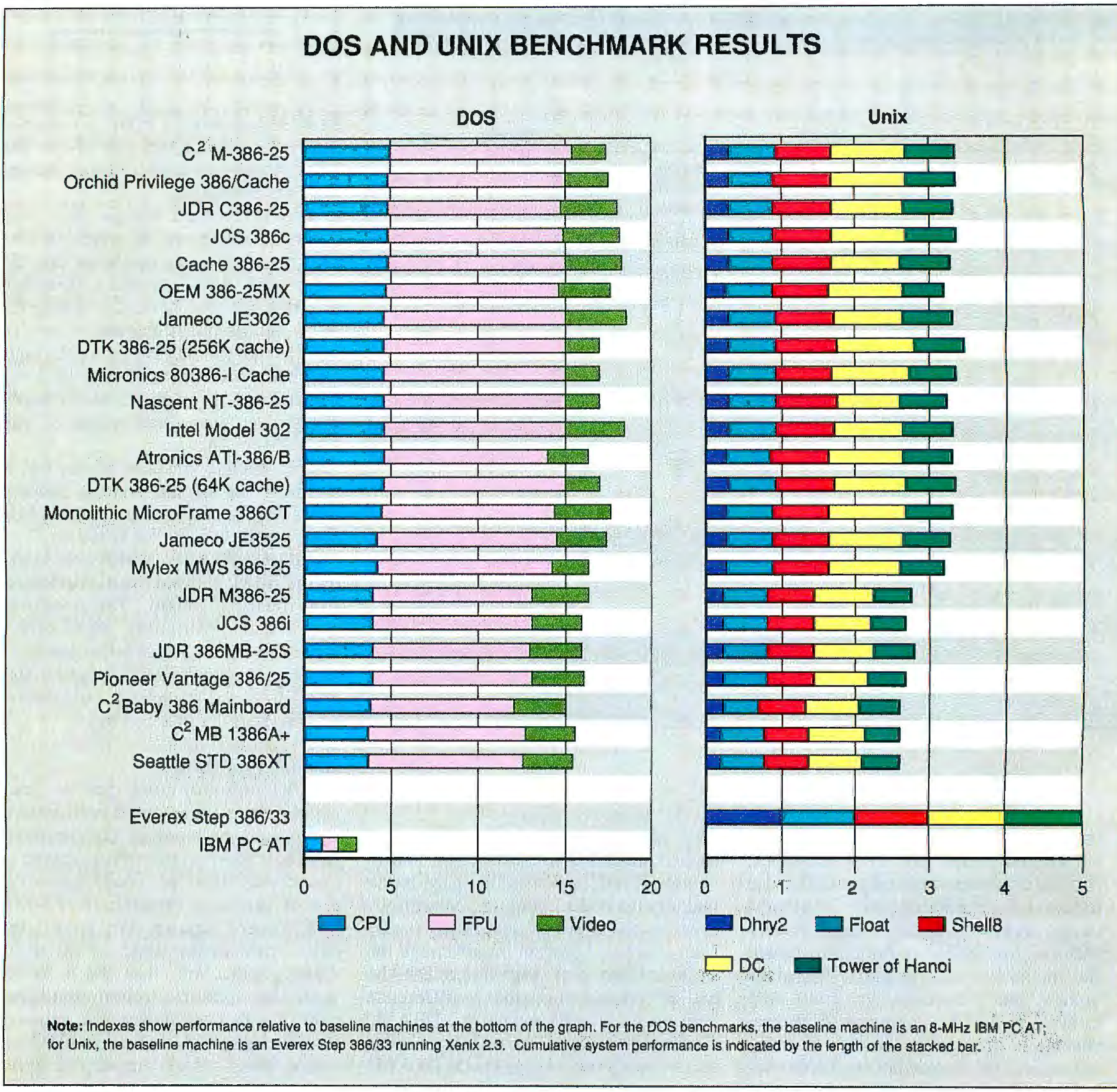

DOS and Unix benchmark performance for each motherboard, shown here ranked by DOS CPU index. While Unix test results showed less difference than DOS tests, both clearly indicate the value of cached memory.

Chips & Technologies' 386/AT chip set, which can address up to 16 MB of 32-bit RAM. While Chips & Technologies' 82C307 cache/memory controller can address up to 64 MB of RAM, none of the motherboards that used it supported that much memory. The Cache 386-25 accepted 16 MB, while the Monolithic MicroFrame and JCS 386c supported 24 MB and 32 MB, respectively. Intel's Model 302 had the largest memory capacity. It used two 32-bit expansion slots to support up to 40 MB of RAM. Pioneer's VMB-386/25 motherboard, on the other hand, didn't have any 32-bit expansion slots and supported only the 8 MB that will fit on-board. Other boards that put all the system memory on the motherboard—the Orchid Privilege 386/Cache and the Cache 386-25—accommodated 16 MB of on-board RAM.

The most common memory ceiling on the boards that we tested was 8 MB of on-board RAM and 8 MB on a 32-bit add-in card. But some manufacturers put all system memory on add-in cards and used 256K-byte or 1-MB single in-line memory modules (SIMMs) or single in-line package (SIP) modules to save space. Jameco and JC Information Systems included an empty memory card with their base systems. Micronics' base model also had a memory card, but if you need more than 8 MB, you have to buy a piggyback card (which comes with 4 MB of RAM) for $795. JDR Microdevices charges an additional $99 for its memory board with no RAM.

Unfortunately, when it comes to 32-bit memory cards, there is no standard; you can't use one company's 32-bit memory card in another motherboard's 32-bit memory slot. With the rapid advances in motherboard technology and the high turnover in new versions of motherboards, you should consider getting a 32-bit memory card when you purchase your motherboard. Delaying the purchase may make getting an expansion card difficult or impossible.

Most boards accepted some combination of DIPs and either SIMMs or SIPs. Both of C²'s full-size entries, JDR's

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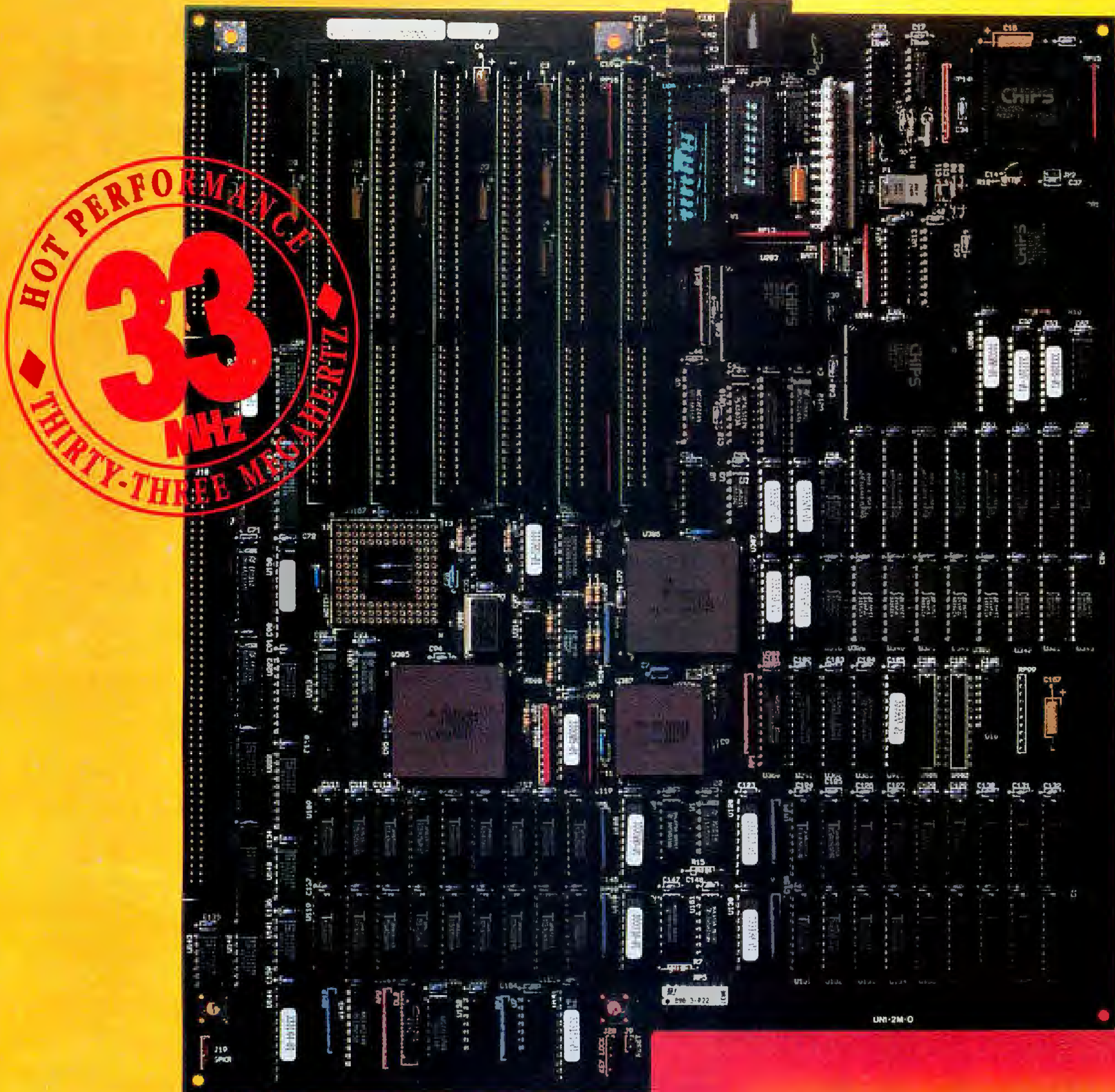

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BENCHMARK RESULTS

Table 3: BYTE benchmark results. Conventional benchmarks and indexes provide a quick summary of performance, while the raw numbers for our CPU benchmarks give a clearer picture of where differences lie. For example, low-level operations like byte-wide moves show considerably greater difference from board to board than high-level algorithms like the Sieve of Eratosthenes.

	BYTE CPU benchmarks								Indexes			Conventional	
		String moves											
	Matrix	Byte-wide	Word-wide		Doubleword-wide		Sieve	Sort	CPU	FPU	Video	Dhrystones (Dhry./sec.)	Livermore Loops (MFLOPS)
Motherboard			Odd	Even	Odd	Even							
C² M-386-25	2.70	16.77	22.46	8.40	16.48	4.20	14.22	10.71	4.94	10.46	1.97	8130	0.2135
JDR C386-25	2.69	17.08	22.98	8.55	16.59	4.28	14.23	10.71	4.89	9.88	3.26	7987	0.2037
Orchid Privilege 386/Cache	2.71	17.10	22.92	8.57	16.58	4.29	14.23	10.72	4.89	10.18	2.43	7987	0.2101
JCS 386c	2.71	16.72	22.90	8.37	16.64	4.17	14.72	10.98	4.88	10.03	3.31	7987	0.2082
Cache 386-25	2.72	16.70	22.92	8.35	16.69	4.18	14.68	11.02	4.88	10.12	3.34	7987	0.2084
OEM 386-25MX	2.80	18.27	24.62	9.13	18.03	4.56	14.35	10.78	4.69	10.01	2.89	7788	0.2083
Jameco JE3026	2.67	20.23	23.16	10.13	17.19	5.08	14.03	10.63	4.64	10.44	3.45	8064	0.2157
DTK Cache 386-25 (256K-byte cache)	2.62	21.18	22.90	10.57	17.60	5.31	14.28	10.71	4.58	10.50	1.94	8431	0.2158
Nascent NT-386-25	2.61	21.42	22.81	10.71	17.41	5.38	14.28	10.63	4.57	10.46	1.96	8347	0.2158
Micronics 80386-I	2.71	20.95	23.69	10.47	16.53	5.22	13.93	10.62	4.57	10.47	2.00	8051	0.2165
Intel Model 302	2.69	21.50	23.59	10.73	18.02	5.38	14.04	10.66	4.53	10.47	3.41	8130	0.2150
Atronics ATI-386/B	2.77	20.71	22.70	10.38	17.59	5.18	14.74	11.02	4.53	9.51	2.27	7776	0.1974
DTK Cache 386-25 (64K-byte cache)	2.66	21.86	23.29	10.89	17.80	5.44	14.30	10.67	4.51	10.58	1.93	8264	0.2155
Monolithic MicroFrame 386CT	2.75	21.03	24.11	10.51	16.79	5.27	14.77	11.04	4.46	9.87	3.29	7911	0.2076
Jameco JE3525	2.75	26.47	23.73	13.23	17.25	6.63	14.28	10.78	4.19	10.30	2.93	7587	0.2144
Mylex MWS 386-25	2.79	24.88	24.80	12.47	18.59	6.20	14.94	11.37	4.16	10.07	2.07	7407	0.2035
JDR M386-25	3.62	23.66	22.67	11.83	16.73	5.95	16.26	14.81	3.88	9.25	3.17	6459	0.1920
JCS 386i	3.59	23.76	22.85	11.88	16.83	5.95	16.29	14.83	3.87	9.20	2.84	6410	0.1918
JDR 386-MB-25S	3.63	23.76	22.85	11.92	16.82	5.95	16.29	14.83	3.86	9.12	2.94	6410	0.1918
Pioneer VMB-386/25	3.66	23.75	22.85	11.90	16.83	5.95	16.29	14.83	3.86	9.17	3.04	6410	0.1919
C² Baby 386 Mainboard	3.70	23.74	23.68	11.92	16.80	5.99	16.35	15.00	3.82	8.26	2.93	6321	0.1695
C² MBI386A+	3.82	24.81	23.25	12.41	17.01	6.21	16.63	15.93	3.71	8.98	2.92	6150	0.1884
Seattle STD 386XT	3.90	24.82	24.08	12.43	16.97	6.22	16.73	16.09	3.67	8.93	2.89	5767	0.1886
IBM PC AT	11.69	80.41	80.41	40.26	N/A	N/A	73.65	84.39	1.00	1.00	1.00	1721	0.0237

All CPU benchmark times are in seconds.
For indexes, Dhrystones, and Livermore Loops, higher numbers indicate better performance.
N/A = Not applicable.

cached model, and the OEM and Micronics boards accepted only DIPs. Convertible DIP sockets allow some boards, like those from DTK and OEM, to accept either 256K by 4-bit or 256K by 1-bit DRAMs. Except for the OEM 386-25MX, all the boards that we tested could be configured for either 256K or 1-megabit memory devices. Jameco and OEM claim that their boards will support 4-Mb DRAMs when they become available.

SIMMs and SIPs are only slightly more expensive than DIPs and are more convenient to install. But if one chip fails, you must replace the entire SIMM or SIP module rather than one chip. The main attraction of modular memory is for board designers, who exploit their space-saving design to squeeze 8 MB or more of RAM onto an XT-size board.

Adding memory was sometimes problematic. SIP modules on the C² Baby 386 Mainboard were located behind expansion slots and could cause problems if you installed full-length add-in cards. On Jameco's JE3525, SIP modules protruded horizontally from the memory card, blocking the adjacent 16-bit slot (to Jameco's credit, the company doesn't count the blocked slot in its advertisements). Nascent requires that you obtain a new set of programmable array logic chips (PALs) when you're upgrading from 256K parts to 1-Mb parts. (There's a $25 charge for the upgrade, and you have to return the old PALs.) And, most critically, one bank of SIPs on JDR's 386-MB-25S motherboard wouldn't fit under the metal drive bay in our generic AT-size case, effectively limiting the motherboard to 4 MB of on-board RAM.

Getting Compatible

All the motherboards that we tested let you insert wait states to lower the effective speed of the CPU. This may be necessary if you're using older software that doesn't work at 25-MHz CPU speeds. Surprisingly, not all offer the de facto compatibility speed of 8 MHz. Several boards ran at alternate speeds of 10 or 16 MHz; C²'s Baby 386 Mainboard runs at 20 or 25 MHz.

Bus speed was more consistent. All but one of the motherboards ran at or close to 8 MHz, and about half of the motherboards could also run at 10 or 12.5 MHz to support higher-speed add-in cards such as caching hard disk drive controller cards or Ethernet LAN cards. DTK's PEM 2500 Cache 386-25 motherboard didn't offer an 8-MHz bus speed: it ran at 6 or 12 MHz. Unfortunately, if your add-in cards won't run faster than 8 MHz, you will have to run them at 6 MHz—25 percent slower than normal.

System Logic

Some vendors used discrete chips to implement the 386 system logic, and one vendor—Atronics—had its own VLSI chip set. But the majority opted for Chips & Technologies' 386/AT chip set.

continued

COMPANY INFORMATION

Atronics International
(ATI-386/B)
1830 McCandless Dr.
Milpitas, CA 95035
(408) 942-3344
Inquiry 1074.

C² Micro Systems
(M-386-25, MBI386A+, Baby 386 Mainboard)
1205 Fulton Place
Fremont, CA 94539
(415) 683-8888
Inquiry 1075.

Cache Computers, Inc.
(386-25)
46714 Fremont Blvd.
Fremont, CA 94538
(415) 226-9922
Inquiry 1076.

DTK Computer, Inc.
(PEM 2500 Cache 386-25)
15711 East Valley Blvd.
City of Industry, CA 91744
(818) 333-5429
Inquiry 1077.

Intel Corp.
(Model 302)
3065 Bowers Ave.
Santa Clara, CA 95052
(800) 538-3373
Inquiry 1078.

Jameco Electronics
(JE3525, JE3026)
1355 Shoreway Rd.
Belmont, CA 94002
(415) 595-2664
Inquiry 1079.

JC Information Systems Corp.
(JCS 386c, JCS 386i)
161 Whitney Place
Fremont, CA 94539
(415) 659-8440
Inquiry 1080.

JDR Microdevices
(C386-25, M386-25, 386-MB-25S)
2233 Branham Lane
San Jose, CA 95124
(408) 559-1200
Inquiry 1081.

Micronics Computers, Inc.
(80386-I Cache)
935 Benecia Ave.
Sunnyvale, CA 94086
(800) 234-4386
(408) 732-0940
Inquiry 1082.

Monolithic Systems Corp.
(MicroFrame 386CT)
7050 South Tucson Way
Englewood, CO 80112
(303) 790-7400
Inquiry 1083.

Mylex
(MWS 386-25)
47650 Westinghouse Dr.
Fremont, CA 94539
(415) 683-4600
Inquiry 1084.

Nascent Technology, Inc.
(NT-386-25)
1630 Oakland Rd., Suite A112
San Jose, CA 95131
(408) 441-7500
Inquiry 1085.

OEM, Ltd.
(386-25MX)
75 Kingsland Ave.
Clifton, NJ 07014
(201) 614-7030
Inquiry 1086.

Orchid Technology
(Privilege 386/Cache)
45365 Northport Loop W
Fremont, CA 94538
(415) 683-0300
Inquiry 1087.

Pioneer Computer, Inc.
(VMB-386/25)
49066 Milmont Dr.
Fremont, CA 94538
(415) 623-0808
Inquiry 1088.

Seattle Telecomm and Data, Inc.
(STD 386XT)
2735 152nd Ave. NE
Redmond, WA 98052
(206) 883-8440
Inquiry 1089.

Implemented in seven VLSI chips, the CS8230 chip set lets manufacturers build smaller 386 motherboards with as few as 40 additional chips (excluding memory). By contrast, the Intel Model 302 motherboard, which uses LSI parts for most of its system and cache controller logic, has well over 150 ICs. Chips & Technologies' CS8230 chip sets support page-mode, interleaved memory. Three vendors, JC Information, Cache, and Monolithic, used Chips & Technologies' CS8231 set, which includes the 82C307 cache/memory controller and does not support interleaved memory. Both sets allow shadowing of BIOS ROMs to main memory to speed performance.

AMI's 386 BIOS, installed on 13 motherboards, was the most popular choice among board manufacturers. AMI's BIOS displays the system configuration on boot-up and offers built-in diagnostics and setup screens. Other BIOSes offered most setup options in ROM, but a few required going to a floppy disk for certain tasks, such as setting the CPU speed or running diagnostics. This was particularly true for boards that used older BIOS ROM versions. Some BIOSes also support shadowing of video ROM, which boosts performance for graphics-intensive applications. If you have a preference, most vendors will substitute another BIOS at no extra charge.

Except for C²'s Baby 386 Mainboard, every board supported Intel's 80387. But one board—Seattle's STD 386XT—required a special daughtercard that plugged into the CPU socket. The daughtercard included decode logic to compensate for pipelining problems in earlier 386s. Other boards required setting a jumper to compensate for this problem. But since those earlier chip versions are mostly out of circulation, this wasn't much of an issue.

Most motherboards also supported the 25-MHz Weitek 3167 or 1167 FPU. A few specifically claim to support the Integrated Information Technology IIT-3C87 and Cyrix CX83D87 math coprocessors. But these should work in any FPU socket that supports Intel's 80387. Some motherboards, including the STD 386XT and JDR's 386-MB-25S, have a separate socket that accepts an 8-MHz 80287. C²'s M-386-25 supports the 80387 and a Weitek chip at the same time. Several other motherboards, including the Mylex and Jameco's JE3026, offer an optional daughtercard that offers the same feature. If you need to crunch numbers with software written for both coprocessors, you may want to look into this option.

Expanding Your Horizons

Whether XT or AT size, all motherboards offered either seven or eight expansion slots. The type and usability of the slots, however, varied. Most motherboards had one or two 8-bit slots, four or five 16-bit slots, and one 32-bit slot that also accepted an 8- or 16-bit card. The Cache 386-25 had seven 16-bit slots—the most on any board.

Several products, including two of the JDR Microdevices boards and the Seattle STD 386XT board, had three 8-bit slots. None of the motherboards exhibited any bus compatibility problems during our tests. But some slots weren't optimally designed. For example, ROMs positioned just behind the two 8-bit slots in JDR Microdevices' C386-25 prevented them from accepting some 8-bit cards or some video boards designed to fit in either 8- or 16-bit slots.

Fit and Finish

All the motherboards appear to be designed well. A few have one or two wire

continued

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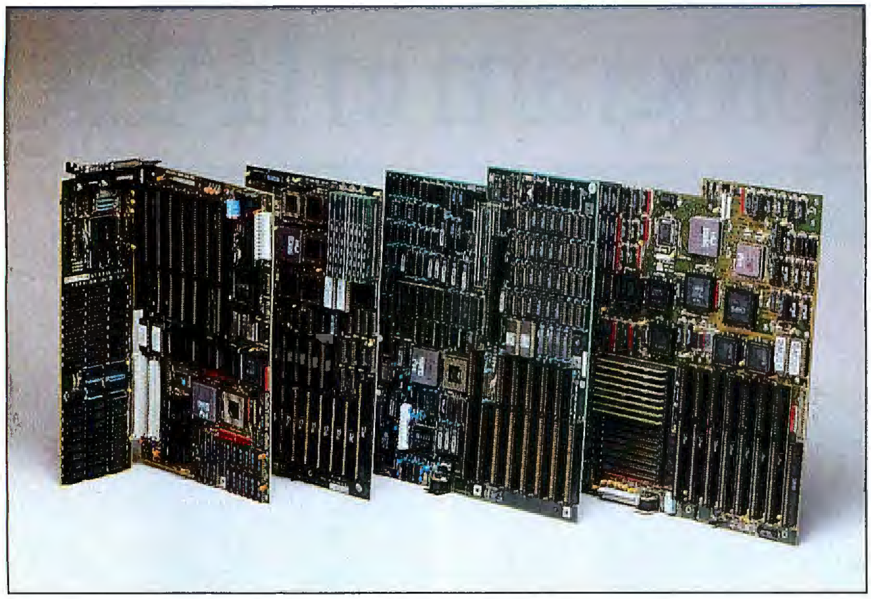


Top performers: JC Information Systems' JCS 386c, JDR Microdevices' M386-25, DTK Computer's PEM 2500 Cache 386-25, and Cache Computers' 386-25.

traces. All are logically laid out and are relatively easy to set up and configure. One vendor, Monolithic, mounts its SIP modules between expansion slots on the motherboard, which makes them tough to install or remove—but once they're in, they work just fine. The SIP problem on JDR's 386-MB-25S, on the other hand, is a limitation that we could live without.

The Seattle STD 386XT's FPU setup is also a little awkward. It runs without any problems, but the daughtercard just clears the drive bay housing in our AT case and is an uncomfortably close fit.

Other details are relatively minor. All the boards except the Seattle STD 386XT and C²'s MBI386A+ and M-386-25 offer a connector for a turbo-mode LED, and all the boards have connectors for keyboard lock and hard reset switches and for an external speaker. Many motherboards have a soldered battery for CMOS memory but also include a connector for an external battery as a backup. Two boards—the Atronics and DTK models—have a soldered battery only, but DTK claims a 10-year life for the module. As often as not, vendors with external battery connectors don't include a battery with their motherboard.

Other Considerations

If you're planning to install one of these motherboards yourself, don't count on learning the finer points of assembly from the manuals. Most of the documentation that we received was disappointing. The text often consists of loose, photocopied pages that you are expected to insert into your own three-ring binder. OEM and JDR sent documentation that was written for previous versions of their motherboards. In one case, the motherboard described didn't look anything like the motherboard we received. Other vendors don't document jumper settings or other specifications. Most of the manuals seem unable to keep up with the rapid design changes that are made to these boards.

On the whole, bigger-name manufacturers provide better documentation: Mylex and AMI (via Jameco) provide readable, informative manuals, and Micronics' bound book is especially good. The standout was Intel's Model 302 manual. This 228-page paperback was professionally printed and exhaustive in detail. It included a full description of all specifications, a glossary, an index, and plenty of illustrations. Not even this excellent document, however, is immune to being a few revisions out of step with the product.

If you have trouble with a motherboard and can't find the answers in the manuals, the vendor may have a help line. Some companies, such as JDR Microdevices and Jameco, offer technical assistance over the phone. Others, including Intel and Mylex, refer you to a local dealer or VAR. None of the manufacturers has a toll-free help line.

Most vendors guarantee their motherboards against defects for one year. Unlike the case with fully assembled PC clones, on-site service is not an option. The user must pay shipping costs to the manufacturer. Orchid, Pioneer, and Nascent all offer a two-year warranty, but Monolithic's five-year warranty is the longest offered by far. One vendor, Atronics, will let you extend its warranty from one to two years as an option. As with most nonmechanical devices, failures tend to come early in the product's life, so a one-year warranty is probably sufficient.

First Choice

It's hard to pick one winner from this group. Several boards came out on top in our DOS tests. The Unix benchmark results were consistent with the DOS benchmark results, but the numbers were much closer. The one exception was DTK's PEM 2500 Cache 386-25 with a 256K-byte cache. Moving from 64K bytes to 256K bytes of cache memory didn't make much difference under DOS, but it produced a marked improvement under Unix. Unfortunately, the extra static RAM also makes the board one of the most expensive that we tested.

Of the five best-performing motherboards on our DOS benchmark tests (see the photo at left), the JCS 386c and Cache 386-25 offered the most bang for the buck. The Cache, a full-size board, was our favorite overall. It was about as fast as the C² M-386-25 and JCS 386c on the CPU test, but it did much better than either on the video tests and had seven 16-bit slots instead of the usual five or six. If you're looking for an XT-size board, the JCS 386c is just $1100 and accepts up to 32 MB of 32-bit memory. The Orchid Privilege 386/Cache and JDR C386-25, the two other top performers, were slightly more expensive.

If $1100 sounds like more than you're willing to spend, consider one of the noncaching boards. JDR Microdevices' XT-size M386-25, the fastest noncaching motherboard that we tested, is $799. The Pioneer VMB-386/25 was on par with the JDR Microdevices M386-25's performance and was slightly less expensive. It was, however, limited to 8 MB of 32-bit RAM. The other noncaching boards had certain drawbacks. The C² Baby 386 Mainboard ran its FPU at 20 MHz instead of 25 MHz, JDR Microdevices' 386-MB-25S wouldn't fit into our AT case with all its SIP sockets filled, and the Seattle STD 386XT board was relatively slow and expensive. ■

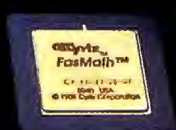
Steve Apiki and Stan Wszola are testing editors for the BYTE Lab. Rob Mitchell is a BYTE technical editor. They can be reached on BIX as "apiki," "stan," and "rob_mitchell," respectively.

FasMath Your 386!

Running in our Number Smasher-386/25 AT accelerator, the FasMath delivers 5.5 megawhetstones of numeric throughput.

Unlike the Inboard, which only accelerates 8 MHz ATs, the Number Smasher runs in 6, 8, 10 and 12 MHz 286 motherboards! Standard production is currently available at 20 or 25 MHz, with a list of options that include sockets for up to 8 megabytes of 32 bit RAM, Intel, Cyrix and Weitek Coprocessors, a 64 Kbyte Cache and interface cables for any of the 3 possible 80286 sockets. Running at 25 MHz with the CX83D87, the number Smasher generates 3.7 Megawhetstones, which is a factor of 30 improvement over an 80287 running in an 8 MHz AT.

CYRIX CX83D87 FasMath™ Coprocessor



This new numerics coprocessor from Cyrix Corporation is a high performance CMOS 80387 compatible device. Its features include a 91 bit wide architecture that results in improved speed and accuracy and an idle cutoff that reduces power consumption, making it ideal for laptops. Long running operations such as square root, division, transcendentals, exponents and logs run between 2 and 4 times as fast as identical functions on an 80387. The improved accuracy results in faster convergence when used with error sensitive routines. Driven by NDP Fortran-386, the FasMath delivers 3.72 Megawhetstones at 25 MHz and 5.05 Megawhetstones at 33 MHz.

Number Smasher 386/25™

The new Number Smasher is the fastest PC accelerator brought to market to date. It replaces the 80286 in any AT or compatible with an 80386 running as an asynchronous emulator (see BYTE "PC Accelerators" Nov. 1986 Stephen Fried).

NDP 386 Compilers

MicroWay's NDP Fortran, C and Pascal are available in 386, 386SX and 486 versions. They are all mainframe quality globally optimizing compliers that have been specially optimized for the 386/486 family using intel, Cyrix or Weitek coprocessors. They support the most common dialects, such as UNIX System V or ANSI C with Microsoft extensions, Fortran 77 with VAX VMS extensions, and ISO Pascal. All include the MicroWay GREX graphics library and run under UNIX, XENIX and the popular 386 DOS Extenders.

Micro Way

World Leader in PC Numerics

Corporate Headquarters: P.O. Box 79, Kingston, MA 02364 USA (508) 746-7341
32 High St., Kingston-Upon-Thames, UK., 01-541-5466
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33MHz. Take our KEEN-3300 Series for example. Its innovative high speed write-back cache memory and 80386-33 microprocessor combine to deliver zero wait state performance and a MIPS rating of 8.2.

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Key Features	KEEN-3300 Series	KEEN-2500 Series	KEEN-2000 Series	PEER-1630 Series
Processor	80386-33	80386-25	80386-20	80386SX-16
Configurations				
Tower Model	KEEN-3304	KEEN-2503	KEEN-2000T	—
Desktop Model	KEEN-3302	KEEN-2500	KEEN-2000D	PEER-1632
Mini-AT Model	—	—	—	PEER-1630
DRAM on Motherboard	Up to 8MB	Up to 8MB	Up to 1MB	Up to 5MB
32-bit DRAM (max.)	16MB	16MB	17MB	5MB
Cache Memory	64/256KB	64/256KB	—	—
Landmark Rating	59MHz	44MHz	27MHz	20MHz

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Circle 101 on Reader Service Card (DEALERS: 102)

Color Hits the Streets

NEC's pioneering ProSpeed CSX brings color to portables for the first time, but at a steep price

Mark L. Van Name and Bill Catchings

The NEC ProSpeed CSX provides true colors, but they are washed out.

Last October, NEC delivered its ProSpeed CSX, the first commercially available laptop with a color liquid crystal diode (LCD) display. Although it's nice to see a color laptop, the CSX's price and display quality leave much to be desired.

Our evaluation unit was a standard ProSpeed CSX, with a 16-MHz 386SX, a socket for a 16-MHz 80387SX math coprocessor, 2 megabytes of memory, a 42-MB hard disk drive, a 3½-inch 1.44-MB floppy disk drive, one serial and one parallel port, an external floppy disk drive connector, an external VGA monitor connector, and an 8-color VGA LCD screen with 256K bytes of video RAM. The CSX requires AC power. Bundled with the system were MS-DOS 3.3, GW-BASIC 3.3, and Windows/386 2.1.

This package costs a hefty $8499. You can also get a model with a 100-MB ESDI hard disk drive for $9499.

The Wide World of Color

At these prices, you really have to want color. The system's display supports all EGA options but only some VGA display models. In VGA text mode, you get a full 25-row by 80-character display. The CSX's 640- by 400-pixel resolution,

continued

NEC ProSpeed CSX

Company
NEC Technologies, Inc.
1414 Massachusetts Ave.
Boxborough, MA 01719
(800) 632-4636
(508) 264-8000

Components
Processor: 16-MHz Intel 386SX; socket for 16-MHz Intel 80387SX math coprocessor
Memory: 2 MB of 80-ns DRAM in 1-megabit SIMMs, expandable to 4 MB; 128K bytes of BIOS ROM
Mass storage: 3½-inch 1.44-MB floppy disk drive; 42-MB 28-ms modified-frequency-modulation hard disk drive
Display: Color, 9¾-inch, cold cathode fluorescent tube, backlit, compensated twisted nematic LCD internal display with direct matrix addressing
Keyboard: 89-key, with modified separate numeric keypad embedded
I/O interfaces: One 9-pin serial port; one 25-pin parallel port; two proprietary expansion slots

Price
Base system: $8499

Inquiry 852.

The color screen costs you a great many things. Two immediately obvious costs are the system's size and power requirements.

however, hurts you on VGA graphics, where you lose 80 pixels off the bottom of the display. You also get only 8 colors, although 16 colors are available on an external monitor, courtesy of a Chips & Technologies 82C455 flat-panel video controller.

The image quality of the LCD display isn't great. The colors are true, but they are washed out. Large areas of the same color tend to be mottled, and the screen bleeds when it scrolls. You can lose a mouse if you move it too quickly, as NEC warns you in a product release bulletin. The screen ghosts vertically a great deal.

Also, while we were testing the system, two vertical lines (one green and one red) appeared on the left side of the screen. They eventually vanished, but not immediately and not when we initially turned off the machine. An NEC spokesperson had not heard of this problem but was not surprised by it. (For more details on the display, see the text box "Competing Color LCD Display Technologies" on page 148.)

The Cost of Color

The color screen also costs you a great many things. Two immediately obvious costs are the system's size and power requirements. It's larger than most laptops by an inch or two in all dimensions, thanks primarily to the thick display and the 70-watt power supply necessary to support the color screen.

Another obvious cost is money. The CSX runs $1904 more than NEC's own monochrome $6995 lunchbox PowerMate SX. Worse, a comparable Dell System 316LT monochrome 386SX portable, which can run off batteries, costs $3999–$4500 less than the CSX. To be fair, the CSX will probably have a street price well below its list, while the Dell will not, but the price difference between the two systems is still likely to be large.

You also pay a performance premium, because the CSX's display is slow. The CSX was nearly three times slower on the BYTE video benchmarks than the desktop IBM PS/2 Model 55 SX, a reasonable but not particularly fast 386SX system. The CSX's anemic video performance also hurt the system's overall application index, which was about 8 percent below the Model 55's. That's too bad, because the CSX performed reasonably well in other areas, including the CPU and hard disk drive tests, where it beat the Model 55 by 11 percent and 15 percent, respectively.

Spotless Compatibility, Good Keyboard

You may give up performance with the CSX, but you lose nothing in compatibility. The system successfully ran all our test programs, including Borland's Paradox/386 2.03, Quattro 1.0, SideKick Plus 1.00A, SuperKey 1.16A, Turbo C 2.0, and Turbo Pascal 4.0; Digitalk's Smalltalk/V 1.2; Foresight's Drafix CAD Ultra 3.03C; Lotus 1-2-3 release 2.2; MicroPro's WordStar 4.0; Microsoft's Windows/386 2.11 and Word 4.0; Novell's NetWare 2.15; the Norton Utilities 3.00; the public domain Kermit 2.32/A; Quarterdeck Office Systems' DESQview 2.00 and QEMM-386 1.10; Symantec's Q&A 1.1; and WordPerfect 5.0. The CSX also worked with our test hardware, which included a Microsoft Serial Mouse and an external Xircom Pocket Ethernet Adapter.

You also sacrifice little with the ProSpeed CSX's keyboard, which has a good feel and 89 full-size keys, including a modified separate numeric keypad. The keyboard basically follows the AT Enhanced keyboard layout, minus the central arrow and cursor-position clumps, and with two keys (/ and Enter) missing from the numeric keypad.

Going Inside

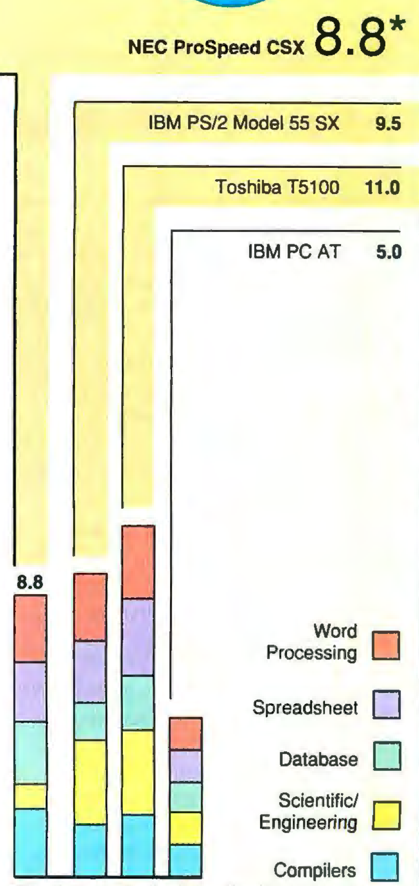
Open the CSX, and the first thing you notice is its power supply, a collection of analog parts and circuits that spans the rear of the machine. There's also a fan, one of the few we've seen in a clamshell portable.

The disk drives sit in front of the power supply—the hard disk drive on the left, and the floppy disk drive on the right. The 3½-inch NEC hard disk drive has a 28-millisecond average access time. It runs off a National Computer ST506 controller that sits on a small

continued

NEC ProSpeed CSX

APPLICATION-LEVEL PERFORMANCE



*Cumulative application index. Graphs are based on indexes at left and show relative performance.

WORD PROCESSING

XyWrite III+ 3.52	Medium/Large
Load (large)	:12
Word count	:04/:28
Search/replace	:07/:28
End of document	:02/:17
Block move	:10/:10
Spelling check	:11/1:24
Microsoft Word 4.0	
Forward delete	:19
Aldus PageMaker 1.0a	
Load document	:12
Change/bold	:33
Align right	:28
Cut 10 pages	:22
Place graphic	:06
Print to file	2:18
Index:	**2.11**

SPREADSHEET

Lotus 1-2-3 2.01	
Block copy	:04
Recalc	:02
Load Monte Carlo	N/A
Recalc Monte Carlo	N/A
Load rlarge3	:05
Recalc rlarge3	:02
Recalc Goal-seek	:05
Microsoft Excel 2.0	
Fill right	:07
Undo fill	2:38
Recalc	:02
Load rlarge3	:30
Recalc rlarge3	:02
Index:	**1.89**

DATABASE

dBASE III+ 1.1	
Copy	:26
Index	:08
List	2:43
Append	2:12
Delete	:03
Pack	1:28
Count	:05
Sort	:55
Index:	**1.96**

SCIENTIFIC/ENGINEERING

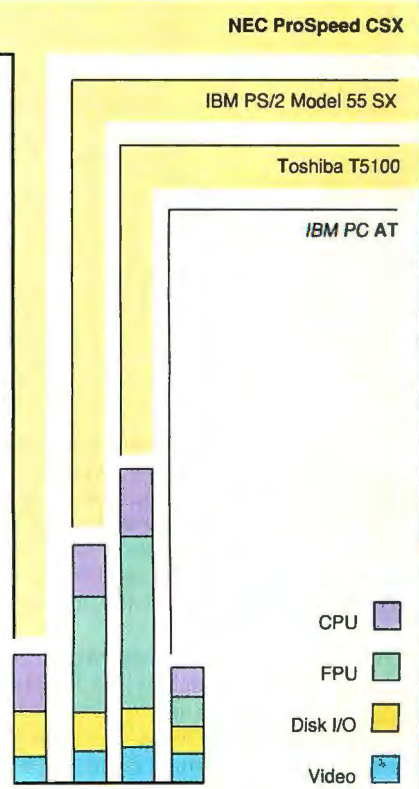
AutoCAD 2.52	
Load SoftWest	2:42
Regen SoftWest	2:30
Load StPauls	:46
Regen StPauls	:42
Hide/redraw	36:16
STATA 1.5	
Graphics	1:43
ANOVA	:55
MathCAD 2.0	
IFS 800 pts.	1:29
FFT/IFFT 1024 pts.	1:45
Index:	**0.78**

COMPILERS

Microsoft C 5.0	
XLisp compile	4:56
Turbo Pascal 4.0	
Pascal S compile	:05
Index:	**2.09**

All times are in minutes:seconds. Indexes show relative performance; for all indexes, an 8-MHz IBM PC AT = 1.

LOW-LEVEL PERFORMANCE[1]



CPU

Matrix	7.07
String Move	
Byte-wide	41.54
Word-wide:	
Odd-bnd.	43.26
Even-bnd.	20.78
Doubleword-wide:	
Odd-bnd.	29.42
Even-bnd.	19.06
Sieve	36.36
Sort	32.33
Index:	**1.98**

FLOATING POINT[2]

Math	N/A
Error	
Sine(x)	N/A
Error	
e^x	N/A
Error	
Index:	**N/A**

DISK I/O

Hard Seek[3]	
Outer track	3.30
Inner track	3.28
Half platter	6.72
Full platter	10.00
Average	5.83
DOS Seek	
1-sector	13.93
32-sector	35.09
File I/O[4]	
Seek	0.21
Read	0.83
Write	0.92
1-megabyte	
Write	5.47
Read	3.66
Index:	**1.57**

VIDEO

Text	
Mode 0	17.03
Mode 1	17.03
Mode 2	17.41
Mode 3	17.41
Mode 7	N/A
Graphics	
CGA:	
Mode 4	2.58
Mode 5	2.58
Mode 6	2.86
EGA:	
Mode 13	4.88
Mode 14	5.55
Mode 15	N/A
Mode 16	5.54
VGA:	
Mode 18	5.77
Mode 19	2.80
Hercules	N/A
Index:	**0.92**

CONVENTIONAL BENCHMARKS

LINPACK	2918.41
Livermore Loops[5] (MFLOPS)	0.01
Dhrystone (MS C 5.0) (Dhry./sec.)	3612

N/A = Not applicable.
[1] All times are in seconds. Figures were generated using the 8088/8086 and 80386 versions (1.1) of Small-C.
[2] The errors for Floating Point indicate the difference between expected and actual values, correct to 10 digits or rounded to 2 digits.
[3] Times reported by the Hard Seek and DOS Seek are for multiple seek operations (number of seeks performed currently set to 100).
[4] Read and write times for File I/O are in seconds per 64K bytes.
[5] For the Livermore Loops and Dhrystone tests only, higher numbers mean faster performance.

For a full description of all the benchmarks, see "Introducing the New BYTE Benchmarks," June 1988 BYTE.

Competing Color LCD Display Technologies

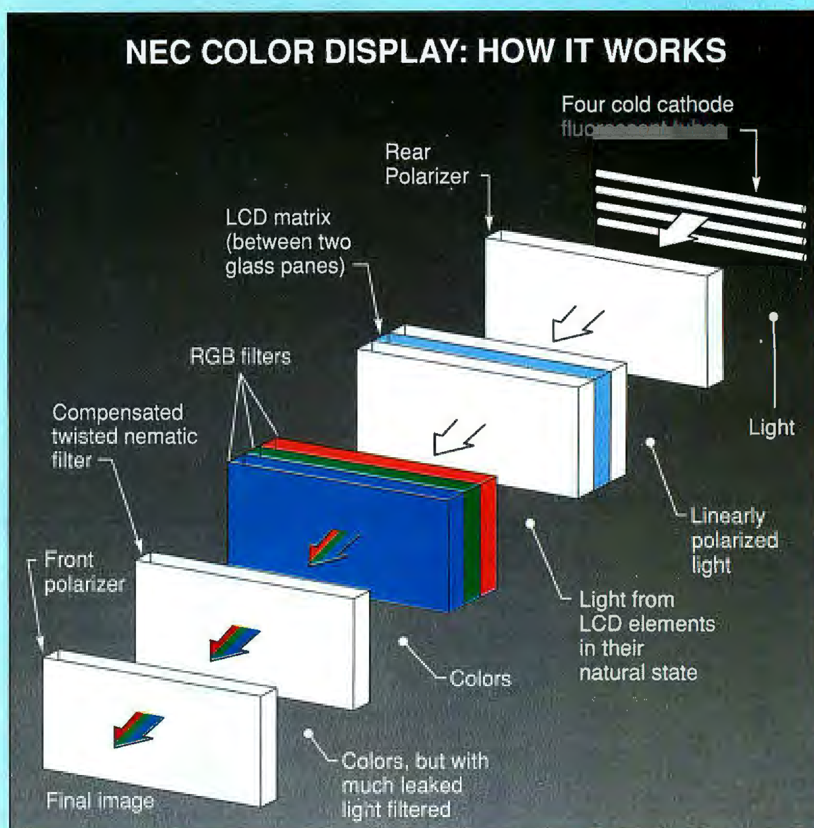
There are currently two major basic color liquid crystal diode (LCD) display technologies. NEC's ProSpeed CSX uses a technique known as direct (or passive) matrix addressing. The competing approach is called indirect (or active) matrix addressing or, sometimes, thin film transistor (TFT). (We will explain these terms below.)

These two color LCD display technologies have much in common, as well as a few key differences. The easiest way to understand them is to follow the light through the many layers that both types of displays typically contain (see the figure).

The rearmost layer is the light source. In the CSX, four cold cathode fluorescent tubes provide the display's backlighting.

Directly in front of the light source is the rear polarizer, which lets through only light that is oriented perpendicularly to the LCD display's crystals. This linearly polarized light passes to the third layer, a sandwich with two panes of glass surrounding a matrix of LCDs. In their natural, twisted state, these LCD elements pass through the polarized light. If you apply current to them, however, they straighten and block the light. The LCD sandwich contains three elements for every screen pixel.

Follow the bouncing light rays. From its original source, the light passes through a rear polarizer, which allows properly oriented light to pass to the LCDs. The LCDs react to the light, blocking some of it. What passes goes to the RGB polarizer, which has red, green, and blue filters that combine to form one of the eight available colors. Another layer blocks "leaked" light, and the remaining light passes through a final polarizing layer and to the viewer.



daughtercard between the hard and floppy disk drives. This design, while unusual in a laptop, makes it easy to upgrade to the ESDI controller of the CSX's optional 100-MB hard disk drive. The NEC floppy disk drive uses a Western Digital controller chip on the motherboard.

There's plenty of room for that chip on the motherboard, which is the biggest (by about an inch in depth) and most crowded motherboard we've ever seen in a 386SX system, desktop or laptop. Not counting memory, the motherboard has over 100 chips, including two Zymos POACH (for "PC on a Chip") application-specific ICs.

The ProSpeed CSX's standard 2 MB of 80-nanosecond DRAM are soldered to the motherboard in 1-megabit single inline memory modules. The system uses a paged/interleaved architecture to avoid wait states most of the time.

The 386SX CPU and the socket for the 80387SX are on a small card under an expansion area cover on the bottom front of the machine—a nice touch that makes it easy to add a math coprocessor. Also under that expansion cover are two proprietary expansion slots, one for a 2400-bps modem and one for an additional 2 MB of DRAM.

Odds and Sods

It's almost easier to add those expansion options than it is to set up the machine. First, you must run the Setup program to make sure that the system's CMOS accurately reflects its configuration. Then you must do a high-level disk format, and, finally, you install DOS. Fortunately, both the Setup program and the system's documentation are good, so this process isn't hard.

If you do run into problems, the CSX

The next layer, the RGB polarizer, houses one filter for every LCD element. Each screen pixel gets one red, one green, and one blue filter for its three LCD elements. By using all possible combinations of these three filters, you get the eight colors possible with the CSX: black, white, red, green, blue, cyan, magenta, and yellow.

You could produce 16 colors by using a fourth LCD element for each screen pixel. The filter in front of that element would be white and would function much like the intensity signal of some color monitors.

LCD displays tend to "leak" some of the light they're trying to block, so the CSX next uses a compensated twisted nematic layer that removes much of the leaked light. Finally, the light passes through another polarizing layer and then out to the viewer.

This design has a problem: Much as dots on CRT screens fade after they are activated, LCD elements relax and begin to lose intensity after they are charged. Direct and indirect addressing displays deal with this problem differently.

In direct matrix addressing, the driver circuit connects directly to each LCD element. The driver circuit then addresses one row of LCD elements at a time, in sequence from top to bottom on the screen (much as the electron gun scans a CRT screen). Unfortunately, as soon as the driver circuit leaves a row, that row's LCD elements begin to relax to their inactivated state. The result is bleeding, or ghosting, as well as a lower contrast ratio.

Indirect matrix addressing produces better images and avoids most of the ghosting by keeping current supplied to every LCD element. To do so, it inserts a memory transistor between the driver circuit and each LCD element. The driver connects only to the transistors (hence the "indirect" in the name), which supply the LCD elements with current while the driver scans the display.

Active matrix sounds so much better that you have to wonder why NEC didn't use it in the CSX. The reason is cost.

An active-matrix display requires one transistor per element. To get eight colors and the full VGA 640- by 480-pixel resolution, it would need at least 640 by 480 by 3 (3 pixels per element) transistors—that's 921,600 transistors in a continuous, thin 10-inch layer. (That's the source of the "thin-film transistor" name.) No one can yet mass-produce such a dense screen with high enough yields to make the manufacturing process cost-effective. An NEC spokesperson estimated that a TFT display today would cost buyers at least $2000 more than the CSX's already expensive display.

These technologies also require much more power than monochrome LCD displays need. In part because of the many filters, the color panel transmits only about 20 percent to 25 percent as much light as a typical paper-white LCD display would. The many transistors of a TFT display demand even more power.

Both technologies are, at least for now, considerably more expensive to produce than standard monochrome LCD displays. We must hope that future developments will make good color LCDs affordable.

comes with a one-year parts-and-labor warranty. While NEC normally directs repair requests to its dealers, the CSX is so new that few dealers will have such crucial spare parts as extra displays; consequently, for now, you must ship the CSX to NEC for repairs.

Your NEC dealer remains your first line of technical support. You can also call NEC technical support if you are unhappy with your dealer's support.

The Color of Money

Some machines are hard to peg, but the NEC ProSpeed CSX isn't one of them. At least for now, it's the only color laptop around.

If you've absolutely got to have a color laptop, go for the NEC ProSpeed CSX. Otherwise, you should wait for the day when color laptop technology matures enough to give us vibrant, quick displays at reasonable prices. ■

Mark L. Van Name and Bill Catchings are BYTE contributing editors. Both are also independent computer consultants and freelance writers based in Raleigh, North Carolina. You can reach them on BIX as "mvanname" and "wbc3," respectively.

Svelte Scanner Is No Fistful of Dollars

Sharp's low-cost scanner delivers high-quality color images to those who can afford to wait

Tom Thompson

The Sharp Electronics Personal Color Scanner's svelte size gives the impression that it's a hand-held scanner. It's not. It's a diminutive ($6\frac{1}{3}$ by $12\frac{2}{3}$ by $1\frac{2}{3}$ inches) flatbed scanner about the size of an add-in board's carton, and its weight is equally modest at just over $3\frac{1}{2}$ pounds. There is a serial interface for communicating with a computer, so no interface boards are required to connect it to a Mac II, a PC, or an Amiga.

The $995 JX-100 produces high-quality images at several resolutions and in a variety of modes (black and white, gray scale, and color). But this convenience has a price. Because of its small size, the scanner handles only small images, and color scanning can be time-consuming.

A Hardware Tour

The JX-100 is a stationary flatbed scanner, unlike its much larger cousin, the JX-450, whose bed moves from side to side. Transparent panels make up most of the JX-100's top and bottom. A white rectangle on the bottom panel delineates the scanning area. Original images must be no greater than 3.93 by 6.29 inches; thus, the scanner is suitable for typical 4- by 5-inch snapshot prints.

A compact scanning head with a sensor strip travels inside the transparent panels to acquire image data. For color images, the scanning head must make three passes over an original, which explains why color scanning can take so long (see the text box "Inside the Personal Scanner" on page 152).

To hook the scanner to a Mac, you'll need the DB-9-to-mini-DIN-8 adapter cable supplied with the Mac scanning software. The scanner's serial cable ends in a DB-9 serial connector for an IBM AT. The scanner works with a PC, a Mac II, or an Amiga, but only the Macintosh software was available as of press time.

Power comes from a 12-volt power-supply brick. An adapter cable from this brick plugs into a special connector on the serial cable. The scanner has no on/off switch; you handle that detail by plugging in or unplugging the power supply.

Scanning Software

The JX-100 handles Mac II scanning with Imagenesis's ChromaScan 100 application software, a modified version of the Sharp JX-450 scanner application. ChromaScan requires 32-Bit QuickDraw, so you can use the software and scanner only on the Mac SE/30 or Mac II-family computers. ChromaScan saves the captured image data in memory, so your Mac needs at least 4 megabytes of RAM; Imagenesis recommends 8 MB.

ChromaScan lets you scan an image in black and white with a user-selectable threshold (a brightness value that determines whether a pixel is white or black). You can also do color scans either as indexed colors (256 colors maximum, using a byte value that corresponds to a color table entry) or as direct colors (the pixel holds the actual color data and can be 16 or 32 bits in size). Indexed colors can be based on the default system color table or on a custom color table sorted by ChromaScan for the best-fit 256 colors. While direct color scans can display more colors, they also take up more memory and more disk space. All captured images are saved in the Mac's PICT2 format, which allows other applications to use them.

ChromaScan's preview mode makes a fast gray-scale scan of the original and then presents it in a special preview window. Here you can drag slider bars over

continued

Sharp JX-100 Personal Color Scanner

Company
Sharp Electronics Corp.
Systems Division
Sharp Plaza
Mahwah, NJ 07430
(201) 529-9500

Hardware Needed
Mac SE/30 or Mac II-family computer with at least 4 MB of RAM and a hard disk drive (SE/30s must have a color monitor set up as the main screen); versions for the IBM AT and Commodore Amiga are planned

Software Needed
System 6.0.3 or higher with 32-Bit QuickDraw

Price
$995

Inquiry 851.

the window to choose what part of the image you want to scan in detail. A Mode window lets you select the resolution (50, 100, or 200 dots per inch, or user-selectable), type of scan (indexed or direct color, gray scale, or black and white), and dithering. A Tone Control window lets you fine-tune the brightness, contrast, and color balance of the incoming data. Once you've adjusted the settings to your satisfaction, you start the scan via keyboard command, by menu selection, or by clicking on a Scan button.

When the JX-100 completes its scan, a window displays the captured image. You can save the image to a file or print it. ChromaScan allows multiple open windows (as much as memory allows) and even opens previously scanned files. However, there are no editing tools for tinkering with the image, and all the tone-control settings apply only to the scan in progress.

Field Test

I put the JX-100 scanner to work on a variety of snapshots, magazine covers, and photos from books. I used a Mac II running System 6.0.3 and equipped with 5 MB of RAM, a Rodime Cobra 210e 210-MB hard disk drive, and a SuperMac 19-inch monitor and Spectrum/8 video board. Installation takes only about 3 minutes: You plug the serial cable into the Mac's modem port, plug in the scanner's power supply, and copy the software to the Cobra drive.

The scanner's viewfinder and ChromaScan's preview window made scanning a snap. I selected what I wanted to scan and what type of scan with just a few mouse-clicks. Previews took only a minute, and 100-dpi gray-scale scans took 2 minutes, 10 seconds. The quality of the color images was excellent, even at 200 dpi. I hadn't expected such quality in the

continued

Inside the Personal Scanner

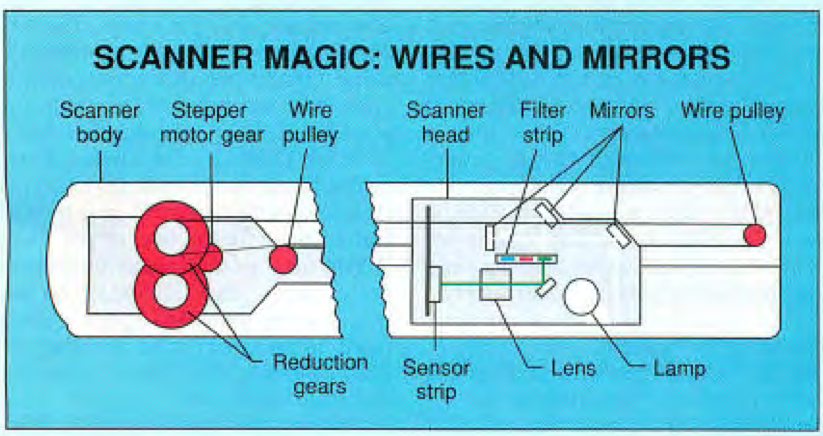
How did Sharp cram so many capabilities into such a small unit as the JX-100? The scanner's compact size and weight result from a combination of tiny components and a clever design that builds on techniques used in Sharp's JX-450 color scanner.

However, the JX-450 acquires an image by moving its bed from side to side, which moves the original over a stationary sensor strip built into the housing (see "Full-Spectrum Scanners," April 1989 BYTE). By contrast, the JX-100 lies atop the original image and remains stationary during the capture process. Inside the JX-100's housing, a scanner head rides on two rails. A precision stepper motor drives a wire pulley that moves the head in precise steps across the image. As the scanner head travels from one end of the housing to the other, a sensor strip inside it captures the image a line at a time (see the figure).

A minuscule fluorescent lamp inside the scanner head illuminates the image. Four mirrors route light reflected from the image through color filters and a lens and then onto a charge-coupled-device sensor strip with 1024 elements. Each element samples the light intensity that corresponds to a spot on the image. While each element can detect 256 different light levels, the accuracy of the sample is good only to 6 bits.

The scanner head samples monochrome image data. With the use of color filters, color scans are possible. The original is scanned three times to collect red, green, and blue information. A clever lever mechanism switches a filter strip inside the scanner head from one color to the next. Each time the scanner head returns to start a new scan, a shaft engages a projection inside the housing that advances the filter strip to the next color.

Inside the Mac, software combines the data from each scan into a color image. For indexed color images, the information is reduced to the 256 best-fit colors. For direct color images, the information is assembled into pixels. For 16-bit scans, a pixel contains 15 bits of color information that can represent 32,768 colors. For 32-bit scans, a pixel contains 24 bits of color information that can represent a possible 16.8 million colors. However, since the accuracy of each color pass is limited to 6 bits, the actual number of colors captured by the JX-100 is 262,144. Nevertheless, this range of colors should be adequate for most color desktop publishing work.



To produce a color image, wire pulleys move the JX-100's scanner head over the original three times to sample red, green, and blue information.

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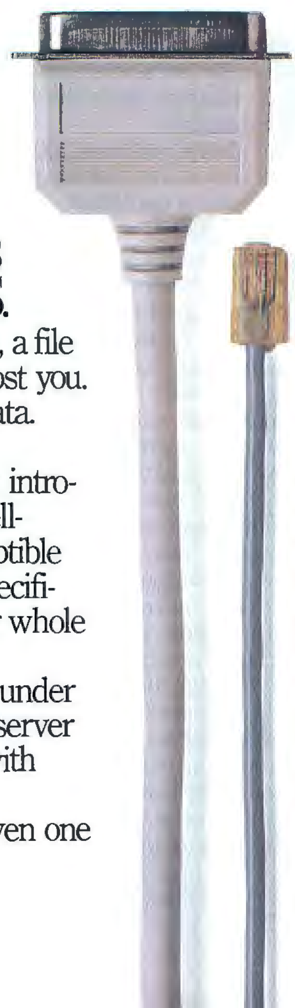

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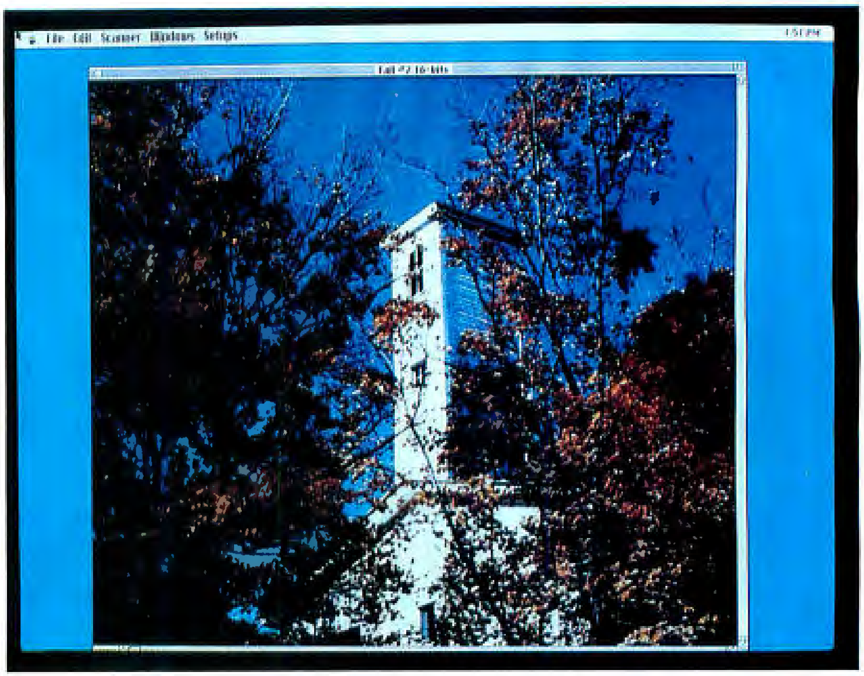


The quality of the JX-100's color images was excellent, even at high resolutions where mechanical misalignment problems can occur.

high-resolution color scans because of the inevitable mechanical misalignment that occurs when the scanner head makes three trips over an image. I saw slight color fringing in the fast scanning mode, but in the slow scanning mode the 100-dpi images were superb.

The scanner always performs 200-dpi imaging in the slow mode, and the quality is as good as that of the 100-dpi scans (see the photo above). PhotoMac 1.1, PixelPaint Professional, and a beta version of PhotoShop easily read 8-, 16-, and 32-bit pixel image files created by ChromaScan. I had no trouble printing images on a Tektronix ColorQuick color inkjet printer. But when I printed to a LaserWriter printer using the color driver (version 6.0), my results were hit-or-miss: Many of the indexed color scans looked good, while direct color scans conked out with a PostScript error before the print job was completed.

The hardware's biggest flaw is the time it takes to scan in color. A 100-dpi dithered scan using the slow mode and indexed colors took nearly 12 minutes to complete. At 200 dpi, the same image took about 35 minutes. The scanning process takes so long because ChromaScan sorts through the image data for the best-fit 256 colors. By contrast, some 16-bit direct color scans at 200 dpi in the slow mode took only 20 minutes.

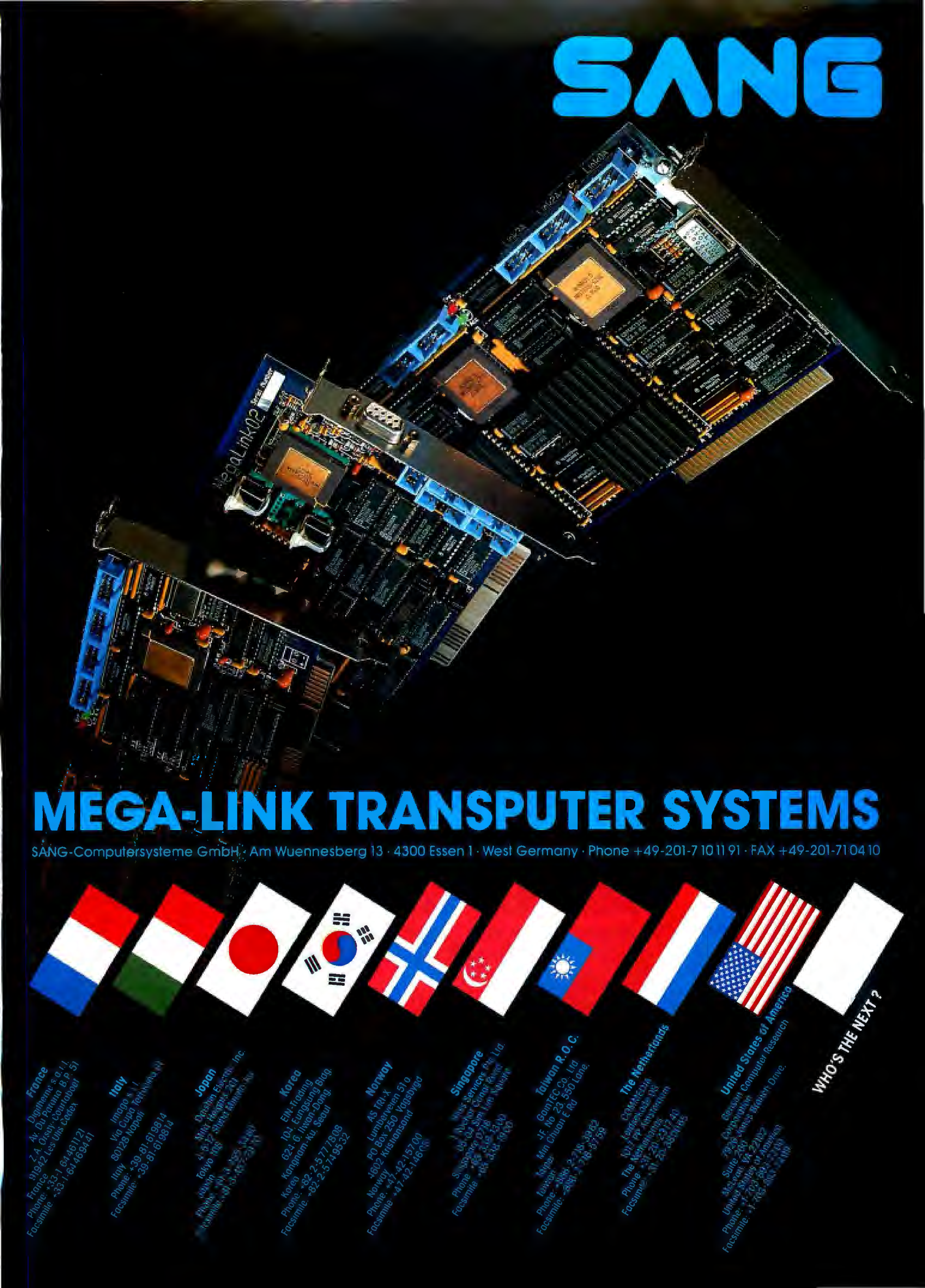
The biggest scanning-software problem is that every color-scan pass is stored in memory. This requires lots of RAM. Even with 5 MB, I often ran out of memory when I tried to make a direct color scan larger than a snapshot. I tried using Connectix's virtual memory INIT to gather more memory, but under virtual memory ChromaScan became erratic, sometimes working, sometimes freezing the system. I'd like ChromaScan to spool each pass to disk during a color scan, to ease up on memory requirements. For now, if you plan to make direct color scans using the scanner's entire imaging area, you'd best have 8 MB of RAM.

Do You Need One?

Make no mistake, the JX-100 works admirably, producing quality color images in the slow mode at the highest resolution. Its low price is attractive, especially for small businesses, and its direct color capabilities will be useful for certain color prepress jobs, as long as the work fits in the scanner's small scanning area.

However, be aware of the trade-offs: You'll need all the RAM you can get, as well as a color graphics package to touch up and print some images. Producing a high-resolution color scan is definitely a start-it-and-leave-for-lunch operation. If you can live with these limitations, then Sharp has a scanner for you. ■

Tom Thompson is a BYTE senior technical editor at large. He can be reached on BIX as "tom_thompson."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Amí Professional, Legend, and Word for Windows provide WYSIWYG editing in Microsoft Windows

Lamont Wood

The PC world has long awaited full-featured WYSIWYG word processing software that could also take a swing at desktop publishing. Now, thanks to Microsoft Windows, there are three such packages: Amí Professional 1.0 from Samna, Word for Windows 1.0 from Microsoft, and Legend 2.0 from NBI. Each is priced at $495.

All three offer a wealth of WYSIWYG functionality such as the budget-minded PC user could only have dreamed of a few years ago. But all three packages paid for it—to varying degrees—with performance problems. Printing speeds are particularly troublesome, and in some situations, you have time to get up and make a sandwich while waiting for a page to be drawn on the screen.

I tested the three Windows-based word processors on a 16-MHz Club American 386 with 3 megabytes of RAM, a 30-millisecond hard disk drive, and a Hercules display. I ran them under Windows/386 and printed them on a QuadLaser 1 that emulated a Hewlett-Packard LaserJet.

The Two Worlds

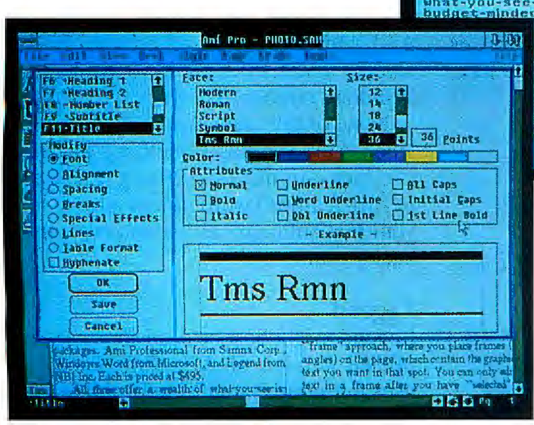
Previously, conventional word processing concentrated on helping you generate text, with spelling checkers, search-and-replace and cut-and-paste functions, and scads of other useful tricks. But any formatting beyond fancy typewriter emulation was not to be expected. Meanwhile, page-layout systems turned your computer into a typesetting machine—but they had no facility for word processing. You were expected to write the material with a word processor and then import it into desktop publishing.

Having both worlds in one package makes sense. The problem is that true WYSIWYG word processing assumes the use of a graphical screen, but composing text on a graphical screen that has to format itself as you type can be a slow and disorienting experience.

These three packages get around the problem by having a draft and a layout mode. You type in draft mode with only text on the screen and switch into layout mode for formatting. (Under many conditions, however, it is possible to type directly into the layout mode. For eye relief, I often edited raw text in layout mode using a 14-point font, without any

continued

Photo 1: *Amí Professional lets you create styles for text through its dialog boxes.*



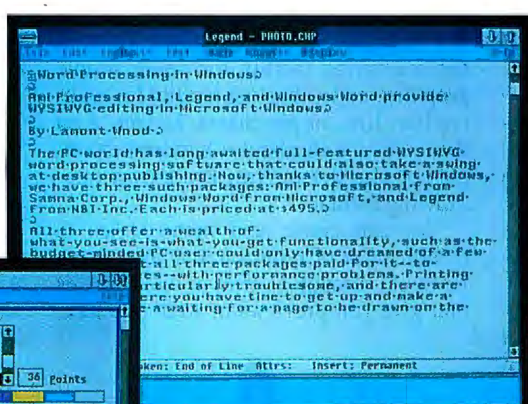


Photo 2: *Legend uses a special large font in draft mode that's easy on your eyes.*

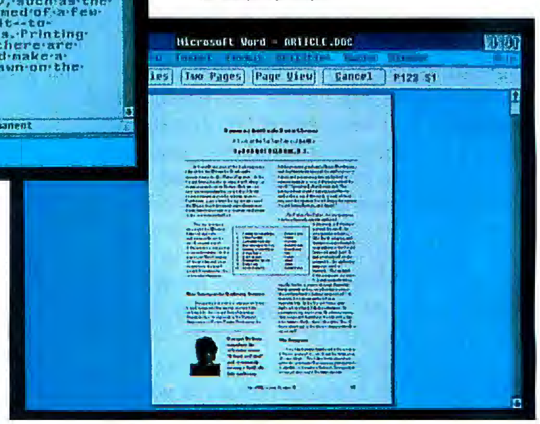


Photo 3: *In Word for Windows' print preview mode, you can move blocks of text, but the detail is lost.*

	Ami Professional 1.0	Legend 2.0	Word for Windows 1.0
Company	Samna Corp. 5600 Glenridge Dr. Atlanta, GA 30342 (404) 851-0007	NBI, Inc. 3450 Mitchell Lane Boulder., CO 80301 (303) 444-5710	Microsoft Corp. 16011 Northeast 36th Way P.O. Box 97017 Redmond, WA 98073 (206) 882-8080
Hardware Needed	IBM or compatible 286-based or higher system with a hard disk drive and Hercules, CGA, EGA, or VGA graphics	IBM or compatible 286- or 386-based system with 640K bytes of RAM, a hard disk drive, a mouse, and Hercules, EGA, or CGA graphics	IBM or compatible 286-based or higher system with 640K bytes of RAM, a hard disk drive, and any Windows-compatible graphics
Software Needed	MS-DOS 3.0 or higher	MS-DOS 3.0 or higher	MS-DOS 3.0 or higher
Price	$495	$495	$495
	Inquiry 881.	**Inquiry 882.**	**Inquiry 883.**

real formatting, and changed to another font just before the final printout.)

Then, there is the problem of positioning things on the page. Both Amí Pro and Legend use the "frame" approach, where you place frames (rectangles) that contain the graphics or text that you want in a certain spot on the page. You can only edit the text in a frame after you have selected that frame. You can move frames about on the page or from page to page as you would scraps of paper.

Word for Windows uses a text-based approach in which you "position" individual paragraphs, sections, or tables. You can position by hand to a certain extent, as with the frame approach, but you are expected to give the system a few rules and let it format the material by itself.

But all three packages stop short of giving you the kind of visual control that a true desktop publishing system like, say, Xerox's Ventura Publisher gives—where you define margins and line thicknesses to a thousandth of an inch. Instead, they give you a cookbook selection of line thicknesses and border patterns. This is probably just as well—most folks would rather produce documents, not experiment with typographic elements.

All three packages come with an optional single-application environment version of Windows, but if you run them under a full version of Windows, you can take advantage of the clipboard and import text or graphics from other applications. Thanks to Windows, you can also have those applications running in the background, flipping back and forth between them. (With Windows/386, you can even leave MS-DOS programs running in the background and grinding out data analyses or file conversions or whatever.) Also, an interesting Windows feature called Dynamic Data Exchange (DDE) lets you link data in one application to data in another, and as one changes, the other will also. (Both applications have to be loaded, of course.)

Keep in mind that Windows is responsible for the screen, printer, and mouse drivers, and third-party fonts are installed in Windows, not in any particular application. Having these details handled by the environment itself (i.e., Windows) has led to Windows' increasing popularity with software developers, who are spared the effort of handling such matters themselves.

Amí Professional

Of the three, Amí Pro has the most features. It has the basic word processing and desktop publishing features found in Amí "nonprofessional," which came out last year, but with numerous additions. It has a drawing facility for doing simple graphics, and a charting facility for making bar, line, or pie charts. In fact, Amí Pro comes with about a hundred examples of clip art in Amí Pro's own line-drawing format.

You can create and name styles (a combination of typeface and formatting features) through a series of dialog boxes that give you previews of what you have selected—on-screen representations of the font or format you've picked, before it's applied (see photo 1).

All three packages stop short of giving you true desktop publishing.

The program uses DDE, so, for example, you could link an entry in an Amí Pro document to a cell in a Windows Excel spreadsheet and change the entry as the cell changes. There are a sophisticated macro language, context-sensitive help screens, and a thesaurus as well as a spelling checker.

Amí Pro tries to embody the whole rationale behind Windows: integration, across or within applications. Thus, your computer becomes your personal assistant, capable of greatly magnifying and enhancing your efforts, rather than a balky tool that demands as much from you as you do from it.

However, Amí Pro has some problems. Loading the drawing or graphing modules can be so slow that you might as well exit and go to another system. Amí Pro would not import PCX (Publisher's Paintbrush) files, and other pictures that it did load were slightly distorted vertically, so that smiling people looked like vampires. I also kept getting meaningless "internal error" messages when performing search-and-replace procedures. And Amí Pro crashed a couple of times when I tried to move text through the Windows clipboard.

None of this, however, got in the way, since Amí Pro has something the other two lack—in fact, something rarely seen in full-featured word processors: It saves your text automatically at intervals in the background.

Legend

Legend might best be described as a simplified version of Amí Professional. It uses the same frame-based approach and includes a drawing function, but it lacks a graphing function, plus some "bells and whistles" such as formatting previews, document descriptions, and a word counter.

Its chief advantage is its draft mode, which does not use the (tiny) default Windows screen text that Amí and Windows Word use, but instead employs a larger, custom typeface (see photo 2). It saves your eyes from having to squint, and since it shows special tokens for carriage returns, it's easier to format E-mail and database downloads. But the use of the larger text also means that, under ordinary conditions, Legend's draft mode scrolls more slowly than its layout mode.

Legend also distinguishes itself by letting you define properties for frames. Therefore, instead of starting from scratch each time you create a frame, you can select from a list of frame types that you've already created.

Legend has no macro language, nor any use of DDE, a thesaurus, or context-sensitive help. While it still embodies more features than most users will probably ever want, it seems overpriced compared to Amí Pro.

Word for Windows

This program is really a superset of Microsoft Word, translated to Windows. Everything is text-oriented—graphics are embedded in the text, rather than placed in frames on the page. You can place text and graphics in "tables" and get some of the effect of frames, but the precision is not there—you can't, for example, wrap a poem around an irregular graphic. You can only move things around on the page while in print preview mode; you get a full page view, but the detail is lost (see photo 3). And there are no drawing or graphing functions.

But if all you need is to spice up a report with some proportional fonts, a logo, and maybe an occasional chart, Word for Windows is great. It offers that spice, plus a complete checklist of features typical of a high-end word processor—document version comparisons, an outliner, a thesaurus, variables you can embed in the text, and a document summary telling how many times the document was edited, for how many minutes, and by whom.

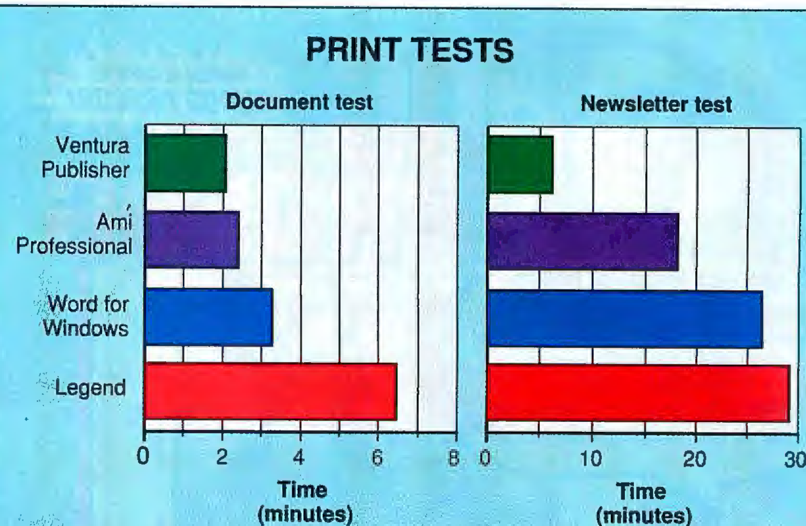
It even has a macro language that is actually a Microsoft QuickBASIC interpreter, allowing a word processing manager to not only customize, but actually change the appearance of Word for Windows. The program supports bidirectional DDE; for example, data that you type in through Word for Windows could affect a Windows Excel spreadsheet cell, which in turn could change another cell and update another section of the original Word for Windows document.

WORD PROCESSING TESTS

All three Windows word processors gave acceptable performance in most standard word processing operations. However, Ami Professional was notably faster at scrolling, and Legend took a relatively long time to load the test document. All times are in seconds.

	Search and replace	ASCII import	ASCII export	Reformat margins	Load	Save	Scroll
Amí Pro	5	5	4	2	4	4	10
Legend	14	9	4	3	23	5	36
Word for Windows	7	3	3	2	4	3	38

Note: Tests used a 4000-word document in 12-point Helvetica. The first test performs 400 search-and-replace operations. ASCII import and export tests time moving the document to or from ASCII format. The Scroll test moves from the top to the bottom of the document using the Windows scroll bar.



Note: Printing times reflect how long it takes for the last page to appear. The document test is based on a 4000-word document printed in 12-point Helvetica with two columns but no graphics or other formatting. The newsletter test is based on a two-page newsletter with two graphics images (107K bytes and 46K bytes), seven type styles (five 12-point varieties, two 24-point varieties), and seven text blocks. All fonts had to be downloaded for both tests.

All three word processors proved to be much slower at printing than the page-layout program Ventura Publisher except for the simplest documents. Amí Professional was faster by far than either Word for Windows or Legend.

Slow Performance

So much for the good news. The bad news is that while all three programs show passable performance while doing straightforward, one-column, text-based word processing tasks (see the table), further demands bring them to their knees rather quickly.

It can take a full minute to import a graphics file, and scrolling horizontally across a graphic can be torture as the picture is redrawn a section at a time. Especially with Legend (but the others are not far behind), you can get to the point where pushing one key will set off 30 seconds of hard disk activity before control returns. With the slow response and jangling hard disk, I felt I was operating a crane in a shipyard.

At first, Word for Windows seemed to be by far the fastest of the three. Invoking a screen menu does not trigger any disk activity, as it does with the other two programs. One might suspect that Microsoft, which surely knows all Windows' programming tricks, has used some of them. Alas, it hardly matters,

continued

because after you add some pictures and formatting to a page, Word for Windows becomes as slow as the others. Its layout mode can be glacial.

Meanwhile, printing speeds for all the packages were sometimes three to five times slower than those for Ventura Publisher (see the figure). Remember that all three packages did fine with straight word processing tasks—it's when you start making graphics-oriented demands that they wilt. But what's the point in going to the trouble of installing Windows and switching to a graphics-based word processor unless you can actually make use of the graphics? You might as well just stick to the old method of creating the text any way you want—any shareware word processor will do—and then importing the text into a desktop publishing package.

The culprit, of course, is Windows. While Windows gives each application automatic access to RAM above the PC's traditional 640K-byte barrier, that extra memory is really just disk emulation. What counts is the "conventional" memory below 640K bytes, where program modules are swapped in and out as they are needed. Basically, you have a large object (the code of these programs) being crammed into a small space (the RAM that Windows can allot to each is below 640K bytes). Of course, things aren't going to work as well as they might.

Amí Professional comes with unpublished Windows settings to change the way Windows allocates memory and thus, you hope, improve performance under certain circumstances. The other two vendors also have plenty of advice to offer. (Windows/286, for instance, may be faster than Windows/386, and it's best to use as much memory as you can for the disk buffer.) Using their suggestions did help somewhat.

But there's hope. Noises emanating from Microsoft indicate that Windows 3 is in the works and will make up for everything. It promises to do away with the 640K-byte barrier and give each application its own "virtual machine" with its own protected range of RAM. Everything will run faster because the applications won't be distracted by the constant need to juggle fragments of code in and out of slivers of RAM. Meanwhile, we remain stuck in the present, with three software packages offering much potential, shackled to the performance problems of the current versions of Windows.

If you control the data processing in a large organization, then Word for Windows with its document production features and its macro language will appeal to you—assuming you're already using Windows. If you're a professional who's interested in coaxing the maximum use out of your personal computer, then Amí Professional will appeal to you. It offers a wealth of features, and the integration possible with Windows is just what a self-reliant professional needs.

If you want something simpler—if you just want correspondence with "high impact"—or if your glasses are getting too thick, you might consider Legend. It lacks DDE and a macro language, but if you're more interested in using your computer than configuring it, you may never notice. Either way, these three packages prove that PC word processing has an exciting future—as soon as it can escape from its past. ■

Lamont Wood is a computer journalist, desktop publisher, and data broker living in San Antonio, Texas. You can reach him on BIX as "lwood."

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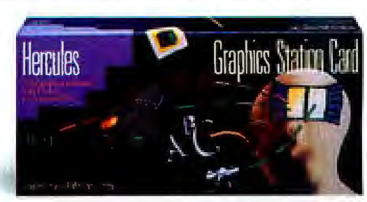

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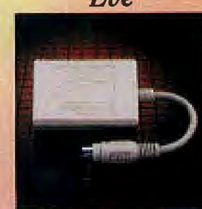

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A Better dBASE

FoxPro pushed the dBASE language to its limits

Steven J. Vaughan-Nichols

For many years, despite determined competition, Ashton-Tate has been the dominant player in the dBASE game. Now, that could change. Fox Software's newest entry in the race is a clear winner over the other challengers.

FoxPro 1.00 is not just the latest bid to trump Ashton-Tate's troubled dBASE IV. Fox Software's $795 package has far more going for it than shaving a few milliseconds off indexing or adding a few dozen more procedures or commands, although it does do all that. Besides providing a high-performance superset of dBASE III Plus and IV commands, FoxPro brings a character-based windowing interface to the PC by way of the well-received FoxBASE+ Mac. As a result, dBASE programming will never be the same.

FoxPro also comes with a nonprocedural, object-oriented front end for its database manager. You can still use the keyboard with the new interface, but the program works best when you use a mouse. The FoxPro interface is about as far removed as you can get from the dot prompt and still be dBASE compatible.

The new interface isn't just for DOS-phobic users, though. Even the most dyed-in-the-wool command-line programmers will be impressed by FoxPro's ability to dynamically move, resize, and temporarily erase windows. It is possible to have an editing, a trace, a debugging, and an output window all either on-screen or a mouse-click away. Combine this with the ability to dynamically set breakpoints, a source code-level debugger, blazingly fast speed, and compatibility with both its own and Ashton-Tate's products, and you have a state-of-the-art dBASE development environment.

That is all very nice in theory, but dBASE IV 1.0 was also supposed to be the greatest thing since sliced bread until the bugs started popping up. To get my feet wet with FoxPro and to see how well it really worked, I performed a major overhaul on a 3000-line application that had started life in dBASE III Plus, and whose code had been expanded during a brief fling with Clipper.

Code Repair Made Easy

Installing FoxPro was a snap. The program, weighing in at more than 3 megabytes, comes in compressed form on merely five 360K-byte floppy disks. The installation program works automatically and, with a minimum of fuss and bother, transfers the program to your hard disk and then expands it without trying to rewrite your AUTOEXEC.BAT or CONFIG.SYS files. You probably will need to change your CONFIG.SYS file, though, because FoxPro needs every file handle it can get. The company recommends that your CONFIG.SYS be set to at least 40 files.

The documentation that comes with the program is well written. It's arranged in such a way that it's easy to use whether you're a novice learning the program or a grizzled dot-prompt veteran looking for examples of obscure command syntax. Unfortunately, the program it's written about isn't quite the same as the one you get. The release notes include no fewer than 47 pages of errata and additions to

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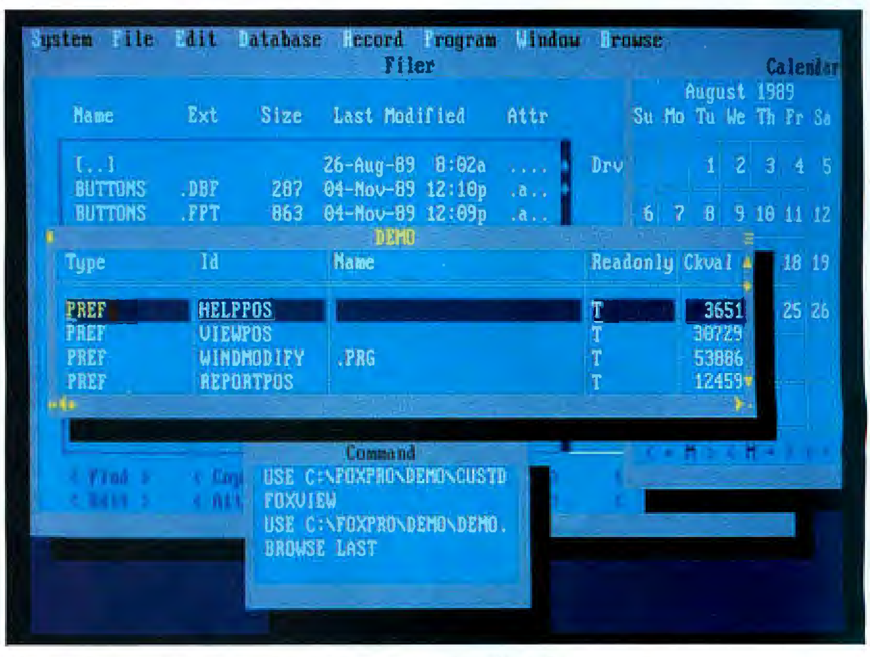

FoxPro brings the look and feel of menus to the dBASE language.

FoxPro 1.00

Company
Fox Software
134 West South Boundary
Perrysburg, OH 43551
(419) 874-0162

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Software Needed
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the main documentation. It's nice knowing the changes made, but I wish the company had integrated the information directly into the manuals, where it belongs, even if it meant delaying the program's release.

I had never seen my project's code before, so the first thing I did was sic FoxPro's integrated documenter, FoxDoc, on it to see what it could make of the hundred or so procedures and 50 programs. About 3 minutes later, I was looking at a system summary that included a complete tree structure, a variable cross-reference list, and summaries of indexes, formats, labels, procedures, and report files. FoxDoc prettied up the code and added comments that included file and procedure calls and listings of all called data and format files. This was a world of improvement over the documentation that came with my program—none. For this alone, I can highly recommend FoxPro to the legion of dBASE code repairers.

After going through the code, I then began tuning it up and adding the new programs required to expand the system's capacities. Again, FoxPro proved to be a godsend. It let me easily jump from watching the program's output to tracing the code and then to watching my debugging routines while dynamically setting variables and breakpoints.

Compared to previous FoxBASE releases, FoxPro has expanded support for user-defined functions. It's still not the equal of Clipper in this respect, though. You can't directly link C or assembly code for that extra performance edge. For this application, however, I could live without that ability.

FoxPro's internal editor is a good one, but I missed the WordStar-compatible commands of Ashton-Tate's editor. Still, it has one outstanding feature that I wish more true word processors had: It lets you retrieve any text deleted during an editing session. On the minus side of the balance, while the editor lets you move and copy text from window to window, it requires an extra step to do it. In theory, FoxPro allows you to call an outside editor in place of its internal editor. In practice, there wasn't enough memory left over for WordStar 5.5, my editor of choice.

Quick and Compatible

Despite its graphical user interface, FoxPro is impressively quick. A first look at FoxPro might make you think that it would be as slow as many Microsoft

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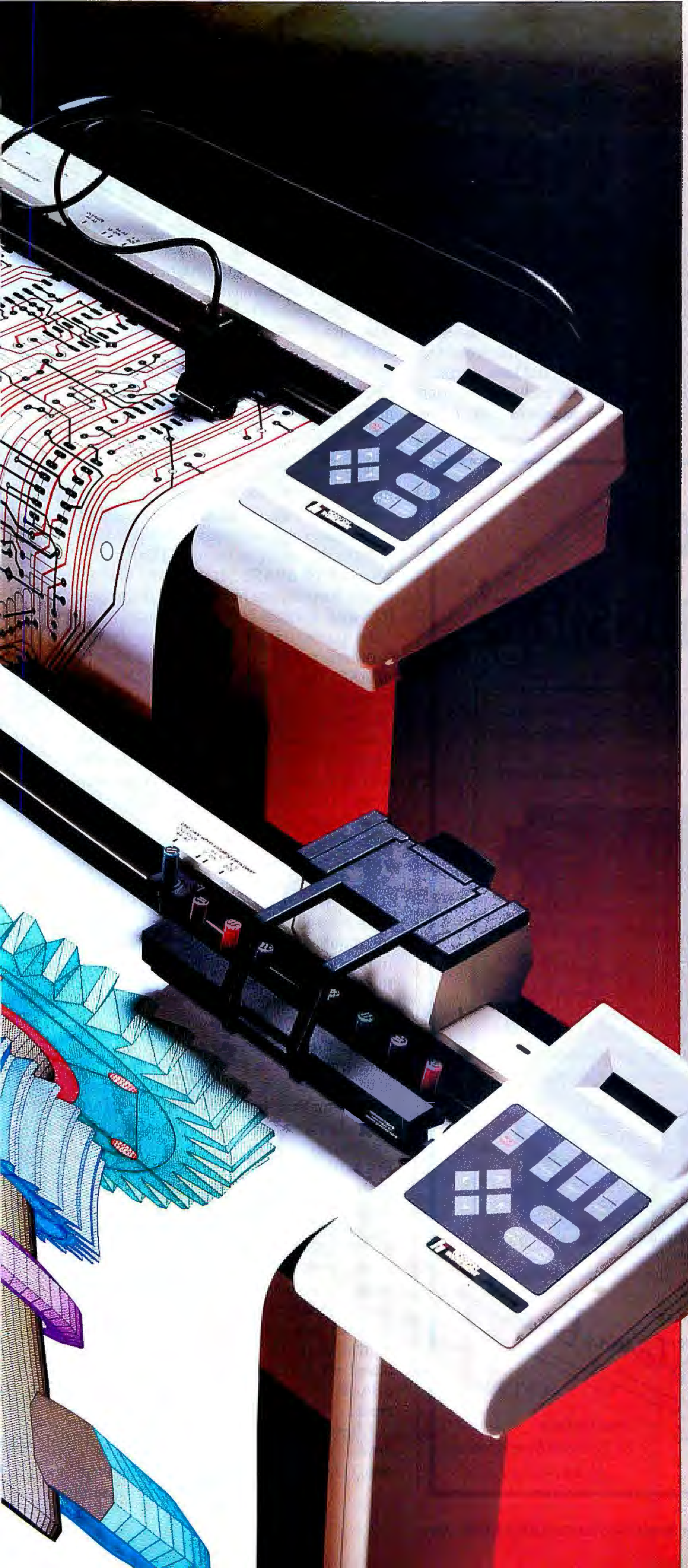

Windows-based programs. That's because its text-mode windows require only a fraction of the display memory that a true GUI requires. The end result is one of the smoothest and fastest windowing interfaces around.

The Browse command is also better than previous implementations. It now has two types of window formats. The first is the usual spreadsheet-like format, while the other corresponds to an Edit window. You can toggle between the two layouts at will. The real strength of the new-and-improved Browse is the ability to dynamically choose what fields or subsets of fields will be displayed, their size, and the order in which they will be displayed.

Despite some difficulties, mostly with Clipper commands that FoxPro doesn't support, I was able to finish the project in about half the time it would have normally taken me—and that includes learning time. There is one caveat to this. I was using a mouse. If I had relied on the keyboard alone to get my work done, it would have gone much more slowly. It's not that the program's key selections are poor, it's just that the program is at its best when mouse-driven.

FoxPro proved to be perfectly compatible with the dBASE III Plus dialect of dBASE. A series of tests on a number of dBASE IV programs that I had lying about revealed no problems with the newer language variant. Unlike its Ashton-Tate predecessor, FoxPro proved to be bug-free.

The program also has no trouble dealing with dBASE IV's database and index structures, with the exception of dBASE IV's master index format (.MDX). Make no mistake about it, though, FoxPro is a superset of dBASE. Its indexes and its memo formats are not backward compatible with Ashton-Tate's products.

In particular, FoxPro's new memo format is not like anything seen before in dBASE. New memo fields are unlimited in length. If you want to have a megabyte-size memo, you can. To make these monstrous memos more manageable, they can be searched and manipulated by several of the more important string functions, including the AT( ) and SUBSTR( ) subroutines. This goes a long way toward making memos more tractable for serious applications. FoxPro can also store binary data in string or memo fields. You can keep digitized images, sounds, and executable files all within the database. Putting binary data to use in the system isn't easy. For this release, the feature is more of a neat trick than a useful tool.

Pluses and Minuses

One thing you can always count on in any new dBASE program is that its makers will claim that their new index structure is smaller and faster than its forerunners. The makers of FoxPro are no exception. But while it may have the fastest indexing routines, they're not always the most efficient in terms of space. FoxPro indexed my files as much as 47 percent faster than dBASE IV with only a minimal amount of expanded memory (see table 1). However, file size was more of a toss-up. For simple index expressions, FoxPro made files an average of 10 percent smaller than dBASE IV's. When an index was based on a long, compound string key, dBASE IV was marginally more efficient.

I based my comparisons on eight indexes—six for a database with 837 records (Database 1) and two for a database

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INDEX PERFORMANCE: FOXPRO VS. DBASE IV

Table 1: FoxPro averaged about 30 percent faster than dBASE IV, but the efficiency (i.e., size) of the files created was more of a toss-up.

	Database 1 indexes						Database 2 indexes	
	1	2	3	4	5	6	1	2
Time to create (seconds)								
FoxPro	6.0	5.6	3.8	4.8	8.5	7.1	5.0	5.7
dBASE IV	11.3	7.0	6.8	5.6	10.4	8.8	8.7	9.1
Index file size (bytes)								
FoxPro	15,360	10,752	10,752	8192	72,192	72,192	43,520	20,480
dBASE IV	19,456	14,848	14,848	11,264	70,656	70,656	45,568	21,504

Note: Indexes were created based on the following expressions:

Database 1:
1. index on str(year(date),4)+str(month(date), 2)+str(day(date),2)+tape_no to date
2. index on trim(tape_no) to number
3. index on trim(format)+trim(tape_no) to format
4. index on trim(location)+trim(tape_no) to location
5. index on trim(subject)+(tape_no) to subject
6. index on trim(title)+trim(tape_no) to title

Database 2:
1. index on trim(key) to keys
2. set unique on index on trim(key) to uniq_key

BENCHMARK DATABASE MAKEUP

Table 2: Of the two databases used to compare FoxPro and dBASE IV, the first consisted of 837 records using several key fields, while the second contained 1470 records and only one key field.

Field name	Field type	Length
Database 1		
Date	Date	8
Format	Character	3
Location	Character	3
Subject	Character	60
Tape_No	Character	4
Title	Character	60
Database 2		
Key	Character	20

with 1470 records (Database 2). The names, types, and lengths of the fields used are shown in table 2.

I ran the tests on an Austin 286 AT compatible running at 12.5 MHz with 640K bytes of conventional memory and 384K bytes of expanded memory. The system also had an 80-MB Plus Development Hardcard II disk drive with a BIOS disk access speed of 28 milliseconds and a 128K-byte hardware disk cache.

There are two points where dBASE IV still has the edge. The first is automatic screen generation—Ashton-Tate's product is easier to handle. The second is the report generator: I rate FoxPro's as equal to dBASE's except for one significant shortcoming. The other dBASE variations let you directly edit a report's code; you can't do this with FoxPro.

The company claims that its report generator is so complete that you'll never need or want to meddle directly with the code. Wrong. Expert dBASE programmers will still want to get their hands dirty working directly with the report's format. Still, for the computerphobes in the office, the nonprocedural, object-/event-oriented front end of FoxPro's report generator is easier to approach than dBASE's.

One of the more remarkable things about FoxPro is that it manages to perform its tricks in as little as 512K bytes of RAM and on your typical 70-ms, slow-as-death, XT-class hard disk drive. It's not fun, mind you, and the program really slows down, but you can do it. FoxPro sings, however, when used with a fast chip and EMS 4.0 memory—the more of the latter, the better. FoxPro will also put any 80x87 math coprocessors in your PC to good use. One thing to be noted, though, is that FoxPro is very sensitive to its environment. Even a small reduction in RAM, either normal or expanded, can make a big difference in its performance.

Of course, FoxPro isn't perfect. The program claims to "compile" files, but it doesn't. FoxPro creates and runs object code faster than it runs source code. You can create true run-time programs only with the purchase of the not-yet-available FoxPro unlimited run-time package, which will set you back an additional $500. You can't simply buy a professional developer's package.

The current package isn't ideal for LAN use, either. However, Fox Software says that it is working with Novell to produce FoxPro/LAN for NetWare.

FoxPro is not a relational database manager and doesn't support Structured Query Language. This is a problem. The relational database model is the wave of the future. SQL, the language of the relational database management system, provides fundamentally stronger query and manipulation tools than dBASE, but good microcomputer SQL implementations are still hard to find. The company says that the next major release of FoxPro will include a SQL interface, but it will take more than that to make a DBMS relational. It is a step in the right direction, though, and I look forward to seeing the revision.

If you just want to get at your data quickly or whip up a simple report, you will be very happy with Fox Software's new product. FoxPro brings more than just a Mac look to the DOS environment. You can master the bread and butter of simple database design (i.e., data entry and report generation) quickly and easily in FoxPro. The program would make a fine choice for most offices.

FoxPro stretches the single-user, single-machine flat-file database model about as far as it can go. I wish it included SQL and improved LAN suitability, but despite these reservations, I plan to use FoxPro for most of my dBASE applications development. ■

Steven J. Vaughan-Nichols is a programmer/analyst for Bendix (Lanham, MD) whose work currently includes designing a database that takes data from a Goddard Space Flight Center telephone digital switch. You can contact him on BIX as "sjvn."

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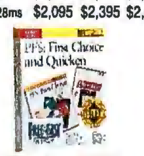

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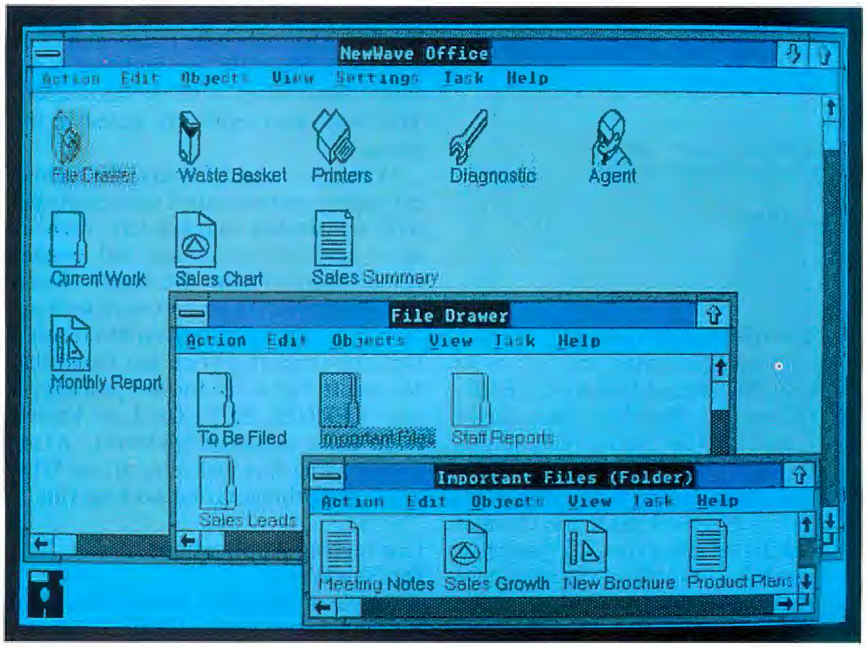
Circle 11 on Reader Service Card

Windows Rides a New Wave

Hewlett-Packard's NewWave is nice, but is it too hard to use?

John Lussmyer



The top level of NewWave, the icon-based "office." Even minimal conversions of Windows applications to the NewWave office are not trivial.

When Microsoft Windows was first introduced, it started people thinking about the potential of a DOS-based graphical user interface. Still, even now, it seems that something is missing. While Windows provides a programming interface and a platform for graphics-based applications, it offers little in the way of amenities to users. Furthermore, while object-oriented paradigms apply well to GUIs, Windows' programming interface does not include many hooks that allow interface elements to be handled as objects.

NewWave, Hewlett-Packard's layered enhancement for Microsoft Windows, promises to change all that. Announced over two years ago, NewWave is supposed to bring a more robust feel to Windows. The goal was to make Windows easier to use and expand the range of functionality available to Windows applications. In this review, I'll examine NewWave, both the user interface and the programming tools, and weigh the benefits it brings against the hardships it creates.

NewWave is much more demanding than Windows. My system, an NEC PowerMate 386/20 with 4 megabytes of RAM and a 40-MB hard disk drive, just barely met the requirements of NewWave. On a 386 system, you need at least 4 MB of RAM and 8.5 MB of disk space. That's a tall order, but moving some files to the Novell network cleared up enough disk space.

The NewWave installation program decided that my system was not set up correctly, wrote out a lengthy error file, told me to read it, and quit. I would have preferred an explanation of the failure on the screen. The error file listed several problems with the way my system was set up. The error messages were fairly verbose and contained references to various application notes; I had a little trouble finding those notes. According to the error messages, my system didn't have any EMS bank pages above 640K bytes, it didn't have enough EMS RAM (installation had found only 80K bytes), it didn't have enough EMS RAM for banking (this time installation found 2528K bytes), the proper version of Windows was not installed, I did not specify a TEMP directory in my environment, and I did not have enough free disk space. If you didn't already know, NewWave is a very demanding, finicky environment.

I fixed the first problem by changing my 386Max installation. I never understood why NewWave saw only 80K bytes of EMS RAM, so I ignored the error. Decreasing the size of the disk cache gave me enough EMS RAM for banking. I had Windows 2.10 in my path; NewWave requires version 2.11, so I installed a newer copy. I then set up a TEMP directory. Finally, I made room on my hard disk drive, and NewWave was satisfied.

I had some questions about NewWave's use of EMS and called the HP NewWave support hotline. After a few levels of voice-mail recordings, I got another recording telling me that all the support people were busy and to please leave a message. I did, but no one returned my call.

continued

NewWave 1.0

Company
Hewlett-Packard Corp.
Santa Clara Information Systems Division
3410 Central Expy.
Santa Clara, CA 95051
(408) 749-9500

Hardware Needed
A 286 or 386 PC with 3 MB of expanded memory (EMS 4.0), a 20-MB hard disk drive, an EGA or VGA monitor, and a Hewlett-Packard or other Microsoft Windows-supported mouse

Software Needed
DOS 3.2 or 3.3; Microsoft Windows/286 version 2.11

Price
NewWave and support pack: $195
NewWave developer's kit: $895

Inquiry 887.

The Trouble with Windows

I had just finished installing Microsoft Windows 2.11 when I found the READ-ME file on the NewWave installation disk 1. Some of the instructions in this file tell you to replace certain files on the Windows installation disks with ones supplied by HP. So I made the changes and reinstalled Windows. If you ever have to reinstall Windows after you have installed NewWave, you must make some minor changes to the Windows installation.

This time when I ran the NewWave installation, everything seemed to run properly. A Windows/NewWave program performs a large part of the NewWave installation. This means that the installation runs slowly with long delays between disk swaps.

Problems began almost immediately after starting NewWave. Most of the Windows utility functions (e.g., Calc, Notepad, and HeapWalker) would not run. They aborted with a "not enough memory to run" message. One of the NewWave tools, Agent (an object that records and plays back user actions), just told me "Agent tool can't be opened in this release." Why was it installed? Every now and then, my NewWave session would inform me that it couldn't find one of its system files and to put it in drive A. Right. I didn't even know which distribution disk it was on. I *knew* that it was on the hard disk drive, but NewWave couldn't find it. I had to either put it on a disk in drive A or use the three-finger salute to reboot (losing any work in progress).

I called the NewWave technical-support line again, and this time I was quickly connected to a person. It turns out that the company has a new phone system and has had some problems with it, but the technical-support person was surprised to hear that no one had called me back. She was quite helpful and answered a few questions I had but couldn't figure out what was going on. The manuals had left me with the impression that NewWave worked only with EGA and VGA, which is wrong; it should work with any Windows-compatible video card, although NewWave has only been tested with EGA and VGA. She also verified that NewWave won't work with Windows/386. This was never explicitly stated in the manuals.

Within a couple of hours, the technical-support person called me again to get more information on my system. An hour or so later, she called and had another person there to help. We finally found that Windows 2.11 doesn't work with my Novell network. So I got on Microsoft's On Line support service and found that Microsoft had a fix for the problem, a new KERNEL.EXE (On Line knowledge base message Q44660). After downloading this and reinstalling Windows, everything started working fine.

Converting Applications for NewWave

A couple of days after getting NewWave running, I received the HP NewWave developer's pack. This is a set of disks with five binders' worth of manuals and another copy of the application notes.

The manuals are not especially helpful. HP really needs a book similar to Charles Petzold's *Programming Windows* (Microsoft Press, 1988) for NewWave. The most helpful manual is the HP NewWave Environment Programmers Guide. It describes how to convert an existing Windows application into a NewWave application, although it explains only a minimal conversion.

I did a minimal conversion of my Windows-based BIX conference viewer. My goal was to create a BixWin object that is a view of a specific portion of the message database. The changes required to even minimally convert an existing Windows application to work in the NewWave office are extensive. If your application makes use of the command line, you will have problems. NewWave has its own internal use for the command line, and, as far as I can tell, you cannot invoke an application from the DOS command line. It really wouldn't make sense in the NewWave object environment to do so. Any special command-line options you have will need to be implemented in some other fashion.

You must change two main functional groups of program code: those groups that use the Object Management Facility (OMF) and those that use the NewWave application programming interface (API). The NewWave OMF consists of a group of messages and functions that you must work with to handle NewWave objects. NewWave will invoke your application when the user (or another program) activates an object belonging to your application. This makes for some changes to the normal menu structure. The normal File menu is renamed Action, and some of the functions are changed. You will no longer have a `New` item; that function is handled by OMF. You can select `Objects` and then `Create a New` from the Office window. The function `Save As` will also create a new object.

Your application will also have more possible states of execution. A stock Windows application is either running or it isn't. Under NewWave, it can be inactive (not running at all), active, or open. When it's active, it creates its window but doesn't display it. A window is only displayed when the application is brought up to open status. This additional state requires changes to the application's initialization functions. You will always create the window, but you don't perform the `ShowWindow` or `UpdateWindow` function calls until NewWave sends you an OMF_OPEN message (which it may never do). To create a window, the `NW_CreateWindow` function is called, which replaces the existing `CreateWindow`. The initialization code also has to call the `OMF_Init` function to tell OMF what your window handle is. NewWave makes extensive use of property lists to maintain information about a window.

After you have called `OMF_Init`, you start getting OMF messages, and you must modify your main window procedure to properly handle them. The first thing your Window procedure must do with each message is call `NW_MessageFilter`. If this function returns `True`, you must immediately return to Windows with a value given to you by this function. You will also have to process some of the various WM_SYSCOMMAND messages. For SC_MAXIMIZE and SC_RESTORE, NewWave provides special functions that should be called. All other WM_SYSCOMMAND messages should be passed on to `DefWindowProc`.

continued

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In addition, you must set up a function to handle the OMF HAS_METHOD messages. This simply returns `True` or `False`, depending on whether your application supports that particular NewWave method. A method is just a name for a particular type of NewWave message. I do not understand why the company didn't provide a standard Window subclassing function to handle the `NW_MessageFilter`, WM_SYSCOMMAND, and HAS_METHOD handling. It looks like these handlers might be identical for all applications. The OMF already has all your HAS_METHOD information from your .IN$ file (a file similar to the Windows .DEF file).

I had a number of objects just disappear until I told NewWave to straighten up the screen and realign by rows.

HP has given quite a few style guidelines for NewWave developers to follow, one of which is that during activation, you get the title of the object being activated and display it in the title bar of the application. You also must obtain the filename and path from OMF and load the file. For BixWin, my objects are just a minimal specification of which conference, topic, and message are to be viewed. Since I wasn't doing this in the original Windows version, I had to add a menu item and code to read and write to the files. The menu that was most affected by this was the Conference View menu. I added Remember, which creates a NewWave object. When this object is activated, it starts a view of the message that was remembered. It is not an easy task to create a new object from within a program. You can only invoke the NewWave dialogue that the user normally uses. The user still has to fill in the blanks in the dialogue. There doesn't seem to be a way to simply create a new object of the same type that is executing.

In addition, do not use the undocumented Windows function `ExitWindows` from your application. NewWave will prompt with a message box that asks whether you really want to exit (which is probably what you were trying to avoid). It will also end up confused about the state of any objects on the screen. I had several objects just disappear until I told NewWave to straighten up the screen and realign by rows.

By the time you do a minimal conversion, your code will look considerably different. Your normal Windows initialization won't actually display the window. You will have added several new functions to process OMF messages, along with a bunch of calls to OMF function for initialization and termination.

HP recommends that you add the line EXETYPE WINDOWS to your .DEF file for proper operation. You also have to create an .IN$ file that gives NewWave some environment-specific information about your program. This includes a list of files that make up the executable file, whether default data files get copied when a new object is created, what methods are supported, and the name of your application.

Going All the Way

At this point, your application will be more NewWave tolerant, but it won't yet fully exploit the new features. The second part of conversion will bring you up to a full NewWave application. This is the heart of the NewWave API: It supports the on-line help facility, Computer Based Training (CBT), and the Agent. I did not have time to perform a full conversion on my large BixWin application. I read the manuals and worked with the supplied sample programs. Each of the sections of the API requires extensive changes to the average application. HP tells you that setting up the Help facility requires no programming; then, a few pages later, there is a list of messages that you must process for Help to work. The Help facility looks nice when it is done. The major problem is writing Help text that makes sense.

Adding the last bit of NewWave functionality to an application renders it even more unrecognizable. You must add calls to quite a few API functions to determine if you are going to process the message, and if so, what to do with it. HP provides sample code sections that can be copied verbatim into your code. These are more correct, you hope, than the usual Windows sample code. Again, it looks like HP could have performed many of these functions by just subclassing the window when you create it. Most of these changes are to support a task language that should

continued

be able to perform all the basic functions of your application. The Agent automates tasks by using this task language, even though much of the work is performed by the application.

Since most Windows programs were not written with a command language in mind, creating a complete one can be a difficult job in itself. HP suggests that you use its YACC (a spin-off from the Unix Yet Another Compiler Compiler, for which HP includes an advertising flyer) to generate the parser for the language. The manuals give examples of task languages and what to do with them, but using the examples causes some basic structural changes to your program. All commands can be processed by the same function. If you use dialog boxes—and who doesn't—you will have to make a number of changes. The dialog boxes should just return command codes for the main command processor to execute. You will not be perfoming much other than entry validation in the dialog box functions.

NewWave isn't easy to port to, but then, nothing worth doing should come easily.

The CBT support lets you write automated tutorials for your program. Again, it requires changes to your main window procedure so that it can monitor what the user is doing and supply actions when necessary. HP supplies a limited animation capability for CBT that helps make things a little more interesting. Creating the animation is a tedious job at best, though. I didn't have time to do more than look at the code changes necessary to support this, and they are considerable.

One of the more interesting features of NewWave is the data sharing, with which a view of your applications data can be pasted into another application. This view is wholly maintained by your application, but support is implemented by handling another set of messages that HP has defined. Again, the code to support this can be rather large. The examples given in the NewWave documentation were not very clear on what it takes to do this.

Another area in your application that will require modifications is the print support. NewWave objects print themselves using a different technique than is normally used by a Windows program. NewWave performs all printing by way of metafiles. The window procedure receives a message indicating that it should print a single page to the given metafile. After each page is done, the window procedure sends a message back to NewWave asking for the next page's metafile, and another message is sent when printing has completed. Since you are printing to metafiles, the normal Windows spooler isn't needed, and NewWave installation disables it by default. A side effect of this is that your normal Windows applications will print more slowly. If you are going to be doing much printing from a normal Windows application, you will probably want to reenable the spooler. Make sure you disable the spooler afterward; otherwise, the (effectively) doubled spooling will make the system seem slow.

Likable, but a Lot of Work

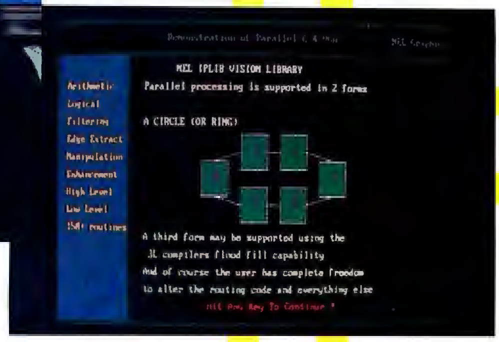
Overall, I liked using the NewWave interface. The icon-/object-oriented interface is easy to use and learn. When more applications are available, it should be a nice environment. I like the idea of sharing views of data between programs. This could make some of my normal bookkeeping a lot easier.

However, modifying an existing program to use is difficult at best. If you don't perform a complete conversion, there is no real advantage to the environment. If you do a complete conversion, you must rewrite major portions of your application. If you are planning to convert your application to the NewWave environment, you should sit down and figure out just what portions of it you need to or can support. The HP NewWave Environment Programmers Guide gives a good (although incomplete) description of how to convert an existing application.

The manuals need some help. If you run into a snag, the support line is good. In any case, expect to spend a lot of time reading the manuals and testing what you've written. NewWave isn't easy to port to, but then, nothing worth doing should come easily. ■

John Lussmyer is a software developer living in Troy, Michigan. He can be reached on BIX as "jlussmyer."

PARALLEL IMAGE PROCESSING



High Speed Parallel Processing

IPLIB is a transputer based image processing library written in C. The library consists of over 200 of the most common and useful image processing functions available. The functions supplied range from simple row, column and pixel manipulation to complex line extraction and component and texture recognition. The supplied routines are able to run in parallel with the commonly available transputer high level languages such as Pascal and Fortan and with Occam in the D705/D711 compiler versions.

As an added advantage, the full source code of every function is supplied with detailed documentation of how the system works. This allows the user great flexibility to adjust the IPLIB functions to their own requirements and to expand the library with their own routines.

As well as providing large numbers of functions for image processing IPLIB also provides a parallel processing harness which operates transparently to the user. Functions are supplied that will automatically allocate data packets to the individual processors and then reassemble the resulting image after processing is complete. These functions allow high performance parallel systems to be constructed quickly and easily.

For details of availability and application please contact: Steven J. Doyle
National Engineering Laboratory East Kilbride, Glasgow G75 0QU, U K
Telephone: East Kilbride (03552) 20222 Telex: 777888 Fax: (03552) 36930

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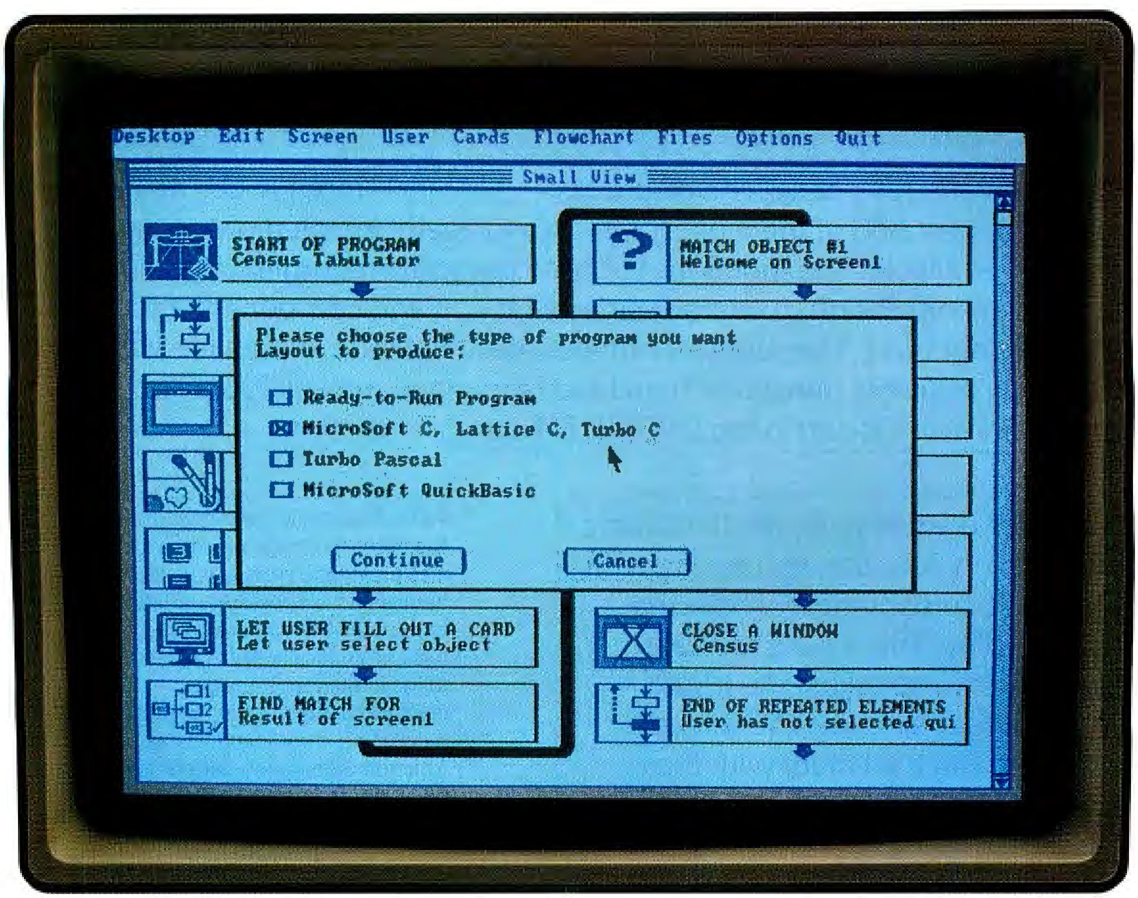

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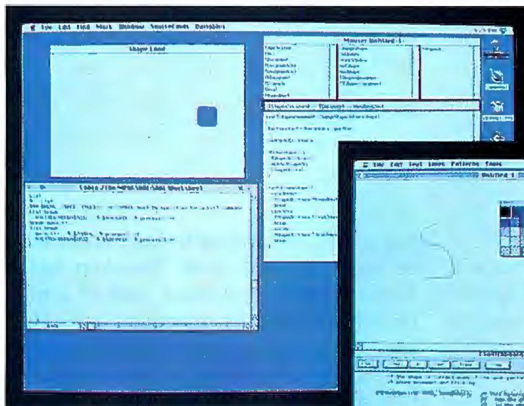
C Compilers Have Different Strengths

Two compilers bring object-oriented power to the Mac

Matt Mashyna



◀ **Photo 2:** *Apple's Symbolic Application Debugging Environment debugger running with MPW C++.*

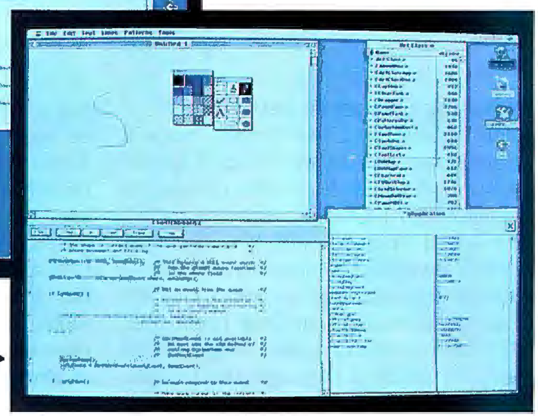


Photo 1: *Think C 4.0's integrated debugger.* ▶

Apple has been dedicated to object-oriented programming—so dedicated that a substantial portion of System 7.0 is being developed in it. Object-oriented code is easier to control, from a software engineering point of view, and the Macintosh's interface suits it very well. Objects that respond to your actions with little dependency or knowledge of other objects free you from worrying about which window or area received a mouse-click or keystroke. The objects know what to do because the framework tells them when to handle an event and when to pass it on.

Apple started by adding object extensions to its Pascal compiler. Then Apple developed an application framework called MacApp. MacApp provided Pascal programmers with a fast development system that gave the programmer all the basic functions—text editing, scrolling lists, and views, to name a few—in self-contained objects. None of the objects required changes to be fully functional, and they were easily changed to meet new needs.

Now C objects are accessible to Mac programmers in two varieties: Symantec's Think C 4.0 and Apple's MPW C++ 3B1.1. Both compilers offer objects, but they are very different animals. Think C is a complete environment that meets the needs of the majority of programmers, while C++ is a more robust, powerhouse language for the MPW Shell.

A Closer Look: Think C

The Think C environment is inviting, and it is streamlined for C development. The object extensions (make no mistake, Think C is not C++) provide you with tools to tame the Macintosh. The program offers a number of improved features, along with the object extensions, over version 3.0.

The new ANSI library supports all the ANSI standard functions. This is nice for portability. It replaces the Unix libraries from earlier versions. It also eliminates some old, peculiar functions in favor of more standard ones. Functions like `clalloc` and `mlalloc` and nonstandard string-to-number conversions are gone.

ANSI prototyping is now supported. This makes for better programs by forcing the compiler to check arguments in function calls and by forcing programmers to properly cast variables. In-line assembly is available, too, and it now accepts all MC68020 and MC68881 instructions and addressing.

A nice feature is the "Once only headers" that lets you define a preprocessor symbol at the top of your header files to prevent multiple inclusion. The rule is that if you define a symbol beginning with _H_ followed by the name of your include file, without the .h extension, it will not be processed a second time if it is included by other header files. For instance, the statement

```
#define _H_foo
```

within the file foo.h stops it from being included again, in case other header files also include foo.h.

Think C makes it easy to build multisegment code resources for desk accessories and device drivers and provides the ability to address globals using register A4 without affecting other applications' A5 addressing.

Another feature that I like is cdev debugging. Symantec has implemented a cdev object. The basic methods are already done, which means you only need to worry about the specifics of your cdev. An example with two projects is included. One project builds a real cdev, and the other builds an application with which you can use the debugger.

continued

MPW C++ 3B1

Company
Apple Computer
Programmers and Developers Assoc.
20525 Mariani Ave, Mail-Stop 33G
Cupertino CA, 95014
(800) 282-2732

Hardware Needed
Mac Plus, SE, SE/30, or II with 2 MB of memory and a hard disk drive

Software Needed
System 6.0.2 or higher; MPW Shell and C Compiler Bundle 3.0 ($400); MacApp 2B9 is optional ($100)

Price
$175

Inquiry 888.

Think C 4.0

Company
Symantec Corp.
10201 Torre Ave.
Cupertino, CA 95014
(408) 253-9600

Hardware Needed
Mac Plus, SE, SE/30, or II with 1 MB of RAM and a hard disk drive; debugger requires 2 MB of RAM

Software Needed
System 5.0 or higher; debugger requires MultiFinder

Price
$249

Inquiry 889.

Switching Channels: MPW C++

Apple calls MPW C++ "beta," but it is shipping the product unrestricted to end users, nonetheless. It consists of Apple's port of AT&T's Cfront preprocessor 2.0 (the latest) coupled with the standard MPW C compiler. As a bonus, the C++ package also includes version 3.1 of the C compiler, which has bug fixes over 3.0. This is a nice compiler with detailed warnings and error messages that tell you what went wrong and what it expected for arguments. Converting files from version 2.0 to 3.0 or 3.1 requires several changes, but Apple throws in a conversion tool that takes most of the pain out of converting.

A lot of the glue has been changed with respect to using call-by-reference versus call-by-value. You can count on making calls-by-reference, now, when *Inside Macintosh* says that the Pascal call uses a VAR. I also like the fact that it gives you many errors, depending on the severity, before it quits. I hate having to do fixes and then compiling the code over and over to catch each error.

To compare these products more evenly, I've combined C++ with MacApp. MacApp is Apple's object library. C++ does not come with a Mac-specific object library. MPW C++ is a complete C++ implementation, and it packs more punch than other object-oriented C compilers. Think C comes with its own Think Class Library. TCL is close to an older version of MacApp (1.1).

Both TCL and MacApp provide you with the basic objects that you'll need to get started, but MacApp is more refined. For example, setting up a scrolling region is effortless using MacApp, but using TCL, it can be a trying experience, at least the first time. MacApp has a Scroller object that takes care of scrolling any view that is embedded in it. TCL uses the older style of windows, scroll panes, and scroll bars that can be a hassle to coordinate. TCL also lacks some of the deluxe features that MacApp provides, like `TextListViews`, which displays scrolling lists of nearly any number of lines.

Stacking Them Up

These two products diverge after their object-orientedness. Think C has some features that I love. It's so easy to create INITs in C. It's also great to make inline assembly calls rather than link another assembled object module, because you can reference your C variables more easily in the assembly code. Another helpful item is Think C's console interface. It allows you to directly port Unix (and other) code that routes I/O calls through `stdin`, `stdout`, and `stderr`. MPW still doesn't do this outside of an MPW tool, and even then, it doesn't work well.

The Think C compiler is also very fast. The ability to include precompiled headers greatly reduces the time needed to read all the header files that are regularly included in your source files. I'm also a big fan of the symbolic debugger. You can't write debugging shell scripts, but it's nice to simply debug applications and cdevs. (It's a straightforward debugger with twin windows—one for source and another for data [see photo 1]. You can watch data and easily set breakpoints, with or without conditions. It reminds me of Microsoft's CodeView.) The Symbolic Application Debugging Environment (SADE) debugger has scripting and other powerful features, but its primitive interface is more difficult to master (see photo 2).

Besides the TCL shortcomings, Think C lacks the ability to create code segments over 32K bytes. It also pales in comparison to MPW's resource compiler. I also don't care for the giant project sizes that it creates. Since the compiler keeps all the object code handy in the project file, the compile/link time is fast, but I think I'd rather share object code between projects and keep them small. When you initially compile a project that uses the TCL, it takes a long time. After your project has been compiled once, though, the TCL doesn't need to be compiled again, and compile time dramatically decreases thereafter. The TCL can't be compiled into its own object-code library, because you would lose the ability to use the debugger on TCL classes.

The MPW editor has features that the Think C editor lacks (e.g., searching backward and marking text for quick reference). Most Unix C++ professionals will not like the fact that it is not C++. It is more akin to MPW's Pascal with object extensions.

As for MPW C++, its biggest feature is that it is *real* C++. You can take Unix C++ programs and expect them to compile. You gain C++ 2.0's multiple inheritance—the ability to combine components of different objects into one—the standard C++ I/O streams, and function and operator overloading (defining multiple functions with the same name). The features of C++ are many, and its power is great. I can't stress enough that these two products are not the same language.

A great virtue of MacApp is its debugging mode. MacApp creates executable files in two modes: debug and nondebug. In debug mode, you can examine your objects and browse through them via an Inspector window. This can be a big help when your object relationships are complex. The Think C debugger allows you to examine your objects, but it's not as handy. With just a few mouse-clicks and without cluttering the screen with data windows, the MacApp inspector gives you a lot of useful information based on the type of object that you're interested in.

When you get a lot of power in a product, you pay a price. The price for using C++ is time, space, and dollars. The compile time using MacApp can hurt. I

continued

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count on an overhead of almost 2 minutes for each file that must include the MacApp headers. The folder that contains my MacApp files is around 7 MB in size. The price of C++ does not include the cost of the MPW Shell, MPW C, MacApp, or the SADE debugger. Perhaps by the time you read this, Apple will have a much faster version of MPW C++ that uses precompiled headers. That should diminish the compile time penalties for using MacApp.

If it sounds like I'm discouraging you from using C++, I'm not. Sure, it's expensive, but when you have all the required elements, the MPW shell with all its tools and flexibility is second to none. Those people who are used to working in a Unix environment will like it. The shell can be bent into the shape that suits you. You can even define shell scripts and variables. The Make facility is also much like Unix. Combining object code from different source languages is a snap. You can create your own tools to help you in your development. If you need a grep (pattern match) utility, just write your own and make it a part of the shell.

The MPW shell with all its tools and flexibility is second to none.

The Need for Speed

I don't think that speed is very important. It's more useful to know how the products compare as development tools. I took the basic, empty shells from Think C and MacApp and created an application with a scrolling, sizable, and zoomable window that did open, close, and save documents—all the basic things you'd want—and built an application with only these lines in the Draw methods:

```
MoveTo(10,10);
DrawString("\pHello, world");
```

The first time, Think C took 4 minutes, 50 seconds to compile on my Mac II. When I recompiled my application, document, view, and main files, the program took 29 seconds. Linking the project into an executable file took 12 seconds. The executable file size came out to be 57K bytes.

With MPW C++, the first compile, Rez, and Link took 2 minutes, 22 seconds. The next compile took 2 minutes, 7 seconds. The executable file size came out to be 92K bytes in nondebug mode and 254K bytes in debug mode. Note that the C++ source program was in a single file that was considerably smaller than the Think C source files, but the point of the comparison is to show the minimal source compile times using the basic frameworks of each class library. Because the integration of C++ and MacApp is not in its final state, Apple recommends that you include all source files in the main file so that, by including them only once rather than in many source compilations, you reduce the time to load the MacApp headers.

As for documentation, MPW C++ includes the standard AT&T C++ product manual, library manual, and selected

continued

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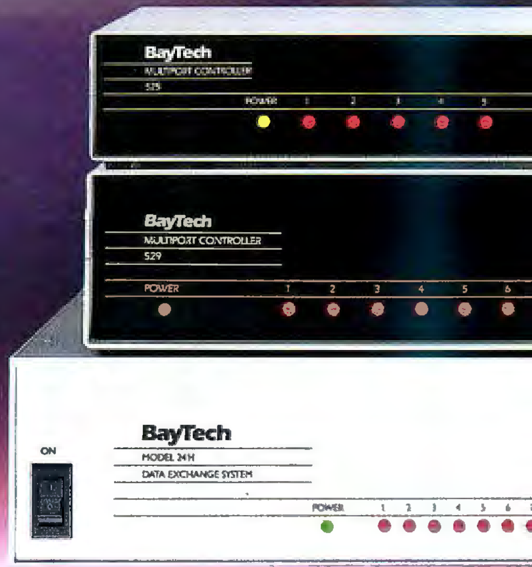

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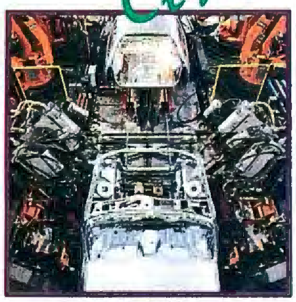

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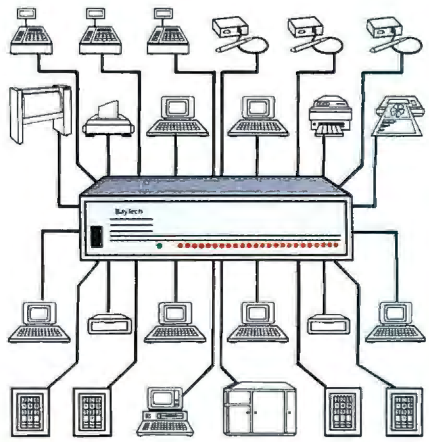

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readings. It's a hefty package that tells you just about everything you'd want to know about C++. The examples are the usual simple text editor and drawing applications. The MacApp documentation is very complete.

I like the Think C manuals. They are very clean, and it's easy to find what you need. The Class documentation lists each TCL class with its ancestors and descendants. Each method is listed with its parameters. A complete manual of standard C library functions is also included.

What do you need to harness these tools? For Think C, you'll need 1 MB of memory (2 MB to use the symbolic debugger), 1.5 MB of hard disk storage or two 800K-byte floppy disks, and Finder 4.2/System 6.0 or higher.

MPW C++ requires the MPW Shell, MPW C 3.1, SADE for debugging, at least 2 MB of memory (realistically, you'll need 5 to 8 MB), an additional 2 MB of disk space over what the MPW Shell uses, and, again, Finder 4.2/System 6.0 or higher.

Objectively Speaking

As I've pointed out, these are two different languages. They can both function to merely compile C code, but that's not what should compel you to buy one over the other. I think of Think C as the Swiss Army knife of compilers. It does so many nice things. I can't imagine wanting to write an INIT in assembly language when I can use Think C. Think C makes building cdevs easy, too, and you can use the debugger on them. It's quick and simple for writing `printf`s to a window. For the price, you can't beat it. When I need to get something done in a hurry, I turn to Think C. In some cases, I use it to prototype methods of large C++ applications because of its sheer speed.

Why use C++ with MacApp? If you really want to exploit object-oriented programming, there's no substitute. MPW C++ is the real McCoy, and the MacApp library is very complete. They have been under development for over five years. They can save you from unexpected crashes and will manage memory segments. C++ comes with ViewEdit for creating everything from simple to extravagant and complex views.

I like both these products very much. If Think C had an improved class library, I'd be tempted to use it for everything, in spite of my dislike for its limited subset of C++, its editor, and its Rmaker resource compiler. I tend to use it more for its non-object-oriented features, but I do use the TCL for "light" applications. If you're on a budget, Think C is the way to go. You can get everything out of it that you would get from MacApp with a little more work.

For product development, I rely on MPW C++ and MacApp. In concert with their tools, I feel pampered. They are slower than Think C, but I don't run into problems building views because ViewEdit lets me create predictable results. For Macintosh interfaces, views are everything, and MacApp gives you much to work with. The MacApp library is very stable and has evolved past the TCL.

No matter which one you choose, I think you will be pleased. These are modern tools for modern times. This is your chance to get a jump on the next wave of programming trends. ■

Matt Mashyna is a software developer living in Pittsburgh, Pennsylvania. He can be reached on BIX c/o "editors."

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Mono	$1199	$1299	$1479	$1619
VGA-Mono	$1379	$1479	$1659	$1799
VGA-Color	$1609	$1709	$1889	$2029
SVGA/Color	$1719	$1819	$1999	$2139

PC BRAND 286/20

w/512k, Hard Disk Drive, Monitor & Video Card

Hard Drives: Mb/Ms	20/40	40/25	66/25	100/25
No Video	$1229	$1329	$1509	$1649
Mono	$1349	$1449	$1629	$1769
VGA-Mono	$1529	$1629	$1809	$1949
VGA-Color	$1759	$1859	$2039	$2179
SVGA/Color	$1869	$1969	$2149	$2289

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WARRANTY

Best "Executive Decision" System.

-Personal Computing, Best Bargain Systems, Dec, 1989

"The PC Brand 386/SX-16 performed at least as well as the far costlier Compaq... We simply began marveling at what is surely the biggest bargain in personal computing"

-Computer Buyer's Guide, Cover Story, Oct, 1989

Intel 386 Technology at 286 Prices the 386SX-16 Only $899

PC BRAND 386/SX-16____$899

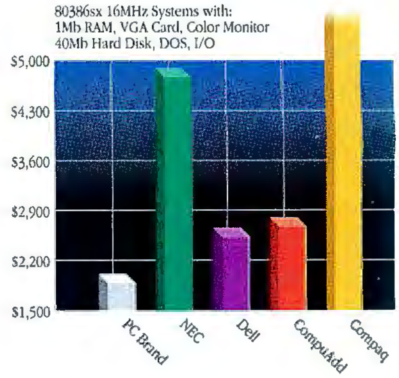
16 MHz Clock, Zero Wait Operation • Norton SI 18.7 Landmark™ 18.3MHz, 512K RAM, 1.2MB or 1.44MB Drive, 101-Keyboard, 2 Serial and 1 Parallel Ports

Standard System Features:

- 80386SX Processor Operating at 16MHz delivering 18MHz Effective Throughput
- 512K RAM expandable to 8MB on the System board using 256K and/or 1MB RAM
- 1.2MB 5.25" or 1.44MB 3.5" Diskette Drive
- FCC Class "A", Intended for business use
- High performance 16bit VGA Cards with 1024x768 capability on all VGA systems
- 1:1 Interleaved Hard/Floppy Drive controllers, 1 Mb/Second disk transfer rates on all 100 Mb drives or larger
- Enhanced 101-key Click/Tactile Keyboard
- 2 Serial & 1Parallel ports on std-configurations
- High Capacity 200 Watt System Power Supply
- Real Time Clock/Calendar with 5 Year Battery
- 80387SX Co-Processor Support
- AMI BIOS with full MS/DOS, OS/2, XENIX, UNIX, NOVELL, 3COM compatibility
- 8 Slot motherboard design (5 16Bit & 3 8Bit)
- Medium foot print case w/ 6 Disk Drive bays (Shown in optional Mini Size Tower ® Case)

Options:

- Low profile Slim Line Case w/3 Disk Drive bays at no extra charge
- Mini Size desk top Tower ® Case w/4 Disk Drive bays (as pictured above)
- LCD or Plasma Portable
- Factory Installed RAM Upgrades
- Custom configurations w/Name Brand peripherals of your choice



PC BRAND 386SX-16

w/512k, Hard Disk Drive, Monitor & Video Card

Hard Drives: Mb/Ms	20/40	40/25	66/25	100/25
No Video	$1229	$1329	$1509	$1649
Mono	$1349	$1449	$1629	$1769
VGA-Mono	$1529	$1629	$1809	$1949
VGA-Color	$1759	$1859	$2039	$2179
SVGA/Color	$1869	$1969	$2149	$2289

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(Call 1-800-722-7263) In All 50 States FAX# 1-800-722-7392

PC Brand, Inc. 954 W. Washington St., Chicago, IL 60607 Canadian Fax # 312-633-2888 Canadian Voice # 312-226-5200. We are open Mon. thru Fri.: 8am to 6pm Central Time. MasterCard, VISA, Discover, Checks and Approved P.O.s are Accepted. Prices and specifications subject to change. **BYTE 15-4**

*TRW-National Computer Maintenance Services

PC BRAND'S 386/20 386/25...

"FASTER THAN A SPEEDING BULLET!"

-Computer Shopper, Cover Story November, 1988

20MHz FROM $1349

25MHz FROM $1499

"The Best Low-Cost Alternative Around!"

-PC Magazine, 25MHz 386 PC's, Feb. 14, 1989

PC BRAND 386/20 _____ $1349

20 MHz Clock, Zero Wait Operation, Norton SI 23.0 Landmark Speed26.1MHz, 1024K RAM, 1.2MB or 1.44MB Drive, 101-Keyboard, 2 Serial and 1 Parallel Ports

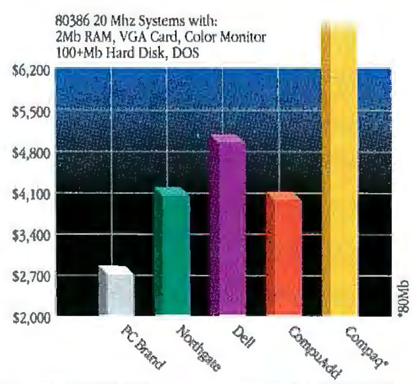
PC BRAND 386/25 _____ $1499

25 MHz Clock, Zero Wait Operation, Norton SI 28.2-Landmark Speed 33.6MHz, Norton SI 31.6-Landmark Speed 43.5 w/Cache, 1024K RAM,1.2MB or 1.44MB Drive, 101-Keyboard, 2 Serial and 1 Parallel Ports

"The PC Brand 386/25 is a fascinating machine. It offers flexible configuration...at a bargain price..."

"and the company backs it all with what may be the longest warranty on the market...PC Brand makes it possible to buy two complete sytems for less than most competitors charge for just one."

- PC Magazine, 25MHz 386 PC's February 14, 1989



Standard System Features:

- True 20MHz or 25MHzZ Intel 80386 CPU Operating with Zero Wait States
- 1024K RAM standard expandable to 16MB using 256K and/or 1MB RAM
- 1.2MB 5.25" or 1.44MB 3.5" Diskette Drive
- FCC Class "A", Intended for business use
- High performance 16bit.VGA Cards with 1024x768 capability on all VGA systems
- 1:1 Interleaving Hard Drive/Floppy Drive controllers, 1Mb/Second disk transfer rates on all 100Mb drives or larger
- Enhanced 101-key Click/Tactile Keyboard
- 2 serial & 1 parallel ports on std-configurations
- High Capacity 200 Watt System Power Supply
- Real Time Clock/Calendar with 5 Year Battery
- 80287, 80387, or Weitek Co-Processor Support
- AMI BIOS with full MS/DOS, OS/2, XENIX, UNIX, NOVELL, 3COM compatibility
- 8 Slot motherboard design (5 16Bit & 3 8Bit)
- Medium foot print case w/6 Disk Drive bays

Options:

- Low profile Slim-Line Case w/3 Disk Drive bays available at no extra charge
- Full Size Tower® Case w/6 Disk Drive bays
- Mini Size Tower® Case w/4 Disk Drive bays
- LCD or VGA Plasma Portable Case
- Custom configurations w/Name Brand peripherals of your choice

PC BRAND 386/20

with Hard Disk Drive, Monitor & Video Card

Hard Drives: Mb/Ms	40/25	66/25	100/25	200/19
No Video	$1779	$1959	$2099	$2549
Mono	$1899	$2079	$2219	$2669
VGA-Mono	$2079	$2259	$2399	$2849
VGA-Color	$2309	$2489	$2629	$3079
SVGA/Color	$2419	$2599	$2739	$3189

PC BRAND 386/25

with Hard Disk Drive, Monitor & Video Card

Hard Drives: Mb/Ms	40/25	66/25	100/25	200/19
No Video	$1929	$2109	$2249	$2699
Mono	$2049	$2229	$2369	$2819
VGA-Mono	$2229	$2409	$2549	$2999
VGA-Color	$2459	$2639	$2779	$3229
SVGA/Color	$2569	$2749	$2889	$3339

"PC BRAND 386/33 HAS FLAWLESS COMPATIBILITY, LOWEST PRICE"

InfoWorld, Product Review, January 8, 1990

FROM $2299

InfoWorld 386/33 Review Scores:

INFO WORLD EXCELLENT VALUE Jan. 8, 1990

PC Brand	8.0
Compaq	7.1
Gateway 2000	7.1

386/33 CACHE ____ $2299

33 MHz Clock, Zero Wait Operation, Norton SI 45.9 • Landmark 58.7 MHz, 1024K RAM, 1.2MB or 1.44MB Drive, 101-Keyboard, 2 Serial and 1 Parallel Ports

"Here's a price $2799... [Now $2299] Must be stripped to nothing, Right? Wrong...You don't sacrifice quality for low price either. The PC Brand machines are an efficient combination of in-house engineering and top-notch off-the-shelf Parts."

-PC Magazine, 33MHz 386 PC's, October 31, 1989

"... great value. *Period*. ...excellent price performance ratio; high quality."

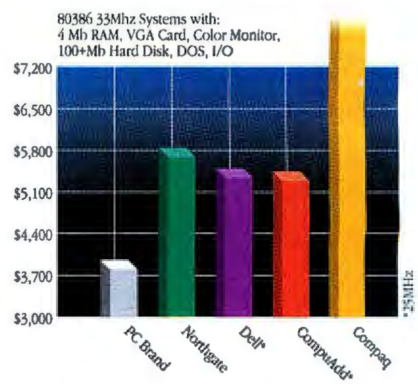
-Computer Buyers Guide, Product Review, February, 1990

Standard System Features:

- True 33 MHz INTEL 80386-33 CPU operating w/Zero Wait States Delivering up to 58.7 MHz Effective Throughput
- Intel 82385-33 Cache Processor with 32K 25NS Static RAM Standard
- 1024K RAM Standard Expandable to 16MB
- FCC Class "A", Intended for business use
- High performance 16bit VGA Cards with 1024x768 capability on all VGA systems
- 1.2MB 5.25" or 1.44MB 3.5" Diskette Drive
- 1:1 Interleaving Hard Drive/Floppy Drive Controllers, 1 Mb/Second disk transfer rates on all 100Mb drives or larger
- Enhanced 101-key Click/Tactile Keyboard
- I/O Ports-2 serial,1 parallel
- High Capacity 200 Watt System Power Supply
- Real Time Clock/Calendar with 5 Year Battery
- 80387 or Weitek Co-Processor support
- Phoenix BIOS with Full MS/DOS, OS/2, XENIX, UNIX, NOVELL, 3COM compatibility
- EMS and Disk Cache in ROM
- 8 Slot motherboard design
- Medium foot print case w/ 6 Disk Drive bays

Options:

- Full size Tower ® Case w/6 Disk Drive bays (as shown above)
- Custom configurations w/Name Brand peripherals of your choice
- Factory Ram Upgrades



PC BRAND 386/33 CACHE

with Hard Disk Drive, Monitor & Video Card

Hard Drives: Mb/Ms	40/25	66/25	100/25	200/19
No Video	$2679	$2859	$2999	$3449
Mono	$2799	$2979	$3119	$3569
VGA-Mono	$2979	$3159	$3299	$3749
VGA-Color	$3209	$3389	$3529	$3979
SVGA/Color	$3319	$3499	$3639	$4089

Turn the page for Portables & Peripherals

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Portables With More Power than Desktops.

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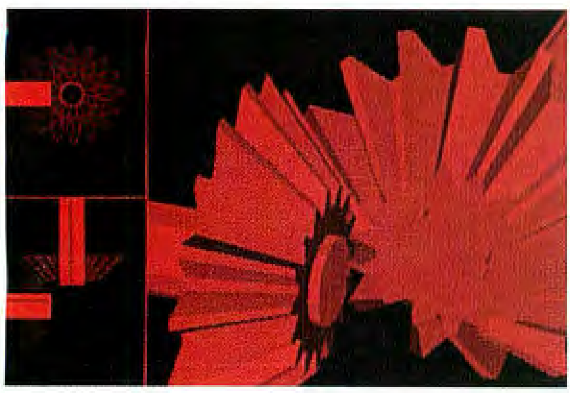
The power, reliability and performance of our desktop system motherboards combine with our portable casing to make our system technically unique!

We support 3 built-in, externally accessible disk drives, enabling dual (3.5" and 5.25") floppys for *total* media compatibility. Including tape CD-ROM drives or other devices to deliver desktop functionality in a Portable Unit.

Simultaneous internal AND external monitor support, VGA functionality, 2 open card slots and our unique 3 drive support, permit this family to be used as a complete *"in the office system"* which you can pick up and take anywhere.



Actual VGA PLASMA Screen Image

Standard System Features:

- All performance and compatibility features as in desktops featured on previous pages
- 16 Grey Scale 640x480 VGA Plasma or 4 Grey Scale 640x400 CGA/Mono Graphics

Standard Features Continued:

- 3 Accessible Drive Bays for (2) 5.25" and (1) 3.5" Units
- 2 Available Peripheral Card Slots
- Simultaneous internal & external displays
- 200 Watt Auto Voltage Switching Power Supply

VVGA Gas Plasma Portables

Drives Mh/Ms	1 Floppy	40-25	100-25	200-19
286/12	$2595	$2995	$3395	$3960
286/20	$2795	$3195	$3595	$4160
386/SX-16	$2895	$3295	$3695	$4260
386/20	$3350	$3750	$4150	$4710
386/25	$3550	$3950	$4350	$4910
386C/25*	$4000	$4400	$4800	$5360
386C/33*	$4300	$4700	$5100	$5600

*32K Cached

LCD Backlit Portables

Drives Mh/Ms	1 Floppy	40-25	100-25	200-19
286/12	$1745	$2145	$2545	$3110
286/20	$1945	$2345	$2745	$3310
386/SX-16	$2045	$2445	$2845	$3410
386/20	$2495	$2895	$3295	$3855
386/25	$2695	$3095	$3495	$4055
386C/25*	$3145	$3545	$3945	$4505
386C/33*	$3445	$3845	$4245	$4805

*32K Cached

Monitors

NEC
GS-2A 14" MultiMono (to 800x600) $249
2A 14" SVGA (800x600) 479
3D 14" SVGA/EGA (1024x768i) 649
4D 16" SVGA/EGA (1024x768) 1150
5D 20" SVGA/EGA (1280x1024) 2350

Cornerstone Technology
19" Dualpage Display (1660x1280) $1950
19" Dualpage 16 level (1660x1280) 2795

Imtek/Samsung
14" VGA Color .31DP (640x480) $369
14" VGA Color .41DP (640x480) 299
14" SVGA Color (to 1028x768i) 419

Magnavox
Newest Models .... Call

Mitsubishi
1381 14" Diamond Scan (to 800x600) $499
HL6605 16" SVGA/EGA (to 1280x1024) 1195
HL6905 20" SVGA/EGA (to 1280x1024) 2095

Panasonic
C1391 PanaSync (to 800x600) $489
M1500 15" Mono DTP with adapter 1208
M1900 19" Mono DTP with adapter 1498

Princeton Graphics
Max15 14" Mono (to 1028x768i) $249
UltraSync 14" SVGA/EGA (800x600) 520
UltraSync 16" SVGA/EGA (1024x768i) 879

Princeton Publishing Labs
Multiview 15" Mono DTP with adapter $890

Relisys
9503 14" VGA Mono (640x480) $135
9513 14" VGA Color (640x480) 369
1520 15" SVGA (1024x768) 679

Seiko
1440 14" SVGA (1024x768i) $599
1450 14" SVGA (1024x768) 779

Sony
1304 14" SVGA (to 1024x768) $689
GDM-1606 16" CADD (1280x1024) .... Call
GDM-1953 19" CADD (1280x1024) .... Call

Zenith
ZCM1492 VGA Flatscreen (640x480) $619

RAM/I-O/Accelerator Boards

Intel
Aboveboard Plus 512K $419
Aboveboard Plus I/O 469
Inboard 386PC with 1M 595
Inboard 386 AT with 0K 859

PC Brand I/O Cards
AT 1P/2S/1G $49
XT 1P/1S/1G/Clock/Calendar 49

Video Cards

ATI
VGA Wonder 256K/512K $259/339
VGA Wonder V-RAM .... Call

NEC
Graphics Engine (1024x768i) 512k/1M ... $999/1349

Paradise
EGA Autoswitch 480 .... $139
VGA+ with 256K (8 bit) 219
VGA+ with 256K (16 bit) 249
VGA Professional 349
VGA 1024 with 512K 239
8514/A Plus .... 569 with VGA 649

PC BRAND VGA Cards

VGA 256K (8 bit) $99
VGA 256K (16 bit) 139
VGA 512K (16 bit) 189

"an outstanding device... compared with the 15 high performance VGA cards tested in PC Magazine's July 1989 issue."

PC Magazine, Product Review, Oct 31, 1989

Video Seven
1024i VGA with 256K $259
VRAM VGA with 512K 495

Fax Cards

Complete PC
4800/9600 .... $249/399
Complete Communicator 549

Intel
Connection Coprocessor $699

Quadram
4800/9600 .... $199/509

Modems

ATI
2400ETC Internal with MNP5 .... $165
2400ETC External with MNP5 205

Hayes
1200B Internal with Smartcom $189
2400B Internal with Smartcom 249
1200 External .... 256 2400 External 359

PC Brand (*100% Hayes Compatible*)
1200 Internal with software $49
1200 External 70
2400 Internal with software 89
2400 External 129
2400 Internal with MNP5 129

US Robotics
Courier HST 14,400 External $599
Courier V.32 9600 External 889
Courier HST/V.32 External 995
Courier HST 9600 Internal 579

Tape Backups

Archive
ST600 60MB Internal with controller $590
FT60 60MB External with controller 590
FT150I 150MB Internal with controller 895
VP150I 150MB Internal Novell certified 925
VP150E 150MB External Novell certified 1175
VP402 Interface Board for VP Series .... Call
VP409 PS/2 Interface Board for VP Series ..... Call

Colorado Memory Systems
DJ-10 Jumbo 40/80MB Internal $249
KE-10 External Chasis Kit with Interface 139

Maynard
Maynstream 60MB Portable $889
Maynstream 150MB Portable 1395
Maynstream 2200HS 2.2GB Portable 4350

Floppy Disk Drives

360K 5.25" Half Height Black $75
720K 3.5" Half Height Black 80
1.2M 5.25" Half Height Grey 85
1.44M 3.5" Half Height Grey 95
CMS 5.25" 360K PS-2 Internal 199

Sysgen
Bridge-File 5.25" 360K/1.2MB External $229
Bridge-File 3.5" 720K/1.44MB External 229
Bridge-File PC/AT Adapter 59

Hard Disk Drives

Compaq/Connor IDE Upgrades
40M 28ms $459
100M 25ms $679
200M 19ms 1249

Iomega
B1201 20M Internal $765
B1441 40M Internal 995
B244X Dual 5.25 44M External 1995
PC2/50 Nonbootable Card 230
PC2B/50 Bootable Card 230

Plus Hardcards
Hardcard 20 8 bit $539
Hardcard 40 8 bit 599
Hardcard 40 16 bit 599
Hardcard 80 16 bit 695

Seagate
20M 65ms ST225 Half Height $209
20M 35ms ST125 Half Height 245
30M 35ms ST138 Half Height 310
40M 28ms ST251-1 Half Height 349
40M 24ms ST151 Half Height 419
80M 28ms ST4096 MFM 590

Add $50 for XT Kit for ST1xx, ST2xx

Co-Processors

Intel
8087-1 .... $189 8087-2 .... $129
80287-10 .... 229 80387-SX 309
80387-16 .... 349 80387-20 399
80387-25 .... 479 80387-33 639

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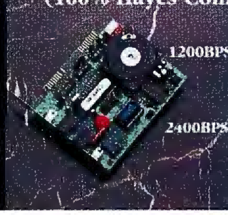
PC Brand Internal Modem (100% Hayes Compatible)



1200BPS $49

2400BPS $89

CD-ROM

Amdek
Laserdeck 2000 500MB External Kit $619

Microsoft
Bookshelf 1.0 ...... $195 Stat Pack $99
Programmer's Library 295

NEC
CDR77 External .. $555 CDR80 Internal $499
XT/AT Interface Kit 129
Clipart 3D .... 285 Image Folio 285

Sony
CDU510 Internal Kit $665
CDU1701 External Kit 779

Printers

(Numbers in Parentheses Indicate Draft/LQ CPS)

Brother
HL8e Laser .... $1875 HL8PS $3295

Canon
BJ130e 15" .... $769 LBP4 Laser $1025
LBP8-III Laser 8PPM 1725

Citizen
GSX 140 (192) .... $339 Color Kit $49

Epson
LX810 (180/30) .... $179 FX850 (330/88) $329
FX1050 (264/54) 439 LQ510 (180/60) 329
LQ850 (330/88) 495 LQ950 (264/88) 495
LQ1010 (150/50) 439 LQ1050 (330/88) 665
LQ2550 (400/108) ..... 899 EPL6000 6 PPM 939

Kodak Diconix
150Plus (150/50) .... $315 300WP (310/73) $439

Hewlett Packard
Deskjet Plus .... $710 LaserJet IIP $1025
Laserjet II .... 1720 Laserjet IID 2995
Laserjet III NEW! .... Call

Laser Jet Accessories

Pacific Data Products
Plotter in Cartridge $249
25 in 1 Cartridge 285
Postscript Cartridge 449

Turn your LaserJet into a Postscript Printer!

CPI
Superfont Cartridge $295
1M Memory Kit 269
2M Memory Kit 549

Princeton Publishing
PS-388 Postscript board $2250

Call about 400dpi Postscript Compatible Laser Printers

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P220XE 192/54CPS $335
P9XL 400/190CPS 1030
LC890 8PPM Postscript 3190
LC890XL 8PPM 4MB 4495
SilentWriter II Printers .... Call

Okidata
ML320 (300/62) .... $345 ML321 (300/62) $479
ML380 (180/60) 359 ML390 (270/90) 475
ML391 (270/90) 655 ML393 (450/120) 995
Okidata OkiLaser 400 4PPM 1010

Panasonic
1180 (192/30) .... $189 1191 (240/48) $245
1124 (192/63) 299 1624 (192/63) 429
1695 330 Wide .... Call 4420 Laser .... Call

Logical Connection *Print Buffers*
256K .... $449 512K $529

**Oversized Monitors, Plotters, Laser Printers, and Portables excluded from Free Freight*

Networking Hardware

Gateway
G/Ethernet AT .... $435 for PS/2 435
G/Ethernet (8 bit) 265

Lantastic .... Call for Prices

Standard Micro
PS110 Board for PS/2 .... $439
PC500WS 16 Bit for WS 375
PC500FS 16 Bit for Server 449
PC550WS 16 Bit Twisted Pair for WS 395
PC550FS 16 Bit Twisted Pair for Server 495
PC270E Twisted Pair 139
PC130 Arcnet Board 135
ARCNET passive hubs / active hubs 72/359
ARCNET intelligent hub coax 495
ARCNET intelligent hub twisted pair 609

Synoptics
505UTP Transceiver $139
1000 Concentrator 2575
2500 Workgroup Concentrator 839

3Com .... Call for Latest Prices

Tiara
4 port hubs .... $49 8 port hubs $285
Lancard/A 8 bit ARCNET 89
Lancard/A 16 bit ARCNET Board 249
Lancard/E 8 bit Ethernet 199
Lancard/E 16 bit Ethernet Twisted Pair 339
Lancard/E 8 bit Twisted Pair 329

Tops
Repeater .... $125 Flashcard $155

Western Digital
Ethercard+ .... $219 A (PS/2) $320
Ethercard+ Twisted Pair 319

Xircom
Pocket ARCNET Adapter Coax $295
Pocket ARCNET Adapter Twisted Pair 295
Pocket Ethernet Adapter Twisted Pair 489

Plotters

CalComp
1023 .... $3450 1043DM $5700

Houston Instruments (Call for Prices)
DMP52 .... DMP52MP DMP61
DMP61DL .... DMP62 .... DMP62DL

Scanners/Digitizers

Complete PC *Scanners*
Full Page .... $499 Half Page $189
Hand Scanner 165

Kurta
IS/One 12X12 ..... $355 IS/One 12x17 .... $509

Microtek
MSF 300G .... $1495 MSF 300Q $1275
MSF 400G .... 2750 MSF Edge Feed 1050

Summasketch *Digitizers*
12x12 .... $335 12x18 .... $599

Input Devices

CalComp WIZ .... Call

Logitech
Hi-Rez C9 Mouse .. $85 with Paint $99
Trackman 320DPI Serial/Bus 99/109

Microsoft Mice
Serial with Paintbrush $109
Serial with Windows 139
Bus mouse with Paintbrush 105

Novell Networking

4 User ELS Level I $429
8 User ELS Leve II 939
Advanced Netware 1850
SFT Netware 286 2850
Netware 386 4550

Network Utilities

CC: Mail
25 User .... $495 Expand $445

Cheyenne Software
Netback .... $189 Monitrox $505

Lan Systems
Lanspace .... $310 Lanspool $259

Norton-Lambert
Close-up Support/ACS $179
Close-up Customer/Terminal 135

Ontrack
Disk Manager -N ...... $99 Netutils .... Call

Tops
NetPrint 2.0 .... $115 Tops 2.1 .... $112

Traveling Software
Desklink 2.2 .... $95 Laplink III $92

Unix/Xenix Multiuser Products

Digiboard
Intelligent Serial Cards:
4/8/16 Port $645/795/1295

Wyse Terminals
WY60 .... $309 WY150 .... $305
WY370 14" Color .... Call
(Call on Keyboard options)

WY50 (with Keyboard) 389
WY86 (with Keyboard) 409

Santa Cruz Operations
Xenix 286 CompleteSys $995
Xenix 386 CompleteSys 1150

Xenix Software
Foxbase+ 386 .... $979
Microsoft Word 495
Open Desktop .... Call
VP/IX 1/3+ User 359/629
Xenix-Net 286/386 .... 439/479
Word Perfect 4.2 569

Supplies

Sony 5.25" 360K (box) $9
Sony 5.25" 1.2M (box) 14
Sony 3.5" 720K (box) 13
Sony 3.5" 1.44M (box) 25
5.25" Diskette Case 9
3.5" Diskette Case 11
Toner cartridge for HP DeskJet Plus, Laserjet II and IIp .... Call

Data Cartridges
DC2000 (each) $19
DC600 (each) 27
DC600XL (each) 29

**Free Freight in the Continental U.S.*

Power Protection Products

Tripplite
SK6 Spike Bar $29
IB4 4 Outlet Isobar 45
CCI+ Isobar 85
LC1200 Line Conditioner 159
BC325 Battery Back-up 279
BC450 Battery Back-up 349
OMNI450 or 450LAN Battery Back-up 419
BC750LAN Battery Back-up 459
OMNI1200 Battery Back-up 795

Software

Aldus Pagemaker $499
AMI for Windows 129
AMI Professional 319
Autosketch Animator 179
dBase IV 449
Borland Quattro ..... 95 Quattro Pro 279
Caere Omnipage 386 2.1 619
Corel Draw 329
Datastorm ProComm Plus 52
Delrina Perform 2.0 159
Delta Technology Direct Access 49
Deskview 386 115
Fifth Generation Fastback Plus 102
Foxbase + ... 189
Generic CADD Level 3 155
Harvard Graphics 329
IBM Displaywrite IV 249
Lotus Freelance Plus 329
Lotus 123 r. 2.2 ..... 339 123 r. 3.0 339
Microrim R:Base 489
Microsoft Excel 2.1 309
Microsoft Windows 386 125
Microsoft Word 5.0 205
Microsoft Word for Windows 325
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Reviewer's Notebook

Reviewer's Notebook is a compilation of brief reviews and updates to previously published evaluations. BYTE will publish Reviewer's Notebook each month as space permits.

Dot-Matrix Printers Rise Again

Dot-matrix printers may sound unexciting these days, especially with all those low-cost laser printers hitting the market. But Panasonic's new KX-P1624 24-pin entry is an intriguing, low-priced, full-featured workhorse that fills an important niche.

Panasonic designed the printer for offices that use dot-matrix printers day in and day out for such mundane (albeit necessary) tasks as printing reams of reports, multipart forms, or mailing labels—in short, for jobs where laser printers don't particularly shine.

The KX-P1624 takes forms up to 15 inches wide. It has five built-in letter-quality fonts: Courier, Prestige, Bold PS, Script, and Sans Serif. All are available in 10 different character sizes ranging from 5 to 20 characters per inch. There are also two draft-quality fonts.

Few dot-matrix printers match the KX-P1624's list of standard features. You can feed paper from four different directions (front, back, bottom, or top). A neat flat-belt tractor feed swivels to act as either a push or pull tractor. The push tractor (used with a built-in perforation-cut feature) is particularly handy for eliminating waste of continuous forms.

You will also find the usual paper-parking feature, which lets you print a single sheet without removing continuous forms. For those worried about software compatibility, the printer emulates the IBM Proprinter XL24E and the Epson LQ-2500. A 12K-byte buffer (expandable to 44K bytes) is standard.

At first glance, I found the printer's "EZ-Set" front panel difficult to understand. You work through several switches (there are no DIP switches) and a panel full of indicator lights to set up the KX-P1624. In the end, I figured out the switches in a short time, and the panel let me set up three macros for my most frequently used combinations.

With a print speed of 160 pica-size characters per second for draft and 53 cps for letter-quality text, the KX-P1624 isn't the fastest 24-pin printer available. But it's speedy enough for all but the most demanding environments. Panasonic could have made it faster, but that would have added to the bottom line, which may be the printer's most surprising feature: At $700, the KX-P1624 is hundreds of dollars less expensive than similar printers.

The KX-P1624's output doesn't match what you get from a laser printer, but I wouldn't be shy about sending out a manuscript, letter, or report printed on this printer to my most important readers. The printer does what it's designed to do and does it well. What's more, it's part of an encouraging trend toward feature-packed printers that won't clear out your wallet.—*Stan Miastkowski*

KX-P1624
Panasonic Communications and Systems Co.
Office Automation Group
Two Panasonic Way
Secaucus, NJ 07094
(201) 348-7000
$699.95
Inquiry 853.

Superbase 4 Windows Outshines GEM Version

In the March 1989 BYTE, I reviewed Precision's Superbase 4, a full-featured database that ran on the GEM graphical user interface but could access only 640K bytes of memory. The program boasted the capability to incorporate graphics and text files as external database fields and had powerful relational capabilities. However, the 640K-byte memory limit and a number of bugs severely hampered the product. In addition, Superbase 4 suffered from inadequate documentation. I concluded that

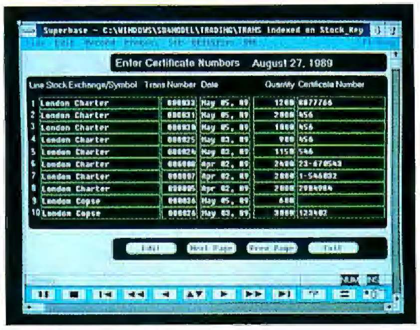
continued

the program had great potential but needed additional memory, the elimination of several bugs, and improved documentation.

Precision seems to have addressed all my complaints in its recently introduced Superbase 4 for Microsoft Windows. Superbase 4 Windows supports both extended and expanded memory, allowing the display of bit-mapped graphics as database fields.

In addition, Superbase 4 Windows includes an external data type that can point to either a bit-mapped graphics file or a text file that can be searched for and queried. The product also includes a comprehensive programming language, a built-in text editor, a telecommunications facility for transferring files, and a powerful Structured Query Language query facility, as well as full-featured forms and report writers.

I checked the program for the bugs that I had found in the earlier GEM version, and all of them had been eliminated. In addition, the documentation has been upgraded and is easier to follow. The communications facility has been



greatly improved, and the VCR-like control panel, which controls the database, works much better than the one in the GEM version. The text-field search feature now works as advertised, and I found it much easier to manage multiple open database files than in the GEM product.

In spite of all these improvements, Superbase 4 Windows is not a product for the casual database user or for the faint of heart. The product has powerful capabilities for database application developers, but you can expect to encounter a steep learning curve before understanding how to really take advantage of those capabilities.

For example, the forms designer presents the user with two rows of more than 30 icons, the functions of which are by no means intuitive and which require a certain amount of effort to learn. The query and file-linking facilities are also complex, and they, too, take some diligence to understand.

Nevertheless, serious database developers for Microsoft Windows should find Precision's Superbase 4 Windows to be an excellent candidate for their development work.—*Nick Baran*

Superbase 4 Windows
Precision, Inc.
8404 Sterling St., Suite A
Irving, TX 75063
(800) 562-9909
(214) 929-4888
$695 with run-time version of Microsoft Windows
$995 for five-user LAN extension (total of six users)
Inquiry 856.

Making Smalltalk with OS/2

Digitalk has taken a large stride with Smalltalk/V PM, a version of its Smalltalk/V environment for OS/2's Presentation Manager. This new release holds great promise for those looking to step up to OS/2 from Digitalk's 286 version, as well as for developers seeking an easier method for developing PM applications.

Smalltalk/V PM makes it easy for OS/2 developers to build, in hours or days, complete applications that are indistinguishable from those built the hard way—with compilers, linkers, and so forth. Smalltalk/V PM hides the complexity of dealing with windows, input events, and the like until you're ready for them. I produced several applications with Smalltalk/V PM before I knew anything at all about PM. The result was that I could focus on the development problem at hand rather than on the user interface.

Although Smalltalk can be a self-contained, self-sustaining environment, Smalltalk/V PM produces *real* PM programs, with access to all of OS/2's advanced features, including Dynamic Link Libraries and Dynamic Data Exchange. Since any resource available under OS/2 and PM is available to Smalltalk/V PM, integrating V PM programs with those produced in conventional languages is simple.

For those who are already familiar with Smalltalk, Smalltalk/V PM offers some surprises. A new, simpler application model consists only of Models and Windows. A cleaner approach to graphics makes using custom graphics in an application much easier than before.

The changes from previous releases of Smalltalk are significant enough that porting to Smalltalk/V PM could be time-consuming, particularly if your application is graphics-intensive. If the application is loaded with homegrown Panes and Dispatchers that are not simple subclasses of the standard set, you may find it necessary to rebuild large portions of the program.

However, even with all the changes, the environment is still recognizable to users of Smalltalk/V 286 and Smalltalk/V Mac (the 286 and Macintosh versions). All the familiar user interface components remain available, and a few more have been added. Users of other Digitalk products will also feel right at home with the programming tools that come with Smalltalk/V PM. The browsers, debugger, and inspector work much as they did before.

Another key change that Smalltalk/V PM brings to the Smalltalk world is compilation. Instead of keeping track of the classes you define and objects you create in a set of data files, Smalltalk/V PM incrementally produces an .EXE file. This file, together with a single Dynamic Link Library, is all that's needed to run the application on any PM system. The resulting executable file is quite large, but Digitalk plans a Developer's Kit to address the problem.

On the whole, Smalltalk/V PM represents a significant new direction in Smalltalk environments. Its close integration with the host system, together with its much-improved application and graphics models, makes this environment far better than what has gone before. The power that it provides to OS/2 developers is valuable. Even if Smalltalk/V PM is used only for rapid prototyping, no OS/2 development team should be without it.—*Eric Smith* ■

Smalltalk/V PM
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Applications Architectures

Editor's note: *You may notice something different about this section—the name has been changed from In Depth to State of the Art. This new name conveys more precisely the type of information this section contains and highlights the balance between this section of BYTE and the extensive "state of the market" product coverage elsewhere in each issue. While we'll still present information in the usual in-depth manner, it's now clearer than ever that this section is where we discuss the leading-edge technologies that herald the products, tools, and techniques you'll be using in the months and years to come.*

When you plan to construct a house, one of the first things you need is a set of blueprints. Until you have those, you don't know where to begin, how big a hole to dig, or what materials to buy.

In the past, writing applications software has been more like making bricks than building something with them. The developers each made their own bricks, some red, some brown, and some blond, some rectangular, some square, and some hexagonal. The end result has been lots of piles of bricks that don't always fit together the way you'd like them to.

The time has come to step back, make a blueprint of what you want to create, trying to incorporate as many of the pieces you already have as possible, and start construction. One name for this blueprint might be applications architecture, a framework for creating order out of the chaos of applications today.

This first State of the Art section begins with "Transparent and Portable" by Mark L. Van Name and Bill Catchings. In it, they describe the types of applications architectures available that provide a consistent framework across different machines. Currently, the Macintosh is the leader in this area in the personal computer field, but over the next few years, you can expect others to appear. Portable, transparent applications make life easier for all of us who use desktop computers.

Then, in "From TTY to VUI," Frank Hayes discusses user interfaces, their pluses and minuses, and how they compare. Many people today prefer a graphical user interface to the command-line interface, but how do the available GUIs compare with each other? Is it really safe to say "when you've seen one, you've seen them all"?

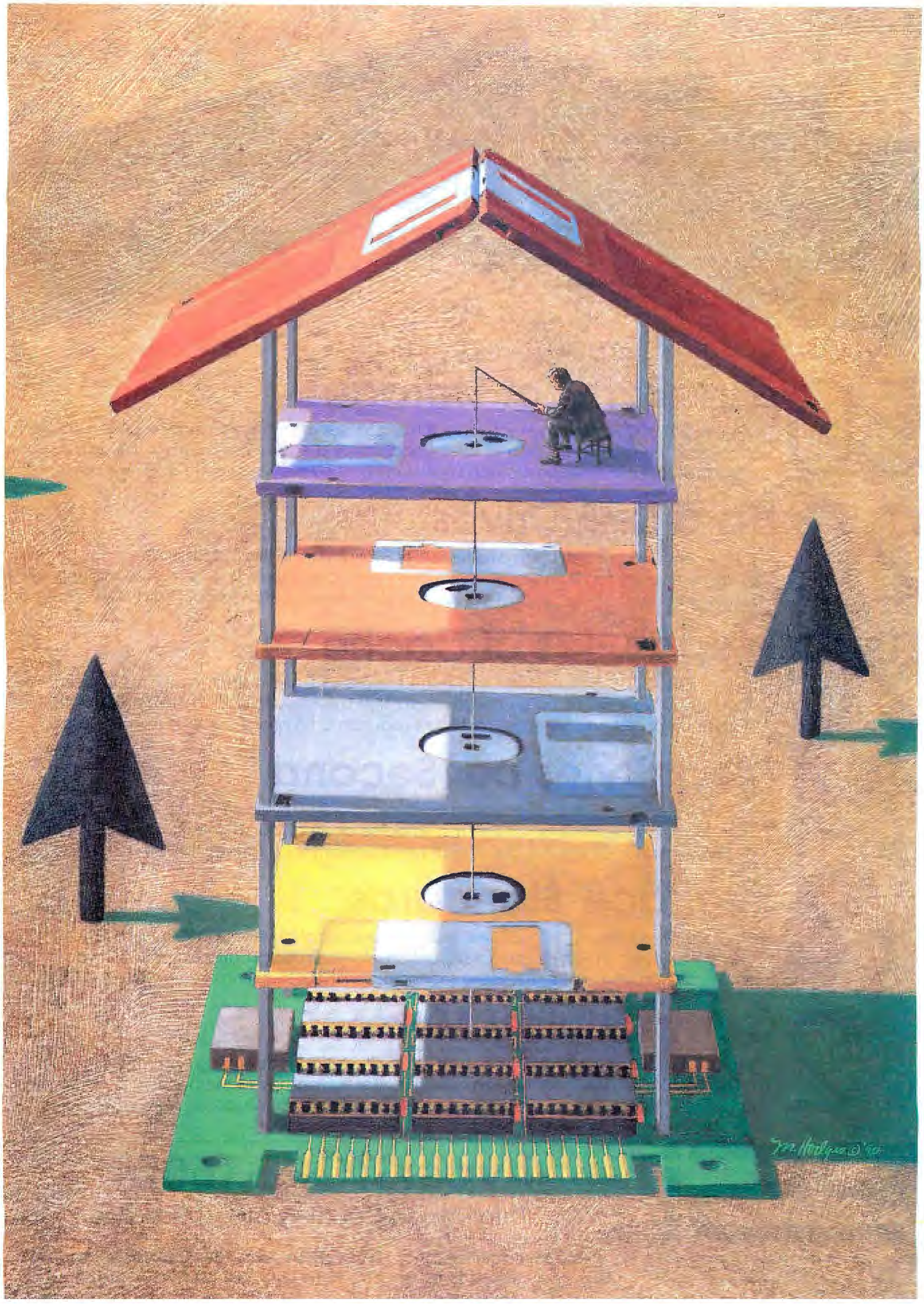
When you go behind the user interface, you come to the application programming interface. In "Behind the Scenes," Howard Eglowstein explores the next level of detail to consider when you choose a user interface: the capabilities behind it as reflected in the API.

Next, in "Bridging Troubled Waters," Jon Udell describes several cross-platform tools that let you use the same software on different machines. This concept and the products that use it solve the problem of which machine and which operating system to support. An application can be written once and then simply ported to a variety of machines.

In "Blueprints for the 1990s," Sheila Osmundsen provides a comparison of the two major applications architectures available today: IBM's Systems Application Architecture and Digital Equipment's Network Applications Support. More and more companies are exploring the advantages of these consistent frameworks: interoperability and greater portability across dissimilar platforms. New players are entering the field at a growing rate. The text box "An Open Approach" looks at Data General's recent entry, Distributed Applications Architecture.

As these architectures proliferate, will Big Brother be watching? Will you lose your independence? I don't think so. Rather, you will gain the freedom to move from one machine to another and from one operating system to another, without retraining. Knowing an applications architecture will broaden your usefulness and your sales appeal. Individually, you can still march to the beat of a different drummer, but, together, you can harmonize.

—Jane Morrill Tazelaar
Senior Technical Editor
State of the Art



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Transparent and Portable

Applications architectures provide compatible access to incompatible machines

Mark L. Van Name and Bill Catchings

Sometimes a single solution can remedy several problems. Consider applications software. Users want programs that are easy to use and consistent across different machines. Developers want to produce bug-free software as efficiently as possible for as many machines as possible. And vendors want to provide a broad range of systems to attract as many buyers as possible. Applications architectures can satisfy the needs of all three groups.

An applications architecture is a set of tools for developing applications. By providing a consistent framework on different machines, it lets you get the most out of your equipment and training budgets. It's also a way out of the dilemma that plagues anyone who uses a computer: compromise.

Newer, faster machines promise improved productivity, but often at the cost of learning a whole new way of working. Existing systems let you work in familiar, comfortable ways, but often at the cost of living with less than optimal performance. An applications architecture solves this conflict. It ensures that your new system works the same way as your current one, or at least close enough so that the cost of learning the new system is bearable.

Such a framework also lets software developers make the most of limited resources. No one has the time or money to support all the interesting and commercially viable systems in use today. Even if you consider just personal computers, you must write software to run under DOS, Windows, OS/2, and the Mac OS to support the major platforms.

In addition, vendors develop applications architectures to bridge multiple environments. While they may strive for compatibility across product lines, time and changing technologies eventually force vendors to offer systems that are incompatible with previous hardware and operating systems. An architecture allows them to provide users and developers with a smooth migration path from the older to the newer systems.

Laying the Foundation

Most of the benefits of a good architecture stem from two basic features: transparency and portability. Not surprisingly, these terms have slightly different, albeit related, meanings for users and developers.

To a user, transparency is the degree to which a new system resembles the existing one. To put it another way, a new system is transparent if you can't tell the difference between it and your current system.

A transparent system should have the same look and feel as the system you use

continued

now. Its appearance, command structure, and menu structure—in other words, its user interface—should be familiar. Typing the same command, for example, should produce the same result on both systems, as should double-clicking on an icon.

The new system should also offer all the applications you currently use. Basically, if you can walk up to a display attached to a new system and feel as if you're working on the same old system, it is transparent.

To a developer, transparency means that a new system's structure is basically the same as the one on the previous system. The new system must provide a consistent set of abstractions, from the application programming interface (API) to the data, file, database, and network organizations. For example, application programs must be able to call memory-allocation, record-retrieval, and record-locking routines that work the same way on both old and new systems. (For a more-detailed discussion of APIs, see "Behind the Scenes" on page 215.)

Portability, while related to transparency, addresses slightly different concerns. For most users, the crucial part of a system's portability is its ability to handle existing data and procedures. When you walk up to a new system, you want to be able to load your working data—whether on disk, tape, or other media—and get down to business. If you have any automated procedures, which may range from keyboard macros to full-fledged programs, you want to be able to run them, too.

Portability is similar for developers, who need to be able to move current source code and development tools to the new system with as little hassle as possible. To meet this requirement, the new system must provide not only a consistent API, but also a consistent set of such development tools as text editors, compilers, linkers, and debuggers.

A complete applications architecture includes specifications and tools that address all these needs. It runs on several different platforms. It includes development guidelines, a consistent API for every aspect of development, and a complete set of development tools. Its user interface is consistent across systems, and, if it is successful, the resulting applications are also available on all systems.

Arguably, the most successful example of such a structure to date is the one offered by the Macintosh. Applications that follow Apple's user-interface and internal programming guidelines—so-called "well-behaved" applications—will run on any Mac, from the least to the most powerful, and with any size monitor and any Mac printer. They will also be relatively easy for experienced Mac users to learn, because they will have the familiar Mac look and feel.

Erecting the Framework

The Mac's applications architecture, like any other, consists of tools and specifications that address many issues. While no two approaches are the same, they all have to deal with the same basic problems.

To gain a broad view of the various architectures, we'll construct a framework within which to analyze them. Within this framework, we'll concentrate on the problems that the architectures must help a developer solve. If they solve those problems well, and if they provide a consistent user interface, then they will also meet the needs of the users.

An applications architecture is basically a set of tools with written guidelines for using them. The tools must be powerful enough to let developers build user interfaces that are consistent with the user interfaces of other products that follow the same approach.

The goal of these tools is to free you from having to deal directly with certain external elements. We'll take a look at each of these elements and the tools that these architectures must provide to deal with them.

Insulation Requirements

An applications architecture on any machine must deal effectively with the underlying hardware and system software. This is the area that usually gets the most attention, largely because it is the area where system vendors tend have the most problems.

Consider, for example, the problems of IBM. This giant firm has customers running such different platforms as its mainframes (with the firm's several different mainframe operating systems), System 38s, System 36s, System 34s, AS/400s, AIX RISC machines, and both DOS and OS/2 PCs. IBM is trying to unite some of these systems with its Systems Application Architecture (SAA), a mammoth task.

To let you work on such different hardware and operating-system combinations, an architecture must insulate you from the complexities of the underlying system. To do this, several key services must be provided.

One is memory management. All applications need to allocate and free memory, a problem that most systems address differently. The underlying architecture must provide tools for static and dynamic memory allocation, memory freeing, and a consistent way to deal with out-of-memory errors.

Another crucial service is task management. Applications must be able to communicate with one another, exchange data, and, ideally, spawn subtasks. To attain these ends, an architecture must provide good interprocess communication facilities, data-sharing tools (such as a clipboard), and a multitasking/multithreading facility. Sometimes, it must forbid certain facilities on some systems, such as multitasking on PCs, but then you must either write to the lowest-common-denominator system or abandon support for some systems entirely.

Another necessary function is hiding low-level aspects of the system or providing transparent ways to take advantage of those features that are present. Some systems, for example, have floating-point and graphics accelerators, while others do not. Ideally, an applications architecture lets programs automatically take advantage of those accelerators when they are present and remain unchanged on systems without them. Another approach is to provide a set of APIs that either passes calls to the accelerators or, when the system has none, emulates their function in software.

Similarly, as more and more systems begin to offer multiple processors, a good architecture must let applications benefit from them when they are present. At the simplest level, this means only hiding the existence of those processors from the applications. A better answer, however, is to provide tools, such as special compilers, that produce code that can take advantage of multiple processors when they are present.

Finally, such a structure must come with a set of rules for developing applications that distance themselves from the underlying system. These rules range from such simple ones as "Don't call the operating system directly; use the standard toolbox instead," to more complex ones, such as "Don't assume a given byte contains the most significant digit in any word." In essence, the applications architecture must become the underlying system. Writing portable applications means learning to live with the features of this "virtual system."

The Flexible Facade

Moving up a level in hardware, these architectures must let applications work with many different types of monitors.

The problems in this area depend in part on whether the system comes with text or graphics displays.

There are two basic problems with text displays: screen sizes and control codes. Applications must be able to work with different size screens so that text can expand to fill the available space. They also must be able to handle the different control codes demanded by displays from different manufacturers. The latter problem is particularly acute for ASCII display terminals, where a Digital VT220 uses different display codes than a TeleVideo 925, which differs from the next, and so on.

Although these problems are answered in different ways, there are just two basic approaches. One is to provide a template file that contains a set of generic display commands and mappings for those commands for different terminals. This is the approach that Unix typically uses, with its `Termcap` and `Terminfo` files. The other approach is to use an insulating software layer. That layer can be anything from a simple receptacle for display drivers, such as those supported by Windows, to a complete set of controlling procedures, such as the Mac's QuickDraw software.

The notion of an insulating layer of software also works for graphics displays, although the problems are more complex. Graphics displays differ in everything from size to resolution to the ways programs must control them. The best solution is to have a set of controlling procedures and an accompanying set of development specifications, such as the Mac's QuickDraw or the X Window System (referred to as X Window for the remainder of this article).

You can, of course, just write drivers for each different graphics standard. This has long been the DOS approach. The differences between the results of this approach and the results of having a layer of graphics software are, however, profound.

Hook a PC up to a high-resolution 21-inch monitor, for example, and most PC applications will still run in 80-column by 25-row mode or 640- by 480-pixel VGA mode, wasting most of the screen's size and resolution. The monitor may come with drivers for certain key applications (typically desktop publishing and CAD/CAM programs), but most programs will run as if they are on a 12-inch display.

Now attach a 21-inch monitor to a Mac. Nearly all Macintosh applications will instantly work with it. At worst, you only have to enlarge their windows. The screen's size and resolution don't matter, because QuickDraw deals with those features at a level below the applications. In fact, QuickDraw goes so far as to let the Mac work with multiple monitors simultaneously, all with no programming effort other than following the development guidelines.

X Window defines a similar set of insulating functions for Unix graphics workstations. Applications that are designed to use these functions can run on any X Window workstation without the specifics of the different displays causing problems.

Hook a PC up to a high-resolution 21-inch monitor and most PC applications will still run as if they are on a 12-inch display.

X Window can also take advantage of the hardware features of a particular display system. If, for example, the display hardware can draw a filled polygon on the screen, X Window maps that feature to one of its own functions. (X Window itself calculates the pixels to activate for display systems that don't have such a polygon-fill function.) X Window applications look basically the same on different displays, no matter how each screen draws pixels.

Entrances and Exits

Keyboard specifics can also be a problem. The easiest way to handle that problem, of course, is to force every keyboard to emit the same codes. That's essentially the answer for PCs, where keyboards have to be PC-compatible for anyone to buy them.

Another approach is to define a basic set of keycodes for the architecture and a way to provide drivers that map the codes from various keyboards to the basic ones. The coming standard for a Streams-based Unix terminal driver will include this type of abstraction. This keyboard driver lets keyboards with different national key sets and layouts work with Unix applications.

Printer codes can also cause difficulties. Historically, applications have required special drivers to support the various printers that are popular for a specific machine. This approach, while expensive, at least lets applications take full advantage of the features of different printers.

To minimize development costs, many vendors built their own internal printer-template files. These files mapped the control codes of different printers to a basic set of printer functions. The problem with this approach, of course, is that the basic set has to be very rich in features or it won't be able to take full advantage of some of the printers.

Sometimes printer pseudostandards, such as the Xerox Diablo 630 or the Hewlett-Packard LaserJet, emerge. These pseudostandards typically are the control codes of printers that became so popular that many other printers emulate them.

Today, the trend is toward sophisticated page-definition languages. A PDL provides you with a standardized way to define the appearance of a printed page. A PDL interpreter then turns PDL commands into something that a particular printer can understand. By far the most widely used PDL is PostScript.

Grist for the Mill

The final piece of the external environment of any program is its data. There are several aspects of data that can vary from one system to another, including its machine representation (e.g., which byte in a word contains the most significant bit), file format (e.g., flat or indexed file), and network location. While we won't go into detail on these topics, an applications architecture must nonetheless address them.

Further, as more and more applications rely on databases for their data, the architectures must provide insulating layers for database functions. Apple's CL/1, for example, is a standard toolbox that lets you work with many different types of databases on many different, possibly remote, systems.

Ergonomic Engineering

The sum of all these insulating layers of software is a set of programming abstractions, or tools, for building applications. Programs developed with these tools will work in many external environments. That's a great step forward, but it's not

continued

the end of the journey.

The next step is to ensure that all applications employ the same user-interface style. Key issues here include consistent visual layouts, the way in which you work with the keyboard (and, typically, a mouse), and menu and command structures.

An architecture should do two basic things to help create applications with "acceptable" user interfaces. The first is to provide a set of specifications that defines exactly what "acceptable" means: Developers must have a goal. The other is to provide a set of tools that makes it easy to reach that goal.

The Mac's Toolbox is one example of such tools. A newer and, according to most reports, more powerful answer is the NeXT Interface Builder, which helps build consistent user interfaces quickly.

Early user interfaces were simple command-line interpreters like the one in DOS. These interfaces left you on your own, forcing you to learn many arcane operating-system commands and different working styles for each application.

Then the Mac popularized the graphical user interface (GUI), a system based on graphical icons, pull-down menus, and other devices designed to free you from having to memorize lots of commands. The Mac's interface standards also gave a standard look and feel to Macintosh applications.

Today, GUIs are all the rage. Windows and NewWave are vying for the GUI title on PCs, with such other players as GEM also in the fray. OS/2 has its own GUI, the Presentation Manager.

The Unix world is perhaps the most complicated one currently, with such major GUI contenders as the Open Software Foundation's Motif and Unix International's Open Look, as well as NeXT's NextStep, and others. The goal of all these systems is to free users from the need to learn cryptic Unix commands, so that Unix can become popular with many of the same people that today work happily with Macs. (For further details on GUIs and other user interfaces, see "From TTY to VUI" on page 205.)

Building Overhead

If by now you're thinking that applications architectures sound like a lot of software, you're right. Complete ones include a substantial amount of code and documentation, and they have some costs as well.

Perhaps the most obvious cost is performance overhead. If you want to squeeze the last drop of performance from a system, you write directly to the hardware, preferably in hand-crafted assembly code designed to take advantage of every feature of the processor and display. These architectures are at the other end of the spectrum: They cover every aspect of the system with a thick, CPU-draining blanket of software.

The standard argument in their favor, however, is that the results justify the performance costs. Besides, ever-faster hardware will handle the CPU requirements easily. We support that argument, but we also think it's important to realize that these architectures have a considerable performance overhead. The more sophisticated the applications architecture that you want to embrace, the more powerful the system you are likely to need.

These architectures can also be complex. The learning time for DOS developers, for example, is far less than the learning time for Mac developers. This is a problem. The best solution to date seems to be using higher-level toolboxes, such as NeXT's Interface Builder, that hide the nitty-gritty under another layer of software.

A final potential cost is in innovation. No architecture can cover everything; when the next great advance in, say, user interfaces comes along, a good one can actually hinder creativity. The only answer here is to design them to grow easily, so that things like user-interface style can evolve to reflect new technologies.

Expansion Plans

Despite the costs, applications architectures are clearly hot. In fact, this is one area where it's easy to make general predictions with confidence.

For one thing, you can expect each of the major vendors to standardize on one applications architecture or, at most, a few. IBM and Digital Equipment Corp. (DEC) are already doing it, and most Unix system vendors are either already standardizing or ready to do so as soon as the Open Software Foundation versus Unix International conflict is resolved.

Another safe bet is that object-oriented programming will play an increasingly important role. Object-oriented systems let you define abstractions that have well-known specifications and are well insulated from the outside world. Objects are the latest and greatest ways to express abstractions in programming, and that's much of what these architectures are all about. The object-oriented approaches of the NeXT system and HP's NewWave are almost certainly just the first of many.

You can also expect to see more high-level cross-system development tools, from large sets of toolboxes built around objects to still-higher-level fourth-generation languages. (For a discussion of some of the various cross-system development tools available, see "Bridging Troubled Waters" on page 225.)

Finally, as the industry learns more about how to build multimedia systems, you can expect to see user interfaces and other aspects of these architectures that take advantage of those systems. Voice and video are likely to become far more common in the future as vendors strive to make computers more accessible.

The Ground Floor

Most of all, you can expect applications architectures to continue to rise in importance. Consistent approaches have proven benefits.

Look, for example, at DEC's success in recent years. While DEC did not have a stated applications architecture a few years ago, it did offer the same basic machine (VAX) and network (DECnet) architecture from its smallest system to its largest. IBM, by contrast, had to support many different system types. The result was a huge increase in DEC's user base, often at IBM's expense.

Even DEC, however, has had to bow to the performance of other machine architectures and now offers workstations based on MIPS Computer's RISC chips. These workstations are not compatible with DEC's VAX products, so now the company is building an applications architecture called Network Applications Support (NAS) to link these two systems and Unix workstations, DOS PCs, and Macs as well. (For a comparison of IBM's and DEC's applications architectures, see "Blueprints for the 1990s" on page 237.)

Over the next few years, you can expect other architectures to join the Mac's as leaders in the personal computer arena. Vendors of other large systems will also strive to offer total architectures on their systems (see the text box "An Open Approach" on page 246). Who will come out ahead is anybody's guess. The only sure thing is that increased portability and transparency will be a plus for everyone who uses desktop computers. ■

Mark L. Van Name and Bill Catchings are BYTE contributing editors. Both are also independent computer consultants and freelance writers based in Raleigh, North Carolina. You can reach them on BIX as "mvanname" and "wbc3," respectively.

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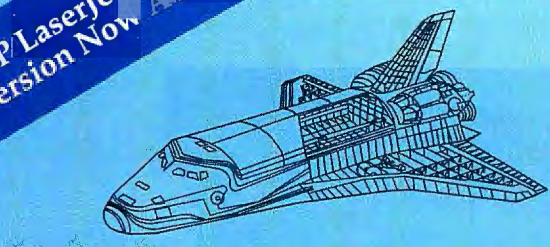
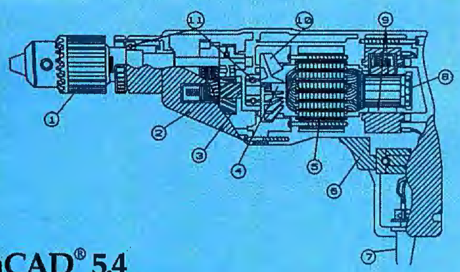
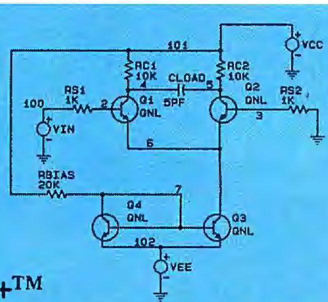
 AutoCAD® Release 10	15 seconds	3 minutes 17 seconds	1 minute 2 seconds
 VersaCAD® 5.4	49 seconds	9 minutes 45 seconds	3 minutes 11 seconds
 Schema II+™	17 seconds	5 minutes 15 seconds	2 minutes 13 seconds

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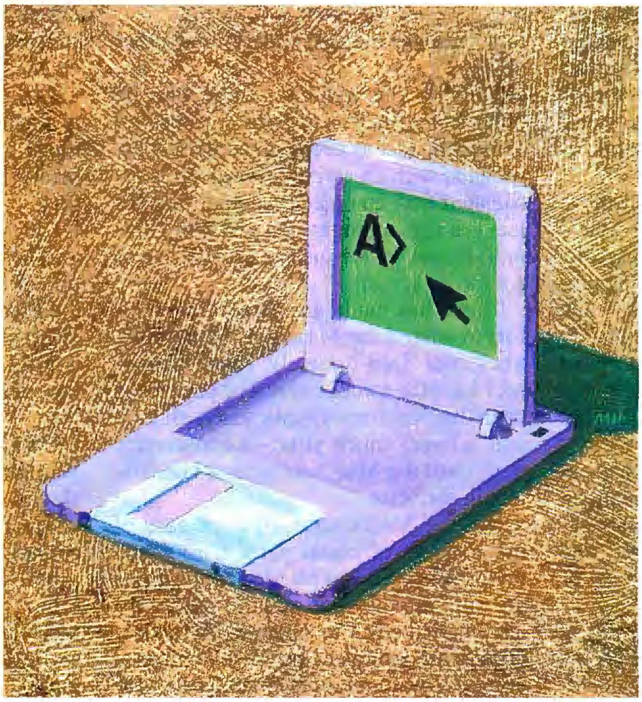
From TTY to VUI

As computers become more complex, using them becomes easier and easier

Frank Hayes

What makes a good user interface? That is not a simple question. Designers have been struggling for decades to create architectures that let you get the most from your software. There are questions of priorities. Should the user interface maximize performance for experts or shorten the learning curve for beginners? Is safeguarding data more crucial than efficiency? And which should take priority: flexibility or throughput?

Not surprisingly, the quality of a user interface depends on the level of technology represented in the underlying hardware. The first interactive computer systems communicated with you through teletypewriters (TTYs)—character-based terminals that could accept only typed input and could print only on paper, one character after another. As technology improved, video display terminals (VDTs) became widely available. These "glass TTYs" could position a character anywhere on the screen. They quickly became the norm in computing. Then came high-resolution graphical displays that could support graphical user interfaces (GUIs), complete with mice.



In the Beginning Was the TTY

The original interactive user interface was the command-line interface. The most familiar CLI today is probably the DOS A> prompt, but the heritage of CLIs goes further back than the IBM PC. They came by way of the TTYs that served as the first terminals for mainframes.

TTYs had a bottleneck problem: Each command you typed had to be sent to the computer across a relatively slow serial link, and once the command arrived, the computer had to decode it. A typical CLI had to minimize the amount of information making its way from the TTY's keyboard to the mainframe. This is part of the reason why all CLIs have inherited a tendency toward short and cryptic commands. The only way around the bottleneck was to limit the amount of information that had to pass through it. Thus, in those early days, every keystroke counted.

TTYs were limited in what they could print out as well. A TTY printed one character at a time, typewriter style. As the TTY gave way to the VDT, something new was added: the ability to alter the position of the cursor. That made it possible to print information anywhere on the screen. Using special keystrokes and a character-based VDT, software allowed you to move a cursor around the screen. You could go back and correct mistakes and update information. It's hard to grasp today what a profound improvement the electronic VDT was over the paper-based TTY.

continued

It's even harder to grasp that the "glass TTY" still defines the limits of CLIs, even on high-powered PCs. Although desktop computers have all but eliminated the bottleneck between the computer and the screen, character-based PCs behave as though the bottleneck still exists. CLI commands are still short and cryptic, and every single keystroke still counts. With a CLI, one wrong key can wipe out a day's work. However, CLIs remain popular because they work with almost any kind of operating-system architecture that can accept or print one character at a time. But they certainly show their age.

Fortunately, when desktop computers eliminated the CPU-to-display bottleneck, they also made graphics practical, and with them, GUIs.

The Mac Standard

The Macintosh user interface was the first GUI to appear on a popular desktop computer. It became a model for almost all the GUIs to follow. By comparison to the one-character-in, one-character-out simplicity of CLIs, GUIs are immensely difficult to program. The goal, however, is to make life easier and more productive for users. Three standard features distinguish almost any Macintosh screen from a non-GUI screen: a mouse pointer, a menu bar, and one or more windows (see photo 1).

The mouse pointer, which you move around the screen by moving the Mac's one-button mouse, is typically an arrow. A program can change it to one of a number of graphical icons, however, each with its own meaning. For example, to indicate that you're supposed to wait while the computer does its work, the software will typically change the pointer to a watch.

There are several standard mouse actions. Clicking selects an item or an action, double-clicking simultaneously selects an item and starts an action, and dragging moves objects on the screen or selects groups of objects.

The menu bar runs across the top of the screen. Clicking on an item on the menu bar causes the menu to drop down. Each menu item is associated with an action, which you can select by clicking on it. You can also select some menu items by using keyboard equivalents (i.e., using key-based commands instead of the mouse and menu).

Other menu items pull down submenus. A submenu appears to the right of the original menu. The items on the submenu can themselves have submenus, so it's possible to work your way deeper and deeper into the command structure and see all the menus as you do. Any item, no matter how deep in the menu structure, can have a keyboard equivalent, which would make it unnecessary to go through the entire menu structure to initiate the action.

A window is a rectangle on the screen that lets you work within a program. On a Mac, you may be able to move the window around on the screen, change its size and shape, open it to fill the screen, close it entirely, or change how much of its contents shows. Windows can also contain buttons, menus, sliders, and other objects.

The "glass TTY" still defines the limits of CLIs, even on high-powered PCs.

Outside the window, there can be other icons, such as disk drive icons or a Trashcan. Just as every menu item is associated with an action, every icon is associated with an object, whether that object is a file, a program, a group of files, or a storage device such as a disk drive or a network server.

Apple has made an extraordinary effort to control the Mac GUI, with guidelines that aren't merely suggestions—they have the force of law. The payoff has been that Macintosh applications all look and act very much alike—a consistency that, until the Mac, was almost nonexistent in software.

But the Mac's reputation for ease of use consists of equal parts reality and myth. While almost all Mac applications are similar, they can require extraordinary calisthenics to operate. A mouse-click is used to select *and* deselect items. Some software requires complex user actions, such as triple-clicking or dragging while a key is held down. And with keyboard equivalents, there are often several different ways to accomplish the same thing.

What's wrong with that? It's not consistent—and it's certainly not simple to learn. Jef Raskin, the Apple designer who originally created the Macintosh project and gave the machine its name, argued that every action should always have the same result, and that every result should have just one action associated with it. For example, there should be only one way of erasing a file.

Raskin's argument is compelling: Efficiency and ease of use come from habit, and if you have one way of erasing a file, you'll become very fast at erasing files that way. The GUI designer's task, Raskin believed, was to find good, easy, efficient ways for you to perform your work. Once those ways have been developed, *all* software should follow them.

Needless to say, Raskin's design changed after he left the project, and the Mac you see today bears little resemblance to his original plan. The result is a plethora of ways to do almost anything on a Mac—which makes it flexible, but much more complex than its reputation implies.

Although the Mac has demonstrated in business settings that it is easier to learn than CLI-based systems, it's still a far cry from a truly easy-to-use system. This is part of the reason that, while Macintosh software was a huge improvement over the software available in 1984, it has not catapulted the Mac into spectacular success.

The Macintosh is certainly not a failure—its consistency across applications is unsurpassed, and Apple's programming guidelines produce software that rarely has trouble coexisting. (By contrast, you often find yourself playing "TSR roulette" when you try to add yet another pop-up program to your collection of DOS utilities and drivers.) And if the Mac hasn't kept the faith of Raskin's original, friendly user-interface design, it still seems like the Holy Grail of interface design compared to DOS.

DOS Opens a Window

While the Macintosh was originally designed with a GUI, the PC was designed with CLIs. PCs get their CLI from a file called COMMAND.COM, which is actually a program that runs when no other programs are running. COMMAND.COM provides the A> prompt and executes simple built-in DOS commands such as ERASE, COPY, and DIR. COMMAND.COM also loads and executes applications and batch files.

Early versions of DOS required that the original COMMAND.COM be in place, but more recent versions allow you to replace COMMAND.COM with other command interpreters, including GUIs. However, there's a fundamental problem in adding a GUI to a PC: DOS lacks many of the building blocks of a GUI,

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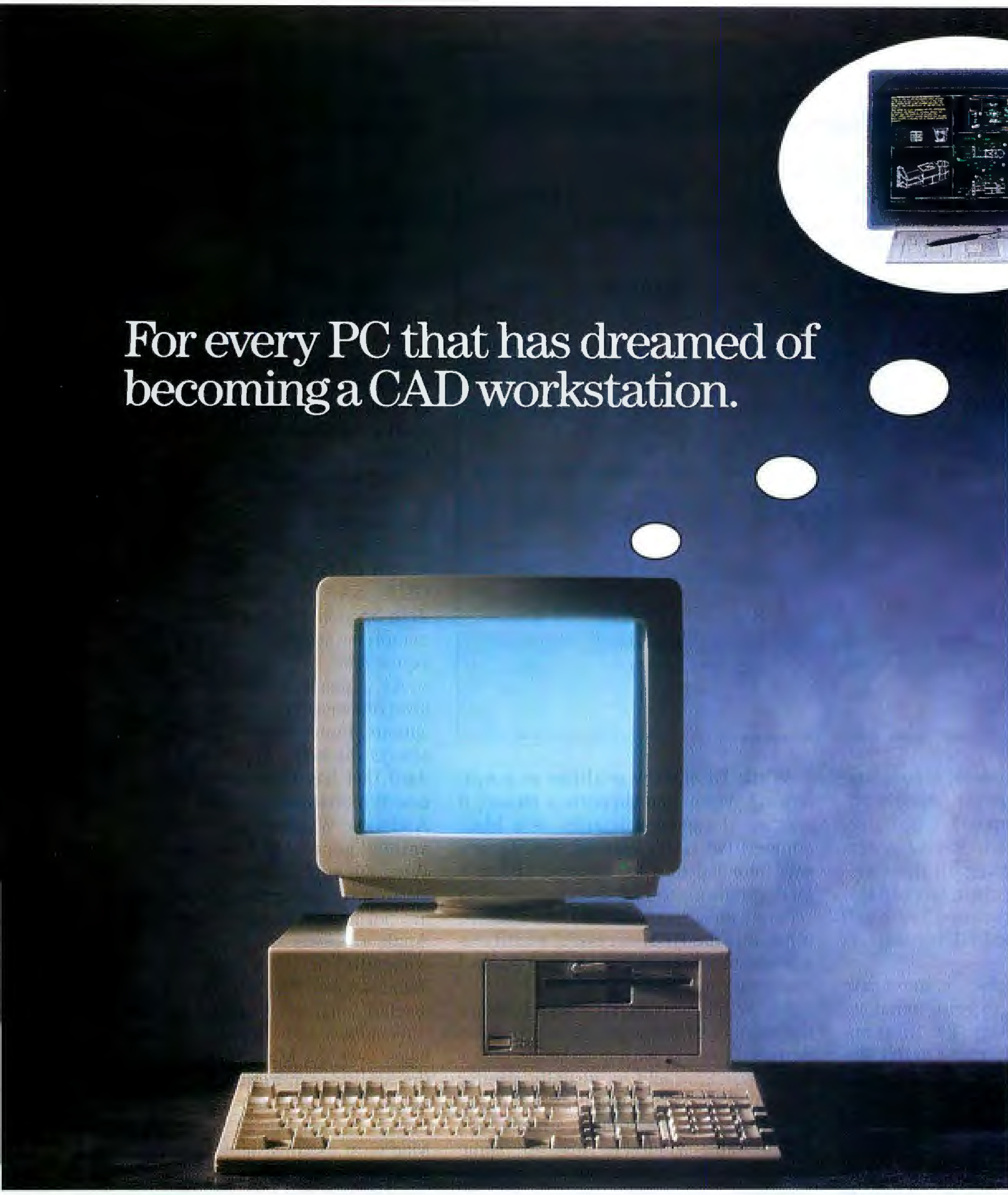

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GUI COMPARISON

These five leading GUIs show their strengths in different areas. The Macintosh is highly consistent across applications; Windows and PM offer SAA compatibility and multitasking; and Open Look and Motif operate through networks but tend to be slow.

GUI	Macintosh	Windows	PM	Open Look	Motif
Operating system	Macintosh	MS-DOS	OS/2	Unix	Unix
Multitasking	No	Yes	Yes	Yes	Yes
Networking GUI	No	No	No	Yes	Yes
File manager	Internal	Internal	Internal	Internal	External
Consistency across applications	Very good	Good	Good	Not available	Not available
Graphics performance	Good	Good	Good	Slow	Slow
Menu style	Pull-down	Drop-down	Drop-down	Pushpin	Drop-down
CLI available	No	Yes	Yes	Yes	Yes
Underlying standards	Macintosh	SAA	SAA	X Window	SAA, X Window
Software base	Large	Moderate	Small	Nonexistent	Nonexistent
Available	Yes	Yes	Yes	No	No

such as a windowing system, mouse support, and screen drivers, to handle objects that appear, disappear, change size, and move. Creating a windowing system for DOS requires building all these elements and then piling them atop DOS's command-oriented structure. The result tends to make PC-based GUIs memory-hungry and slow.

Despite the basic problems, there have been several attempts to bring windowing environments to DOS. The most notable have been GEM from Digital Research, Inc. (DRI), Microsoft Windows, and Quarterdeck's DESQview.

GEM was originally designed as a full mouse-and-menus windowing system. It ran into legal trouble with Apple very early, and DRI had to make significant changes to GEM's desktop. Windows was another early contender that ran into trouble with Apple. Microsoft's solution was to sign a license for some of the Apple technology.

But other problems stood in the way of the success of Windows and GEM. Users complained that both systems were slow and required too much memory. In addition, both GEM and Windows require that programs be designed explicitly for them, thus slowing their acceptance. GEM finally found a niche as the shell for Xerox's Ventura Publisher desktop publishing software. It has taken years for Windows to build a significant following.

While DESQview qualifies as a windowing system and supports a mouse, it was not designed primarily as a Mac-competitive GUI. Instead, DESQview was intended to allow several ordinary DOS programs to run simultaneously in separate on-screen windows. As a result, it became the first successful multitasking system for the PC, although it doesn't really fall into the GUI category.

But Windows is a GUI, and a substantial number of programs have now been designed to work with it. Like the Mac's GUI, Windows and its visually similar cousin, OS/2's Presentation Manager (PM), use a mouse pointer, a menu bar, and movable windows. However, some superficial differences quickly become apparent.

For example, menus drop down immediately when the mouse points to an item on the menu bar. (Windows has drop-down menus as opposed to the Mac's pull-down menus.) The windows themselves share only some of the standard features of Mac windows. For example, you can move a Windows or PM window by its title bar, but you can change its shape by dragging any of the other three sides.

Windows and PM also have boxes to *minimize* a window, allowing a program to continue running in the background and remain visible on-screen only as a small icon (see photo 2). That feature—part of their support for multitasking—is their most recognizable advantage over the standard Macintosh GUI.

But something else sets Windows and PM apart: They are designed to conform to IBM's Systems Application Architecture. SAA is part of IBM's plan to bring a level of standardization to some of its operating systems, from mainframes to PCs. The fundamental idea is to design an architecture in which the same software can be used on a terminal connected to a mainframe, a workstation connected to a minicomputer, and a desktop microcomputer—with only minimal changes to support the wide range of hardware involved.

That task is difficult, because the lowest common denominator, character-based terminals, does not support graphical displays or mice. To allow software to run on both terminals and PCs with GUIs, SAA mandates that every menu item or mouse-based action in an SAA-compliant system must have a keyboard equivalent.

As a result, there will be a certain level of consistency across all SAA applications. Function key F1, for example, is always the help key under SAA (a standard that has been picked up by many non-Windows and non-PM applications). And most Windows applications, for example, generally function like other Windows applications.

However, Microsoft's style guidelines are not nearly as rigorously enforced as Apple's. Given the PC's history of incompatibilities, it's hard to believe that Windows and PM will ever achieve the level of consistency of Mac software.

Windows and PM offer some advantages over the Mac, however, including the ability to minimize a window, but neither Windows nor PM offers a GUI that is as smooth or attractive as the Mac's, or as consistent. Also, Windows and PM, with their mandatory keyboard equivalents, stray even further than the Mac from the principles of ease of use. Ultimately, even more than the Mac does, Windows and PM may suffer from programmers who would rather substitute a windowing system for careful, friendly program design.

X Marks the Spot

Unix poses its own problems for GUIs. Like DOS, Unix was designed as a character-oriented system; any graphical elements must be built on top of the original system. But Unix has another problem: Unlike DOS or OS/2 systems, in which the display is closely tied to the CPU, a Unix system can have a display terminal

continued

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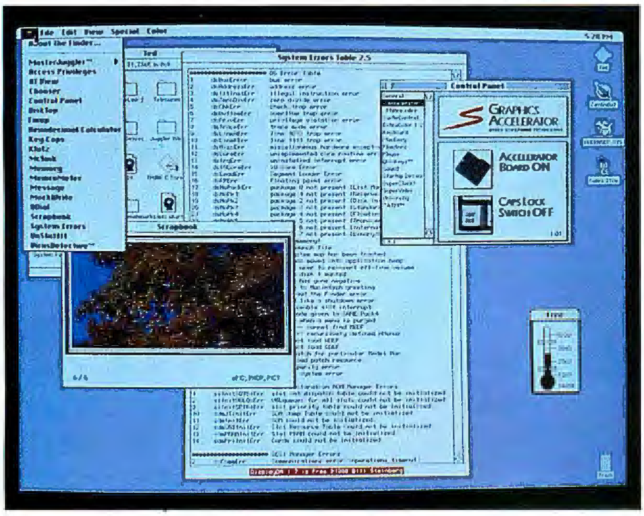

Photo 1: *The Macintosh interface contains all the elements of a typical GUI. The pointer (upper left) lets you make selections and position the cursor. Menus supply you with choices among a range of actions. Windows display the output of programs.*

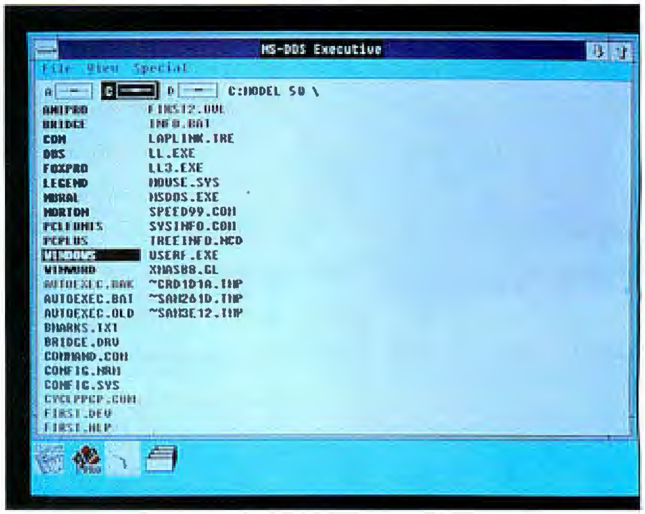

Photo 2: *The minimize feature of Windows and PM keeps your display uncluttered while you run multiple applications. Programs running in the background are represented by their icons, rather than by an output window.*

that's far from the central computer. It's the bottleneck problem all over again: How can you send large amounts of graphical information through a conventional communications link?

The commonly accepted solution is MIT's X Window System (referred to as X Window for the remainder of this article). X Window is a standard way of describing graphically oriented displays and sending the information from one X Window system to another. X Window also provides the ability to send keystrokes and mouse-movement information, so you can interact fully with the program. X Window doesn't completely solve the bottleneck problem, but it's a great improvement over sending a GUI display to a terminal one pixel at a time.

However, X Window is not a GUI. You might say it's just a graphical communications interface. Several X Window–based GUIs have been built (including proprietary systems, such as DECwindows, which runs only on DEC computers). But the two X Window–based Unix GUIs that promise to become the most widespread are Unix International's Open Look and the Open Software Foundation's (OSF) Motif.

Open Look was designed by Sun in close association with AT&T. In fact, it was originally designed to be *the* GUI for the new version of Unix (System V release 4), which is scheduled to appear this year. However, Open Look has both technical and political peculiarities. It can use some of the X Window System, but it also depends heavily on Sun's own operating-system features.

One of the reasons for a hybrid approach was X Window's notorious slowness in updating some screens. This slowness is more than a minor annoyance. It's the most obvious characteristic of many X Window implementations. Users complain that they can move a mouse and wait seconds before the on-screen mouse pointer moves. However, a new version of X Window was recently released, and it's said to be much more responsive.

Another reason may have been Sun's long investment in its own non–X Window GUIs. The Sun alliance with AT&T was directly responsible for the creation of Open Look's main competitor, Motif, which *is* fully X Window–based.

As you'd expect, Open Look resembles the Mac and PC windowing systems. The usual windows and mouse pointer are there, and, as with Windows and PM, a window can be reduced to an icon while its program continues to run.

But Open Look has some different features as well. You can move a copy of a menu around on-screen, for example, or hold it in position with a pushpin (see photo 3). Even more significant is Open Look's mouse. It has three buttons, each of which has a specific purpose. The left button is for selecting items from menus; the middle button is for moving and resizing windows; and the right button is for pulling up so-called *invisible* windows and menus, which appear separately from any menu bar.

Open Look's unusual use of the mouse is both its greatest weakness and its greatest strength. If you're accustomed to using other GUIs, the three-button approach is unfamiliar. But it's also much more consistent—a particular mouse button *always* serves the same function. As a result, although the learning curve is somewhat steeper, some users say Open Look is ultimately much more efficient than other GUIs.

OSF/Motif has its own political and technical history. OSF was formed by several Sun competitors who feared that Sun's close relationship with AT&T would produce a version of Unix that would be especially well suited to Sun's workstations—giving Sun a head start in getting products to market. OSF's first project was a competition to design an X Window–based GUI that would compete with Open Look. The result was Motif (see photo 4)—a blend of the look of Hewlett-Packard's NewWave, the feel and behavior of OS/2's PM, and the toolkit from DEC's DECwindows system.

Motif looks very much like Windows or PM, except that it has the characteristic three-dimensional look of NewWave. It works very much like the PC-oriented GUIs and has the ability to minimize a window. However, Motif doesn't come with its own file manager—the portion of the GUI that actually allows you to copy and delete files. Some current implementations of Motif (including The Santa Cruz Operation's Open Desktop) use IXI's X.desktop as the file manager. However, X.desktop can be jarring to some users, since it and Motif don't

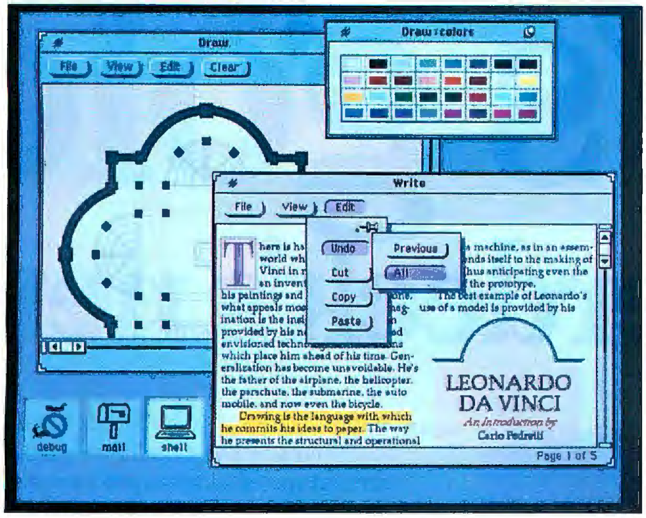

Photo 3: *The Open Look pushpin menus let you position a menu wherever you like on the screen.*

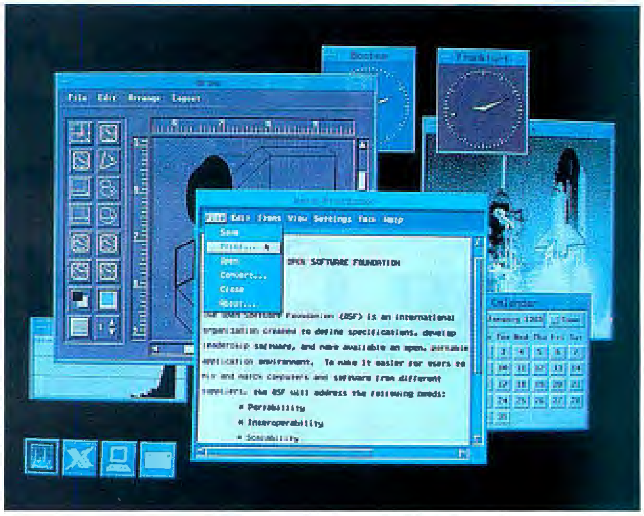

Photo 4: *Motif features a distinctive three-dimensional look, while conforming to the X Window System and IBM's SAA interface standard.*

share the same visual style.

Both Open Look and Motif have extensive specifications for conforming to a standard style, but it's too soon to tell whether either system will approach the Mac's consistency across applications. In fact, both GUIs have just been introduced, although several different software vendors have demonstrated their products using early versions of the interfaces. At the moment, Open Look seems almost ready to go. Meanwhile, Motif, with its conventional use of X Window and the mouse, seems to be a more familiar and popular choice, but it isn't yet ready for users.

With either system, it may take a long time before much Unix software makes the jump from a character-based interface to a GUI. However, it does have some things going for it. For example, the more powerful workstations that traditionally run Unix have useful advantages over PCs or Macs. On a Macintosh screen, dragging a window is indicated by a dotted outline; in Motif and Open Look, the entire window moves. But the complexity of X Window and the remaining communications bottleneck will continue to keep it substantially slower than its non-Unix competitors. Still, for communicating across networks with a GUI, X Window is far ahead of its competition (see the table).

Coming Attractions?

If GUIs present a far more complex architecture than CLIs, will the next generation bring still more complexity to programmers in the search for easier-to-use software? Probably not. The most innovative systems for desktop computers today are racing toward object-oriented programming.

Apple's MultiFinder, a multitasking operating system for the Macintosh, replaces conventional time-sliced preemptive multitasking with event-oriented, cooperative multitasking. This is a step in the direction of the Smalltalk environment that gave birth to modern GUIs. NeXT's NextStep provides tools designed explicitly to speed up programming. NewWave and applications such as ViewLink and Magellan move much of what was once programming into the hands of users.

Meanwhile, hardware is no longer a critical barrier for better user interfaces. While low-speed TTYs once forced you to deal with CLIs, today fiber optics and inexpensive video technology are making an entirely new set of views possible for your desktop windows. In the Knowledge Navigator, the imaginary future computer that Apple president John Sculley likes to describe to his audiences, an animated talking head answers your questions.

But, in the real world, video images are already part of some GUI systems. The images are what might be called semi-interactive video: You can't change the contents of the video, but you can control how to view the images—in what order and at what speed. The combined GUI/video interface even has a name: the video user interface, or VUI.

One use of semi-interactive video, as part of Japan's TRON project, is in software designed for education and running on a modified PC. In one demonstration, you can watch a short video image of the African grassland and then click with a mouse on various animals or plants within the picture to see close-ups, get information, or run a related video. The video images are stored on a videodisk but appear within windows on the computer screen.

Another use of video in a windowed user interface is in networking, particularly in groupware. Researchers at the Xerox Palo Alto Research Center—home of the first GUIs—have experimented with continuous remote video conferencing between the PARC and a facility near Portland, Oregon. With improving video (and networking) technology, the approach could eventually put the faces of every member of your workgroup on your screen—along with a project, document, or spreadsheet the group is working on.

The VUI is an important step in the evolution of user interfaces for desktop computers. Just as the move from CLIs to GUIs made working with a computer less abstract and more "real," VUIs hold the promise of combining graphical, video, and audio information to bring the real world into the computer. ■

Frank Hayes, a former BYTE news editor, is a writer for UnixWorld and lives in Portland, Oregon. You can contact him on BIX as "frankhayes."

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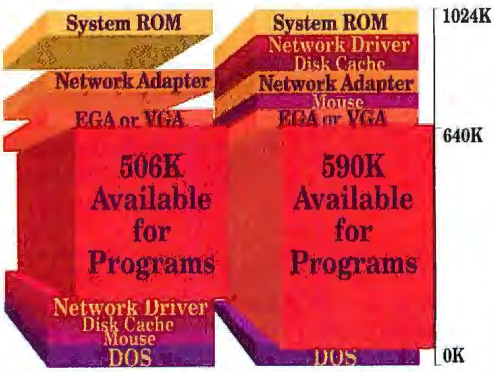

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QEMM also works with Microsoft's XMS spec to extend memory for Windows users.

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Behind the Scenes

A good API makes development a piece of cake, and a bad one can drive you bananas

Howard Eglowstein

Providing a user interface that you can learn to use quickly and easily has been a driving force in the computer industry since the Macintosh made "ease of use" a religion in 1984. The major interfaces—DOS and Unix command interpreters, Macintosh Finder, Windows, Presentation Manager, and the X Window System—provide different levels of functionality and comprehensibility.

Deciding which user interface to support in a multiple-machine environment requires more than a simple examination of the different interfaces. It requires an understanding of the programming interface that underlies what you see on your computer screen.

The application programming interface is what gives your program access to the system's resources. A good API will make it easy to concentrate on the task at hand, and a bad one can drive you bananas.

The API lets your program communicate with the operating system, which is responsible for managing all the resources available in the system. At a minimum, this involves managing the keyboard, display, disk drives, and file system. Most personal computers extend operating-system support to include the management of printer ports, serial I/O ports, and memory.

Giving all programs unrestricted access to all system resources would result in chaos. The operating system needs to be in control to sort out conflicting requests for scarce resources. You need a way to tell the operating system what your program needs to do. That's what the API is for.

A Bushel of APIs

At the simplest level, the API is just the definition of the raw operating-system calls. CP/M or DOS programmers who work in assembly language use such calls exclusively.

At the next level, a high-level language like BASIC, C, or Pascal incorporates operating-system calls into its own language primitives and standard libraries, making it easier to use the operating system and providing some level of code portability. The high-level-language approach also cuts down radically on learning time; the language designers have programmed the hardest routines for you.

Perhaps the most interesting API is an event-driven windowing environment. From the outside, a windowing program normally has menu bars and movable windows and uses some sort of pointing device to control a free-roaming cursor. These elements constitute a graphical user interface (GUI). Microsoft Windows and the Mac interface are the most common examples.

A windowing interface combines basic

continued

ILLUSTRATION: MIKE HODGES © 1990

Listing 1: *Programming DOS in assembly language involves manipulating the registers directly and triggering specific interrupts. This code fragment opens a file.*

```
Fname   db  'FACE.DMG',0
Fhandle dw  ?
;
        mov DX,offset Fname  ; DX register points to the filename
        mov AX,3D00h         ; AH=the 'open' function (3Dh)
                             ; AL=file mode is open for read (00h)
        int 21h              ; Software interrupt 21h is the
                             ; standard MS-DOS file system interrupt.
        jc  Open_error       ; When DOS returns, check the Carry bit to see
                             ; if the operation was successful. If it didn't
                             ; work, jump to our error-handling routine.
        mov Fhandle,AX       ; Since we didn't jump, it must have worked.
                             ; DOS returned the file "handle" in AX.  Save it.
; Go on and do more stuff
```

Listing 2: *This piece of code demonstrates how to open a DOS file using C. The high-level language shields you from the complexities of the assembly API.*

```
#include <stdio.h>           /* Standard DOS information, stored in an include
                                file. */
char name[] = "FACE.DMG";    /* The file we want opened. */

FILE *fp, *fopen();          /* Open the file, store the 'handle' in fp. */

  if ((fp = fopen(name,"r") != NULL)) {
                             /* If we failed, fp = NULL. Punt. */
      /* Do some stuff with the file. */
      fclose(fp);            /* Close the file. */
      }
  else {
      /* We couldn't open the file. */
      }
```

Listing 3: *Opening the same file from another high-level language, GWBASIC. The same method works under Microsoft QuickBASIC and BASIC 7.0.*

```
10 ON ERROR GOTO 200    : ' If the OPEN doesn't work.
20 ' When the file is opened, it will be accessed as channel 1.
30 ' BASIC "channels" are analogous to MS-DOS "handles."
40 OPEN "FACE.DMG" FOR INPUT AS #1
50 ' If FACE.DMG couldn't be opened, we would have jumped
60 ' to line 200.
70 PRINT "File is opened"
80 CLOSE#1
90 STOP
200 ' Error-handling routine.
```

operating-system calls with special libraries that control the graphics display, pointing device, memory allocation, and (if it is supported) multitasking. A high-level language normally ties it all together. However, unlike conventional text-based applications, the event-driven mode of a windowing interface takes control of all user input.

The GUI checks the keyboard and pointing devices and determines which key press or mouse-click is meant for which program. Along with any timer or other interrupts, these input events are placed in a special *event queue*, which the API controls. Instead of checking the input devices, an application asks the API for any relevant events and processes input by dispatching control to the appropriate *event handler*. Applications that are programmed with an event-driven API have a distinctive look and feel that many people find easier to learn and use. GUIs also provide a more intuitive way of handling a multitasking environment.

Inside the Command Line

DOS and CP/M share a common lineage and thus have similar APIs. In both programming environments, a set of common entry points is set aside for standard operating-system functions. In CP/M (which supports only a 64K-byte program area), the memory at 0005 hexadecimal points to the *jump table*, which contains the address of each of the operating-system functions in a specific order. DOS reserves several of the 808x processor's software-interrupt vectors for accessing the operating system.

With both systems, you access an operating-system function by first placing any necessary addresses or data in the appropriate CPU registers and calling the correct interrupt (DOS) or CALL 0005 (CP/M). The operating system takes control, completes the operation, and returns to your program. Your program finds returned data or status information in CPU registers or designated memory buffers.

Both DOS and CP/M function calls are limited to keyboard input, simple screen output, and disk and file system calls. DOS also provides some control over the division of system memory up to 640K bytes. Running DOS on an IBM-compatible machine lets you access the system BIOS as well, enabling you to control the serial and printer ports, graphics screen, and system clock without doing any low-level programming.

APIs Speak Your Language

If assembly programming isn't to your liking, you can program CP/M and DOS machines in a high-level language. BASIC and C are probably the most commonly used high-level languages. They completely shield you from having to manipulate CPU registers directly.

Listing 1 shows an assembly DOS program opening a disk file. Listing 2 contains the same function, written in C. The C compiler handles all the DOS functions and remaps them into a standard ANSI C format. BASIC performs a similar function, except that the standard BASIC implementation on DOS machines is Microsoft's GWBASIC, which is not an ANSI standard. Listing 3 shows how you open a file using GWBASIC.

In these sample listings, note that the filename is designated using the DOS naming conventions. While high-level languages give you some degree of code portability, the operating system always determines the file-naming convention.

Screen control in DOS is not nearly as flexible as file access. DOS uses the system BIOS to give you simple teletypewriter emulation. By outputting characters to a standard file handle, DOS can pass them through the BIOS to the screen. This handle does not support cursor commands, colors, or any display attributes—just characters. (CP/M implementations at least provided some

continued

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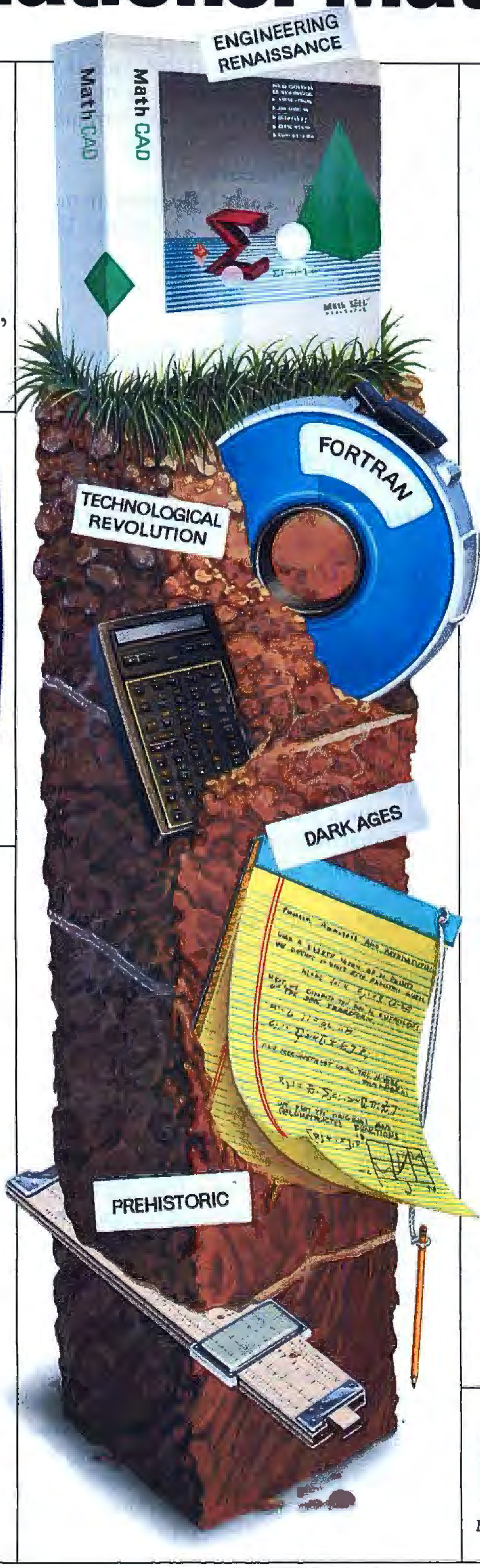

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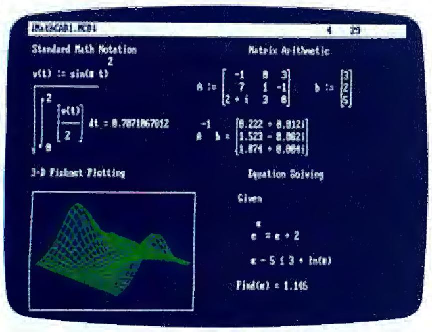

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form of terminal emulation, normally with VT52 or similar escape sequences.) However, an IBM-compatible machine gives you control over display attributes, such as cursor location and text colors, through calls to the system BIOS.

In assembly language, you set screen attributes using the INT 10h BIOS interrupt and access the display-file handle through the INT 21h DOS interrupt. GW-BASIC provides its own interface to the BIOS. Sadly, standard C libraries provide only the teletypewriter emulation of DOS—C does not support BIOS calls. To correct that omission, most compilers can be fitted with function libraries that give you full control over the screen. In some cases, these libraries come with the compiler. They are also available from numerous third-party developers.

DOS and Don'ts

DOS is essentially a collection of device-control functions waiting to be called by your application program. Writing for DOS is simply a matter of working in the standard definition of a language, making the appropriate function calls as needed. This limits your program to the functions that DOS defines. (It also restricts your programs to a maximum of 640K bytes of memory.)

Thus, DOS programs tend to be very keyboard-oriented and often have a sparse look about them. Perhaps the most common complaint from DOS users is the lack of a standard user interface. Because DOS handles only basic screen output or keyboard entry, your program is free to use any keystrokes you wish. You can also make the screen look any way you please. However, if you choose to use the DOS API, you should strive to be consistent.

The Nonstandard Standard

Unix has been around much longer than DOS, but it wasn't a practical operating system for desktop equipment until the arrival of fast processors, cheap memory, and high-capacity hard disk drives. Unix is semiportable, and it has been adapted to many different processors and architectures. In the world of Unix, however, there's no such thing as standard hardware, never mind a standard machine-instruction set. If you're going to work with Unix, you have to stay with C or some other high-level language.

C programs written for Unix, like those written for DOS, are based on the standard ANSI C definition. Each Unix manufacturer provides a specific flavor of C compiler designed to generate code compatible with its hardware. All you have to do is write standard C, compile it on your machine, and you're set. File I/O works through `fopen( )`—even the keyboard, since C maps all keyboard input to the `stdin` file pointer.

In theory, any program you write for a DOS machine should compile directly under Unix. There are exceptions, so you can't expect to have portable code if you use direct memory pointers or make assumptions about internal data formats.

The Unix Difference

Unix systems usually have more memory than DOS machines—*lots* more. Unix system libraries have built-in support for terminal control and true multitasking.

In Unix, there's no such thing as standard hardware, never mind a standard machine-instruction set.

Preemptive multitasking can make programming a complex system much easier on a Unix machine than it is on a DOS machine. For example, say you're writing the ultimate word processing package and you want it to run under both DOS and Unix. One feature you want to add is background printing, where the software can print one file while editing another.

DOS provides two ways to accomplish this, neither of them terribly elegant. Because a word processor spends most of its time waiting for keystrokes, you can perform limited multitasking within the code by writing a keyboard-sampling routine that prints out a few characters, then samples the keyboard, and then prints a few more characters. Since your program polls the keyboard at regular intervals, this approach works well for a word processor. It is not appropriate for most programs, however.

Another facility available under DOS is the background "multiplex" interrupt, which will perform simple background tasks as a part of DOS's overhead. A standard DOS utility, PRINT, uses this interrupt to handle file printing in the background. A number of DOS word processing packages send output to a temporary file and then have DOS use PRINT to output the file. Elegant? No, but it is functional.

On a true multitasking operating system such as Unix, you can spawn a separate task to handle printing. In fact, this task could be a separate copy of the same word processor. The spawned task handles the printing as needed and then destroys itself. The operating system handles task switching and resource conflicts automatically, making the code much simpler.

Terminal Affairs

Screen I/O under Unix isn't much better than it is under DOS. When Unix was developed, bit-mapped graphics screens were an oddity. Until the advent of the microcomputer, all output screens were part of data terminals, some of which featured better functionality than others.

Unix handles a terminal by treating it like a file and using standard file I/O commands to spit characters back and forth. Simply sending ASCII characters wouldn't give you any cursor control, and it's impractical to write support for every possible terminal type into your program. (This is not a problem under DOS, however, because all PCs look alike to DOS.)

To get around this problem, Unix systems provide you with a standard terminal-interface package. A terminal is assumed to support a standard set of functions, driven by escape sequences. A table of all possible terminals is stored in the Termcap file, and the system variable TERM will tell your program which kind of terminal it's on. It's not nearly as convenient as the single DOS machine type, but it's a good compromise and is one step toward a device-independent interface.

A Sashay Through the Windows

Imagine adding one layer of graphics support between you and the operating system. Further, give this layer complete control over the system memory, keyboard, and file system. Then, have the graphics support offer a wide variety of window types and support any type of screen (within reason). What you wind up with is an API that supports a GUI.

Apple calls its GUI API the Toolbox and puts it into the system ROM of every Macintosh it makes. DOS users can buy something similar (in the guise of Windows/286 or Windows/386). Those running OS/2 have access to similar technology with Presentation Manager. In the following discussion, I use Mac termi-

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Listing 4: *A sample Macintosh event loop. Most of the code has been removed to show the file structure better.*

```
{This source is for MPW Pascal}
Program  Excellent;
{Program name:  Excellent.P}
{Function:  This is the main module for this program.}
{History: 1/2/90. Original by Prototyper.}

   repeat                         {Start of main event loop}
     if (theInput <> nil) then    {See if a TE is active}
        TEIdle(theInput);         {Blink the cursor if everything is OK}
     SystemTask;                  {For support of desk accessories}

     if GetNextEvent(everyEvent, myEvent) then
                                  {If event then...}
        begin                     {Start handling the event}
           code := FindWindow(myEvent.where, whichWindow);
                                  {Get which window the event happened in}

           case myEvent.what of   {Decide type of event}
              MouseDown :         {Mouse button pressed}
                 begin            {Handle the pressed button}
                    if (code = inMenuBar) then
                                  {See if a menu selection}
                       begin      {Get the menu selection and handle it}
                          {Do the menu-handling stuff here}
                       end;       {End of inMenuBar}

                    if (code = InDrag) then
                                  {See if in a window drag area}
                       begin
                          {Do the window dragging stuff here}
                       end;       {End of InDrag}

                    if ((code = inGrow) and (whichWindow <> nil)) then
                                  {In a grow area of the window}
                       begin
                          {Window growing stuff}
                       end;       {End of doing the growing}

                    SystemClick(myEvent, whichWindow)
                                  {Let other programs jump in}
                 end;             {End of MouseDown}

              KeyDown,AutoKey:    {Handle key inputs}
                 begin            {Get the key and handle it}
                    {Get the key, and dispatch to any routines}
                 end;             {End for KeyDown,AutoKey}

              UpDateEvt :         {Update event for a window}
                 begin            {Handle the update}
                    whichWindow := WindowPtr(myEvent.message);
                                  {Get the window that the update is for}
                    BeginUpdate(whichWindow);
                                  {Set the clipping to the update area}
                    EndUpdate(whichWindow);
                                  {Return to normal clipping area}
                 end;             {End of UpDateEvt}
           end;                   {End of case}
     end;                         {end of GetNextEvent}
   until doneFlag;                {End of the event loop}
end.                              {End of the program}
```

nology. Bear in mind, however, that Windows, PM, and the Macintosh are similar and work in much the same way.

In an event-driven environment, the operating system automatically samples the keyboard, mouse, serial ports, and other sources of input. The windowing software directs input events into the proper window's queue. The software then calls the program that controls the window.

When notified of an event, your program looks at the event type and dispatches a routine to handle it. Normally, this event handling takes the form of a case statement in C or Pascal.

Your program would normally provide routines to handle keystrokes, mouse movements, serial I/O (if you're using the serial ports), button clicks, and disk insertions. In addition, the windowing software informs your program when its window is covered up by other windows, when it's uncovered, and when it should be closed.

Listing 4 is a Pascal program (Excellent.P) for the Macintosh that displays a window and waits until you select Quit from the System menu. Most of the meat has been removed to make the structure visible.

`GetNextEvent` returns the next event in the queue. The `case` statement isolates `MouseDown` and `KeyDown` events, calls the necessary routines, and then loops until `doneFlag` is set. In a complete program, `doneFlag` is set by clicking the close box, selecting `Quit` from the System menu, or some other action. `SystemClick` passes a `MouseDown` event off to activate desk accessories.

Microsoft Windows uses a similar scheme. Listing 5 is an excerpt from SHOBITS, a program in C that displays arbitrary graphics on the screen and wraps text around them. `WinMain` is the main procedure that displays the graphics window and polls for messages from the event queue. Note the structural similarity between the Windows program and the Macintosh program. In this example, `GetMessage` serves the same purpose as the Macintosh's `GetNextEvent`.

Share and Share Alike

Windowing systems are often multitasking, so it's possible that other programs will be vying for the same resources. Thus, the windowing system normally manages memory, as well as screen I/O, which requires special calls to send text to the active window. Keystrokes come in through the event queue. File I/O, on the other hand, is usually handled directly by the operating system.

Multitasking is handled in various ways. Nonpreemptive systems such as the Macintosh use cooperative multitasking, which takes advantage of the fact that programs have to query the system for events. By asking for an event, the program indicates to the event handler that it is waiting for something to do. Another program can then get control of the processor for a while and return control when it is waiting for an event.

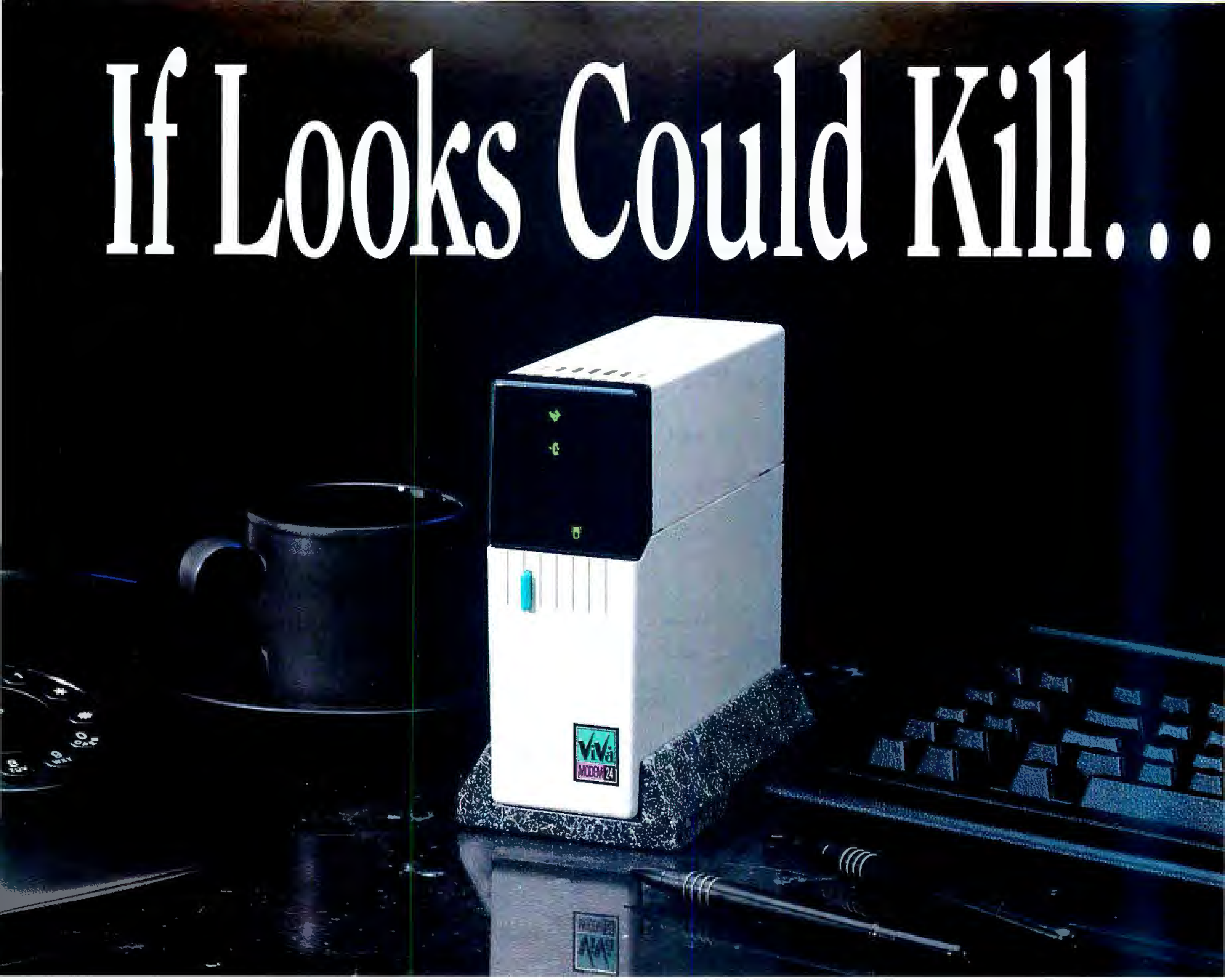
If all the programs on such a system are well behaved, then everyone gets a turn. Of course, there are always a few programs that don't play fair and never relinquish control. On the Macintosh or under Windows, there simply is no way for an application to regain control from these ill-behaved ones.

On the other hand, OS/2 is truly a preemptive operating system, and PM can simply take control whenever it wants. Whether you have a preemptive or nonpreemptive environment, it's best to make sure your applications can coexist with other programs in a multitasking system.

A Standard Standard

Windowing interfaces depend on high-resolution graphics displays. In this

continued



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Listing 5: *A main procedure and event loop from Microsoft Windows.*

```
Listing 5

/* The Source file:  shobits.c  */
#include "windows.h"
#include "shobits.h"                /* There's no bits like SHOBITS */

int PASCAL WinMain( hInstance, hPrevInstance, lpszCmdLine, cmdShow )
{
    msg.wParam = 0;

    if ( hPrevInstance ) {
        {
         /* Copy data from previous instance */
        }
    else {
        {
         /* Call initialization procedure - this is the first instance. */
        }

    if (hWnd = CreateWindow((LPSTR)szAppName,
                            (LPSTR)szMessage,
                             WS_TILEDWINDOW,
                             0,    /*  x - ignored for tiled windows */
                             0,    /*  y - ignored for tiled windows */
                             0,    /* cx - ignored for tiled windows */
                             0,    /* cy - ignored for tiled windows */
                             (HWND)NULL,        /* no parent */
                             (HMENU)NULL,       /* use class menu */
                             (HANDLE)hInstance, /* handle to window instance */
                             (LPSTR)NULL ) ) {  /* no parameters to pass on */

        hInst = hInstance;          /* Save instance handle for DialogBox. */

        while ( GetMessage( (LPMSG)&msg, NULL, 0, 0) ) {
                                    /* Polling messages from event queue. */
           TranslateMessage( (LPMSG)&msg );
           DispatchMessage( (LPMSG)&msg );
           }
    }
    return (int)msg.wParam;
}

}
/* Procedures that make up the window class. */
long FAR PASCAL ShoBitsWndProc( hWnd, message, wParam, lParam )
   switch (message)
      {
      case WM_SYSCOMMAND:
          switch (wParam)
              {
              case IDSABOUT:
                  DialogBox( hInst, MAKEINTRESOURCE(ABOUTBOX), hWnd,lpprocAbout );
                  break;
              default:
                  return DefWindowProc( hWnd, message, wParam, lParam );
              }
          break;
      case WM_DESTROY:              /* Quit was selected from the File menu */
          PostQuitMessage( 0 );
          break;
      case WM_MOUSEMOVE:            /* Any time the mouse moves */
          if (bMouseDown) {
              {
               /* Erase old line and draw a new one */
              }
          break;
      case WM_LBUTTONDOWN:          /* If either mouse button is pressed */
      case WM_RBUTTONDOWN:
          if (!bMouseDown) {
              {
               /* snag a starting X and Y coord */
              }
          break;
      case WM_LBUTTONUP:
      case WM_RBUTTONUP:
          if (bMouseDown) {
              {
               /* The button was down and has just been released */
              }
          break;
      case WM_PAINT:           /* Windows has just asked us to repaint the screen */
          BeginPaint( hWnd, (LPPAINTSTRUCT)&ps );
          if ( PlsAddTxt ) {        /* Wrap two columns of text */
              Column1 ( hWnd, GetDC( hWnd ) );
              Column2 ( hWnd, GetDC( hWnd ) );
              }
           PlsAddTxt = FALSE;
           ReadClipboard ( hWnd, GetDC( hWnd ) );
           XorBox ( hWnd, startx, starty, endx, endy );
           EndPaint( hWnd, (LPPAINTSTRUCT)&ps );
           break;
      default:                      /* Any message we don't have a handler for */
           return DefWindowProc( hWnd, message, wParam, lParam );
           break;
    }
    return(0L);
}
```

regard, the Mac Toolbox enjoys the advantage of always running on a Macintosh. There are no problems with nonstandard displays. The Toolbox can run any program on any type of display that conforms to Apple's standard. In fact, you can have your program ask the Toolbox about the color and resolution of the display and use this information in your program. Device independence on the Macintosh is excellent.

The PC, however, has few standards, and life with Windows becomes interesting because of it. Microsoft has built in support for the usual screen displays: CGA, EGA, and VGA. Because of the popularity of the monochrome Hercules graphics board, recent versions of Windows now support that card as well. But that's about it. If you want to use one of the new full-page displays with Windows, you will have to make sure that the manufacturer supplies a Windows driver. PM is limited to standard Windows devices.

Cooking Up an Application

APIs are not all sweetness and light. Those who work with Windows or the Macintosh probably consider the DOS API half-baked. Conversely, the eyes of those involved with DOS tend to glaze over when they first investigate Windows. Happily, the recipe for picking the right API is an easy one.

If you work on the Macintosh, you have no choice. The standard Mac operating system is programmed solely through the Toolbox and event-loop programming. A/UX, the Unix port for the Mac II family, combines the multitasking of Unix with the best of the Toolbox functions.

The X Window System is a standard that is beginning to show up on Unix workstations. However, the GUIs built on top of it are not yet generally available on desktop machines and are incompatible with one another. Until the X Window System-based GUIs make greater inroads into the desktop arena, Unix hackers will have to be content with their true multitasking and Termcap screen control.

If you work on an IBM-compatible machine, you have a few options. Programming conventional DOS applications is easy, and the new crop of DOS extenders allows access to memory beyond the standard 640K bytes. You can choose between two GUI environments: Windows running under DOS, and PM running under OS/2. All three of these APIs have appeal.

If your applications rely heavily on multitasking, OS/2 is probably the correct choice. However, it may be a long time before OS/2 becomes the standard operating system for IBM compatibles, if it ever does.

If you need to be able to port your application to other machines, straight C under DOS or Unix would be a good choice. If ease of use is a primary concern, then Windows may well be your best choice.

Examining user interfaces is only part of the picture in determining which system to support. Understanding the strengths and weaknesses of each API and matching the right API to the job at hand will make your efforts much more fruitful. ■

Howard Eglowstein is a testing editor for the BYTE Lab. He can be reached on BIX as "heglowstein."

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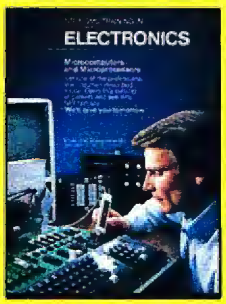

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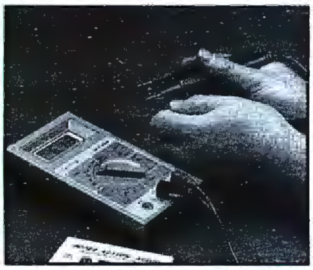

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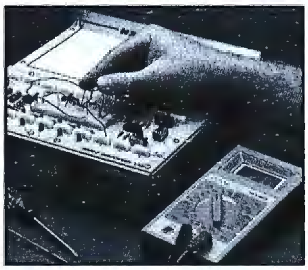

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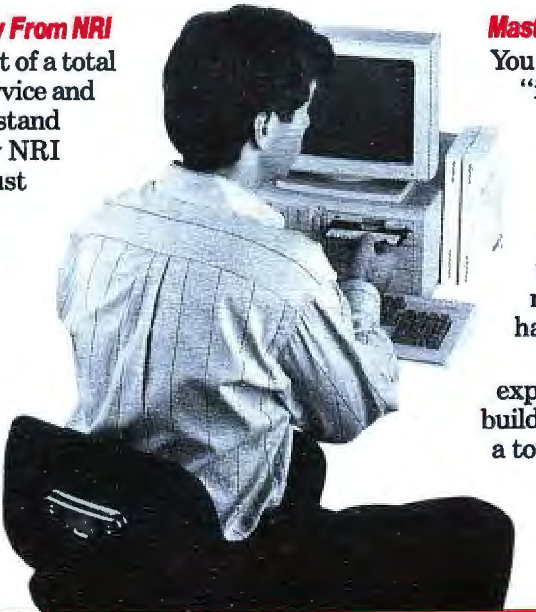

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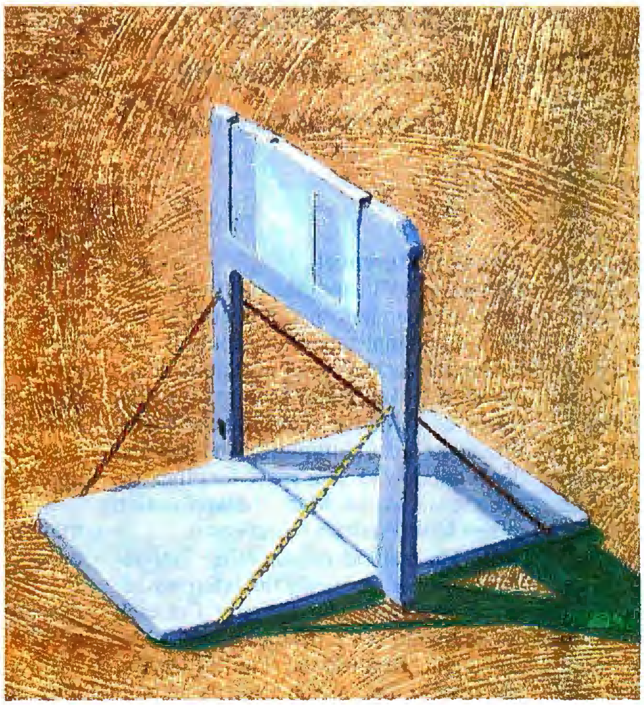


As desktop computing "standards" proliferate like wildfire, both users and software developers face a similar question: Which machine, and which operating system, should they support? DOS continues to dominate the installed base of microcomputers and thus has the greatest software support, but the Mac has many attractive features, and Unix and OS/2 are coming on strong.

All this results in four operating systems (lumping together the many Unix variations); five major graphical user interfaces—Microsoft Windows, OS/2's Presentation Manager (PM), the Mac, and the X Window System–based Motif and Open Look; many more minor GUIs; and an uncounted number of different machine architectures.

The choice comes down to limiting your prospects by supporting one machine or facing the daunting prospect of supporting multiple, complex computing environments and application programming interfaces (APIs).

New tools, however, can provide a third alternative. What if you could write an application once to a universal API and then move it to a variety of popular systems? This would make it easy to support multiple standards and to use the same software on different machines.

I will discuss five toolkits that allow this kind of portability. XVT and Smalltalk/V (both of which are general-purpose toolkits), HOOPS and Design/OA (two graphics libraries), and FoxBase (a DBMS) each provide a common API across multiple platforms. These toolkits—and others like them—can make it easier for users and programmers to support multiple environments.

Solving a Sticky Problem

XVT (for Extensible Virtual Toolkit) from the Advanced Programming Institute is a set of libraries, one for each graphical environment that it supports. Each library maps a set of common XVT function calls to equivalent system-specific calls. For example, XVT's `new_window` turns into `NewWindow` on the Mac and `CreateWindow` under Microsoft Windows.

But XVT is more than a Rosetta stone. Although Windows, PM, and the X Window System (referred to as *X Window* for the remainder of this article) owe much to the event-driven style of programming that the Mac has popularized, they differ from the Mac and from one another in ways that go beyond a one-for-one translation of function names.

For example, each GUI system defines a different set of events. There are 11 Mac events, 24 X Window events, and more than 100 Windows messages. XVT

continued

makes do with 15 events. How does it handle all the complexity of Windows with so few events? It doesn't.

For the sake of portability, XVT sacrifices some of the uniqueness of each of the environments it supports. So you lose, for example, Dynamic Data Exchange, which carries conversations between concurrently executing Windows or PM programs and supports interapplication *hot links*. Since there isn't a DDE analog on the Mac yet, XVT pretends that Windows and PM don't have DDE, either.

Common Cause

Still, XVT handles the basics nicely. Recently, I wrote an XVT program to try out the capabilities of a mixed Mac and PC network. My goal was to build a simple multiuser database that would present an identical user interface to PC and Mac users. Although I'm a relative beginner when it comes to GUI programming, my progress was swift.

Building on the examples provided ("clone first, ask questions later" is my motto), I put together a simple program that displays three flat-file databases, each in its own scrollable window, and provides menu options to add, search for, and delete records. The C source code for the Mac and PC versions was identical. Well, almost identical.

My application needed some network functions (e.g., open a file in share mode, lock a record, unlock a record) that XVT doesn't provide. So I defined my own common interface to these functions and supplied separate Mac- and PC-specific implementations.

The other nonportable part of the project was the resource scripts required to build the program's menus and dialogues. XVT does provide a tool that translates Macintosh RMaker scripts to Windows resource-compiler scripts. And because I used Prototyper 2.0 from SmethersBarnes to build the menus and dialogues interactively, tuning the sizes and locations of dialogue components was easy. Nonetheless, XVT's success in creating a uniform GUI programming environment makes you wish for a uniform resource-tinkering environment, as well.

One result of XVT's least-common-denominator approach is that an XVT program is somewhat simpler than its native counterparts. For example, under Windows, you have to register each window as a member of a class and provide a filter that can trap messages sent to that window before they go to the default message handler. In XVT, as on the Macintosh, you can simply create a window.

The Mac in native mode, however, requires more work to make that window behave properly. Say you indicate, by clicking the mouse, your intention to drag a window across the Desktop. The programmer must ask the Toolbox which window received the mouse-click, determine that the click happened in the window's `inDrag` region, and then explicitly call the Toolbox's `DragWindow` function. XVT, like Windows, handles these details automatically.

XVT's success in creating a uniform GUI programming environment makes you wish for a uniform resource-tinkering environment, as well.

Vive la Différence!

Although XVT smooths out the differences among platforms, it doesn't stamp them out completely. Nor should it. Although the two halves of my database application looked alike, each retained the flavor of its native environment. Under Windows, I could minimize the application's window to clear space for other applications; on the Mac, the application joined MultiFinder's round-robin.

XVT's method for handling font selection illustrates nicely the interplay between portability and diversity. For each environment, XVT defines a font-selection menu. Because the families, styles, and sizes of fonts are necessarily system-specific, a portable program can't refer directly to the contents of that menu.

XVT's solution is fascinating. It defines a new event, called the `font` event, which the system sends to an XVT program when you request a font change. The program can then query the system, find out that you asked for, say, font family 15, size 3, and then ask the system to make those the effective settings. It never uses a nonportable name such as "12-point Times Roman."

This scheme has a surprising consequence, though. An application cannot itself decide to use 12-point Times Roman type. It can only enable you to do so. Because XVT uses drab system fonts by default, this limitation is frustrating. An application can only ask for "big," "normal," and "small" sizes of the default font. I hope future versions of XVT will let an application ask for a style, too.

It's important to understand what XVT isn't, as well as what it is. It isn't intended for shrink-wrapped commercial products like Aldus PageMaker or Microsoft Excel. The authors of these programs use all the environment-specific knowledge they possess to squeeze the last drop of performance out of them. However, if you don't have the time or inclination to master multiple GUIs but still need useful software that is available across the diverse mixture of graphical computers that populate offices today, XVT makes portability practical.

Catching Up with Smalltalk

When BYTE dedicated an entire issue to Smalltalk in August 1981, it was the first glimpse many readers had of two intertwining themes—the GUI and object-oriented programming (OOP). At the time, however, Smalltalk was little more than an academic curiosity. The Apple II and CP/M systems of the day couldn't support Smalltalk, and most people could only dream about the Xerox workstations shown in the articles.

Today, the descendants of those exotic workstations roll off assembly lines. The Macintosh, Windows, and PM operating environments embody the GUI and OOP ideas that Smalltalk inspired. Yet Smalltalk itself, designed specifically to help explore and construct complex graphical applications, remains exotic.

Smalltalk may yet have its day. Two main dialects of the language exist, and each spans multiple platforms. ParcPlace Systems' Smalltalk-80, a direct descendant of the original Xerox PARC system, runs on Sun, Apollo, and HP 9000 workstations, as well as Macs and 386 PCs. Digitalk's Smalltalk/V, the one I've worked with, has 286 (non-Microsoft Windows), Macintosh, and PM incarnations.

The two dialects differ considerably. Their underlying class libraries aren't compatible. And in the same way that Smalltalk-80 makes each of its hosts look and feel like a Xerox workstation, Digitalk's latest offerings, Smalltalk/V Mac and Smalltalk/V PM, wear the look

continued

Listing 1: *Programming the Smalltalk way involves creating methods that interact with objects via messages. Smalltalk is a natural for developing GUI-based applications.*

```
|window file list word|              "declare local variables"
window := TextEditor                 "create window"
  windowLabeled: 'Test'
  frame: (0 @ 0 extent: 400 @ 100).
file := File pathName: 'test.txt'.  "open file"
list := Bag new.                     "create an empty collection"
[(word := file nextWord:) isNil]     "read words into collection"
  whileFalse: [list add: word].
list asSet asSortedCollection        "eliminate duplicates and sort"
  do:
    [:w|                             "get each item"
      window
        nextPutAll: w;               "send it to the window"
        cr].                         "followed by carriage return"
```

that's locally appropriate. Either way, you get a machine-independent programming toolkit.

Digitalk's host-sensitive approach, coupled with the improved performance and packageability that the new Smalltalk/V PM supports, has recently ignited something of a Smalltalk revival. Leading the charge, Microsoft's Bill Gates delivered the ringing endorsement that Smalltalk/V PM is "the right way to develop PM applications."

An Object Lesson

Smalltalk's all-encompassing object orientation takes some getting used to. Listing 1 shows a snippet of Smalltalk/V code—a *method*—to read a text file and write a sorted list of the different words that it contains to a scrollable window.

The short code does quite a bit of work. The `TextEditor` and `File` objects respond to the "messages" they receive by asking the host to open a document window and a file, respectively, and by returning Smalltalk objects (assigned to `file` and `window`) that can be used to manipulate them. The `Bag` object answers the message `new` with an object that can hold a bunch of objects of any kind.

Next, the method sends `nextWord` to `file`, assigns the result to `word`, and sends `isNil` to `word`. To the resulting object—a Boolean, since the response to `isNil` will be true or false—the method sends `whileFalse` along with a block of code to be evaluated each time a non-nil `word` appears. That block, in turn, tells `list` to add `word` to itself.

Finally, the method sends `list` the messages `asSet` (return yourself without duplicates), `asSortedCollection` (return yourself sorted), and `do`. The `do` message iterates over `list`, picks up each word, and asks `window` to display it.

I'll agree that the syntax looks strange. But is it really any stranger than the equivalent Microsoft C or Think C programs, with their event loops and baroque APIs? And the Smalltalk code is *much* smaller than its C counterparts would be.

The Smalltalk Way

Smalltalk encourages an exploratory, cannibalistic style of programming. For example, when I moved the word-cataloging code from the Mac to PM, I decided to add a fancy way to choose the input file. The Smalltalk/V PM environment has a nifty "Browse Disk" menu option. It activates a multipane window that works like PM's own File Manager. The browser is an instance of a Smalltalk class called DiskBrowser. So I created another instance,

```
DB := DiskBrowser new open.
```

I selected a directory and a file and then asked the Smalltalk object inspector to unpack `DB`. It showed me that two instance variables, `selectedDirectory` and `selectedFile`, held the information I needed. Did the DiskBrowser class already define methods to return those items? No, the Class Hierarchy Browser reported, so I used its method editor to create them. Practically for free, my program got a big chunk of the system's user interface. That's the kind of reusability that makes some people religious about Smalltalk.

With all this to offer (and portability, too), why does the language's profile remain low? There are four reasons. Historically, Smalltalk applications didn't adapt to native windowing systems, ran more slowly than did conventional programs, were far more difficult to package and distribute, and required mastering an abstruse class hierarchy.

Smalltalk/V Mac silenced the first objection; Smalltalk/V PM attacks the remaining ones. It replaces the traditional interpreted "image" with a true OS/2 executable file, into which methods incrementally compile. That executable file, along with dynamic-link libraries containing necessary run-time support, constitutes a stand-alone PM program—and a pretty fast one at that.

Finally, the traditional scheme for organizing an application's windows, the "model-Pane-Dispatcher" class triad, has evolved into a more natural system based on a new class, ApplicationWindow. The new PM class hierarchy compromises Smalltalk/V's portability to a degree. If you rely on the new classes (although you don't have to), your code won't be guaranteed total transportability to other Smalltalk/V platforms until the new system becomes standard across the product line.

There is no magic bullet. Modern graphical programming is a tricky business, and programming for multiple platforms is even trickier. The results, however, are worth the effort, particularly to the user community. I think that the latest incarnation of Smalltalk/V will spark renewed interest in Smalltalk as an appropriate technology for building portable, user-interface-intensive programs.

There are still more surprises to come. At the 1989 OOPSLA show, an object-oriented database company called Servio Logic showed a Smalltalk application coupled to its GemStone server. What looked to Smalltalk like just an ordinary SortedCollection was, at the other end of a network cable, an industrial-strength database. Now *there's* an architecture for the 1990s.

Jumping Through HOOPS

Now that desktop hardware can do reasonable three-dimensional graphics, there's a large and growing demand for software that can work with 3-D models. The ability to display and manipulate representations of landscapes, machinery, furniture, buildings, and anatomy is revolutionizing a number of engineering and medical disciplines.

One approach to creating portable software for these markets is to build on top of a commercial 3-D CAD package. Most of the leading ones come with tools that you can use to build customized applications. Several, including AutoCAD, MicroStation, and VersaCAD, run on multiple platforms.

Or you could use HOOPS (Hierarchical Object-Oriented Picture System) from Ithaca Software. It's a general-purpose 3-D graphics library, with both C and FORTRAN bindings. It runs on all the high-end Unix workstations, as well as the Macintosh and (with the help of a DOS extender) 386 PCs (a PM version should be available by the time this article sees print). Several leading PC CAD vendors have incorporated HOOPS into the 386 versions of their products to take advantage of its fast rendering capabilities. So it's clear that HOOPS doesn't trade performance for portability.

I've worked with the 386 and Macintosh versions of HOOPS. Central to its architecture is a database of 3-D geometry—points, lines, and polygons—organized as a hierarchy of named segments.

A typical HOOPS program creates a bunch of segments and inserts geometry into them. Then it sets attributes to control things like the size and location of the display window, the orientation of the model, and the method of rendering (wire-frame or solid). HOOPS automatically makes the screen represent the current state of the database, so there's no redraw function to call.

The hierarchical database means that HOOPS programs can be much more flexible than most CAD programs are. The layers that CAD programs typically use to organize models are nothing more than electronic transparencies. While that approach yields the outputs that architectural and engineering professionals require, a hierarchical scheme can better represent complex structure and interrelationships. For example, because a subordinate segment in a HOOPS database inherits the orientation of its parent, a model is implicitly animatible.

This method of organization is the basis of HOOPS's claim to be object-oriented. The program is mainly declarative: It classifies and describes physical structures and lets HOOPS worry about how to display and render them. It must also contain user-interaction code so you can tell the database things like "Turn the model 30 degrees to the left."

HOOPS and You

HOOPS handles the user interface in a fairly heavy-handed way. It wraps its own event loop around the screen, keyboard, and mouse. When you perform a mouse-click, HOOPS provides the name of the segment you pointed to. You can implement a menu by creating segments with names such as `?picture/menu/file`, displaying appropriate text in them (e.g., "File Options"), and setting up the program to react to hits in those segments.

Ithaca Software realizes that it underestimated the GUI juggernaut when it designed HOOPS this way. Although most commercial graphics and CAD programs create their own user interfaces, people really do want standards. There's no shortage of standards to choose from, but it's reasonable to expect a PM, Mac, or X Window program to obey the local conventions.

So, although it's easier to let HOOPS run the show, you can arrange for it to share screen space and event processing with the host's GUI. Fair warning: This is easier said than done. Nevertheless, HOOPS is a remarkable toolkit. If you want to incorporate 3-D geometry into portable applications, you will want to investigate it.

Design Away with Design/OA

MetaDesign, from Meta Software, is an innovative graphical editor that is available on the Macintosh and under Windows and X Window. The editor helps you to build intelligent diagrams made of nodes and connectors. Nodes automatically maintain their connections when they are moved, making hierarchical networks of nodes easy to create and navigate. In fact, a node hierarchy with attached chunks of text acts like a hypertext document.

Although it's easier to let HOOPS run the show, you can arrange for it to share screen space and event processing with the host's GUI.

These features are often found in computer-aided software engineering tools, and MetaDesign is in fact marketed as a cross between a graphical outline processor and an entry-level CASE tool. But that's really just the tip of the iceberg.

MetaDesign grew out of long-term research into systems analysis. The company's founders, experimenting with a formal technique for analyzing concurrent systems, built the graphical toolkit that they needed to create representations and executable models of such systems. That toolkit has two manifestations: MetaDesign, a basic graphical editor, and Design/OA, the open-architecture version for building specialized applications on top of the basic editor.

Meta Software has used Design/OA for vertical-market applications that analyze transaction processing in, for example, the banking industry. Other applications include a graphical interface to a relational database, and a hypertext word processor for programmers.

The R Factor

Design/OA thoroughly insulates you from the underlying operating system and its GUI. Working with the toolkit is a lot like working with a programmable text editor. You're given a fully functional program and access to its primitives, which you can deploy to specialize the program.

The Design/OA kernel handles the main event loop and manages the display of the current diagram. An application can intercept and react to menu choices and other events (such as the double-click) and then pass them along to the kernel (or not). With calls to `DSmenudelete` and `DSmenuadd`, the kernel can customize the default menu system, so an application need not look just like MetaDesign.

Two particularly interesting events that an application might want to capture are the node-creation and node-connection operations. The demonstration program that comes with Design/OA captures them to implement an editor that handles a kind of formal diagram called a predicate/transition net.

The modified editor enforces a graphical syntax: It associates types with nodes, requires you to label nodes and connectors, and implements rules like "a transition node can't be connected to another transition node." Dialogues triggered by the creation of a node gather and store information about the node. Syntax-checking routines monitor all requests to connect the node.

With Design/OA, it's pretty straightforward to add interesting and useful extensions to MetaDesign, and easy to move the results from one platform to another. As with any full-blown programming environment, there's a lot to be learned, and the Design/OA documentation (which essentially consists of a couple of sample programs and an alphabetical list of functions) isn't as much help as it should be. But if an application requires intelligent diagraming and has to be portable, Meta Software is a place to look for one.

continued

Mixed-Network Data Management

With all the fanfare surrounding the new generation of server-based database software, it's easy to sneer at the old-fashioned, workstation-based programs. However, for many applications, it's not necessary to locate processing and data in the same box.

Multiuser databases that rely on simple file- and byte-range locking to synchronize access to shared data can be quite effective. It is true that a server-based application transmits fewer packets, but how many databases used in typical office situations sustain a transaction intensity that is likely to choke a network?

The reality is that multiuser dBASE and dBASE compatibles like FoxBase, though hardly leading-edge, are nonetheless effective toolkits for building applications that manage shared data. When the toolkit spans the PC-to-Macintosh gulf (as FoxBase does), and when you have both PCs and Macs hanging off your network (something that Novell, 3Com, and TOPS all support), things can become pretty interesting.

My XVT project yielded a simple multiuser database that ran almost identically on PCs and Macintoshes. The problem was that it was too simple: It had no indexing, keyed-searching, or data-definition capabilities. One solution would have been a portable database library. But the ones I investigated didn't support locking on mixed PC and Macintosh networks. So I looked into FoxBase, which does.

Environmentally Fit

If you've never seen FoxBase on the Macintosh, you'll be amazed at what the Mac interface does for the stodgy "dot prompt" that the PC FoxBase inherits from dBASE. With multiple browse windows, you can view linked databases side by side. Horizontal and vertical scroll bars make browsing easy. To freeze columns (i.e., make them immune to horizontal scrolling), you just drag a divider from the left margin. The view window displays icons for open databases, and arrows for the relational links between databases. You can even set up links by clicking and dragging.

A typical FoxBase application opens databases and index files and then deploys a couple of tools—the browser and the record editor—under program control. In a multiuser situation, an application should do an RLOCK (record lock) on your behalf if you ask to edit a record, notify you of the success or failure of the lock request, and take the appropriate action in either case.

Fox claims that the code required to do these things ports transparently from the PC to the Macintosh. That's basically true, but I did end up making some adjustments to the application I wrote. The APPEND command on the Macintosh didn't quite work as advertised (although there's an acceptable workaround), and PC-style pop-up menus don't retain their look and feel on the Mac (although you can use the Mac's menu bar instead). Fox's newest PC product, FoxPro, emulates (in character mode) FoxBase/Mac's interface. So the forthcoming multiuser FoxPro should work even more smoothly with FoxBase/Mac.

I'd have preferred the simplicity of identical source code, but the changes were minimal and the end result—PC and Mac users sharing a common database—was well worth the trouble. Imagine the convenience. Whether you're using a Mac or a PC, you have access to the exact same data from both machines. No copies, no keeping multiple versions updated.

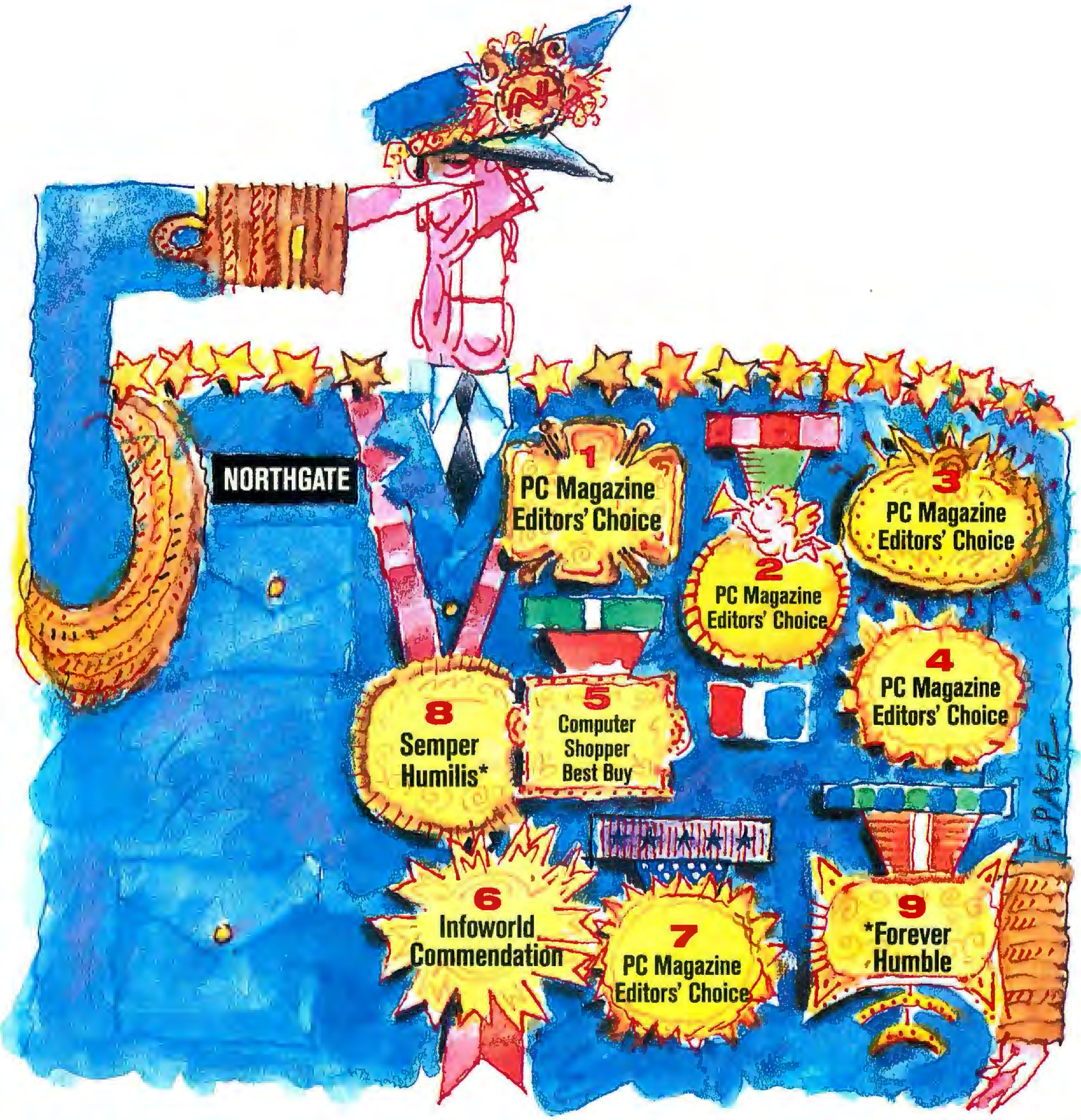
I'm no fan of the dBASE language. And I'll agree that the workstation-based architecture that DOS and Macintosh LANs support will, ultimately, give way to a server-based architecture. But there's much that you can do with these basic technologies. And with FoxBase, you can do it portably.

In Praise of Diversity

Walk into a typical office, and you're likely to find an eclectic mix of computers. The fact is, different machines excel at different things. I use a PC and a Mac and wouldn't want to give up either one. I prefer most Mac applications to their PC counterparts, but for writing and programming I'll take the PC with its fast character mode. When X Window–based applications become common, I'm sure they will have their advantages and disadvantages, too.

Using portable toolkits, developers don't have to target one market at the expense of all others, and users can run similar or identical applications on dissimilar machines. This is important now, and will become more important as networks that encompass diverse machines continue to flourish. It enables you to maintain your choice of hardware while staying fully functional within your work environment. Freedom of choice survives. ■

Jon Udell is a BYTE senior technical editor at large. He can be reached on BIX as "judell."



The Highly Decorated General Northgate

A bit pushy? Not at all. General George Patton would, on occasion, walk around with all of his medals in place. So would Generals Douglas MacArthur and Dwight D. Eisenhower when the spirit grabbed them.

And Samuel F.B. Morse, father of an earlier form of communications, before the world became computerized. (If you think we're making this up, check out Morse's be-medaled photo on the back page of this special Northgate insert.) In the meantime, we could go on and on with the reasons to buy a Northgate system, but we thought the awards said it better than we could.

1. PC Magazine "Editors' Choice" award: 80286 SuperMicro. (PC Magazine, January, 1989)
2. PC Magazine "Editors' Choice" award: 80386™ Elegance 20 MHz. (PC Magazine, May, 1989)
3. PC Magazine "Editors' Choice" award: 80386 Elegance 25 MHz. (PC Magazine, May, 1989)
4. PC Magazine "Editors' Choice" award: 80386 Elegance 33 MHz. (PC Magazine, October, 1989) 5. Computer Shopper "Best Buy" awards, three years in a row, based on a vote of the magazine's readers. • Best Buy — complete computer system • Best Buy — overall (all products advertised in the magazine) • Best Buy — Input device: Northgate Omnikey Keyboard.
6. Infoworld. In April of 1989, they saluted Northgate's Elegance 386/25 with the headline: "The Elegance 3000 among the fastest 25-MHz systems" (Infoworld, April 10, 1989). In November, in their review of our Elegance 386/33, they said the following: "Northgate's Elegance 386-33/2000 computer is a top product in most of our scoring categories including value, where it earns just the second excellent mark we've awarded to 33 MHz systems." Overall rating 9.1, their highest ever.
7. PC Magazine "Editors' Choice" award: Northgate's Omnikey Keyboard. 8. "The Northgate Humility award" given to the most modest computer company in Plymouth Minnesota. So there you have it. And the year is still young. Northgate: "Semper Humilis." (Forever Humble).

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Elegance*

PHOTO: HARRY LANGDON

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b. Tasteful opulence in form, decoration or presentation.

2. Something that is elegant." (American Heritage Dictionary)

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Technobabble*

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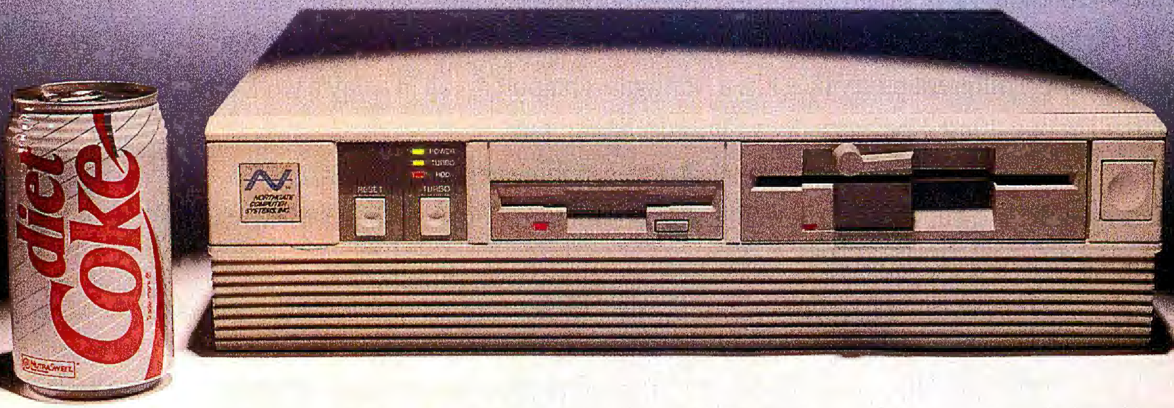

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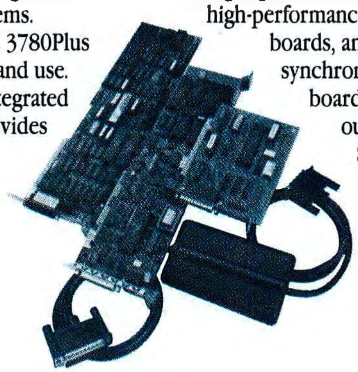

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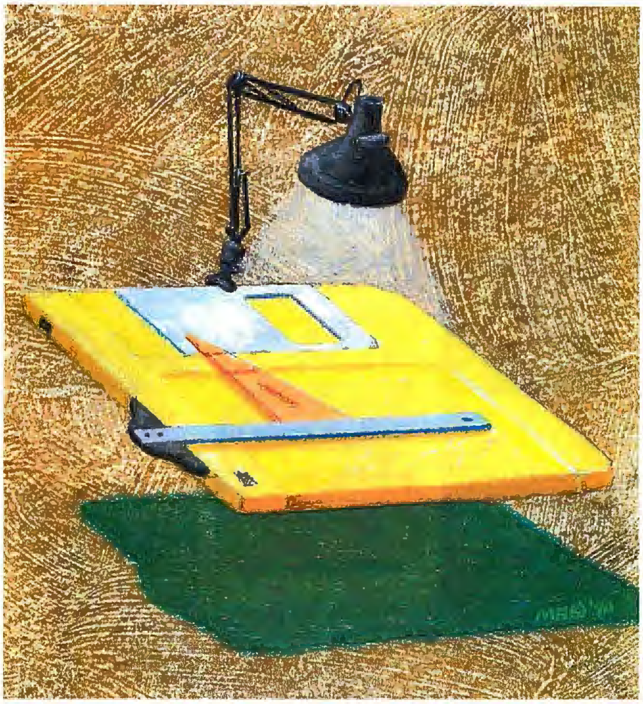
Blueprints for the 1990s

IBM's SAA and DEC's NAS both provide interoperability and greater portability across divergent platforms

Sheila Osmundsen



Total applications architectures that create a single environment across multiple platforms don't apply to microcomputers—or do they? They do if the choice of such an architecture affects whether or not you can keep your favorite microcomputer. They do if that choice affects what operating systems you can use. And they do if you're trying to create a more productive environment where changing jobs doesn't involve retraining computer skills.

Currently, two total applications architectures are available, one each from IBM and Digital Equipment Corp. A third one is also in the works (see the text box "An Open Approach" on page 246). IBM, with its Systems Application Architecture, and DEC, with its Network Applications Support, are the major players in this arena. The similarities and differences between SAA and NAS are endlessly debated and will continue to be, for they are IBM's and DEC's software blueprints for the 1990s.

Systems Application Architecture

When SAA was introduced in 1987, IBM was suffering from increasing demands among its customers for compatibility across its divergent platforms. DEC underlined that pressure with its now famous "one operating system" message. DEC could claim a common programming environment across an entire hardware line: the VAX. IBM could not. In addition, the VAX's range of performance was rapidly encroaching on the range that IBM covered with its microcomputer, minicomputer, and mainframe platforms.

SAA is an attempt to provide common ground for a selection of IBM's platforms with the structure shown in figure 1. The platforms are OS/2 Extended Edition (for microcomputers), OS/400 (for minicomputers), and, within its S/370 (mainframe) hardware architecture, the VM/SP and MVS operating systems (subsystems TSO/E, CMS, CICS, and IMS). CICS and IMS, as transaction-processing monitors, are participating systems; only the relevant elements are supported for these.

SAA is divided into three parts: Common Communications Support (CCS), Common User Access (CUA), and Common Programming Interface (CPI).

CCS identifies the following communications options to be implemented across SAA's platforms: Data streams—3270, Document Content Architecture (now MO:DCA [mixed-object DCA]), Intelligent Printer Data Stream; Applications services—System Network Architecture's distributed service, Document Interchange Architecture office system, SNA Network Management

continued

Architecture; Session services—LU 6.2; Network control—Low-Entry Networking (Type 2.1 nodes); and Data-link controls—Synchronous data-link control, Token Ring network.

The inclusion of IBM's LU 6.2/APPC (advanced program-to-program communications) interface provides SAA's solution for program-to-program connections between IBM computers. This is the major reason IBM people and others sometimes characterize SAA as an extension of SNA.

CUA identifies the elements of the user interface that must be supported across the various platforms, including keyboard, mouse, stream layouts and palettes, applications flow, and user interaction with applications.

CPI provides a common programming environment for all SAA operating systems. This includes specifying and using an identical set of language implementations. The chosen ones are C, COBOL, and FORTRAN (being implemented in that order), and RPG and PL/I (added to SAA in 1989). In addition, CPI specifies the use of the IBM Cross System Product applications generator and the REXX command-procedures language.

CPI also provides common application programming interfaces (APIs) that specify how to access key services (i.e., programming support), shown in the center of the standard SAA diagram in figure 1. This support includes Presentation Manager (PM), which is the OS/2 Extended Edition implementation toolkit for the Presentation Interface API, and the relational DBMS of each system that supports the Database Interface.

The system services currently announced are as follows:

- Common Programming Interface (Communications): CPI to LU 6.2/APPC on the various platforms, initially implemented in the CMS subsystem of MVS only.
- Presentation Interface: device-independent APIs for CUA-compliant windowing, keyboard, mouse, fonts, and graphics support based on the S/370 Graphical Data Display Manager (GDDM).
- Dialog Interface: CPI for setting up menus, help functions, data requests, and message selections on user screens.

continued

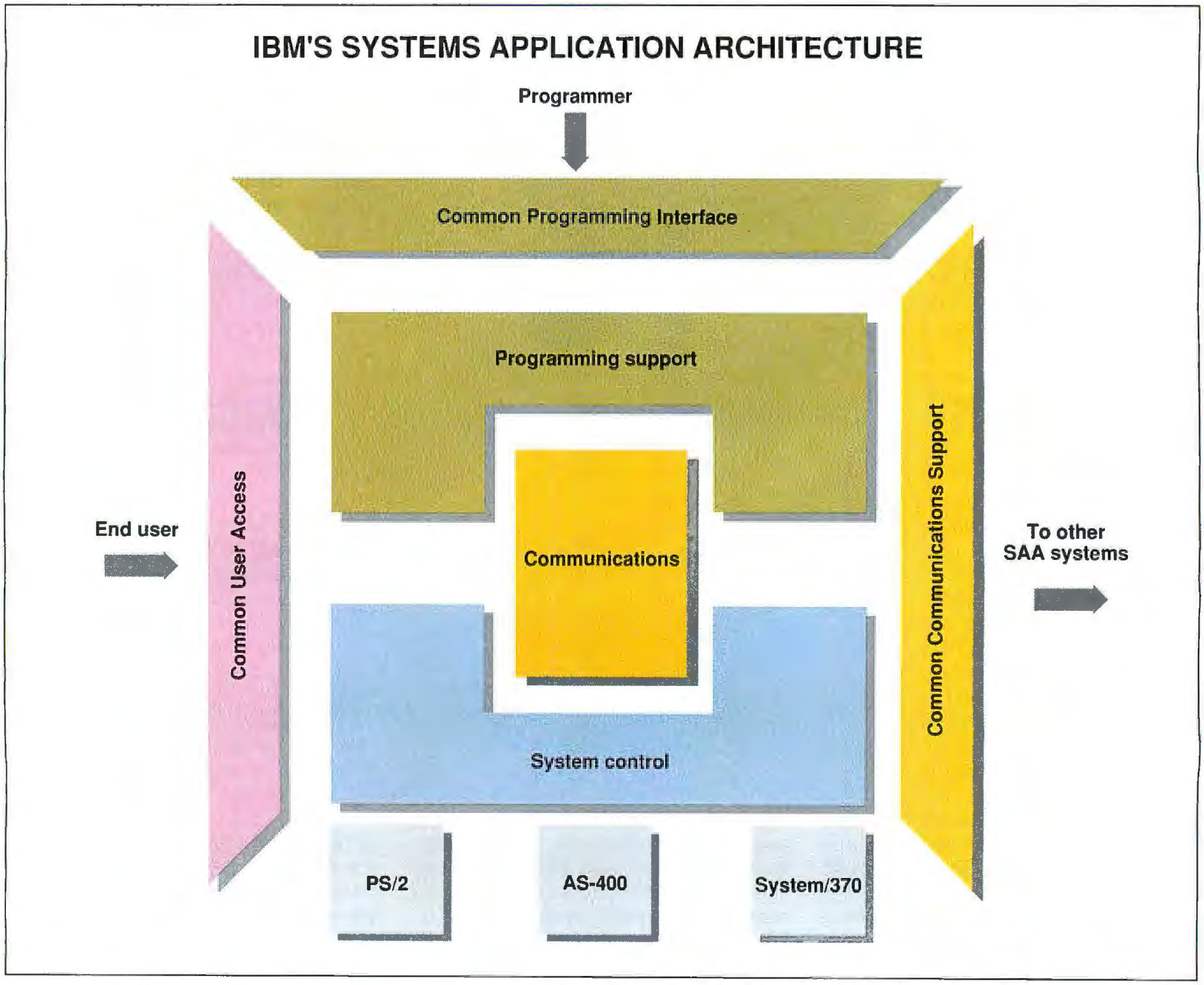
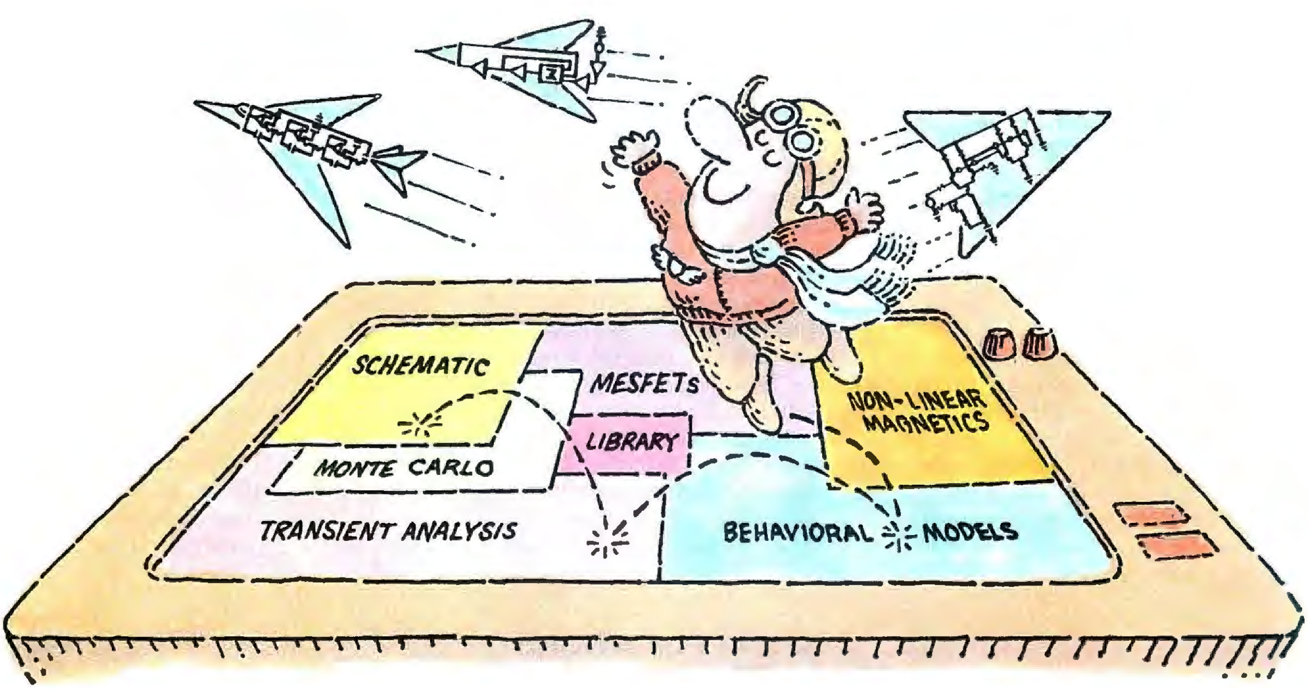


Figure 1: *SAA attempts to provide common ground for OS/2 Extended Edition, OS/400, and certain operating systems within IBM's S/370 line. This diagram shows the standard colors for the different layers. These layers are often referred to by their colors: the yellow layer, the blue layer, and so on.*



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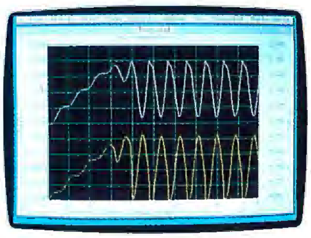
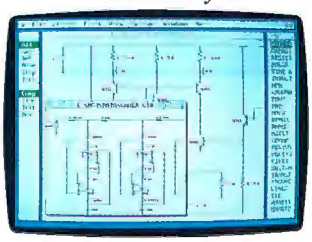
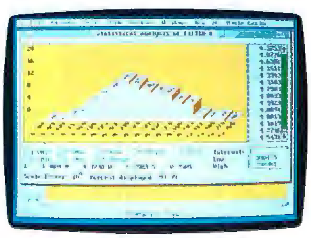


Transient analysis



Schematic editor



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spectrum

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- Database Interface: implemented in Structured Query Language (SQL).
- Query Interface: query and report-writing facilities.
- Repository Interface.
- Distributed Data Management (DDM).

As platform-specific implementations of SAA generally support additional functions, you must use the CPIs with CCS and CUA specifications to ensure applications portability. For example, IBM is redesigning many applications to conform with SAA and may still support some of their original functions as well. If you use nonconforming functions, your application might not be portable to other SAA platforms.

On the other hand, IBM ensures that source code written to the "ordered subset" of functions that SAA supports in the CPIs will endure, whatever enhancements may be made in the future.

IBM has not yet implemented all the elements of SAA: Internal guidelines state that SAA support on one platform must be followed with support on all the other platforms within two years. But SAA is not static. Repository Interface was announced in September 1989, and IBM is planning its first implementation on the MVS operating system for June.

Network Applications Support

While IBM is providing applications integration for its own systems, DEC is going ahead with integrating Unix and providing interoperability with popular desktop platforms—VMS, its proprietary operating system, and Ultrix workstations, DOS PCs, OS/2 PCs, and Macintoshes. SAA does not address this mission at all.

As IBM's development of its Unix environment (AIX) has been on a separate track for the first three years of SAA's existence, DEC's Unix support may be an advantage that will stand for some time. But then, strong in technical computing where Unix has its bedrock, DEC

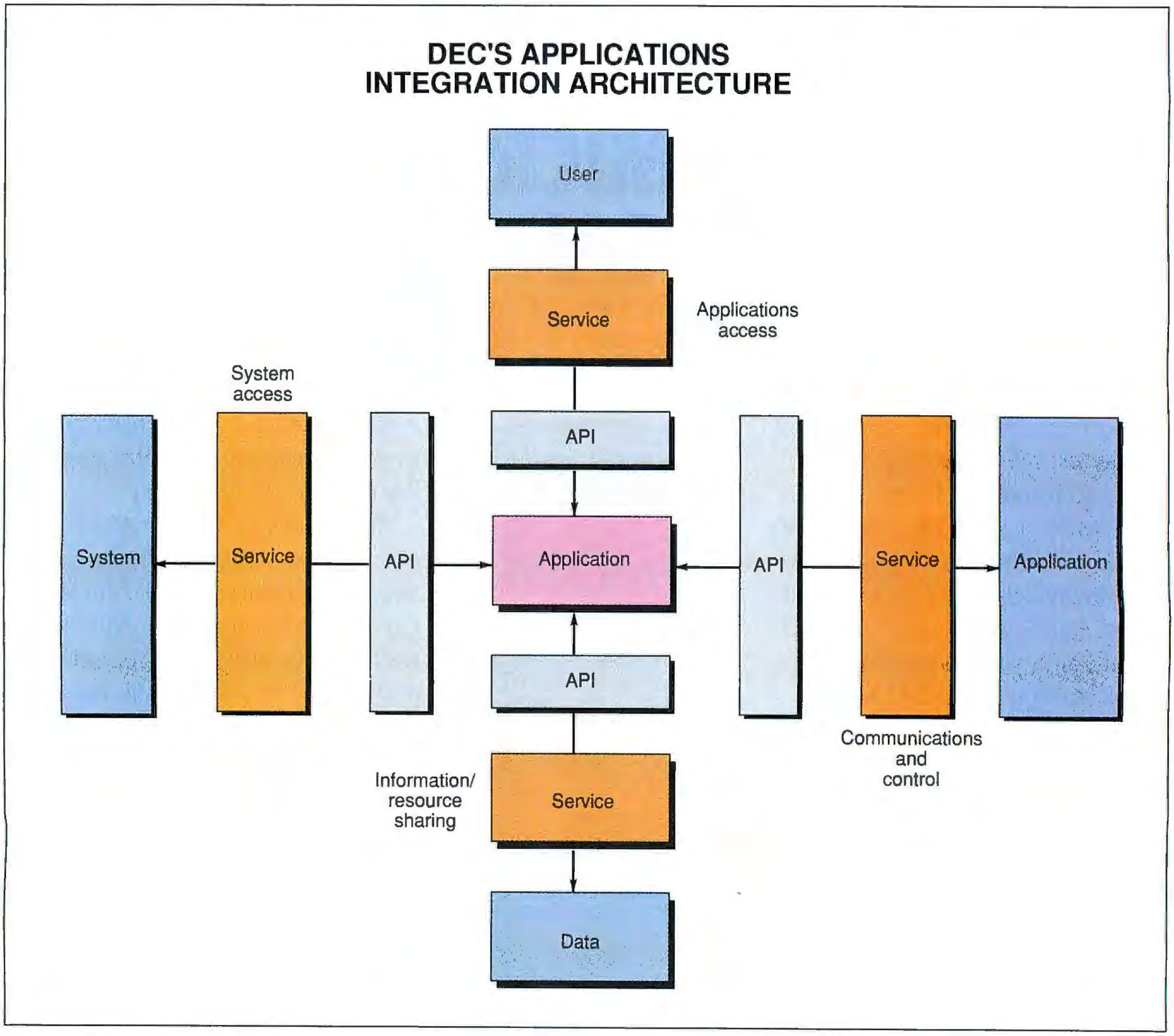

Figure 2: *AIA provides the architectural categories for NAS. NAS attempts to integrate Unix and provide interoperability with VMS and Ultrix workstations, DOS PCs, OS/2 PCs, and Macintoshes. The colors used group like elements together but do not have the significance of the colors in figure 1.*

has had more reason to focus on Unix.

The NAS scheme provides applications on the five platforms mentioned with access to common services that run under VMS and Ultrix. Those services may exist on larger machines or on the VMS or Ultrix workstations. (VMS and Ultrix workstations can perform as servers as well as clients. The other three desktop computers are clients only, although a server role may be in the future for OS/2.)

In addition, DEC claims greater openness for NAS because it is based on de facto and de jure industry standards. SAA's ingredients may or may not adhere to standards: It's not in the charter. However, many of them do, and whatever IBM does is often so widely implemented that it becomes a de facto standard, anyway. Both companies are trying to drive relevant standards in their respective strategies, especially in integrating new technologies for which standards are just emerging.

DEC uses the label Applications Integration Architecture (AIA) to describe NAS architecturally, according to the structure shown in figure 2. However, NAS is the overall term used. The NAS implementations deliver that architecture and map directly to it. The table on page 242 contains the generic designation that AIA supplies for the various pieces of the environment followed by the current names of NAS implementations. Due to NAS's basis in standards, the pieces often match up with various standardization efforts.

Like SAA, NAS reflects much intention as well as reality. For example, DEC's electronic document interchange (EDI) services, although they have been outlined, will not show up until late this year. The slot for Repository services is filled by DEC's Common Data Dictionary/Plus for VMS. Last spring, DEC announced that it will support an API for CDD/Plus based on a draft standard jointly developed with Atherton Technology. The proposed standard is now before standards-review committees.

The API, an Ultrix version of CDD/Plus, and client support for DOS and OS/2 are forthcoming, probably beginning later this year. LiveLinks and Builder in the NAS list are data-link technologies currently offered by DEC in compound-document-architecture (CDA) based applications; DEC plans to make them generic services for NAS.

The System access category also requires explanation. POSIX provides an interface to System services in contrast to the high-level services in the other categories. DEC now supports it in Ultrix, with VMS support to come. This will provide a common portable development environment. The use of POSIX is a possible route to further integration of OS/2 into the NAS scheme, since Microsoft has stated that OS/2 will support POSIX.

Finally, with the sole exception of POSIX, NAS's base in standards does not mean that standard functionality is synonymous with the NAS service functionality. Standardized function is a variably important component of full-function NAS services, depending on how far a standard has progressed. For example, DECwindows was developed on an X Window System (referred to as X Window for the remainder of this article) base and incorporates a look and feel that is slated to migrate to conformance with the Open Software Foundation's Motif, both fully fleshed-out standards.

On the other hand, DEC's CDA implementation incorporates existing open document architecture/open document interchange format standards, as does IBM's MO:DCA, in fact. But those standards are minimal so far. DEC hopes its work in the relevant standards processes will lead to incorporating its technology for tabular data handling and live links, for example, into the standard.

Adherence to industry standards creates an additional dimension to portability and interoperability under NAS that can be significant. The X Window underpinnings of DECwindows, for example, allow a DECwindows user to run a program that supports X Window even if it was written for another system with a different user interface. In addition, the X Window base is portable.

Similarities

SAA and NAS share some generic characteristics. Both provide CPIs that address heterogeneous collections of computing resources. These CPIs allow applications to access the various services that different operating systems deliver. They provide interoperability and greater portability across dissimilar platforms.

In addition, both SAA and NAS are emerging concurrently with new technologies—graphical interfaces, repositories, compound document architectures, and distributed databases. The architectures are important elements in their companies' respective development efforts around new technologies as well as in rewriting programs to bring existing products into line.

Each is a Chinese puzzle of components in various states of conformance. Neither SAA nor NAS is static. New elements are continually being added. The results are often strikingly similar, especially when you consider how far apart IBM's and DEC's recipes for computing were just five years ago.

Differences

Nevertheless, tracking SAA and NAS requires understanding the differences between them. These differences show up in purpose, in structure, and in delivery, partly owing to the unwritten maxim that competing vendors don't completely match capabilities. You don't catch up, you leapfrog and differentiate.

You can summarize the major differences in the following ways.

IBM's SAA provides

- a common applications environment for those IBM operating systems chosen for SAA support; and
- an extension of IBM's SNA to provide a new degree of peer-to-peer communications among those systems.

DEC's NAS uses the company's peer-to-peer networking strength (DECnet/OSI and the Unix-oriented TCP/IP protocols) to provide

- common services to applications running on a variety of desktop platforms, including its own VMS and Ultrix (Unix) workstations, DOS PCs, OS/2 PCs, and Macintoshes;
- a common applications development environment between DEC's VMS operating system and its Ultrix platform; and
- an environment that is based on industry standards.

When comparing the breakdowns of NAS and SAA structures, a difference and possible source of confusion is that DEC names the implementation in which an API is contained. The implementation and the API are separate in IBM's definition of SAA. Like SAA, however, NAS also makes strict distinctions; the API in each instance is inviolate.

For example, in SAA, CUA specifies the graphical user interface, and Presentation Interface is the API for interfacing to PM, IBM's version of CUA for OS/2 Extended Edition. DECwindows, by contrast, is a complete toolkit for graphical interface, akin to PM and incorporating the necessary APIs.

Further, DEC has used various means to implement NAS goals. For example, MS-DOS Display Facility (in table 1) is a

continued

NAS FUNCTIONALITY LIST

The Applications Integration Architecture describes Network Applications Support architecturally. The NAS implementations deliver that architecture. Notice that the pieces of the environment are the same as the services shown in figure 2.

Pieces of environment	Generic AIA designations	Current NAS implementations
Applications access	Windowing services	DECwindows (for VMS, Ultrix) MS-DOS Display Facility
	Forms services	DECforms
	Terminal services	Terminal emulators (all platforms)
	Graphics services	DEC GKS DEC PHIGS
	Application control services	LiveLink Builder
Communications and control	Messaging services EDI services	Mailbus VAX/EDI
Information/resource sharing	Compound document services	CDA Toolkit CDA Viewers CDA Converter Library DECimage Applications Services
	Data access services	SQL Services
	Repository/dictionary services	CDD/Plus
	File-sharing services	VMS Services for PCs NFS for Ultrix VMS/Ultrix Connection
	Print services	DECprint
System access	System services	POSIX interface

separate implementation that allows the DOS desktop to use a DECwindows application, even though its lack of multitasking prevents it from running as a true DECwindows workstation.

When comparing the lists of functions as definitions of an applications environment, some other differences pop up. SAA's specification of many protocols for communications has no parallel in the NAS list. DEC has provided all NAS platforms with support for DECnet and TCP/IP protocols, and applications built on top of NAS services are network-independent. Also, communications functions in the NAS list are built on the underlying network mechanisms.

Apples, Oranges, and Sequels

At this stage in their development, even when equivalent NAS and SAA functions have been implemented, a 1-to-1 comparison is elusive and difficult to generalize from. A close look at one case offered in both frameworks, however—SQL database access—illustrates some of the differences between them. It also shows how similar SAA and NAS can be when they both conform to the same standard.

Two comparisons are relevant for clarity. The first addresses DEC's evolving integration of VMS and Ultrix under the NAS umbrella, comparing the current VAX SQL interface for VMS's relational database to SAA's SQL CPI.

The VAX SQL interface is slated to present a common API to the relational DBMS for Ultrix, which DEC is expected to release this year, based on technology licensed from Ingres. As such, VAX SQL is the strict apples-to-apples comparison to SAA's SQL CPI. Listings 1 and 2 show the almost identical steps required to retrieve payroll information in a C application using the VAX SQL and SAA SQL interfaces.

Notably, IBM has been talking about extending the SAA SQL CPI umbrella to embrace its relational DBMS for AIX, for which it initially licensed technology from Oracle. Although this extension would entail communications issues,

continued

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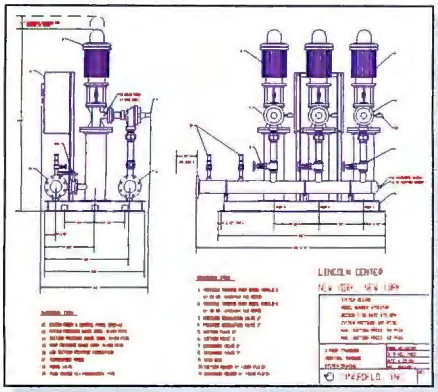

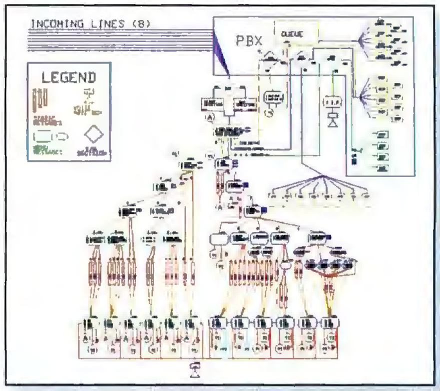

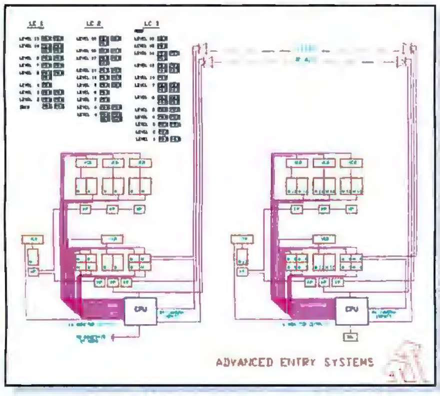

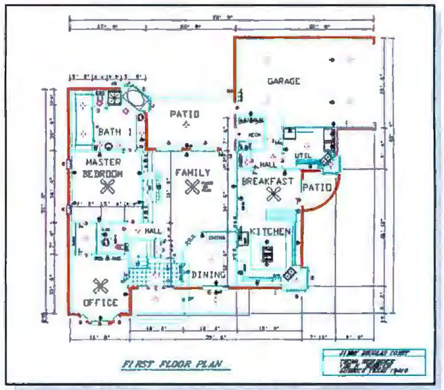

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Listing 1: *This C code shows the programming required for NAS's SQL Services to access data in DEC's Rdb relational database. Compare this to listing 2. Both programs are in dynamic SQL but use quoted strings to replace user input.*

1. To set up program for SQL communications

```
#include <sqlsrvda.h>
#include <sqlsrvca.h>
#include <sqlsrv.h>
```

2. To declare SQL variables

```
char *assoc_id, *stmt_id;
struct SQLDA *sel_list;
char name[20],ssn[10];
int hours_worked
```

3. To prepare `select` statement

```
sqlsrv_prepare(assoc id,0,
              "SELECT * FROM PAYROLL WHERE PAY = 0",
               stmt_id,0,&sel_list);
```

4. To open cursor

```
sqlsrv_open_cursor(assoc_id,"C1",stmt_id,0);
```

5. To fetch

```
sel_list->SQLVARARY[0].SQLDATA = &name;
sel_list->SQLVARARY[1].SQLDATA = &ssn;
sel_list->SQLVARARY[2].SQLDATA = &hours_worked;
sqlsrv_fetch(assoc_id,"C1",0,0,sel_list);
```

Listing 2: *This C code uses SAA's CPI to access a relational database. It differs from the VAX SQL in the* `stmt.len` *statement, which reformats the input string from C to COBOL format in the IBM case.*

1. To set up program for SQL communications

```
EXEC SQL INCLUDE SQLCA;
```

2. To declare SQL variables

```
EXEC SQL BEGIN DECLARE SECTION;
char name[20],ssn[10];
int hours_worked;
struct {short len;
        char stg[36];
       }stmt;
EXEC SQL END DECLARE SECTION;
```

3. To prepare `select` statement

```
stmt.len = 35;
strncpy(stmt.stg,"SELECT FROM PAYROLL WHERE PAY = 0",35);
EXEC SQL PREPARE SELECT1 FROM :stmt;
```

4. To open cursor

```
EXEC SQL DECLARE C1 CURSOR FOR SELECT1;
EXEC SQL OPEN C1;
```

5. To fetch

```
EXEC SQL FETCH C1 INTO :name, :ssn, :hours_worked;
```

necessitating an interface for LU 6.2 and TCP/IP, it may be one of the first steps IBM takes to merge the separate path of AIX development with SAA.

NAS provides database access from the desktop platforms via SQL Services as client/server software. The emphasis is on relieving the client of as much processing as possible due to the memory and processing limitations of DOS.

As the primary results, NAS's SQL Services omits the use of precompilers and supports only dynamic SQL (rather than dynamic and static SQL, as in both VAX SQL and SAA). Dynamic SQL software analyzes statements at run time, the function that permits ad hoc queries. The server can perform this analysis in the NAS scheme, so you don't have to run a precompiler locally.

Programming for OS/2 Extended Edition queries under SAA is somewhat simpler than programming for DOS using NAS's SQL Services. Still, SAA does not support DOS. In addition, code written to the NAS API for DOS is portable to other supported NAS platforms. So far, DEC supports SQL Services for VMS, Ultrix, and DOS clients.

However, the DOS deficiencies arbitrate unnecessary restrictions on the other two platforms. When DEC provides a common SQL for Ultrix and VMS relational DBMSes, it will probably introduce an unrestricted optional version of SQL Services for those systems as clients. They will remain clients, however. The other ingredient of SQL Services is establishing a session between the desktop and the remote host that has the database.

In SAA, the remote connection is established transparently. IBM plans to incorporate LU 6.2 communications capabilities into its relational DBMSes on all SAA platforms; that is, into Database Manager on OS/2 Extended Edition, into the integral relational DBMS of OS/400, into SQL/DS for VM, and into DB2 for MVS. A catalog and optimizer in each system determine where remote data is located.

In this transparent distributed database-access scheme, a query goes to the local database, which determines the location of the remote database being accessed. At the present time, transparent access is supported only between like systems. From an OS/2 Extended Edition system, the program in listing 2 could retrieve data from a database on another OS/2 Extended Edition system, but not from DB2.

DEC plans to provide a SQL Services API for OS/2 this year. In addition, DEC and Apple are jointly developing Mac support for NAS. Last May, Apple announced that a SQL Services product supplying a VMS server and an API for the Macintosh will be forthcoming.

Both IBM and DEC support the ISO/ANSI X3.135 standard for SQL, each with its own extensions. However, NAS supports some 54 functions compared to 19 in the SAA CPI.

Current Directions

This year, DEC is likely to move a remote procedure call into its lineup. Program-to-program applications have been held back in the past because DEC never provided an easy-to-use API for the sophisticated bidirectional communications services in DECnet. As IBM backs up its new LU 6.2 CPI with more support, such applications will become more attractive, and DEC is expected to jump ahead to incorporate the RPC as a service in NAS.

As the flow of DECwindows and PM implementations from third-party sources increases to more than a trickle, it will be interesting to see if IBM comes out with high-level communications support. This would allow applications on remote systems to open windows on the PS/2s, fulfilling one of IBM's aims: to off-load mainframes from having to do screen management.

It will also be interesting to see how open IBM's protocols will be. Right now, DECwindows, with the X Window base providing that capability across a network, is far more attractive. While SAA leaves you on your own for high-level support, DECwindows allows you a variety of options. In addition to building DECwindows applications, you can build compatible workstations, alternative network services, and applications with a look and feel suited to custom environments.

Keeping Score

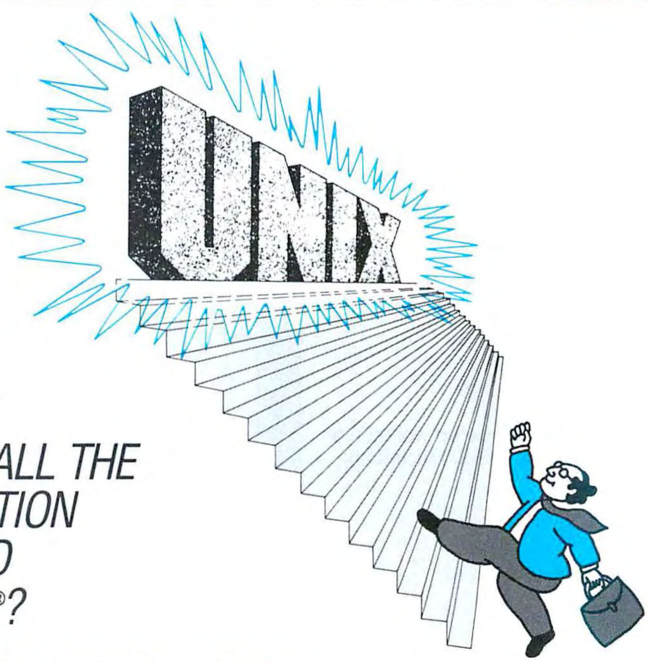
How do NAS and SAA stack up in the microcomputer arena? Clearly, at this time and for plans currently in place, DEC has the edge. NAS supports DOS; SAA does not. NAS supports the Macintosh; SAA does not. NAS supports Unix; SAA does not. The tally is not entirely one-sided, however. Both NAS and SAA support versions of OS/2, and both support forms of SQL.

In addition, both IBM and DEC claim adherence to standards, although DEC seems to be more serious about it. IBM is accustomed to being able to influence the setting of standards by brute force: If IBM does it, then it will probably become a de facto standard. DEC is also trying to influence standards in its favor: DEC is intensifying its participation in the industry processes for standards setting.

NAS and SAA show transformations in DEC's and IBM's approaches to the 1990s as the two vendors who most loudly claim the ability to mastermind enterprise-wide computing. They are only just beginning to make their marks. New players are entering the field, and IBM and DEC are still jockeying for position. Keep your scorecards handy. ■

ACKNOWLEDGMENT
Thanks to Harold Lockhart, senior consultant at Technology Concepts, Inc. (Sudbury, MA), for writing the listings.

Sheila Osmundsen is an industry analyst in Boston, Massachusetts, who specializes in tracking DEC and IBM. She can be reached on BIX c/o "editors."



An Open Approach

Herb Osher

In today's multivendor environments, it is difficult, if not impossible, to completely integrate information artifacts—a Macintosh desktop, a Unix mail message, a Lotus 1-2-3 spreadsheet—without trade-offs.

A technical writer, for example, may value the Mac's user-friendly interface, but struggle when accessing data on DOS-based PCs over a Token Ring LAN. A CAD/CAM expert may prize a high-performance Unix workstation for mathematical analysis, but hit a brick wall when trying to include data residing on an IBM mainframe. Although there are many ways to share data in mixed environments, little progress has been made in integrating applications across proprietary systems.

Major innovations in the microcomputer world of the 1990s will most likely come from the development of distributed architectures based on industry standards. In recent years, Data General has been creating such an architecture that targets open systems: Distributed Applications Architecture (DAA).

The Architecture

DAA is a set of written specifications and software products that allows you to integrate distributed applications across mixed environments. It gives you a consistent view of data, applications, and services no matter what machine or operating system you use. DAA is based on the client/server computing model. It's not limited to one hardware or software environment. Clients are portable to a range of operating systems, and servers to new hardware architectures that support Unix V release 3.

The architecture provides an integrated environment for those who write applications to a variety of standards. It also integrates popular shrink-wrapped applications. The standard environments that DAA supports include DOS, OS/2, Unix, POSIX, and the Motorola 88000 Binary Compatibility Standard.

Data General began announcing products based on DAA in 1989. In February, it launched the AViiON family of computers—servers and workstations based on the 88000 RISC chip—and a version of Unix called DG/UX. The AViiON systems comply with the

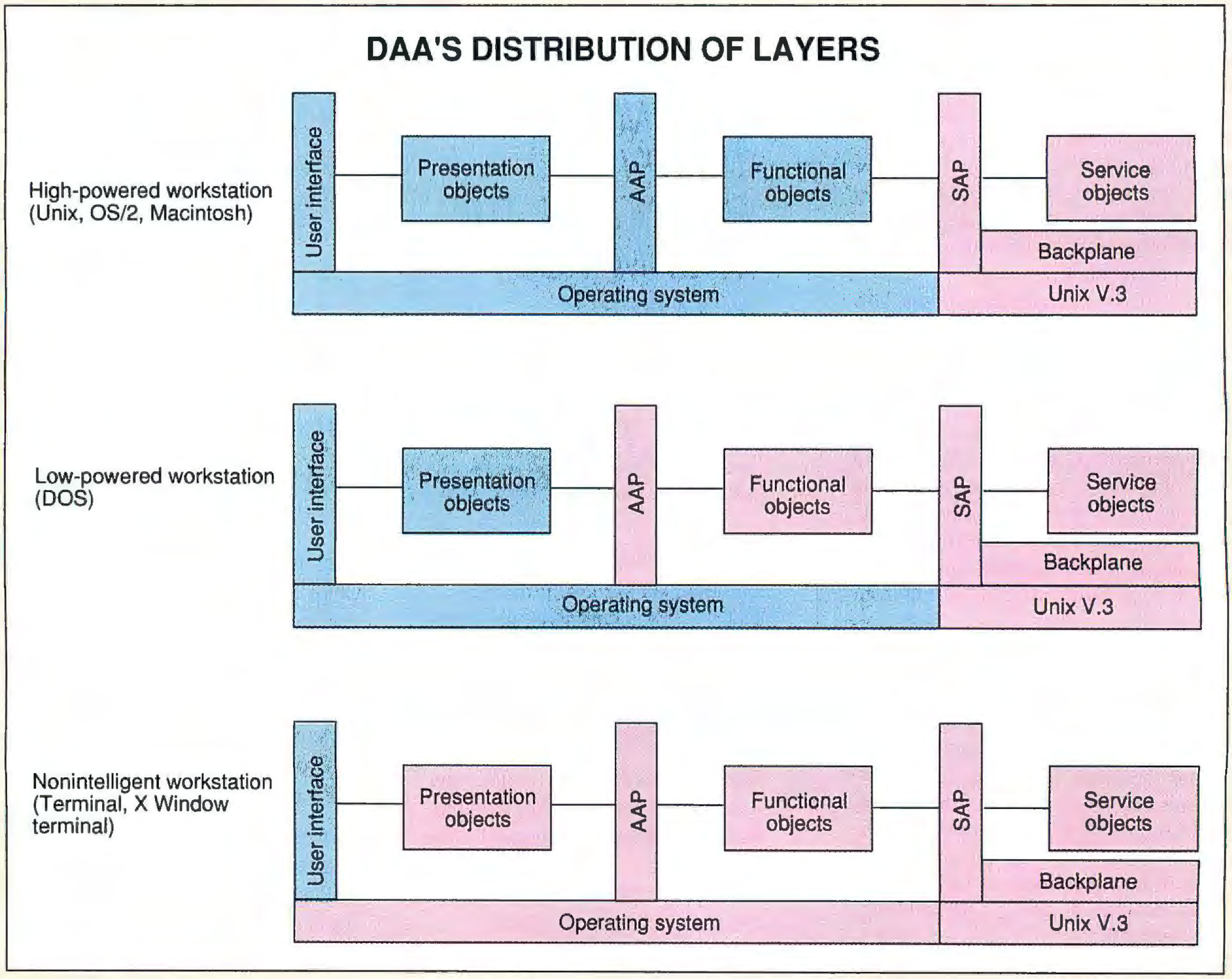


Figure A: *The applications-access point (AAP) and service-access point (SAP) are industry-standard remote procedure calls that allow you to configure DAA for different workstations. Notice how the distribution of layers depends on the sophistication of the workstation used. (The red shows the portion residing on the server; the blue shows that on the clients.)*

88open Binary Compatibility Standard, which ensures applications portability on all 88000-based products.

Built on these RISC and Unix technologies is the most critical component of the design: an open client/server platform that's based on an object-oriented model. DAA's object-oriented facilities support the object-action paradigm, which allows you to select objects and then apply actions to them.

DAA lets you choose your own workstations, network protocols, and database software. The design, from the beginning, centered around distributed object management. Object orientation has been integrated into the client, network, and database components, and object-management services are provided at the presentation, function, and data management levels.

In addition, DAA is a complete implementation of a distributed architecture. This encompasses a backplane of software services (e.g., object database, communications link, name, authentication, notification, and systems management services). Similar to a hardware backplane design, DAA's software backplane allows you to plug in services such as mail, calendar, and print, and to expand to other services when necessary. DAA also provides a set of application programming interfaces (APIs) based on remote procedure calls (RPCs) used to integrate distributed applications across networks.

The Clients

The DAA platform is organized into user communities. It connects clients across LANs and wide-area networks to geographically dispersed servers. This environment can consist of various heterogeneous computing components using a mix of operating systems such as Unix, DOS, OS/2, and the Mac OS.

Clients are *logical workstations* that can run on RISC-based Unix workstations, Macs, PS/2s, PCs, and ANSI and X Window System terminals. The DAA platform provides you with a common user environment across workstation clients using any of the following: Microsoft Windows and Hewlett-Packard's NewWave for PCs; Open Software Foundation's Motif for Unix workstations; Presentation Manager for PS/2s; and text-based menu interfaces for ANSI and X Window terminals. A Mac implementation will preserve the traditional Mac look and feel.

Based on an object-oriented paradigm, the logical workstation includes *functional objects*, such as an in-box object and related methods like read, reply, and forward. Functional objects provide functionality at the applications level and interact with *presentation objects*, which provide a view of the functional objects. In addition, clients can integrate popular shrink-wrapped software as applications-level objects to run on PCs and workstations. A *local object manager* manages these objects.

The client also has access to two powerful mechanisms that leverage functions and services scattered across multiple clients and servers (see figure A). An applications-access point (AAP) allows presentation objects to transparently invoke functional objects that may reside on a client or server. The service-access point (SAP) interface connects the functional objects on the logical workstation with service objects in the object database. The SAP defines the point where the functional objects plug into a DAA server backplane. You can build custom-integrated applications using the SAP interface.

The Servers

The DAA servers consist of communications links, service-providing shared computers, and their peripherals. The server is composed of a service backplane with service objects built on it. It can span more than one physical computer.

At the heart of the object-oriented computing platform is the object database. A component of the service backplane, this database stores all objects, including services. Objects are self-contained units that encapsulate the data and the methods that manipulate it. Object orientation enables DAA to define its objects using high-level abstractions. The database is based on an extension of the SQL model and operates with a range of SQL relational database systems, such as Informix, Oracle, Ingres, and Sybase.

The API available to clients, the SAP, makes RPCs to methods in objects in the database. The DAA platform provides a library of basic objects. It also provides a library of presentation objects that supports a common user interface based on a HyperCard-like model.

The service backplane also houses additional services. An X.500-based name service keeps track of all user names, workstations, and services. Communications links, to allow workstations and services to communicate transparently, are based on industry-standard RPCs, like NetWise. An authentication service enables client and server to authenticate themselves and guarantee secure sessions. A notification service notifies you of changes in status, like new mail. The backplane also houses systems management services for distributing software and managing networks, users, and objects.

The Networks

Users, clients, servers, and the objects associated with them are organized geographically into groups called *domains* and *communities*. Domains and communities provide a home, or address, for these entities and an organization that is the basis for system management.

A domain is a group of users, a list of clients and servers, and all the objects that these clients and servers own. The system can authenticate, register, and centrally manage all users and services within it. A community is a collection of interconnected domains. No central authority controls its members. Rather, a loose federation of domains exists.

As an open architecture based on industry standards, DAA can communicate with other environments. For example, it embraces Data General's Systems Application Architecture communications strategy, which is aimed at compliance with SAA protocols. This architecture allows a meaningful subset of SAA applications to execute in DAA client/server environments. It also provides extensive support for cooperative processing and data distribution between SAA and DAA applications.

At the transport level, the platform is based on Data General's Open LAN architecture, which allows integration over TCP/IP, Novell NetWare, LAN Manager, Token Ring, Open Systems Interconnection, and AppleTalk networks. OSI standards are used as the basis for DAA's naming and management services.

A Single-System Image

DAA presents an open approach to computing in the 1990s. The architecture significantly reduces the trade-offs commonly experienced when you integrate popular operating systems, workstations, interfaces, and applications in today's multivendor environments.

DAA provides much information-processing power, with network-based applications distributed optimally throughout the system. It creates a unified single-system image among heterogeneous computing environments.

Herb Osher is division director of the Office Systems and Distributed Computing Group at Data General Corp. (Westborough, MA). He can be reached on BIX c/o "editors."

Building Blocks

The future course of applications software depends on the interplay of diverse concepts, standards, products, and market forces. For more information on the elements discussed in this section, contact the organizations listed below.

ANSI X3.135 (SQL)
American National Standards Institute (ANSI)
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MultiFinder
QuickDraw
Apple Computer, Inc.
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(408) 996-1010
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DECwindows
Network Applications Support (NAS)
Digital Equipment Corp.
146 Main St.
Maynard, MA 01754
(508) 493-5111
Inquiry 1053.

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MetaDesign
Meta Software
150 Cambridge Park Dr.
Cambridge, MA 02140
(617) 576-6920
Inquiry 1054.

DESQview
Quarterdeck Office Systems
150 Pico Blvd.
Santa Monica, CA 90405
(213) 392-9851
Inquiry 1055.

Distributed Applications Architecture (DAA)
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4400 Computer Dr.
Westborough, MA 01580
(508) 366-8911
Inquiry 1056.

88open Binary Compatibility Standard
88open Consortium, Ltd.
8560 Southwest Salish Lane, Suite 500
Wilsonville, OR 97070
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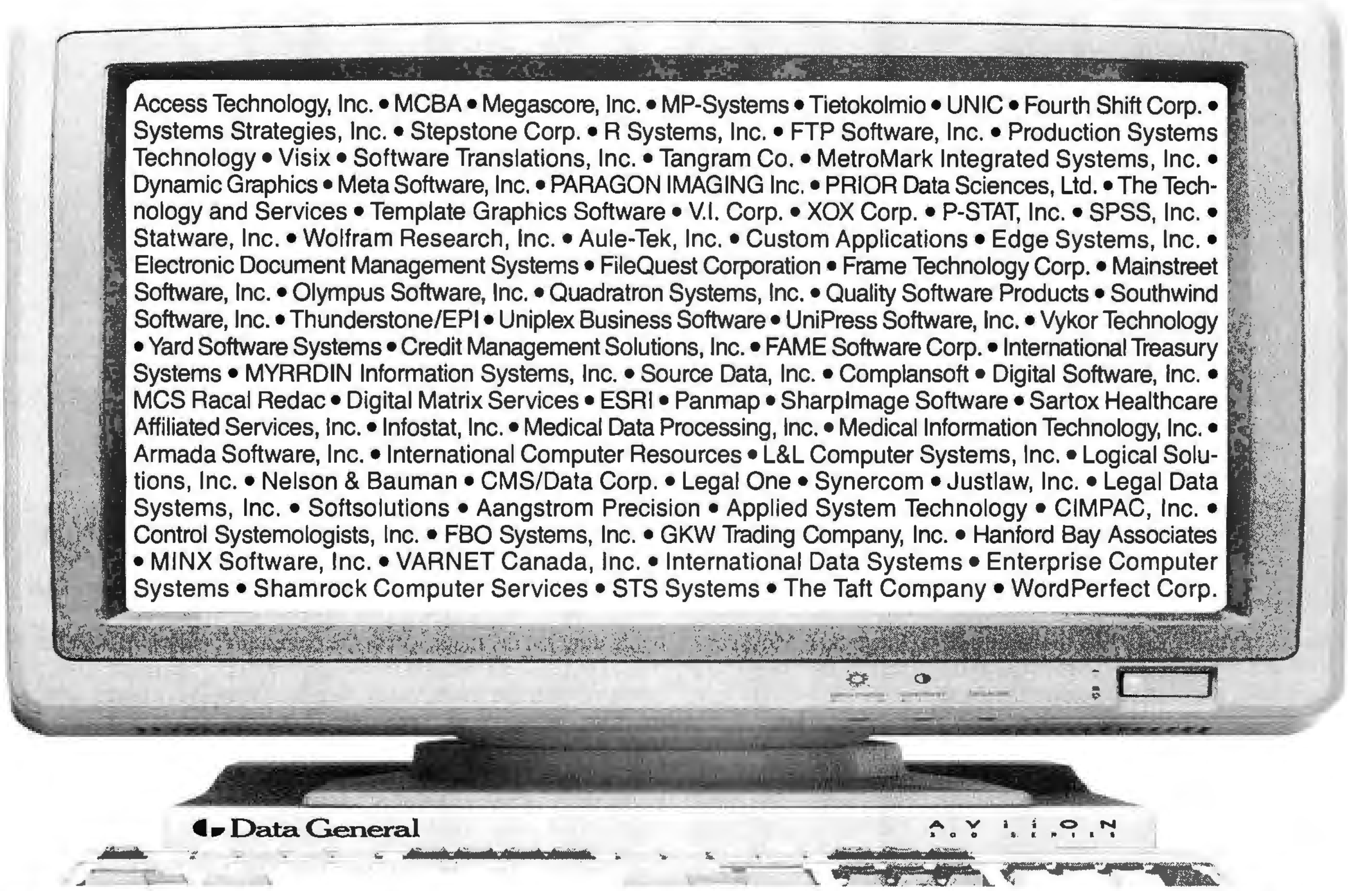

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TIME AND MONEY

In a distributed operating system called Spawn, computers buy and sell time to balance the workload

Peter Wayner

In the world of mainframe computers, time is quite often money. The system administrators often allocate the company computer's time by charging the users more for using the machine in the hours of high demand and less at times when demand is low (like in the middle of the night). Most personal computer users are hardly familiar with this concept because they never have to share their machines. This situation is changing, though, as networks connect many machines.

People with overloaded computers will soon realize that there might be an idle computer on the network that could handle some of the work and lessen the load on their own. The only problem is building an operating system for the network that makes it easy, quick, and efficient to share time.

In the Beginning...

At Xerox's Palo Alto Research Center (PARC), one team of researchers is borrowing the metaphor from the old mainframe system and putting a price on computer time. Their new network, called Spawn, is not just a collection of wires for transferring files; it is a miniature auction economy where machines trade time for a computerized version of cash.

The one big difference between these new networks and the mainframes is the structure of the "economy." The mainframes sell computer time to users at fixed prices and guess how the pricing will control demand. This new system for managing a distributed system of computers is a pure market filled with many buyers and sellers who set prices by bidding for computer time. The result seems to be an ideal way to allocate resources and also, incidentally, to study how markets work.

The basic Spawn system operates on a network of Unix computers running Sun Microsystems' protocols for Remote Procedure Calls (RPC) and accessing a Network File System (NFS). The designers chose Unix and C because they make up the core of an almost universal operating system that can handle multitasking and network computing. They also chose this combination in spite of the fact that much of Unix's power wasn't necessary and a smaller, finely tuned distributed operating system would be more efficient. But they gained ease of implementation and universality in the trade-off.

The structure of Spawn is easy to understand. Each computer runs a resource-managing process that keeps track of the work being done on the machine. If the computer is idle, the resource manager holds an auction to sell a slice of the spare time to another machine on the network. If one of the jobs running on the machine needs more computer time, the resource manager watches for auction announcements and bids at the auctions until it finds the necessary computer cycles. The manager also keeps track of the amount of electronic "cash" that each process has to spend, although the current implementation makes no attempt to guard against fraud or counterfeiting. (Other researchers are developing secure cash systems relying on clever cryptography, but these ideas are outside the scope of this article.)

Finding the Parallelism

Under Spawn, each application must call up the resource manager when it has a task that could be spun off to run on another machine. The programmer must build the intelligence into the application itself so the application can know when it has a bit of computation that can be "spawned" and executed in parallel.

The process is not automatic. Once the application makes the decision, it hands off the procedure to Spawn, which finds another machine to do the work. The program must know how to integrate the information when it comes back.

For example, ray tracing is an application suited for parallel processing (see "The Art of Ray Tracing," February BYTE). The programmer might set up a program, break it up into 100 different sections, hand those 100 different sections to Spawn, and ask it to bid for time on 100 different machines. If 100 different machines are free, the information will come back very quickly. If fewer machines are free, the resource manager will bid on the available time and continue looking until all 100 jobs

continued

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are finished. (Note that even if there are 100 free machines holding auctions for their free time, the whole job will not get done 100 times faster. The overhead of communication and bidding prevents perfect efficiency. Preliminary test results show overhead has ranged from 7 percent to 10 percent.) The ray-tracing program then reassembles the data into final results.

The jobs Spawn sets up on different machines can vary in intelligence. The simplest subapplications act like black boxes and only report their results after they've finished their work. The more sophisticated ones send information regarding their partial progress to their manager, which examines all their reports and will often send back instructions to the subapplications regarding the best way to proceed.

Many of the simple experiments conducted at the Xerox PARC ran with simple processes that bid all their available cash at each auction. The process with the most cash will win the beginning auction, but eventually the poorer versions will save money and have enough to buy time.

This interaction is especially useful for solving problems such as the traveling salesman problem—finding the fastest, shortest route to many locations. Different processes could search different routes and, through the manager, keep track of the current best solution.

The subapplications can also recursively create their own subapplications by splitting their part of the problem into small sections. The entire structure of applications and subapplications can form a big tree-like structure in the network. These subapplications get the money to bid for new time from the process, this managing process in turn obtains money from the process above it, and so on. The manager of the top application is responsible for passing enough currency down to the entire tree so that subapplications can buy enough time to finish their tasks.

The strategies used by the top applications to guide their subapplications can be simple or complex. Equal funding is easy to implement, but it's only efficient if all subapplications are performing an equivalent amount of work. The top application, for example, might create several different applications that would each explore a different approach to the same problem. More funding, though, could be allocated to the solution that is more likely to succeed. A better but more complex heuristic for allocating the currency would reward the more successful subprocesses with more cash to spend on more computer cycles. Of course, this method relies on the existence of some measure of relative progress and success.

Bad Code in the Node?

A major advantage of the economic model is its ability to survive disasters such as other computers crashing on the network. A centralized allocation scheme not only must devote a large amount of time maintaining an active list of machines but must not fail itself. If it stopped, every job would be lost. Some other complex distributed systems have provisions for electing a new central processor in the event of a crash. These protocols are complex and time-consuming because the new central processor must either discover the status of the jobs or restart them.

In the Spawn environment, the resource manager does not need to know the operating status of all the machines. When it wants to buy time, it just watches for announcements of new auctions. However, the application itself must watch for trouble. If a machine running a subprocess crashes in the middle of the job, the top process must notice that no results were returned and restart the subprocess by buying time at the next auction. Fault tolerance can be built in by starting subapplications simultaneously on different machines and accepting the results of the first successful subtask. Obviously, if the top manager halts, the entire job will crash as well. The rest of the network, though, will not be affected.

The Auctions

Spawn conducts closed auctions that are clever combinations of open auctions and sealed-bid auctions. Open auctions aren't efficient on a computer network because they can run indefinitely and flood the network with message after message. Spawn requests sealed bids and sells the computer time to the top bidder, but at the price offered by the *second-place* bidder.

Using sealed bids reduces the network load, since they consist of only one message. Setting the price at the second-place bid results in almost exactly the same price as if there were an open auction. (The difference between taking the first and the second price is important. A normal sealed-bid auction charges the winner just what the time is worth to the top bidder alone. Consequently, the price paid is always the largest amount the top bidder is willing to spend—not the equilibrium price obtained when supply balances demand. The second-place bid is the price at which the second-place bidder would have dropped out of an open auction.) Interestingly enough, if there is only one bidder, the slice of computer time is given away gratis because the effective second-place bid is 0.

Each process must use some strategy to decide what to bid. Many of the simple experiments conducted at the Xerox PARC ran with simple processes that bid all their available cash at each auction. In the meantime, they received a constant trickle of money from their manager. The effect of this system is simple and fair. The process with the most cash will win the beginning auction, but eventually the poorer versions will save money and have enough to buy time.

How Spawn Performs

The best measure of the system, of course, is its performance. The team at the Xerox PARC has tested Spawn with a number of different experiments. These tests have revealed a great deal about the fairness, adaptability, and chaotic behavior of the system.

Some experiments parceled out parts of a Monte Carlo simulation to the various machines. (A Monte Carlo process is a testing method for analyzing large, complex simulations by generating random initial conditions and checking the results. For example, a Monte Carlo simulation of a craps game would roll the dice enough to show that the house has a distinct advantage.)

continued

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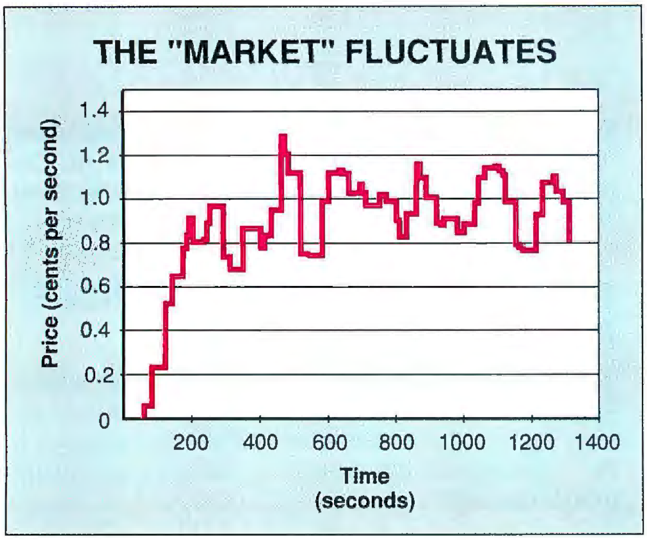


Figure 1: *This graph shows how the price of computer time on the Spawn network fluctuates. Six Sun workstations ran three tasks that were given 30, 20, and 10 cents, respectively, every 10 seconds to bid for more computation time. Once the jobs began, the price quickly increased, eventually oscillating at around 1 cent per second. Such chaotic behavior is typical of the economic marketplace on which Spawn is modeled.*

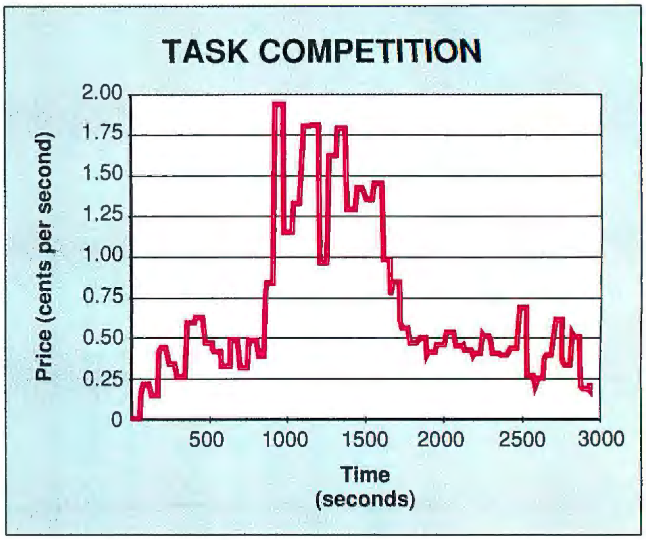


Figure 2: *In this graph, you can see how the price of computing time soars when a high-priority job with plenty of funding enters the market. Two processes with 1 and 2 cents per second to spend begin to lose most of the auctions (at around the 900-second mark) to a process that has 7 cents per second to spend. The price returns to normal when the later process is finished.*

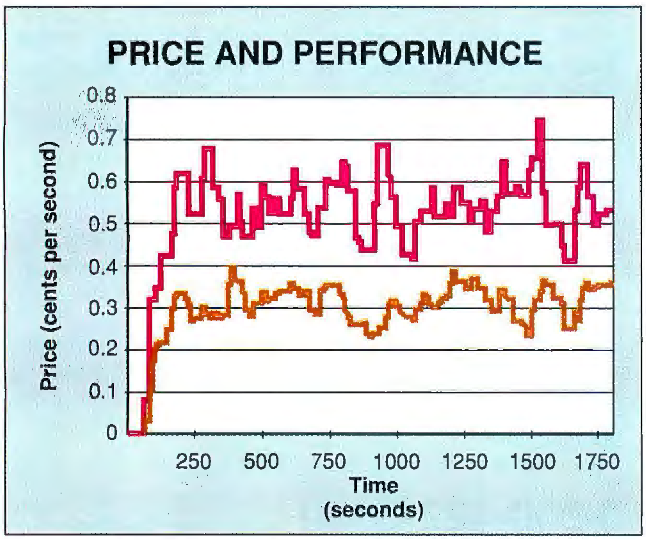


Figure 3: *The price of computing time on different machines is different if the machines have different capabilities. The dark line shows the price of time (established by auction) on the faster and consequentially more valuable Sun-4/260. The gray line is the price of computation on a Sun-4/100.*

The simulations are very easy to split into many sections and run in parallel.

The researchers experimented with various funding strategies. Figure 1 shows the results of connecting six Sun workstations and running three tasks that are given 30 cents, 20 cents, and 10 cents, respectively, every 10 seconds to bid for more computation time. Once the jobs begin, the price quickly increases until it oscillates around an equilibrium price of 1 cent per second.

Because there are six machines, and therefore six auctions conducted, the total money spent per second is, on average, equal to the money flowing to the processes. The fluctuations in the prices shown in the figure are just the first evidence of the random nature of the system. If the same set of programs is restarted, the price graph will be different. The average price will remain the same, but the shape of the price oscillating randomly around this average will be different. The chaos enters the system because the bidding is not linear: Each auction is priced at the value of the second-largest bid.

Team members Bernardo Huberman and Tad Hogg studied a similar system of equations that are easier to analyze theoretically. They discovered that the chaos was often unavoidable when there were delays in communication between computers and each computer's knowledge about the status of the others was incomplete.

The noisy, erratic behavior of the price should be familiar to anyone who plays the stock market. The process is fair, at least to those who subscribe to free-market doctrines, which form the axioms at the foundation of the system. The processes that receive the highest priority are the ones with the most money. In the simulation shown in figure 1, where the ratio of capitalization was 3 to 2 to 1, the allocation of computer cycles was roughly 2.79 to 2.00 to 1.00. The chaotic behavior is probably the cause of the discrepancy between the two ratios.

High-Priority Jobs

The effects of high-priority jobs are easy to see in figure 2. The system begins and ends with two processes (with 1 cent and 2 cents to spend per second). In the middle of the graph, a process starts with 7 cents per second. It quickly begins winning about 60 percent to 80 percent of the auctions, and the price soars. When the job finishes, the price quickly returns to normal. This effect should be familiar to people who watch real markets perform in the same way. (The price of homes in the

continued

San Francisco Bay area, for instance, soared over the last 20 years as the computer industry brought more and more spending money into the area. The price of homes in Houston, on the other hand, collapsed after the price of oil dropped, cutting the flow of money into the region.)

If there are two different machines in the network with different capabilities, different prices will develop. Figure 3 shows the prices of the auctions run on a network of three Sun-4/260s (top line) and six Sun-4/110s (bottom line). The 4/260 is roughly 40 percent faster than the 4/110, and the average prices are quite different. The 4/260 gets more work done, so it is more valuable.

The most important part of the economic model is its support of an easily scalable, very diverse system. A large network will almost certainly not be made up of equivalent machines. Some will be faster than others. Some will have access to special data, and others may have numerical processors suited only for special problems. The value of these systems to all the users will change as they run different programs. If everyone is interested in inverting matrices, then the price of time on the systolic array will be high. On another day, with users running different applications, the time might be free. Dynamic pricing strategies ensure that the network will adapt.

Tying It Up

The chaotic nature of Spawn may seem a bit disconcerting, but, unfortunately, theoretical analysis seems to imply that the chaos is unavoidable. A system with built-in delays and imperfect knowledge seems to lead to chaos. This noise makes it difficult to predict exactly what the network will do. Spawn, though, always seems to behave as intuition might predict. The difficult problem is finding a strategy for bidding that can attempt to watch auction prices and plan intelligently.

Other systems for trading cycles between machines and balancing the network load often behave quite similarly when the Spawn applications bid naively. These other systems are often just economies that use terms like *priority quotient* instead of economic terms. The difference is usually largely semantic.

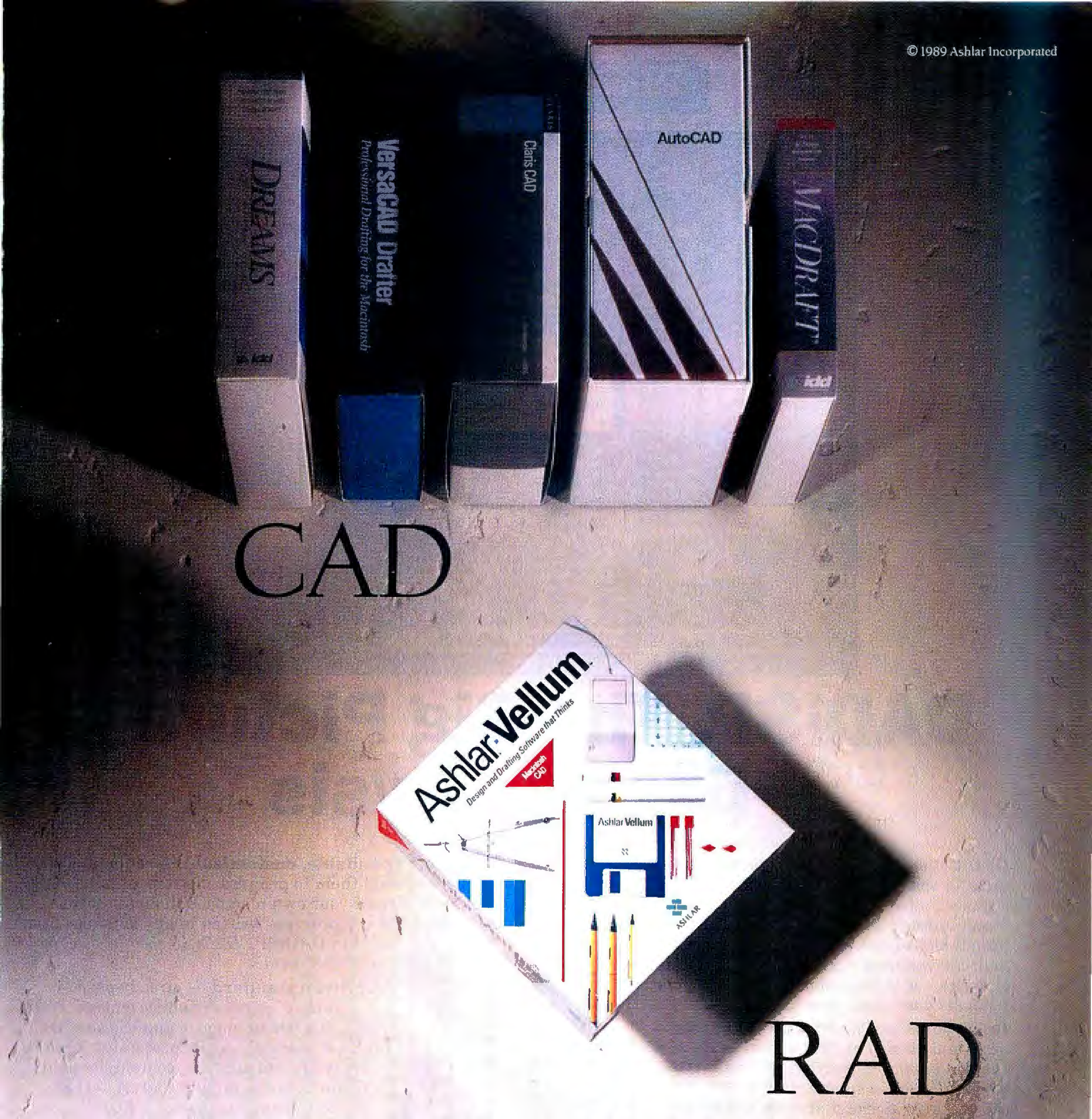
Setting up a distributed network of computers to share their cycles is a difficult problem that must be solved as networks become more prevalent. The free-market metaphor is not only easy for the mind to understand, but truly useful. Spawn effectively and flexibly allocates computer cycles with a small amount of interaction.

For further reading on the subject, try *The Ecology of Computation* (edited by B. A. Huberman, Elsevier Science Publishing, 1988). This book contains articles about distributed networks, including a piece about a system built at MIT called the Enterprise. In this system, instead of bidding money, the computers bid estimated finishing time. ■

ACKNOWLEDGMENTS

My thanks to Carl Waldspurger, Bernardo Huberman, Jeffery Kephart, Tad Hogg, and Scott Stornetta, members of the Spawn team at the Xerox PARC, for providing background material.

Peter Wayner is reading toward a Ph.D. in computer science at Cornell University. He can be reached on BIX c/o "pwayner."



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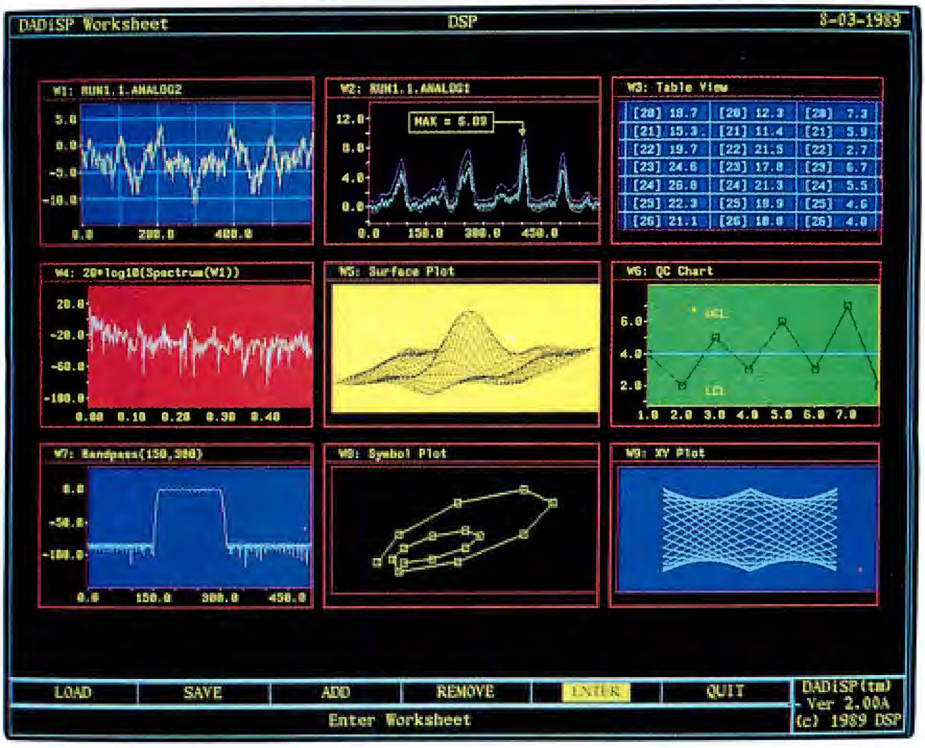

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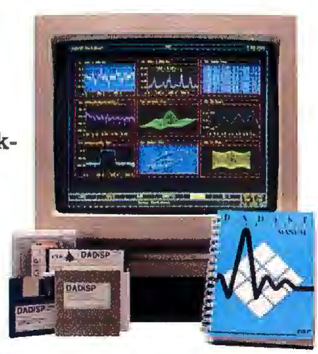

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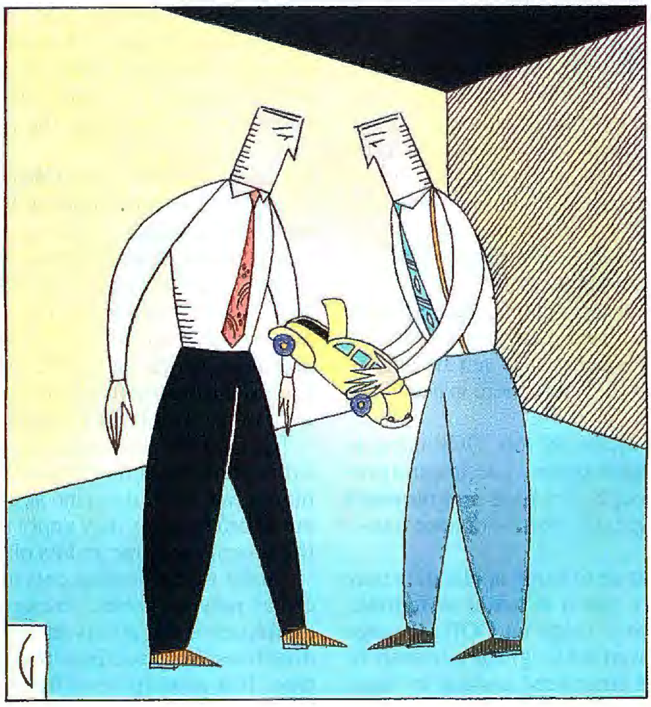
NEW OBJECTS FOR OLD STRUCTURES

Converting existing applications to object-oriented applications is possible and often very advantageous

Jeff Duntemann and Chris Marinacci

When you forge ahead to apply new language technology to new projects, existing applications usually get left behind. Writing new applications is fun; converting old ones is just drudgery. Besides, existing applications work already. If they're not broken, why spend the time to fix them?

This last question is actually another question in disguise. Is the benefit to be gained from new language technology worth the risk in "lifting the hood" on a completed application? The answer, of course, is that it all depends on the value of the technology.



Ring out the Old; Ring in the OOP

New technology shows up with great regularity in the programming tools business. Still, it's been a long time since anything has generated the excitement that's been created by object-oriented programming (OOP) systems—probably not since the appearance of structured methods in the 1960s. (See "Object-Oriented Programming," February BYTE.)

Is OOP worth the bother?

The answer is almost certainly yes, and the same reasons that apply to new applications also apply to converting old applications:

• *Maintainability*—OOP programs are more easily read and understood (and hence changed) than traditional structured programs. OOP techniques provide a highly effective means of controlling program complexity by imposing a functional hierarchy on program details and hiding whatever details the programmer doesn't have to face at any given time.

• *Reusability*—It is possible for programmers to write objects so loosely coupled that they can be considered "black boxes" that can be dropped into programs with little disruption of unrelated code. If they design them well, programmers can use these same black boxes as standard software parts in future applications, and often with no changes whatsoever.

• *Extensibility*—One benefit of OOP's inheritance concept is that objects can be easily extended with new features without any unnecessary duplication of code. A child object is declared that inherits everything its parent object has and defines only those things that differ from (or must be added to) the parent object.

Weigh Costs and Benefits

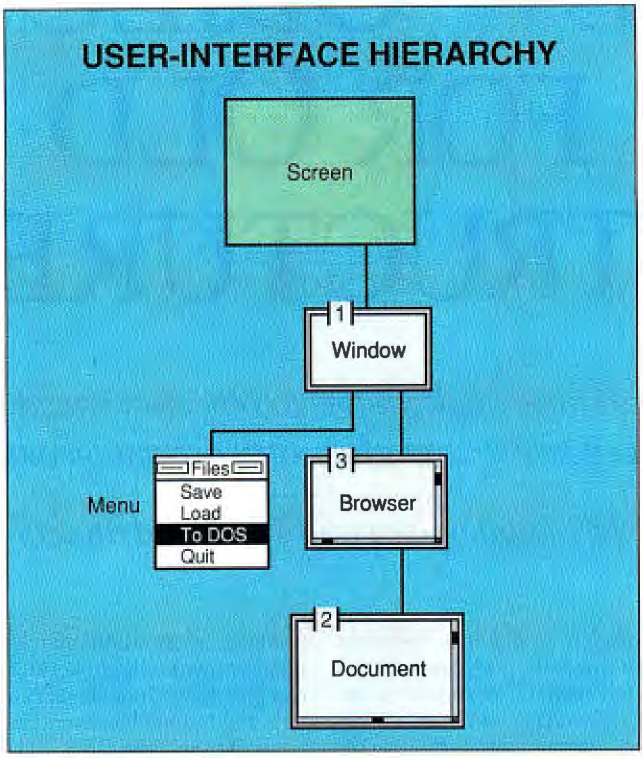
Converting an application involves several important decisions regarding the shape of not only that application, but of applications that will be written or converted in the future. Actually, before developers convert any old applications to object-oriented applications, they should put a

continued

An Object's Heritage

The Screen object type contains all the methods that manipulate the display controller directly. It models the full screen only. The Window object type subdivides the screen with methods to allow sizing, dragging, and border control.

Other screen subsets, including menus and browsers, are children of the Window type. The browser models a read-only editor. It contains methods to manage vertical and horizontal scrolling. The Browser object is an abstract object, meaning that it exists to be inherited from. Its child objects implement specific methods to handle the display of particular types of data—that is, a text browser, a hexadecimal dump browser for memory or files, and so forth.



The Document object inherits the ability to display data to the screen from the Browser type and adds the additional methods needed to edit, search, load, and save text. Note that because the Document object inherits its "frame" from the user-interface hierarchy (see the figure), changing the user-interface objects propagates the changes to the document without any changes to the Document object itself.

Making the application's central object a descendant of the user interface ensures that the application will be consistent with the user interface to the very highest level—that of the application proper.

strategy in place for designing object orientation into future applications. This way, they can spread costs between future development projects and current applications. Developers should, in fact, be thoroughly familiar with these costs before they begin any conversion project. The main costs involve time, tools, talent, and inconvertible applications.

Viable big-picture planning is time-consuming, difficult, and expensive. Without a well-designed hierarchy, there's no way to take advantage of the powers of late binding and polymorphism. But designing the hierarchy isn't easy and can require a level of coordination of efforts among individuals that has never been achieved. The application's architects and support personnel need to be part of the process. Object-oriented conversion is not a small matter to be left to the programmers in the trenches who have been maintaining the code.

In addition, existing development tools may be incompatible with OOP techniques. Older code libraries may not link with new object-oriented modules. Debuggers may not be able to trace object-oriented code, especially where there is heavy use of late binding.

In this early stage of OOP's acceptance, too, OOP talent is still fairly hard to come by, and object-oriented design and programming skills may be a little rough. Training programmers is costly, and staff turnover may greatly retard—or even halt—an important conversion project.

Finally, it's always possible that an existing application may require so much effort to convert that it is better to rethink, redesign, and recode it from scratch using an OOP language that may be completely different from the language currently in use. Applications not written in a structured fashion to begin with, for example, are nearly impossible to recode along OOP lines without a total rewrite.

In general, the higher the coupling between application components—modules, procedures, or whatever—the harder it will be to recode for OOP. Also, code that takes full advantage of system-level resources such as interrupts is hard to meld with true object-oriented code. Some applications convert more easily than others. It's a good idea to know which ones are easier to convert before you begin the conversion process.

Structured Pascal vs. Object-Oriented Pascal

People long assumed that OOP would require new and radically different languages, such as Smalltalk. But over the last few years, major object-oriented extensions to both Pascal and C have shown this concept to be false. Apple published its Object Pascal specification in the mid-1980s. Soon after, Bjarne Stroustrup defined the C++ object-oriented extension to the C language. Since then, effective and efficient object-oriented extensions to structured languages—most notably Objective C, used in the NeXT workstation—have appeared on the scene.

In mid-1989, Borland International extended its Turbo Pascal implementation of Pascal to incorporate objects. The techniques that we'll describe assume the use of Turbo Pascal 5.5, but in broad terms they apply to any language bridge between a traditional language and its object-oriented extensions.

Turbo Pascal implements all three key object-oriented concepts: polymorphism, encapsulation, and inheritance. Polymorphism is the ability of objects to respond appropriately to directives from routines that do not know the objects' exact type. It is accomplished through late binding, which is the determination of call destination addresses at run time rather than at compile time.

Encapsulation is the melding of code and data into a single structure. It is embodied in the object structure, which is defined very much like a record:

```
type
  Point = object
      X,Y : Integer;
      Visible : Boolean;
      procedure MoveTo(NewX,NewY : Integer);
      procedure WhereIs(VAR PosX,PosY : Integer);
      function IsVisible : Boolean;
      procedure Show; procedure Hide;
    end;
```

In an object, data fields like X and Y and methods like IsVisible and Show are defined (encapsulated) together. You can freely access the data fields from outside the record or use the in-place methods that perform all useful manipulations on the data fields.

Inheritance allows a child object to make use of all data and methods belonging to its parent object, while adding or changing only what it must to implement its new features:

```
Circle = object(Point) { Inherits from Point }
    Radius : Integer;
    procedure Grow(GrowBy : Integer);
    procedure Shrink(ShrinkBy : Integer);
  end;
```

A circle differs from a point only in that a circle has a radius. The Grow and Shrink methods are provided to change the radius without directly accessing the Radius data field. All of Point's definitions are directly accessible from Circle as though Circle had defined them itself. In other words, given an instance of Circle named ACircle, the inherited Show method is called by the statement ACircle.Show.

Turbo Pascal objects can override inherited methods simply by redefining them. The compiler knows that an identifier has been redefined when it parses an identifier's second definition; Object Pascal's OVERRIDE reserved word is therefore redundant and unnecessary.

Late binding is implemented by declaring a method as virtual using the new reserved word VIRTUAL. Objects that are descended from one another in an object hierarchy can all share a single virtual method name (like Show), but each can implement that method differently as its individual needs require. Which implementation is actually executed for a given invocation of a virtual method is not decided until run time—hence the term *late binding*. Traditional Pascal procedure calls are *bound* (i.e., the calling logic is given the address of the procedure) at compile time.

Late binding in Turbo Pascal 5.5 makes possible polymorphism (from the Greek for "many shapes"). A single virtual method call can have many shapes, depending on which object type is being called at the moment.

Can You Convert This Application?

Before we discuss how to do a conversion, it's worthwhile to consider which applications may be difficult or impossible to move toward object orientation. You should ask several important questions of any conversion prospect.

Is it structured to begin with? Unstructured applications should be left as they are or totally rewritten. Unstructured Pascal applications make little use of procedures and data structures. Data is scattered across dozens or hundreds of global variables. The main program is large, and loops are often implemented with GOTOs and labels. Many line-for-line ports from older versions of BASIC and FORTRAN end up looking like this, and they tend to be as flexible as concrete.

Object orientation is in one sense a structure of structures. If fundamental program structures such as procedures and records are missing, making it object-oriented might as well be considered a complete rewrite from scratch. Even the specifications may have to be rewritten, as an unstructured spec will be more hindrance than help in writing object-oriented code.

A lesser but related question should be asked of any application. Does anyone in-house really understand it? Old, rarely used, and poorly commented applications should be left alone, or else respecified and rewritten by someone who has never even seen the old application.

The second question is less plain and more troublesome. Does the application or any major part of it depend on non-object-oriented tools? Screen generators that create Pascal code for data-entry modules fall into this category, as do toolbox products consisting of many interrelated procedures and functions that must be linked into the program code. These products are "object-ignorant" and require the application to perform procedure calls and set up data structures in certain ways.

While you can, to a degree, make applications that use such tools object-oriented, the tools will eventually become a source of considerable frustration and will limit the evolution of the object-oriented application along natural object-oriented lines. Furthermore, reusability and extensibility of modules that incorporate non-object-oriented tools will be severely limited or rendered impossible.

First Steps Toward Conversion

Unlike with totally object-oriented languages such as Smalltalk, Turbo Pascal programmers have a lot of choice regarding to what degree an application will be object-oriented. Furthermore, you can convert a traditional Pascal application incrementally without degrading the performance of the application.

The first steps are easy. Remove conflicts with reserved words and predefined identifiers. Turbo Pascal 5.5 adds only four new reserved words to the language: OBJECT, VIRTUAL, CONSTRUCTOR, and DESTRUCTOR. If the application contains any use of any of these words, you must choose new identifiers. There are only two new predefined identifiers that, if at all possible, you should not redefine: Self and Fail. Note that there is nothing in Turbo Pascal's overlay scheme that hinders object orientation. Objects can exist in overlays without modification or special considerations.

Looking for Near-Objects in Old Applications

Programmers are often surprised at how easily they can recast certain portions of an application in object form. The surprise comes from the fact that they sometimes unwittingly create libraries of procedures and functions along object-oriented lines without thinking of them as object-oriented. Often, then, by this time, they have performed everything but encapsulation.

Such "near-objects" usually consist of a data structure or family of data structures and several procedures and functions that act on those data structures. The whole is often defined within a unit, which reduces coupling with other program code and further facilitates "objectification."

One common example of a near-object is a unit that defines a calendar date record and several routines for manipulating

continued

Listing 1: *A long string object type definition produced by encapsulation.*

```
const
  MaxLStringLength = 65521;  { The maximum amount that can be
                               allocated to a pointer }

type
  LStringRange = 0..MaxLStringLength;
  LStringData = array [1..MaxLStringLength] of Char;
  LStringDataPtr = ^LStringData;
  LStringPtr = ^LString;
  LString = object
    Len : LStringRange;         { Current length }
    MaxLen : LStringRange;      { Length that has been
                                  allocated.  This is always
                                  allocated in blocks of 16
                                  bytes so that the long
                                  string's data doesn't have
                                  to be reallocated every time
                                  the long string grows. }

    Data : LStringDataPtr;
    constructor Init;
    destructor Done;
    function SetValue(NewLen : LStringRange; NewData :
       Pointer) : Boolean;
    function FromString(S : String) : Boolean;
    function ToString : String;
    function Length : LStringRange;
    function Copy(Start, Amt : LStringRange) : String;
    function Insert(S : String; Start : LStringRange) :
       Boolean;
    procedure Delete(Start, Amt : LStringRange);
    function Append(S : String) : Boolean;
    procedure Change(Ch : Char; Start : LStringRange);
    function Assign(LS : LString) : Boolean;
    function FromStream(var S : DosStream) : Boolean;
    procedure ToStream(var S : DosStream);
  end;
```

dates. The date record generally contains the date expressed as a month, day, and year value:

```
type
  Date =
    record
      Month, Day, Year : Integer;
    end;
```

Other expressions of the date, such as the DOS time stamp, a slash-delimited string form such as "6/29/89," or a fully spelled-out string form such as "June 29, 1989," are usually calculated and returned by routines defined in the unit. Other useful routines might include a procedure to set a date variable to the current date in the system clock, or to calculate the days between two date values.

```
interface
  procedure SetToToday(When : Date);
  function AsDOSStamp(When : Date) : Word;
  function AsShortString(When : Date) : String;
  function AsLongString(When : Date) : String;
  function AsJulian(When : Date) : LongInt;
  function DayOfTheWeek(When : Date) : Integer;
  function DaysBetween(Date1,Date2 : Date) : LongInt;
```

All these routines can become methods in a date object if you remove the unnecessary parameters (it is assumed that the methods will act on the object's own date data) and place their headers within an object type definition.

```
type
  Date =
    object
      Month, Day, Year : Integer;
      procedure SetToToday;
      function AsDOSStamp : Word;
      function AsShortString : String;
      function AsLongString : String;
      function AsJulian : LongInt;
      function DayOfTheWeek : Integer;
      function DaysBetween(Date2 : Date) : LongInt;
    END;
```

The DaysBetween method retains one parameter and returns the number of days between its own date value and the value of the Date2 object passed as a parameter.

Long Strings as Objects

One of Borland's ongoing research projects during the development of Turbo Pascal's object extensions was the creation of the TurboCalc spreadsheet program. One near-object identified during the specification process was the long string type (capable of storing up to 64K-byte characters) used by the spreadsheet.

In a way similar to the date example presented earlier, a long string was originally implemented as a record containing the string length and a pointer to an array of characters containing the string data. A suite of functions and procedures performed the necessary manipulations on the string record: insert, append, copy, return length, and so on. Encapsulating the data from the original record with the procedure definitions of the routines that acted on the data produced the long string object type definition shown in listing 1.

Recasting utility libraries as objects provides some immediate benefits. In almost all cases, the resulting objects are more loosely coupled than the original library. This reduction in coupling allows their reuse in other applications that are either being converted or under development. Creating objects from utility libraries confers future benefits, as well. Long after their creation, objects can be easily and efficiently extended by creating child objects from these objects. Inheritance confers all the parent's code and data on the child object while allowing the child object to change only that code and data that differ from the parent type.

Identifying the Central Object Within an Application

At the core of most applications of any consequence is a large and often complex data structure representing the work that the application does. For a word processor, this is the document that is often created as a linked list of text lines on the heap. For a database, it may be a binary tree or some other system of records and indexes tied together through pointers. For a spreadsheet, it is usually some kind of sparse array held together with pointers.

This data structure is the essence of what goes on in a program, and all the rest of the code in the program serves it in some way. However the data structure is represented, it should become an object during conversion. The trick here is knowing what code belongs to this central object and what code belongs elsewhere in the program. The identification process is one of "drawing a line around the object," including the code that works with the data structure directly and excluding the code that performs other tasks.

This process sounds simpler than it is, especially when you consider that large objects can (and should) manage their own complexity by containing other smaller and simpler objects. A word processor document is a good example. Most word processors express a document as a linked list of text lines. Each line is a string, and strings are excellent candidates for objectification. The string object should contain the methods for managing string data within the string. The document object should leave manipulation of data within the strings to the string objects themselves and concentrate on managing the relationships of the strings to one another. These relationships include data that flows among strings, say, during the reformatting of a paragraph.

Obviously, drawing this line becomes a lot easier when you have some plan for an object hierarchy in mind. One of the knottiest problems is that of drawing the line between the data structure and the user interface. In order to achieve speed in displaying data to the screen, the central data structure is often very tightly coupled to the display routines. This tight coupling makes isolating the user-interface objects as a separate (and easily reusable) hierarchy much more difficult.

One way around this problem is to make the central data structure a child object of the user-interface hierarchy (see the text box "An Object's Heritage" on page 262). The browser object would presumably have a `redraw` method, which could be overridden by the data structure object with a method that displays the data structure to the screen or window. Don't be afraid to make the central object of the application a descendant of the user interface: The object inherits the ability to present itself to the user according to the rules you have established for your applications.

There are nonobvious benefits to this procedure, as well. If you have a windowing system in which you can create and display a new window at will, making the document or spreadsheet object a descendant of the window object means that splitting the screen into as many documents or spreadsheets as you need is as easy as instantiating a second document or spreadsheet object. The screen-splitting code is right there, inherited from the parent user-interface object.

Incremental Conversion

As you develop object-oriented subsystems for new applications, try grafting them onto old applications under conversion. The tremendous advantage of an object-oriented subsystem is that it is completely decoupled from the application itself. Assuming it doesn't conflict with any existing subsystems within the application, you can add a proven object-oriented subsystem as easily as linking it in and calling its methods.

The hardest part of such a graft might in fact be stubbing out or removing procedures and functions made obsolete by the new subsystem. Watch out for any and all unexpected side effects. Coupling is a snake with an infinite number of heads.

The Application as Object

As you work with OOP, you might get used to thinking of applications as containers for objects. But why not design applications that *are* objects? The entire application then becomes reusable as a component part of larger systems.

Such an application-object might have only two methods: `Activate`, which initializes and executes the application, and `Deactivate`, which "cleans up" any resources used by the application and returns control to the execution platform, which might be a DOS shell. Additional methods to export data to a clipboard for exchange with other applications would be right in line with the object philosophy.

Paradoxically, this forward-thinking conversion strategy is one that you might apply to old applications that are too unstructured or too poorly understood to be converted any other

continued

way. Putting an object "wrapper" around the entire application might be considerably easier than attempting to convert its tangled innards.

If you use this scheme, a word processor becomes a document object, and an accounting application becomes a ledger object. A hidden benefit of this scheme is that the ledger object could become a field in a database, as could a spreadsheet object or document object. Similarly, a document might become a cell in an object-oriented spreadsheet, subject to formulas that might return the document's size or time stamp or even a Boolean flag indicating whether the document contains certain patterns.

Guidelines for Conversion

Converting a traditional application into an object-oriented one is not an all-or-nothing proposition. You can convert incrementally and go as far as time and energy—and the design of the original application—allow. Here is a simple strategy for conversion:

- Find the near-objects in the application and make them objects, ideally set off in a separate module. These near-objects would include string objects, time and date objects, and so on. Performing this procedure is a good way to learn object-oriented techniques when starting from scratch.
- Establish an object-oriented hierarchy plan for future applications. This process involves high-level planning of a user interface, a help system, on-line tutorials, and other relatively application-independent and reusable subsystems.
- With the hierarchy in mind, return to the application being converted and identify the central data structure. Recast the data structure as an object, separating it as much as possible from the other subsystems, such as the user interface and help system.
- As you develop other object-oriented subsystems for future applications, try to add them to the application being converted. This step may involve a lot of rewriting if the original application is object-unfriendly. The amount of programming time you can reasonably allow for the project will dictate the amount of rewriting that takes place.

Watch out for some pitfalls. First, don't get overzealous and try to turn simple data types into objects. Leave characters, enumerations, numeric types, and Booleans as they are. Simple types are treated specially by the language in numerous ways, most of which are lost when the simple types are surrounded by an object framework. The benefits gained by turning simple types into objects are not worth the complication and loss of flexibility.

Don't use virtual methods unless late binding is necessary. Static method calls are identical in speed and overhead to ordinary procedure calls. Moreover, Turbo Pascal's smart linker will strip out any static methods that are never called within an application, reducing the application's code size. Because calls to virtual methods are not known to the compiler at compile and link time, they cannot be stripped out.

Don't design an object hierarchy to accommodate the quirks of a non-object-oriented application. Reusing such a hierarchy in future development will carry those quirks into all your future applications. Instead, wipe the slate clean and design your hierarchy for the future, and then put as many resources as you can afford to into rewriting the old application to adhere to the principles of a fully object-oriented design.

Keep in mind that change for the sake of change isn't the goal. You make an application object-oriented to obtain certain benefits, but the process involves trade-offs. After taking a good hard look at your existing application, you may correctly decide that the benefits aren't worth the costs. The danger here is that you may base your decision on too little information and have too little experience in OOP.

Write at least one fully object-oriented application before you attempt to convert an existing application. Give the conversion process a chance. The compelling benefits of object-oriented techniques turn up in surprising places. ■

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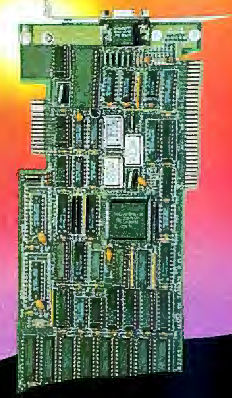

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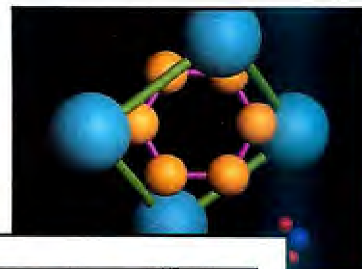

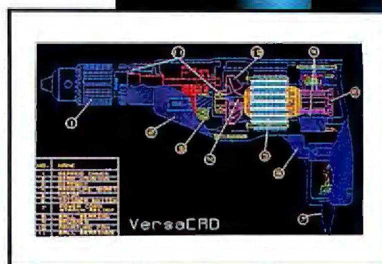

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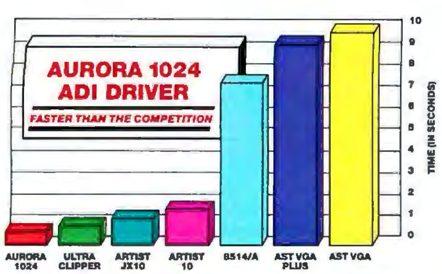

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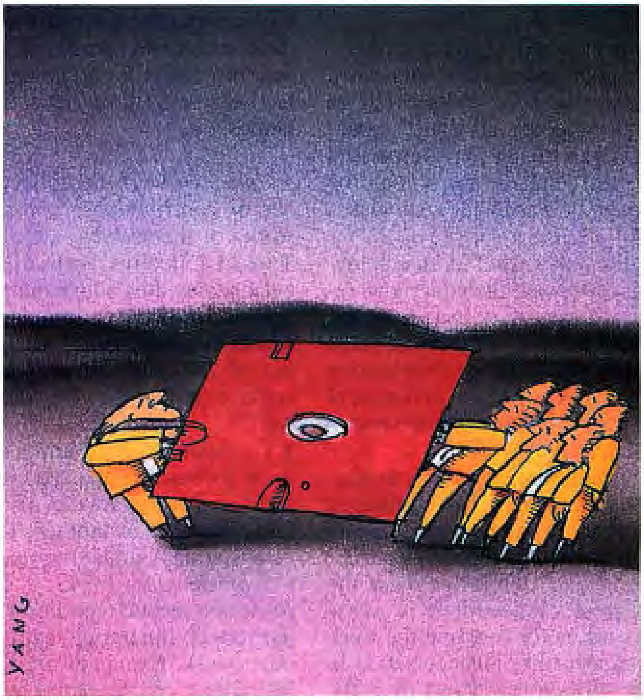
WHO OWNS THE COPYRIGHTS?

All those involved in creating a computer program should make sure to determine their copyright interests

William T. McGrath

With the proliferation of computer usage in the business world, the importance of copyright ownership in computer programs can no longer be overlooked. A copyright owner obtains an array of valuable rights, including the exclusive right to sell copies of an original work and to sell new works based on or derived from the original work.

As a general rule, the author of a work is the owner of the copyright. However, if the author is an employee of a corporation or other business entity, and the work is created within the scope of employment, then the employer is the owner of the copyright.



More difficult questions arise if the author of the work is an independent contractor. In a typical situation, a company contracts with a freelance programmer to create software for a particular business application. The program is successful, and the company starts marketing the software commercially. The programmer also begins marketing the software or a modification of it.

Litigation is bound to follow—each party claiming that it has the exclusive right to sell the software. Much hangs in the balance, since the copyright owner not only can prevent the other party from selling the software but may also recover an award of damages, including any profits the infringer made from marketing the program.

The ownership question has been veiled in confusion for several years. The problem arose from conflicting interpretations given by courts to the "work-made-for-hire" rule of the Copyright Act.

Supreme Court Ruling

A recent decision by the U.S. Supreme Court, *Community for Creative Non-Violence* v. *Reid*, will eliminate much of the confusion. In the *Reid* case, involving ownership of a copyright to a sculpture, the Court for the first time addressed the issue of who owns the copyright to works created by independent contractors. The Court resolved the conflicting interpretations of the lower courts in a decision that greatly expands the rights of independent contractors.

For independent contractors, the decision is a boon. For hiring parties, the decision is a clear indication that certain contractual measures should be taken if the party wants to obtain ownership of a program's copyright.

The decision is a departure from the way the ownership issue has been analyzed in the past. It should cause computer professionals to reexamine the status of copyright ownership in the programs they have created or commissioned

continued

CATEGORIES OF WORK-MADE-FOR-HIRE

Works-made-for-hire by independent contractors must fall into one of these categories. In addition, there must also be a written agreement between the parties.

- Contribution to a collective work, such as a magazine or anthology*
- Audiovisual works
- Translations*
- Supplementary works, including work published as an adjunct to a work by another author*
- Compilations*
- Instructional texts
- Tests
- Answer material for tests
- Atlases

* These are the categories that, if broadly construed by the courts, a computer program could arguably fall into.

others to create. As a result of the Supreme Court's ruling, freelance programmers may own the copyrights to past works without realizing it.

The work-made-for-hire doctrine has two parts. The first part says that if a work is created by an employee within the scope of his or her employment, then the copyright is automatically owned by the employer. No written agreement is required, and it does not matter what kind of work is involved. This aspect of the Copyright Act is fairly straightforward and easy to apply.

The second part deals with "specially ordered or commissioned works" and provides that the commissioning party owns the copyright if the work is a work-made-for-hire. The Act provides that a commissioned work can be a work-made-for-hire if there is a signed agreement to that effect and the work falls into one of nine specifically identified categories of works (see the table). If these requirements are met, the commissioning party owns the copyright.

This seemingly clear dichotomy between works by employees and works on commission became hopelessly clouded when some lower courts held that commissioned works could be works-made-for-hire even though there was no signed agreement. The courts reasoned that if the hiring party exercised "supervision and control," the creator of the work could be considered an employee even though he was by most standards an independent contractor.

Since the independent contractor was viewed as an employee, the courts said that the employer owned the copyright, regardless of the type of work or whether there was a signed agreement. Several court cases applied this analysis and ruled that computer programs were owned by the commissioning party. The courts gave little guidance as to the type or degree of supervision and control necessary to give copyright ownership to the hiring party rather than the creator.

The *Reid* case has entirely changed the analysis for determining copyright ownership. The Supreme Court has eliminated the fiction that an independent contractor can be considered an employee merely as a result of supervision by the hiring party.

The Court ruled that an independent contractor owns the copyright to any work he or she creates unless there is an express signed agreement that the work is for hire and the work falls into one of the nine categories specifically identified in the Copyright Act. If there is no written agreement or if the work is not one of the types mentioned in the Act, the independent contractor retains ownership of the copyright.

In *Reid*, the Court ruled that the artist was an independent contractor, not an employee. Since there was no written agreement and sculpture did not fall into one of the nine categories, the artist owned the copyright.

Who Is an "Employee?"

The Court ruled that the determination of whether a hired party is an employee or independent contractor should be made according to traditional principles of agency law.

Under common law agency principles, several factors distinguish independent contractors from employees. In order to determine which is which, courts look at the skill the job requires, who owns the instruments and tools used in the job, the location of the work, the duration of the relationship between the parties, whether the hiring party has the right to assign additional projects to the hired party, and the extent of the hired party's discretion over when and how long to work.

The courts take into consideration additional factors, such as the method of payment, the hired party's role in retaining and paying assistants, whether the work is part of the regular business of the hiring party, whether the hiring party is in business, the provision of employee benefits, and the tax treatment of the hired party. No one of these factors is determinative.

What Qualifies as Work-Made-for-Hire?

As previously noted, a work by an independent contractor can only become a work-made-for-hire if it falls into one of nine categories of works listed in the Copyright Act. These categories are an odd conglomeration of different types of works. They are the result of lobbying efforts and compromises made during the legislative process.

Computer programs are not specifically identified. However, some of the categories are arguably broad enough to encompass programs under some circumstances. The scope of these categories is unclear, and they are sure to become the next battlefield in litigation over copyright ownership.

Courts have thus far provided no guidance as to whether they will be construed broadly or narrowly. If the courts interpret these categories broadly, a computer program could arguably fall into one of the following categories: contribution to a collective work, translations, supplementary works, and compilations.

- *Collective works*: A collective work is a work in which a number of contributions, constituting separate and independent works in themselves, are assembled into a collective whole. Typical collective works are periodicals, anthologies, and encyclopedias. It is not uncommon, however, for separate and independent software modules to be assembled into a collective whole. A recent court case involved a software system consisting of 236 separate programs. These independent modules could arguably be considered contributions to a collective work.
- *Translations*: Programmers often translate a program from a form written for one type of computer to a form suitable for another. A program can also be translated from one programming language to another. These arguably could be considered "translations" under the statute.
- *Supplementary works*: A supplementary work is a work prepared as a secondary adjunct to a work by another author for the purpose of illustrating, explaining, or assisting in the use of the other work. Examples are forewords, afterwords, pictorial illustrations, charts, tables, and indexes. In the computer indus-

It is not likely that Congress had the computer industry in mind when it adopted the nine categories of work-made-for-hire.

try, the user documentation and manuals accompanying the programs will often constitute supplementary works.

• *Compilations*: A compilation is a work formed by a collection of preexisting materials or data, arranged and selected so as to constitute an original work. Typical examples include telephone books, directories, and catalogs. But some computer programs could arguably be considered compilations, as in cases, for example, where subroutines from different programs are combined into a new program.

It is unlikely that Congress had the computer industry in mind when it adopted the nine categories of work-made-for-hire, and it remains to be seen how the courts will treat software in connection with these categories.

Joint Authorship of Computer Programs

Since the concept of "supervision and control" alone is not enough to create a work-made-for-hire, commissioning parties sometimes claim copyright ownership by virtue of being joint authors of the software.

The Copyright Act defines a joint work in true lawyer-like language as "a work prepared by two or more authors with the intention that their contributions be merged into inseparable or interdependent parts of a unitary whole." To be a joint work, it is essential that at the time the work is created, the authors intend that their respective contributions will be merged into an integrated unit.

An author of a joint work is a co-owner of the work's copyright and is entitled to modify, reproduce, or distribute copies of the work. A joint author's protection extends to the entire work, not just the portion he or she contributed. Each author has the independent right to sell or license the joint work but has a duty to account to the co-owners for any profits earned.

Several cases have recently addressed the question of requirements to qualify as a joint author in the development of software. It is clear from these cases that a commissioning party who merely describes to the programmer what the software should do or look like is not a joint author.

In *Whelan* v. *Jaslow Dental Laboratory*, a case decided by the federal appeals court in Philadelphia, a dental laboratory owner commissioned the creation of software for use in his business. The owner gave the programmer a detailed description of the operation of the business, dictated the functions to be performed by the computer, and even helped design the language and format of some of the screens that would appear on the computer's visual displays.

The court nonetheless found that the programmer was the sole author of the software. The court's principal focus was on the creation of the source and object codes. The owner's general assistance and contributions to the fund of knowledge of the author did not make him a creator of any original work. The court made an analogy to an owner explaining to an architect the type and functions of a building the architect is to design. The owner is not a coauthor of the architectural drawings no matter how detailed the ideas or instructions he or she provides.

Obtaining Copyright by an Assignment

The Supreme Court's work-made-for-hire decision does not leave commissioning parties entirely out in the cold, however. A party can still obtain ownership of a copyright by a written agreement transferring the copyright. The ownership of the copyright simply becomes a matter of contract negotiation.

There are some pitfalls, though. To be valid, the transfer of copyright ownership must be in writing and signed by the copyright owner. Further, the Copyright Act provides that after 35 years, the copyright ownership will revert to the original author. While most software would be obsolete long before the reversion, it is conceivable that some systems could have a life that long.

Copyright Importance to Programmers

The importance of copyright ownership cannot be overstated. The copyright owner controls reproduction, modification, and sale or licensing of a computer program. The financial benefits of ownership, too, are very real, especially where the software is unique or has high marketability.

The Supreme Court's decision resolves some issues, but it leaves many questions unanswered. Consequently, all parties involved in a computer program (even those programs that are already implemented) should exercise care in determining their copyright interest. As for future transactions, programmers should negotiate up front the matter of copyright ownership, and hiring parties should obtain a written assignment if they want to be sure they own the copyright to programs created by freelancers. ■

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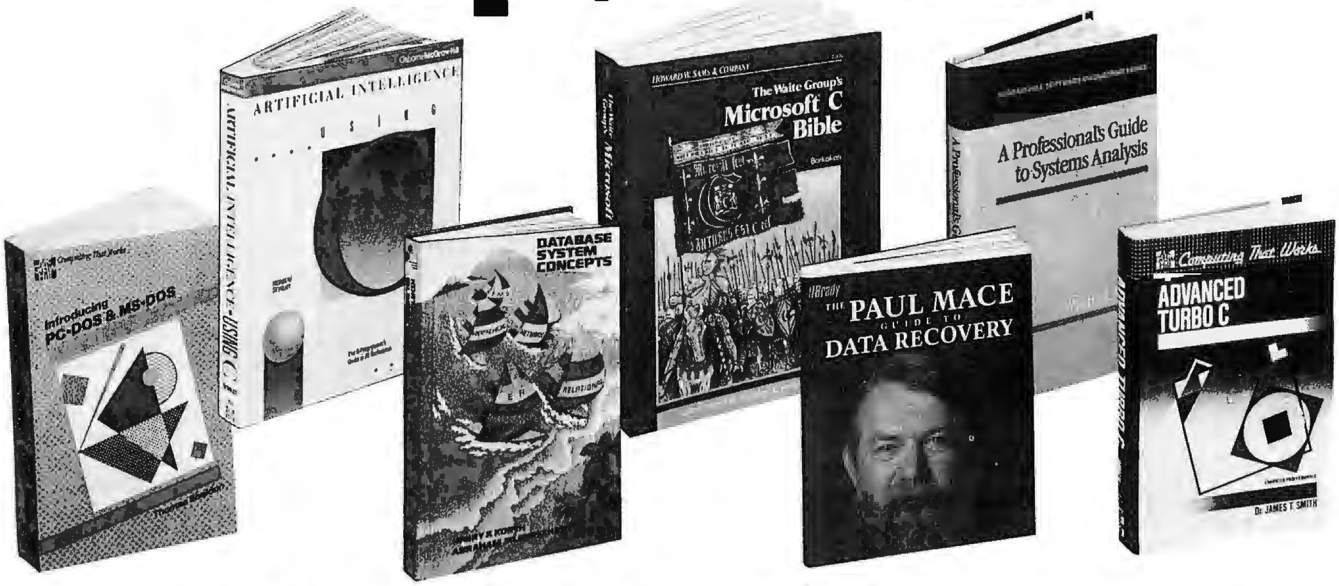

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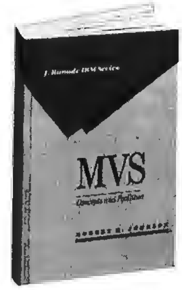

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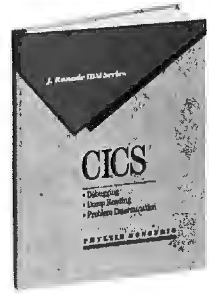

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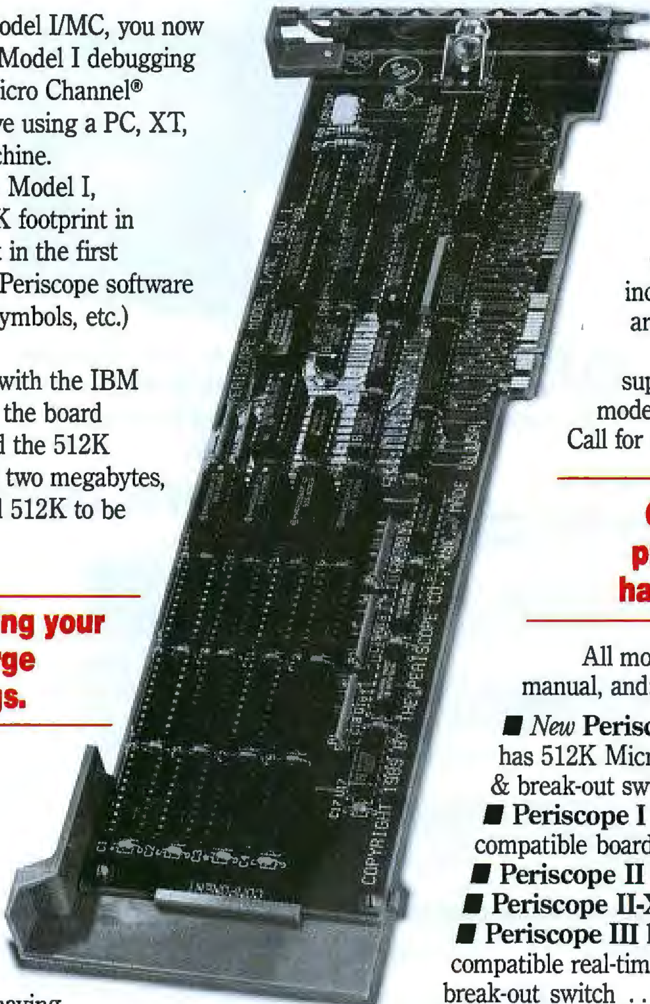

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MANAGING THE WELL-TEMPERED LAN

Network management can be a daunting task, but new tools and emerging standards can help

William Stallings

A recent survey of Fortune 500 companies by a market research firm, Infonetics (Santa Clara, CA) revealed that these firms are suffering an average of two local network outages per month, with an average outage time of 5 hours. About 5 percent of the companies averaged more than two such outages per week. Company executives estimate the average annual costs per firm at $3.5 million in lost productivity and over $600,000 in lost revenue.

These are Fortune 500 companies with the budget and technical staff to handle local network installations, so how can this be? The answer is their lack of effective network management. Networks have grown in many ways—physical extent, number of users, amount and diversity of traffic, and complexity of supporting communications software. In addition, in too many companies, network management tools and procedures have not kept pace with these factors.

One University's Experience

LAN administrators who follow the industry's product offerings are aware that software tools can help to keep a LAN or set of LANs running smoothly. For example, a large university (which, for security reasons, will remain nameless) has developed an effective networking strategy based solely on Ethernet products. It began with a very simple architecture based on the use of a central backbone Ethernet. Attached to this central backbone were repeaters to 35 of the 110 on-campus buildings. Each remote site, designated a *minihub*, serviced equipment in a single building or a cluster of buildings. Thus, the architecture was a star arrangement, with a central backbone network and a number of minihub networks attached to the backbone.

With the use of repeaters, the entire system functioned as a single Ethernet providing a total capacity of 10 megabits per second. With growth in the number of users and in the amount of time average users utilize the network, however, this capacity soon became insufficient.

As the load on the network increased, the university was able to keep pace by splitting the backbone into two backbones connected by an Ethernet bridge. Effective use of this configuration requires thoughtful load balancing to minimize the traffic through the bridge and avoid a bottleneck. With the aid of a traffic-monitoring package, the university was able to observe the traffic between pairs of stations and make an effective split.

At present, this architecture is sufficient to serve the needs of the main campus. However, there are also five

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ILLUSTRATION: PAUL COZZOLINO © 1990

regional campuses located in a 90-mile radius around the main campus. Each of these sites requires a network for on-campus communications, as well as links to the other regional campuses and the main campus. In keeping with their main-campus configuration, the university has developed an architecture that is simple, uniform, and compatible with the central campus architecture and that provides communications both within each

Any regional minihub linked to the central network can become the central segment in a starlike expansion using repeaters and Ethernet segments, replicating the central campus architecture.

regional campus and among all the campuses.

Each regional campus is served by a minihub. Each minihub is connected to the main campus by means of a pair of remote bridges. At installation, each pair of remote bridges is connected by a 56,000-bps link provided by a university-owned private microwave system.

For emergency backup, an alternative path via 9600-bps modems using dial-up telephone lines is in place. Thus, if the microwave system fails, by using the public telephone network, the university still has a limited amount of connectivity. If the single 56,000-bps link becomes saturated, it is possible to install an additional 56,000-bps link between the same two bridges. The bridges use multiple links simultaneously, load-balancing between them automatically.

This scheme extends the transparent, seamless interconnection of devices to the regional campuses. In effect, the regional networks and the central system perform as a single Ethernet.

Every station on the expanded network has a unique address, and any station can address any other station with no knowledge of its physical location. The consistent use of repeaters and bridges guarantees this transparency. Furthermore, the regional campuses are poised for expansion with no disruption or reconfiguration of the overall network. Any regional minihub linked to the central network can become the central segment in a starlike expansion using repeaters and Ethernet segments, replicating the central campus architecture. Indeed, any of the regional campuses can establish a two-segment backbone in the same manner as the central campus. The same seamless interconnection exists no matter how much the remote network expands.

Automated Tools Help

The network management group uses several software control tools. These tools support the institution's ability to configure devices remotely, to diagnose problems, and to reboot terminal servers. The university uses utilities for automating password changes, collecting server usage statistics, and reviewing server-PROM revision levels.

The university also uses network management software to produce audit trails for all connections, disconnections, occurrences of queues, network faults, and other network events of significance. The audit trail helps determine future needs for additional host computer connections, identify common client mistakes, and study other usage trends.

Also obtainable is a LAN-monitoring package that provides cumulative information on overall Ethernet traffic. Reports, available in real time, supply information regarding peak throughput and long-term utilization trends. The information helps determine expansion requirements, assists in deciding how to load-balance the two halves of the core network, and generally provides a good picture of overall use and performance of the Ethernet.

The software is deficient in one area, however: fault isolation. Initially, the university mixed Ethernet components from two different vendors. Each of these products had strong points. However, this mix created chronic problems. Each manufacturer, of course, credited the other manufacturer's equipment as the source of the intermittent (but severe) network disruptions. Finally, for the sake of standardization, the university eliminated all LAN equipment except that of a single vendor. The improvement in network reliability was dramatic.

Prior to the standardization, there was an average of three user-perceivable Ethernet disruptions per day. After standardization, the rate settled down to fewer than one disruption per month. This improvement resulted not because the remaining vendor was the only reliable one, but because there was a single point of responsibility for errors.

Configuration Assistance Welcome

As another example, consider the difficulties of a government research center that was relying on a broadband LAN to tie together mainframes, minicomputers, personal computers, and terminals located in over 100 buildings spread across a 350-acre site. As the traffic on the LAN grew, it became impossible to accommodate all the equipment on a single 5-Mbps, 6-MHz channel. As a result, the center opened up five channels on the LAN with channel-to-channel bridges to allow any device to talk to any other device.

The center tried to cluster groups of users on the same channel, but, even so, users occasionally reported slow responses. Also, there were instances when connections seemed to lock up and require cancellation. To manage the network properly and plan for growth, the center installed performance-monitoring software that provided a profile of connections across bridges versus connections on the same channel, traffic per connection, traffic per bridge, and other useful statistics. Thus, the center was able to continually adjust channel assignments to maintain proper load balancing.

This software, however, was insufficient to diagnose a new problem that cropped up. At random times, a surge of traffic would drastically reduce response time. This situation would occur without any noticeable change in the number of connections or active users. The center decided to add software that could count the number of retransmissions of packets by source and by channel. As a result of the installation, a clue emerged. The slow response time coincided with high retransmissions on two particular channels involving a terminal cluster on one channel and a large minicomputer on the other.

The monitoring software was set to generate an alarm when this condition occurred. When the alarm sounded, a network administrator checked the jobs running on the minicomputer and eventually traced the problem to a high-volume graphics job that would dump large volumes of data onto the LAN. After

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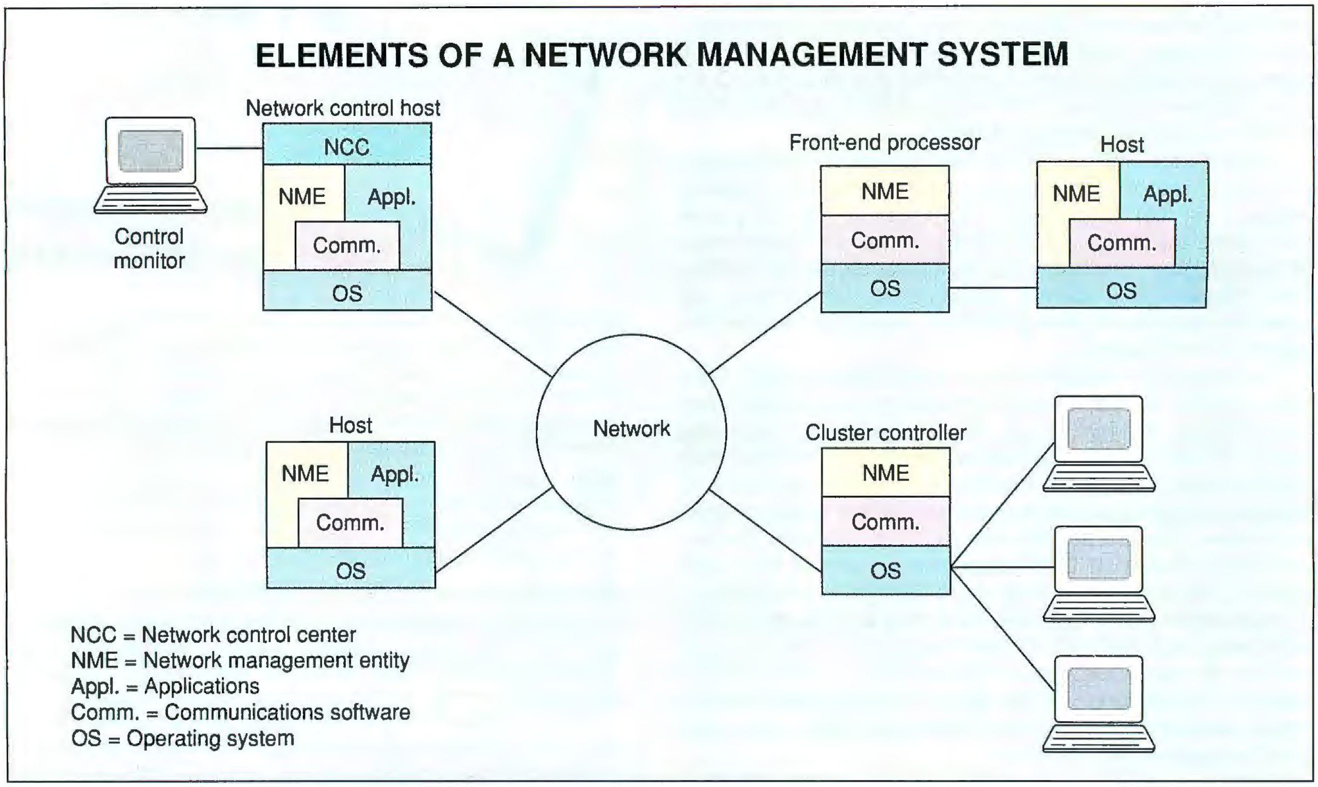

Each system includes a network management entity package that performs local functions. It can communicate with a network control center that has the same software as other nodes, plus network control software that provides a user interface for managing the entire network.

this diagnosis, it was possible to reconfigure the network to solve the problem.

The use of monitoring software to diagnose and resolve performance problems is perhaps an obvious tactic that most LAN customers will employ. There are other areas that may seem more mundane but that nevertheless can save much time and energy. Any software that will help in the configuration process becomes valuable when an organization grows from a small user population on one LAN to a large population on a number of LANs spread throughout several sites.

Network Management Systems

Most personnel responsible for network management appreciate the value of network management software. But two problems confront the manager. First, the variety of tools needed can lead to the procurement and use of a number of packages with different user interfaces and different hardware platform requirements. Second, if the facility includes equipment from a number of vendors, it is difficult to find software that works effectively across all vendor brands.

From the user's point of view, the best approach would be to obtain a set of tools for network management that provides several features. It would contain a single-operator interface with a powerful but user-friendly set of commands for performing most or all network management tasks. It would require a minimal amount of separate equipment. That is, most of the hardware and software required for network management would be incorporated into the existing user equipment.

A system that supplies this type of integration is generally referred to as a network management system. It consists of incremental hardware and software additions implemented among existing network components. The software used in accomplishing the network management tasks resides in the host computers and communications processors (e.g., front-end processors and network interface units). A network management system is designed to view the entire network as a unified architecture, with addresses and labels assigned to each point and the specific attributes of each element and link known to the system. The active elements of the network provide regular feedback of status information to the network control center.

The figure illustrates the architecture of a generic network management system. Each network node contains a collection of software devoted to the network management task, referred to in the diagram as a network management entity. Each NME collects statistics on communications and network-related activities and stores statistics locally. Each NME also responds to commands from the network control center, including those that transmit collected statistics to the network control center, change a parameter (e.g., a timer used in a transport protocol), provide status information (e.g., parameter values and active links), and generate artificial traffic to perform a test.

At least one host in the network is designated as the network control host. In addition to the NME software, the network control host includes a collection of software called the network control center. The NCC includes an operator interface to allow an authorized user to manage the network. The NCC responds to user commands by displaying information and/or by issuing commands to NMEs throughout the network. This communication is carried out using an application-level network management protocol that uses the communications architecture in the same way as any other distributed application.

continued

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DIVISIONS OF NETWORK MANAGEMENT

Table 1: ISO is developing standards for network management within a framework consisting of five main functional areas.

Fault management	The facilities that enable the detection, isolation, and correction of abnormal operation of the OSI environment.
Accounting management	The facilities that enable charges to be established for the use of managed objects and costs to be identified for the use of those managed objects.
Configuration and name management	The facilities that exercise management control over, identify, collect data from, and provide data to managed objects. They assist in providing for continuous operation of interconnection services.
Performance management	The facilities needed to evaluate the behavior of managed objects and the effectiveness of communications activities.
Security management	The facilities that address those aspects of OSI security essential to operate OSI network management correctly and to protect managed objects.

NETWORK MANAGEMENT STANDARDS

Table 2: So far, ISO has issued five standards that relate to network management. The overall management framework is part of the OSI model specification.

ISO 7498-2	Open Systems Interconnection—Basic Reference Model Part 4: Management Framework
DIS 9595	Common Management Information Service (CMIS) definition
DIS 9596	Common Management Information Protocol (CMIP) specification
DP 10040	Systems Management Overview
DP 10164	Structure of Management Information

Several observations are in order. Since the network management software relies on both the host operating system and the communications architecture, most offerings to date are designed for use on a single vendor's equipment. In the case of a network of personal computers, there are a number of LAN network management packages that will tie together personal computers from a number of vendors. Standards in this area are still immature, but in the next few years, there should emerge standardized network management systems designed to manage a multiple-vendor network.

As depicted in the figure, the NCC communicates with and controls what are essentially software monitors in other systems. The architecture can be extended to include technical control hardware and specialized performance-monitoring hardware as well.

To maintain high availability of the network management function, it makes sense to use two or more NCCs. In normal operation, one of the centers idles or simply collects statistics while the other performs control functions. If the primary NCC fails, the backup system should still function.

Network Management Standards

As LANs for personal computers expand to become networks of LANs, the need for network management becomes increasingly important. Until now, LAN users have had to rely on a simple network control facility provided by the LAN hardware vendor, or a set of proprietary software, such as IBM's NetView or the Novell software. These approaches will ultimately be inadequate for several reasons.

Users want the freedom to mix equipment from different vendors and yet retain a unified network management architecture with a single interface. Also, tools developed to deal with single-LAN management are inadequate for dealing with an internet consisting of multiple LANs and wide-area networks.

What is needed is a standard for network management that would function as the basis for multivendor and multinetwork management tools. The International Standards Organization (ISO) has developed a standard for network management referred to as the Open Systems Interconnection (OSI) management framework. It specifies the functions to be performed by a network management system and defines protocols for the exchange of commands, responses, and measurement data.

This standard is relatively new, and no products are yet available. However, it is serving as the basis for network management systems being developed by computer and LAN vendors and, as such, will assume increasing importance in the marketplace.

Functional Areas

The ISO document divides the network management task into five functional areas (see table 1). These areas provide a useful checklist for assessing any network management offering.

Fault management facilities allow network managers to detect problems in the communications network and the OSI environment. These facilities include mechanisms for the detection, isolation, and correction of abnormal operation in any network component or any of the OSI layers.

Fault management facilities detect and report the occurrence of faults. These procedures allow a managed system to notify its manager of the detection of a fault, using a standardized event-reporting protocol. Other facilities log the received event report. This log can then be examined and processed. In addition, there are fault management procedures that schedule and execute diagnostic tests, trace faults, and initiate correction of faults. These procedures can be invoked as a result of analyzing the event log.

Accounting management facilities allow a network manager to determine and allocate costs and charges for the use of network resources. They provide procedures that inform users of costs incurred, using event reporting and data manipulation software, and enable accounting limits to be set for the use of managed resources. They also enable costs to be combined where multiple resources are used to achieve needed communication.

continued

Configuration and name management facilities allow network managers to exercise control over the configuration of the network components and OSI layer entities. Configurations can be changed to alleviate congestion, isolate faults, or meet changing user needs. Configuration management provides procedures to collect and disseminate data concerning the current state of resources. Locally initiated changes or changes due to unpredicted occurrences are communicated to management facilities by means of standardized protocols.

These facilities also provide procedures that set and modify parameters related to network components and OSI layer software, as well as initialize and close down managed objects. They also change the configuration and associate names with objects and sets of objects.

Performance management facilities enable the network manager to monitor and evaluate the performance of network and layer entities. Performance management provides procedures to collect and disseminate data concerning the current level of performance of resources, and maintain and examine performance logs for purposes such as planning and analysis.

Security management facilities allow a network manager to manage those services that provide access protection for communications resources. Security management provides support for the management of authorization facilities, access control, encryption and key management, authentication, and security logs.

OSI Management Architecture

The key elements of the architectural model of an OSI system are as follows:

- *Network management application.* This application provides the mechanism for the network manager, a human, to read or alter data, control the network, and access reports. Residing in the NCC, this application could be a very simple command interpreter or an expert system requiring very little interaction with the network manager.
- *System management application process (SMAP).* This application is the local software within a system responsible for executing the network management functions on a single system (e.g., host and front-end processor). It has access to an overall view of system parameters and capabilities and can, therefore, manage all aspects of the system and coordinate with the network management application and SMAPs on other systems.
- *System management application entity (SMAE).* This application is responsible for communication with other nodes, especially with the network management application in the NCC host. Standardized application-level protocols are used for this purpose.
- *Layer management entity (LME).* Software is embedded into each layer of the OSI architecture to provide network management functions specific to that layer.
- *Management information base (MIB).* This is a collection of information at each node pertaining to network management.

By defining these five items, ISO has created a structure within which developers can create standards relating to network management.

Related ISO Standards

The OSI management framework document (ISO 7498-4) is part of the overall specification of the OSI architecture. It supplies a general structure for network management. In addition, ISO is developing specific standards for various aspects of network management (see table 2).

These ISO standards are important to the user who is planning a future network management strategy. Although the standards have not been finalized, several vendors are positioning themselves to provide ISO-compliant network management products. Furthermore, the products being developed will operate not only on the OSI architecture, as you would expect, but also on the TCP/IP protocol suite.

This latter communications architecture, developed as a set of military standards, is widely used in LAN products. Thus, whether your installation uses TCP/IP or OSI-based products, the ISO standards offer the means for developing a vendor-independent network management capability.

The ISO standards are based on three key concepts: the management information base (MIB), the Common Management Information Protocol (CMIP), and the Common Management Information Service (CMIS).

The MIB is a list of items that can be managed by the network management system. The network management specifications developed for TCP/IP make use of the same formats and include a subset of the objects defined in the ISO standard.

The CMIP is the protocol by which various management entities communicate. The use of the term *common* refers to the fact that the protocol is used to support work in all five functional areas of OSI network management (those listed in table 1). This application-level protocol is part of the OSI protocol suite and is intended to work with systems that implement the OSI architecture.

In the TCP/IP community, the current draft version of CMIP is used in CMOT (for CMIP over TCP/IP). This is the same protocol; the difference is that the protocol is specified to run over TCP/IP rather than the OSI protocols. A number of TCP/IP vendors are working on CMOT implementations. In the meantime, the TCP/IP community is relying on the Simple Network Management Protocol (SNMP), which provides a rudimentary network management capability that can be used in the near term. SNMP and CMOT share the same management information base, which will make migration easier.

Finally, the CMIS defines the services that can be supported by CMIP.

Network Management Solutions

The need for network management grows with the complexity and scale of the networks to be managed. Although it is possible to acquire software and hardware tools that address specific areas individually (e.g., fault detection and security), a full-fledged integrated network management system is the most effective way to satisfy the spectrum of network management requirements.

As in other aspects of computer communications, proprietary approaches to network management create difficulties in the areas of flexibility and vendor independence. Accordingly, the ISO network management framework and evolving standards offer hope for resolution of the network management problems facing those with substantial network installations. Both TCP/IP and OSI-based products that conform to this set of standards are beginning to appear. Now is the time to plan for the use of this effective network management system. ■

Editor's note: *This article is based on material in the author's new book,* Business Data Communications *(Macmillan, 1990).*

William Stallings is president of Comp-Comm Consulting in Prides Crossing, Massachusetts, and the author of 14 books on data communications and computer systems. He can be reached on BIX c/o "editors."

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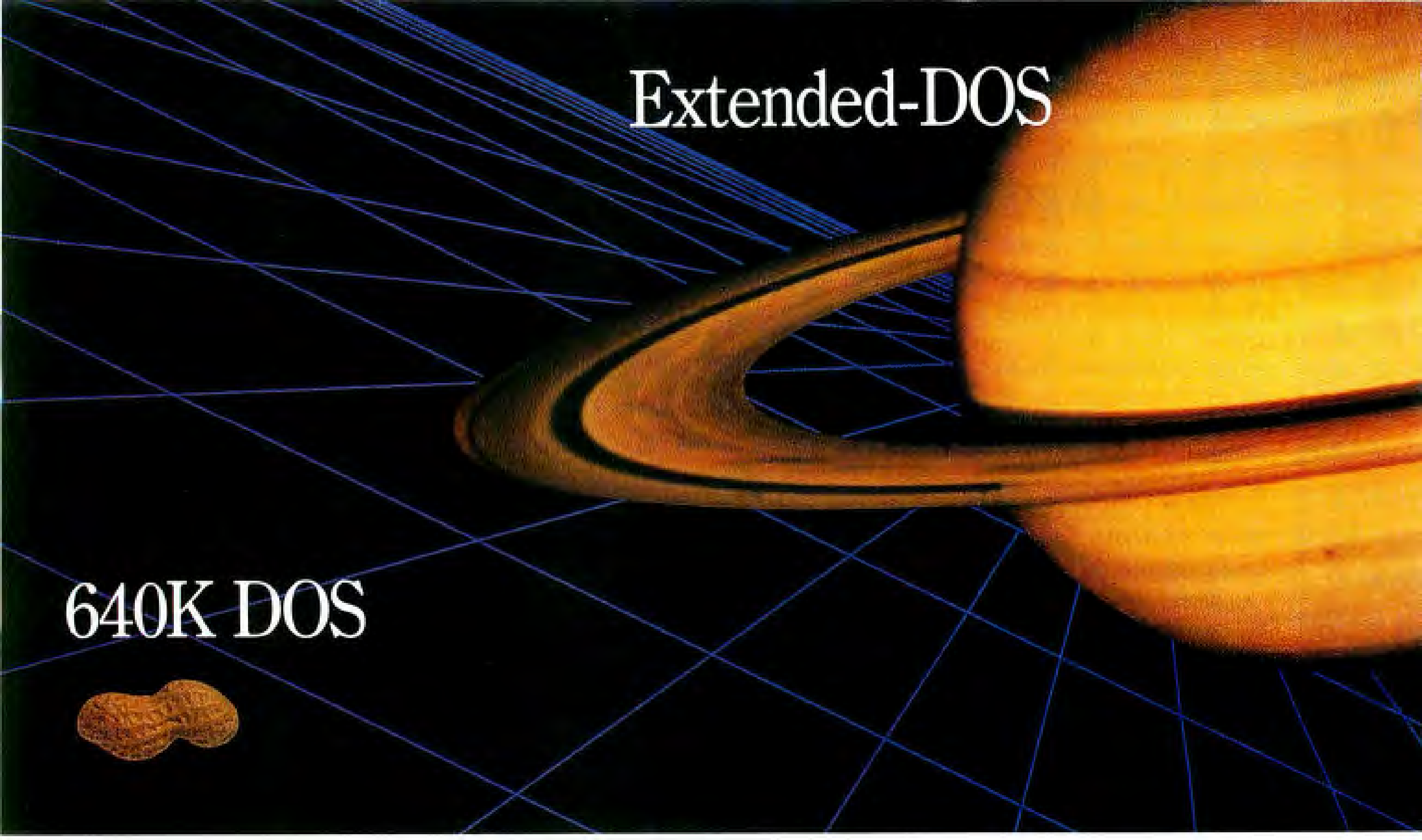

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GATEWAYS TO PROTECTED MODE

DOS extenders offer the best of two worlds: DOS compatibility and access to protected mode

For programmers and users of Intel-based microcomputers, the architectural legacy of the IBM PC is a blessing and a curse. No other industry-standard architecture enjoys as wide a variety of polished prepackaged software, useful utilities, and high-powered development tools.

However, few architectures have as many restrictions and limitations. The most hobbling of these are the formidable 640K-byte barrier, which prevents programs, data, and DOS from using more than 640K bytes of directly accessible memory, and the 64K-byte limit on memory segment size, which requires programs to perform special gymnastics to manipulate large data objects.

Both limitations arise from the design of the original PC and its CPU, the Intel 8088. The 8088's address space contains only 1 megabyte, and only 640K bytes of this was made available for programs and data on the PC. Despite the introduction of the 286, which can address up to 16 MB of RAM, and the 386, which can perform 32-bit arithmetic and address up to 4 gigabytes in a single segment, the need for downward compatibility and lack of a standard operating environment that supports the new features force most users to run these microprocessors as fast 8088s, in what is called real mode.

Seeking to extract more performance from today's faster clones, clever engineers have come up with numerous ways to circumvent these two limitations. Among these are EMS, add-on program switchers and multitaskers, completely new operating systems, and DOS extenders. Each has advantages and disadvantages vis-à-vis features, compatibility, performance, development techniques, and hardware requirements. In this installment of Under the Hood, I'll discuss how DOS extenders work and how they compare to other methods of getting around the PC's limitations.

Why a DOS Extender?

A DOS extender lets a program run in the protected mode of the 286 or 386, while maintaining access to DOS, DOS device drivers, TSR programs, and the IBM PC BIOS. DOS-extender programs can use all the memory in the machine, including extended memory (i.e., the region above the 1-MB address reach of the original 8088). Protected mode costs some speed, typically 5 percent to 10 percent for the enhanced security of "sanity checking" on accesses to memory and I/O devices, but large memory and—on the 386—full 32-bit addressing and arithmetic usually offset that performance hit by a wide margin.

The user of a DOS-extender program starts it from the DOS prompt the same way he or she would run any other program. There's no new environment to learn, and the user need not even be aware that the extender is at work. DOS-extender makers have gone out of their way to ensure that an ordinary DOS application must be modified only in very minor ways to work with the extender; it might even take just a recompilation.

The downside of DOS extenders is that they run only on systems that use 286, 386, and i486 microprocessors. Users of 8088- and 8086-based machines are left out in the cold. And because the machine must switch back to real mode to handle many system interrupts (including timer ticks and keystrokes), some operations are actually slower, especially on the 286. It's possible, in fact, to drop incoming characters when doing serial I/O at 9600 bps. Fortunately, this problem can

continued

be circumvented with special programming techniques.

What are the other options for getting around the PC's limitations, and how do they compare? While a complete discussion of this topic could fill an entire column by itself, I'll now summarize the key methods.

Other Possibilities

Expanded memory is a bank-switching scheme that switches memory in and out of the PC's address space in 16K-byte blocks. Its key advantage is that it's available on most PC compatibles, including those with 8-bit CPUs.

Expanded-memory emulator programs are available to turn the extended memory on an AT clone into expanded memory, and memory managers (e.g., CEMM, QEMM-386, and 386Max) can use the 386 paging unit to do the bank switching.

Expanded memory's main disadvantages are lack of speed (it takes time to switch banks) and the awkwardness of dealing with RAM that's been broken up into 16K-byte chunks. Expanded memory does not provide access to protected mode or the enhanced addressing and math facilities of the 386 chip.

386 operand and address size overrides let a program running on the 386 in real mode use 32-bit arithmetic and enhanced addressing modes. This simple but little-known feature of the 386 can be used to speed up key parts of a computation. I've seen one program that uses operand size overrides to compute the Mandelbrot set five times faster than it could otherwise.

However, this technique may cause compatibility problems with some OEMs' versions of OS/2, specifically those that don't preserve the full 386 registers during a task switch.

Address size overrides let real-mode programs use powerful array-addressing modes with 32-bit offsets and built-in "shift and add" operations. They can also be used to address segments larger than 64K bytes and memory above 1 MB. However, the techniques for doing so are undocumented (and hence unsupported) by Intel; they may disappear in later chips. And, of course, the 286 supports none of these features.

Other operating environments—notably Unix, OS/2, Concurrent DOS, PC-MOS, and QNX—have been developed to support the enhanced architectural features of the newer chips, but users have been loath to migrate to them. Why? Because they're expensive, require large investments in RAM and hard disk space, and lack DOS's phenomenal software base. Rewriting your own code to run under these new environments can be expensive and incredibly time-consuming.

Fortunately, many of these systems have facilities to run DOS programs—or even several at once—as tasks, but they often do it slowly and with limited compatibility. And the DOS programs they do run are still limited to 640K bytes within their individual "virtual machines" or "compatibility boxes."

Add-on multitaskers (e.g., DESQview and VM/386) let multiple DOS applications run simultaneously and offer good DOS compatibility, but they don't offer a full-up enhanced operating-system environment. And the individual programs they run are still subject to the same limitations they'd encounter under DOS. Note, though, that many of these environments now support DOS-extender

continued

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applications, thanks to VCPI (see "Stretching DOS to the Limit," *IBM Special Edition*, Fall 1989).

Microsoft Windows provides a graphical user interface as well as some multitasking, but it's hungry for RAM and sucks the wind out of a slow CPU. Applications must be extensively rewritten to take advantage of the GUI, and Windows/386 (at least in its current incarnation) won't coexist with some TSR programs or with DOS extenders.

Inside a DOS Extender

A DOS extender's job is a tricky one. DOS and the BIOS run in real mode. Thus, they perform operations that are illegal in a protected-mode system. The DOS extender filters requests from the application program to the system, as well as any information that comes back. The result: DOS and the BIOS "look" like protected-mode system software to the application, and it looks like a real-mode application to them.

The figure shows, schematically, where the DOS extender fits into the scheme of things. The DOS extender manages and filters communications between the program and other system software. It also performs mode switches as necessary and sets up the descriptor tables (i.e., GDT, LDT, and IDT) that control how memory is used.

Care and Feeding of DOS and the BIOS

To make the BIOS and DOS useful to a protected-mode program, the DOS extender must run the system software in real mode and make it think it's dealing with an ordinary real-mode program. This can require a good deal of work.

For one thing, DOS and the BIOS don't know how to handle protected-mode addresses. If a DOS or BIOS call requires a pointer to a parameter (as is often the case with disk functions), the protected-mode address furnished by the application (which contains an abstract segment selector and an offset) must be converted to a real-mode address (which contains a physical segment number and an offset).

What's more, since DOS and the BIOS can't access memory above F000:FFFF hexadecimal (the 1-MB limit), any parameters passed in high memory must be either copied down into the lower part of RAM or mapped into it with the 386's paging unit. Likewise, results must often be copied back up to high memory after a call.

Not all DOS extenders have a full repertoire of DOS and BIOS calls, however. For instance, Phar Lap Software's 386/DOS-Extender does not support DOS functions that use file-control blocks, and none automatically supports NetBIOS (although Rational Systems supplies sample source code that can be used to make NetBIOS calls from the DOS extender). Eclipse Computer Solutions' DOS extenders do buffer copying, but they limit it to 16K bytes on many calls.

A DOS extender must handle interrupts in both real and protected modes. Interrupts can arise from three sources: software interrupts (like the ones used to call DOS and the BIOS), hardware interrupts (usually generated by peripherals), and processor exceptions (usually caused by errors in the application). Furthermore, because the IBM PC BIOS disregards Intel's recommendations and uses some "reserved" interrupt vectors for BIOS functions, the extender must also figure out the cause of each interrupt and call the proper routine.

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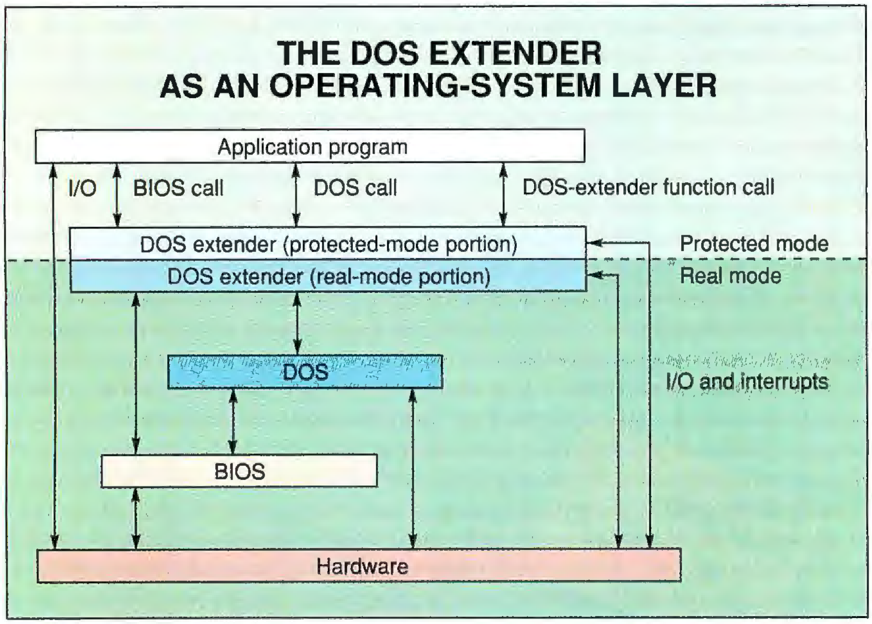

A DOS extender accepts DOS and BIOS calls from a protected-mode application, processes the parameters, and reissues the request in real mode. It also fields interrupts in protected mode (and some in real mode as well), performing mode switches and reissuing interrupt requests as necessary. A DOS-extender application can also have a portion that runs in real mode (not shown), usually for the purpose of handling interrupts without a mode switch.

Turning Off the Engine

One problem that the DOS extender must overcome in each machine is that of switching quickly and nondestructively between real and protected modes. The technique varies with the microprocessor involved. The 286 can be switched from real mode to protected mode in a few instructions. Unfortunately, Intel, in its zeal to make sure that the protection mechanisms on the 286 were secure, provided no way to switch it back! The only way to do so is to reset the microprocessor via a hardware reset line or a particularly nasty sequence of erroneous instructions.

When IBM designed the AT, it noted this problem and provided a hardware workaround for it. An output from the keyboard controller was connected to the main CPU's reset line. The CPU could "commit suicide" by ordering the keyboard controller to toggle the line. The keyboard controller could also be ordered to mask or unmask the 286's A20 address line to simulate the 8088's behavior in real mode.

Some compatibles—including many Compaq machines, systems that use application-specific IC chip sets, and the PS/2s—provide more direct ways of forcing resets and toggling A20. The 386 can be returned to real mode quickly without a reset, and the i486 even provides a pin to notify the internal cache controller that A20 is masked, so that the address used by the cache corresponds to the physical address that appears on the machine's data bus. The bottom line: The time to switch back to real mode can be as short as 30 microseconds on a fast 386 or as long as half a millisecond on a 6-MHz 286.

Protected-Mode Constraints

While the DOS extender is doing its job, the application program must cooperate with it by following the architectural guidelines for protected mode.

As I mentioned in the December 1989 Under the Hood, the most important of these restrictions have to do with memory addresses. A program can access only the memory for which it has a segment selector, and then only in a way that corresponds to the type of the segment. You cannot write to a code segment or execute a data segment (although it is possible to create an *alias*—a writable data segment that overlaps a code segment—if you must).

You can only perform an intersegment jump or call to a "safe" entry point through a call gate. You can't read or write beyond the end of a segment. And you can't trash the operating system by mistake—unless, of course, it chooses to let you do so. If you try to do any of these things, you will get a GP (General Protection) fault, and your program will stop running.

Generally speaking, protection is a good idea. It tends to catch program bugs like wild pointers and out-of-bounds array indexes. Different DOS extenders provide different degrees of protection, however, as you'll see shortly when I look at some actual products.

Virtual Memory

Another advantage of protected mode is the possibility of virtual memory. If you like writing programs that use 64 MB of RAM, and you don't happen to have that much handy, a DOS extender can help. Virtual memory in the 286 must be implemented by swapping whole segments, up to 64K bytes at a time. On the 386, however, the paging unit works with 4K-byte pages.

In either case, a simple least-recently used algorithm is usually sufficient to keep the system from thrashing. All the manufacturers of DOS extenders I've seen either have virtual memory or plan to have it in the near future.

Four DOS Extenders

To gain experience with DOS extenders, I obtained copies of four products: two for the 286 and two for the 386. These included Rational Systems' DOS/16M (the DOS extender that Lotus picked for 1-2-3), Eclipse Computer Solutions' OS/286 and OS/386, and Phar Lap Software's 386/DOS-Extender. To familiarize myself with the development process for each one, I wrote a simple program—the ever-popular "hello world"—in assembly language. It made only two DOS calls: one to function 9 (Write String), and another to function 4C hexadecimal (Terminate Program).

I then built and executed each program, using my own AT clone for the 286 extenders and a 20-MHz 386 system lent to me by Arche Technologies for the 386 extenders. All the programs generated by the 286 extenders also ran on the 386 with no changes, as you might expect.

Although the source code used with both of the 286 extenders was the same, DOS/16M required me to assemble and link an additional module into my code. The purpose of this module was to set up a series of segments for descriptor tables and video screens and to make sure the segments were in the right order.

Building a DOS-Extender Program

For each 286 DOS extender, I used the Microsoft Macro Assembler (MASM)

continued

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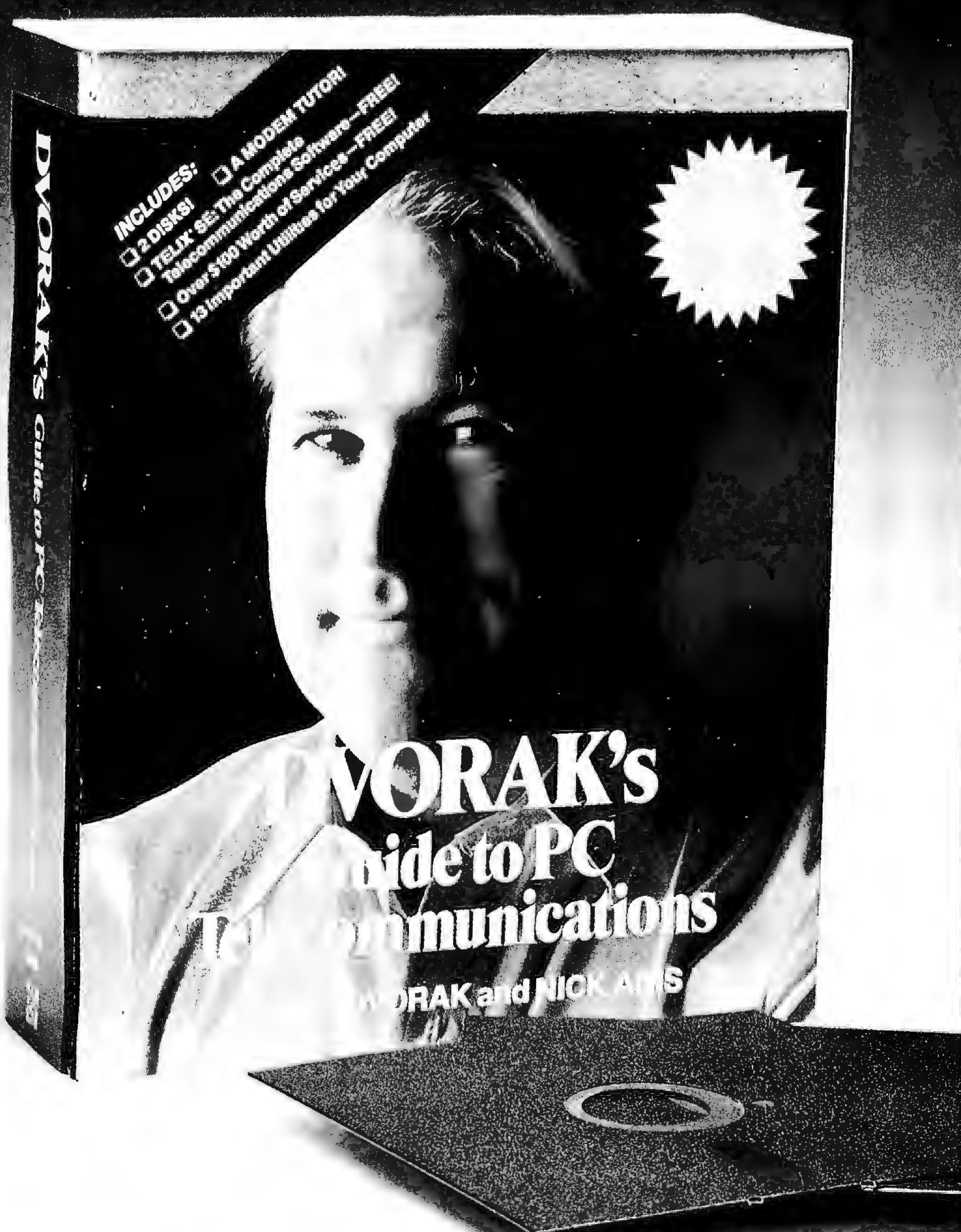

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5.10 and the Microsoft Overlay Linker 3.65 to generate the initial .EXE files and associated .MAP files. (The .MAP files are very important, because they let the postprocessors set up call gates for intrasegment calls.) Both .EXE files ran as ordinary real-mode programs from the DOS prompt. I then passed each through a postprocessor (.EXPress for OS/286 and MAKEPM for DOS/16M), which converted them to a protected-mode format.

To execute the OS/286 program, I loaded the OS/286 kernel as a TSR program by simply typing OS286 at the DOS prompt; I could then execute the "hello world" program by typing UP HELLO. DOS/16M didn't require a resident kernel; I was able to run that version by typing LOADER HELLO.

I assembled the 386 examples with MASM, but I linked each with a 32-bit linker provided by the manufacturer of the DOS extender. I did the version for OS/386 first, and it assembled, linked, and ran on the first try. However, the Phar Lap linker rejected the code with a complaint about a *segment fixup* in the object module. (A segment fixup is used in large-model programs to let the loader insert segment selectors into the code just before it runs.) Phar Lap uses a small—or "flat"—memory model. The one segment used for code, data, and the stack covers all of memory. Its linker and loader therefore don't need to handle the concept of fixups.

I solved the problem by removing a reference to SEG DATA in the source code. The program then linked and ran without a hitch. OS/386, like OS/286, loads the kernel as a TSR program. You use the UP command to run programs. (OS/386 will also run 16-bit protected-mode programs created for OS/286, so you can keep one kernel loaded for both.) Phar Lap provides a loader that's called RUN386 to run its programs. All three DOS extenders came with debuggers. None was of the quality of CodeView or Turbo Debugger, but they all seemed adequate for simple debugging jobs.

Run-Time Environments

Each of the DOS extenders I used presented a slightly different run-time environment to the program. Phar Lap's is the simplest: The code, data, and stack are all mapped into a single large program segment. This segment is normally aliased so that all the segment registers point to it. (Unfortunately, this means that it's very easy for a buggy program to clobber its own code.)

The other three extenders allow multiple segments. The Phar Lap and Rational Systems extenders run all protected-mode code at PL 0, but the Eclipse extenders run the kernel at PL 0 and the user program at PL 3. The latter seems to me to be a wise decision; it's a good idea to take as much advantage as possible of the facilities of protected mode.

High-Level Languages and DOS Extenders

All the DOS extenders I tested came with lists of high-level-language compilers that they supported. (There's no room here to list them all; contact the manufacturers for the most current lists.) Some compiler manufacturers (e.g., MetaWare) work with the DOS-extender manufacturers to make their products compatible; others (e.g., Microsoft) aren't as cooperative and are supported via third-party patches to the run-time libraries. Almost all the patches are workarounds for areas where the run-time libraries access absolute addresses directly, create self-modifying code, or do segment-address arithmetic.

To see what it was like to work with a high-level language under a DOS extender, I tried Meridian Software Systems' AdaVantage Ada compiler and environment, which work with OS/286. Once I got the system installed, I could hardly tell the difference between developing for real and protected modes. The environment "knew" about the DOS extender and behaved appropriately. I was able to get some simple Ada programs running in about an hour.

I tried one more experiment. Eclipse claimed in its manual that the .EXPress program would convert many real-mode programs to run in protected mode, as long as there was no segment arithmetic and the program was reasonably well behaved. I decided to test this by writing a simple Turbo Pascal "hello world" program, generating a .MAP file, and then running the output through .EXPress.

That didn't work, as .EXPress complained that it couldn't find a "Publics by Name" section in the .MAP file (there wasn't one) and quit without producing any output. Daringly, I used a text editor to add the required heading to the .MAP file and tried again. This time—lo and behold!—the conversion worked, and the program ran in protected mode.

Eclipse says that it will soon support Turbo Pascal with a patched run-time library that allows the heap and overlays to work completely.

Compatibility Problems

DOS extenders work hard to make your hardware perform unusual stunts—and

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Inquiry 984.

sometimes the hardware doesn't cooperate. Before you can run Eclipse's OS/286 kernel, you must run a program called Tune, which checks the characteristics of your machine and sets the kernel up to work with it. The documentation warns that Tune may crash the machine a few times as it works, so when this happened on my trusty 8-MHz 286 clone, I calmly rebooted and tried again.

Alas, Tune hung the machine more than 20 times before I stopped trying. It couldn't figure out how things needed to be configured. I therefore called Eclipse, and its technical-support people were very helpful. They gave me a command that forced Tune to configure the kernel as if my machine were a standard AT. The resulting kernel ran with no problems.

What Price Speed?

Each of the DOS extenders I tested lets you "bind" the extender to the loader program to create an .EXE file that can be run directly from the DOS prompt. However, only Rational Systems' package actually included such a utility. The other vendors required you to buy a license before you could use it.

Suppose you're now sold on the idea of using a DOS extender in your application. How much can you expect to pay in royalties? If you have a successful product, you will probably pay a great deal, regardless of which vendor you choose.

Phar Lap charges $1995 for the first 1000 copies and 2 percent of the list price of your program for each copy thereafter.

Rational Systems' DOS/16M, which has a $5000 price tag to start with, comes with a license that lets you distribute 200 copies of your programs. After that, you pay $30 per copy up to the 999th copy and $15 per copy thereafter. If you wish to prepay for some larger number of copies or buy a blanket license, you need to negotiate directly with the company.

Eclipse lets you distribute 2500 copies of your application(s) for a single $10 registration fee, but after that you must pay more, up to a maximum of $15,000.

These prices may be sufficiently daunting to developers that they are inspired to roll their own DOS extenders. While this is a tricky business, it's certainly possible—and even likely—that some will do so. And compiler developers, eager to cash in on the DOS-extender market, may develop extenders exclusively for their own products.

I asked each vendor if its agreement made provisions for distribution of products as shareware; so far, none had. Unfortunately, without special terms for this mode of distribution, it's unlikely that we'll see protected-mode programs written with these DOS extenders in the shareware arena.

The Right Choice?

With OS/2, Windows, Unix, DESQview, DOS extenders, and DOS replacements all competing for pieces of the operating-environment marketplace, DOS extenders have two key advantages. First, they don't require you to run out and buy an expensive piece of software (and possibly hardware to match); second, they provide better performance than most (perhaps all) of the other environments. The 386 DOS extenders run consistently ahead of Unix and OS/2 on virtually all benchmark tests, probably because they eliminate the overhead of a multitasking kernel and scheduler.

I plan to experiment further with DOS extenders as a way of getting more out of my systems and honing my protected-mode programming skills. While vanilla DOS and real mode will surely be around for a long time to come, it's clear that protected-mode programming will play an important role in the future of the Intel-based world. ■

ACKNOWLEDGMENT
Many thanks to Arche Technologies for the loan of a 386 system for use with the 386 DOS extenders.

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Your questions and comments are welcome. Write to: Editor, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458.

FLIRTING WITH ASSEMBLY

When in Finland, do as the Finnish do; when in assembly, try the same

In *The Mythical Man-Month*, Frederick P. Brooks Jr. estimates that replacing 1 percent to 5 percent of high-level-language code with machine language is the best fix for any speed problem. For many hackers, that's been the most tantalizing of statements. True, a number of high-level languages, notably the ones in Borland's Turbo family, do provide machine language interfaces; but wasn't your reason for mastering one of those languages precisely that you'd be spared a byte-by-byte coping with assembly? If so, then (like me) you may have no grasp of assembly at all, and the luscious fruit Brooks dangles is just out of reach.

All need not be lost. Although I'll not be denying that the more you know the better, I'll offer a case history of how enlightened ignorance can sometimes lead to useful work. A Turbo Pascal program I'd written got speeded by a factor of six when I replaced two short procedures with assembly equivalents. One of them, yes, I copied from a book, but the other I devised on the principle by which a nonspeaker of Finnish might manage to order breakfast in rural Finland: Observe the natives and imitate their ways.

Ignorance can be enlightened by two things: by the fact that all computer languages have structural analogies that the very nature of the computer enforces, and by the fact that once you find a skeleton to flesh out, a few hints from a good book may suffice.

A Dark and Stormy Night

It all started when I needed a program that would locate text strings (words and phrases) in large text files and then tell me where and how often it had found them. Well, don't the MS-DOS utilities offer FIND.EXE? Yes, yes; but FIND doesn't tell you how often it found its quarry; it can tell you on how many distinct lines, which may be quite a different number. Also, for my purposes, FIND has at least two trouble areas.

The first is awkwardness. Each and every search requires a complex command line, where you specify the file to be searched, the string to be sought, refinements like "Ignore letter case" and "Display line numbers," instructions about where the output should go (disk? printer?): in short, much finicky keypushing per search. And I envisaged perhaps dozens of searches per session.

The other trouble with FIND is that you can't make it disregard punctuation. That can cause no end of trouble. Say you want all instances of the word *up* in a file that contains, among other items, the following:

1. go up to
2. Up there
3. puppy
4. Get up!
5. Upset

The instances you want are 1, 2, and 4. FIND's search will locate 1, 3, and 4, overlooking "Up" and including an unwanted "puppy." The same search with the /I switch set (to ignore case distinctions) will locate not only the three items you do want, but also two you don't—items 3 and 5. By prefixing a space to the search string, you could exclude "puppy," and spaces both before and after would exclude "Upset" too; but then the trailing space would make the search miss "Get up!" So can't you somehow suppress punctuation as well as case?

Not, so far as I can see, with the DOS version of FIND. So my next step was to write a Turbo Pascal program, called SEEK, with the following specifications:

1. Just once, at the start, you name the file you plan to search.
2. The program asks you where you want the output: Printer? Disk file? Screen?
3. After that, it asks you for something to find (the Quarry), and each time you supply a Quarry it offers you two options:
   Ignore case distinctions? <y/n>
   Ignore punctuation? <y/n>
4. Output consists of numbered lines containing the Quarry.

If the Quarry appears twice on a line, the line is shown twice. At the end, the program tells you that the Quarry was found *n* times, or else it tells you, "I didn't find [Quarry]." It then asks you for a new Quarry; by answering "-" you can exit to DOS.

Like most no-fuss programs, SEEK devotes much code to getting filenames, error-checking, and other such housekeeping. But once under way, it spends most of its time as follows:

1. Read the next line of text to a string;
2. On a working copy of the string, (a) attach a leading and a trailing space; (b) swamp case differences if required; (c) kill punctuation if required;
3. Search the modified `CopyString` for Quarry; (a) If found, write the original line (numbered) to Outfile. (b) Search further along the string for a recurrence. (c) Found another? Back to 3a. No more? Back to 1.

The Game Is Afoot

I didn't need to write a search algorithm; Turbo Pascal has a very fast POS function to return an integer designating the first appearance of your Quarry in a line. A zero means "not found," so only when

```
POS (Quarry, CopyString) <> 0
```

continued

do you have to do anything more. (What you do is print `LineNumber` and `Line`, then behead `CopyString` right up to the end of the Quarry you've found, and then search what's left anew, just in case your Quarry is present more than once.)

That worked—not as fast as FIND but agreeably fast—so long as I didn't request it to "Ignore case differences" or "Ignore punctuation." In particular, the latter mired SEEK's feet in molasses.

The obvious way to "Ignore case differences" was to put both the Quarry and the working copy of each input line into uppercase. That meant, for each of perhaps many hundred input lines, a FOR loop that ran from 1 to the length of the line, uppercasing characters as necessary. Turbo's UPCASE function made that go a lot faster than it might have; the procedure increased SEEK's run times by some 30 percent, ascribable mostly to loop overhead. Without UPCASE—well, read on.

And the obvious way to "Ignore punctuation" meant a similar FOR loop, to ask each character in the line if it's contained in the set [0..9, a..z, A..Z] and replace it by a space if it isn't. (Quarry also gets a space appended if it hasn't one already; thus, a search for "up" with both options set becomes a search for "UP ," and lo, you find "Get Up!" because it's been transformed into "GET UP "; meanwhile, the space guards us against distraction by "PUPPY.") Neat, yes. But you've no built-in Turbo function to help you, and that loop increases run time by an intolerable 650 percent.

I've since replaced the search function itself with an assembly version derived from Robert Jourdain's book *Turbo Pascal Express*. As published, it had a bug, which Dan Mick fixed for me via BIX. Moreover, so efficient is the Turbo Pascal POS that the speed gain proved unspectacular. Still, it was there.

Closing In on the Quarry

So back to *The Mythical Man-Month*'s rule of thumb: When a program spends most of its time doing one thing over and over, then optimize that routine and watch the sparks fly. Obvious candidates for optimization were perhaps the Line Uppercaser and certainly the Punctuation Killer. To optimize a Turbo Pascal routine, you'd rewrite it in assembly language. But I didn't know assembly.

I did, though, chance to remember a detail from the Turbo Pascal 3.0 manual. To illustrate Turbo's in-line assembly code, it offered a sample procedure that did just what "Ignore case" wanted: converted entire strings to uppercase. So I replaced my Pascal `Procedure UpperCase` with a careful copy of what the manual listed. The assembly version ran so fast that for files of, say, 25K bytes, the difference between ignoring case differences and not ignoring them was nearly unmeasurable. *The Mythical Man-Month* was right; I was on to something.

But could I also deal with punctuation in assembly? How long would it take to learn what I'd need? Weeks, likely, with luck. The payoff, savings measured in seconds, seemed insufficient.

But then two things dawned on me in rapid succession. First, when you need code in a language you don't know, best get it from a book, which was what I'd just done with `Procedure UpperCase`. Second, if you can't find it in a book, look for something structurally similar and work out just the modifications. And that is the secret of flirting with assembly (or any other) language. Let a wizard handle the grunt work. Save your own attention for the details you need.

Something structurally similar? Well, I needed to read in a string, check it character by character, and replace anything that wasn't a numeral or letter with a space. And what does `Procedure UpperCase` do? It reads in a string, checks it character by character, and replaces any lowercase characters with uppercase. That seemed close enough to be promising. Possibly, just by retouching `Procedure UpperCase`, I could come up with machine code for a `Procedure DePunct`. I finally did, and here's a play-by-play.

All Is Revealed

The first step was to gain some understanding of how `Procedure UpperCase` worked. It is listed in full in listing 1. I'll be scrutinizing those mysterious assembly statements toward the right. Any reader fluent in MS-DOS assembly can either look away or relive the struggle.

First to catch the eye is that pair of labels, L1: and L2:. And since assembly items are supposed to jog human memories, an instruction beginning with J is probably a jump. (Yes, a book confirmed that.) Examining the code more closely, you find three jumps up to L1: and one jump clear out to L2:. Coming right after a counter has decremented, that JZ likely means "jump if zero" and jumps you to the exit point. Yes, L2:, at the very bottom, does look like an exit. If so, then the business part of the procedure, its repeated looping and testing, is confined to L1: and below. So the lines down to L1: are doing setup, and you can likely take them over as they stand. (All that turned out to be true.)

Now, how does the testing work? It looks as though the range *a* through *z* is being tested, since a character within that range wants uppercasing. A way to uppercase is to subtract decimal 32 (20 hexadecimal) from the character's ASCII value, and that must be what's happening in the second-to-last line of code, which begins with SUB and ends with 20H. Thereafter, a JMP takes us back up to L1:, which must be where a new character starts getting fetched.

Another detail: Our character is evidently not being checked against all 26 of the letters *a* through *z*. The routine is just looking at boundary conditions. An assembly manual confirms the guess that JA means "jump if above" and JB means "jump if below." "Above" and "below" confused me for a little while. "Below" means "lower in value"—that is, nearer the *top* of the ASCII table. So if the character's ASCII value is less than hexadecimal 61 (*a*), or if it's higher than hexadecimal 7A (*z*), it's not a lowercase letter, and the jump takes us back to L1: to fetch the next candidate.

You can see how this is getting promising: Checking for membership in a range seems quick. Now recall the coarse structure of the ASCII table, where the alphanumeric characters come in just three blocks: decimal 48–57 (the numerals 0 through 9), 65–90 (the uppercased *A* through *Z*), and 97–122 (the lowercased *a* through *z*). You might check your character for membership in each block; keep it if it qualifies or have a space quash it otherwise.

So envisage a label SP: where that space gets substituted, and (as before) label L1: where you get the next character. An automatic jump to L1: should follow SP:. Using "below" the way assembly jargon uses it—to mean "nearer the top of the ASCII table"—pseudocode might look like this:

```
Initialize.
L1: Get a character.
Below 0? Jump to SP:, then to L1:.
Below or equal to 9? Jump to L1:.
Below A? Jump to SP:, then to L1:.
Below or equal to Z? Jump to L1:.
Below a? Jump to SP:, then to L1:.
Below or equal to z? Jump to L1:.
```

Notice that when you've descended as far as *A*, you've already eliminated the numerals, leaving it safe to exclude anything above *A*. Likewise, when you've reached *a*, you've eliminated all capitals as well as all numerals. And the place to put SP: is under the *z* test. That's because

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Listing 1: *The compiler sees only the column at the left, where slashes separate binary instructions and $ is Turbo Pascal's marker for a hexadecimal number; thus,* $C4 *says what C4h would say in C, and either of them represents decimal 196, or binary 1100 0100. To the right of each statement, between curly brackets, is its assembly equivalent, meant solely for human consumption.*

```
PROCEDURE UpperCase (VAR Strg : LineStr);
   {From Turbo Pascal 3.0 manual, p. 213} BEGIN
     INLINE (
      $C4 / $BE / Strg /         {     LES   DI,Strg[BP]             }
      $26 / $8A / $0D /          {     MOV   CL,ES[DI]               }
      $FE / $C1 /                {     INC   CL                      }
      $FE / $C9 /                {L1:  DEC   CL                      }
      $74 / $13 /                {     JZ    L2                      }
      $47 /                      {     INC   DI                      }
      $26 / $80 / $3D / $61      {     CMP   ES:BYTE PTR [DI], 'a'   }
      $72 / $F5 /                {     JB    L1                      }
      $26 / $80 / $3D / $7A /    {     CMP   ES:BYTE PTR [DI], 'z'   }
      $77 / $EF /                {     JA    L1                      }
      $26 / $80 / $2D / $20 /    {     SUB   ES:BYTE PTR [DI], 20H   }
      $EB / $E9                  {     JMP   SHORT L1                }
      )                          {L2:                                }
END; {Procedure UpperCase}
```

Listing 2: *The Turbo Pascal in-line code for a procedure that strips all but alphanumeric characters from a string, replacing suppressed characters by spaces. Jumps are represented by their decimal (not hexadecimal) equivalents; backward (negative) jumps are in two's-complement notation (256 plus the negative value).*

```
PROCEDURE DePunct (VAR Strg : LineStr); BEGIN
     INLINE (
      $C4 / $BE / Strg /         {     LES   DI,Strg[BP]             }
      $26 / $8A / $0D /          {     MOV   CL,ES[DI]               }
      $FE / $C1 /                {     INC   CL                      }
      $FE / $C9 /                {L1:  DEC   CL                      }
      $74 / 44 /                 {     JZ    L2         (+44)        }
      $47 /                      {     INC   DI                      }
      $26 / $80 / $3D / 48 /     {     CMP   ES:BYTE PTR [DI], '0'   }
      $72 / 30 /                 {     JB    SP         (+30)        }
      $26 / $80 / $3D / 57 /     {     CMP   ES:BYTE PTR [DI], '9'   }
      $76 / 239 /                {     JBE   L1         (-17)        }
      $26 / $80 / $3D / 65 /     {     CMP   ES:BYTE PTR [DI], 'A'   }
      $72 / 18 /                 {     JB    SP         (+18)        }
      $26 / $80 / $3D / 90 /     {     CMP   ES:BYTE PTR [DI], 'Z'   }
      $76 / 227 /                {     JBE   L1         (-29)        }
      $26 / $80 / $3D / 97 /     {     CMP   ES:BYTE PTR [DI], 'a'   }
      $72 / 06 /                 {     JB    SP         (+6)         }
      $26 / $80 / $3D / 122 /    {     CMP   ES:BYTE PTR [DI], 'z'   }
      $76 / 215 /                {     JBE   L1         (-41)        }
      $26 / $C6 / $05 / $20 /    {SP:  MOV   ES:BYTE PTR [DI], ' '   }
      $EB / 209                  {     JMP   SHORT L1  (-47)         }
                                 {L2:                                }
   ) END; {Procedure DePunct}
```

unwanted characters still lurk below *z*, and a descent that gets as far down as those can safely fall through to SP: without further testing.

A Necessary Confrontation

And now it's time to confront the need to write that Turbo Pascal in-line code in hexadecimal. Help is needed here, and the most suave and savvy help around is Jeff Duntemann's *Turbo Pascal Solutions* (Scott Foresman, 1988). After Duntemann has done everything he can to discourage you from even attempting Turbo Pascal in-line code, he offers ample hints, backed up by an invaluable 70-page "Eyeball Assembler."

His most salient hint is this: Unlike real assembly, Turbo Pascal in-line code cannot just jump to a label. It must supply the number of steps in the jump, and "if you miss it by even a single byte, you could be reaching for the power switch." Moreover, *backward* jumps mean negative steps, supplied in two's-complement format. For short jumps, that means just subtracting the number of backward steps from decimal 256, although Duntemann offers a handy hexadecimal table.

The sole thing he doesn't stress sufficiently is that Turbo Pascal in-line code does not *demand* hexadecimal. Converting a decimal count to hexadecimal (or worse, trying to count in hexadecimal) is one more thing that's likely to bollix nonexperts. But it needn't be done. Instead of, say, $2C (Turboese for 2CH), you can just insert plain decimal 44. Blessedly, the compiler won't care. (And how might you obtain decimal 44? As I'll be explaining in a moment, you simply count, kindergarten-style.)

Counting the Steps

Now look at listing 2, which is what I arrived at after some hours. The top five lines are copied straight from `Procedure UpperCase` in the Turbo 3.0 manual. Next, you'll easily spot the checks for the three ranges: 0 through 9, *A* through *Z*, and *a* through *z*. Once more, their syntax is lifted from the parent program; all I did was supply decimal numbers to mark where the ranges begin and end.

When the character's ASCII number is smaller than the number at the start of the range, then you jump (JB) down to SP:, where a MOV instruction substitutes a space. If you've taken that jump, you're done with this character, and you head back up to L1: to fetch another. If you haven't, you next try a match with the number at the end of the range. This time, if it's equal or smaller, you're within the range, and a jump-if-below-or-equal (JBE) takes you back up to L1:, where you pull in the next candidate from your string, or else you exit to L2: if no more string is left. And if both of those tests have failed, you move to the next range and repeat the process.

It all works perfectly. And fast! An unencumbered search clear through the 42,000 characters in a 750-line text file takes about 10 seconds. Depunctuating every line the Pascal way adds 55 seconds more. But depunctuating by this assembly procedure adds exactly 1 second: a stunning 55-to-1 improvement.

The Final Clue

Now for a few last details. Where did I get the code for JBE, which is not to be found in that parent program? I looked it up in Jeff Duntemann's "Eyeball Assembler," which spells out the hexadecimal codes for every useful assembly combination. That's also where I got the

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B

code for the key command

MOV ES:BYTE PTR [DI], ' '

which moves a space into the slot in memory that some unwanted character is occupying. (And no, I did not know that assembly command. I hunted through Duntemann's long list of MOV commands for one that looked like the SUB command I was replacing. You see what I meant about imitating the natives.)

And what about the lengths of all those jumps? The length is inserted as the last element in each jump instruction, and for forward jumps you just count how many elements are to be jumped over. Thus, the code for the last JB SP: ends with a 6, because to get to the start of SP: you must jump over the six machine-code elements in the next two lines. As I mentioned earlier, Turbo Pascal's compiler understands decimal numbers, although purists would prefer that you convert to hexadecimal.

The backward jumps to L1: are a little trickier. Examine the JBE L1:, just after the comparison with 9. Count the jump counter itself as 1, and count backward along each line of machine code until you reach the first instruction ($FE) for L1:, and you'll get 17. Subtract that from 256 to get its two's-complement value, 239. That's your jump counter.

Assembly, My Dear Watson

So, lo, without any real grasp of MS-DOS assembly, you've acquired in-line machine code for a fast `DePunct` procedure. Let me repeat that I'm making no claims for ignorance. I'm certainly prepared to learn that a better assembly version of `DePunct` is possible. But I'm still asserting that a little patience, a little luck, a little analytic effort, and one good book can take you further with an unfamiliar language than you may have imagined you could go. ■

Editor's note: *The Turbo Pascal source code and a compiled version of SEEK are available in a variety of formats.* *See page 5.*

Hugh Kenner is a professor of English at Johns Hopkins University. His reviews have appeared in publications like the New York Times *and* Harper's. *His recent books include* A Sinking Island *and* Mazes. *He can be contacted on BIX as "hkenner."*

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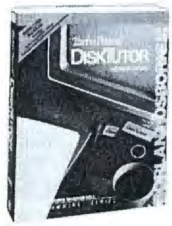

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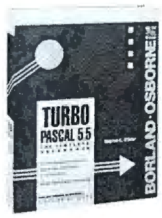

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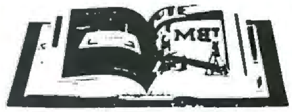

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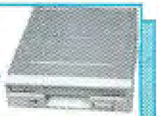

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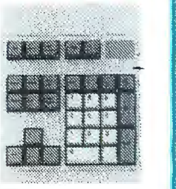

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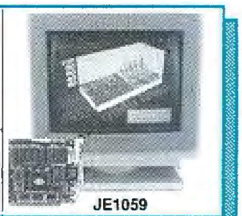

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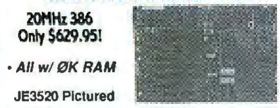

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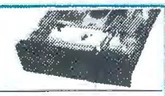

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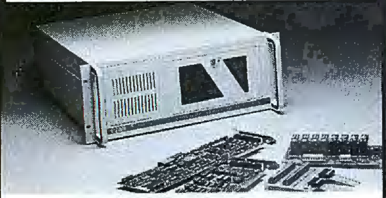

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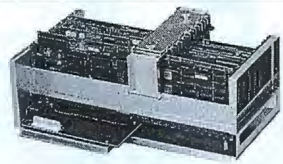

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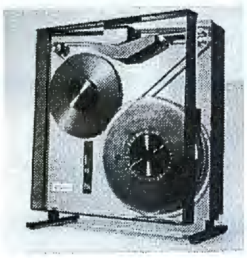

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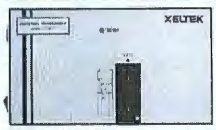

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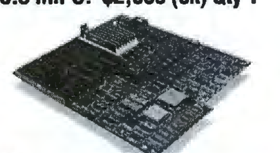

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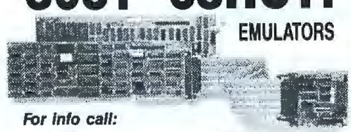

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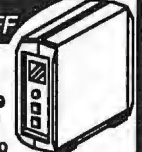

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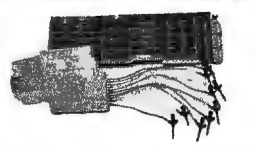

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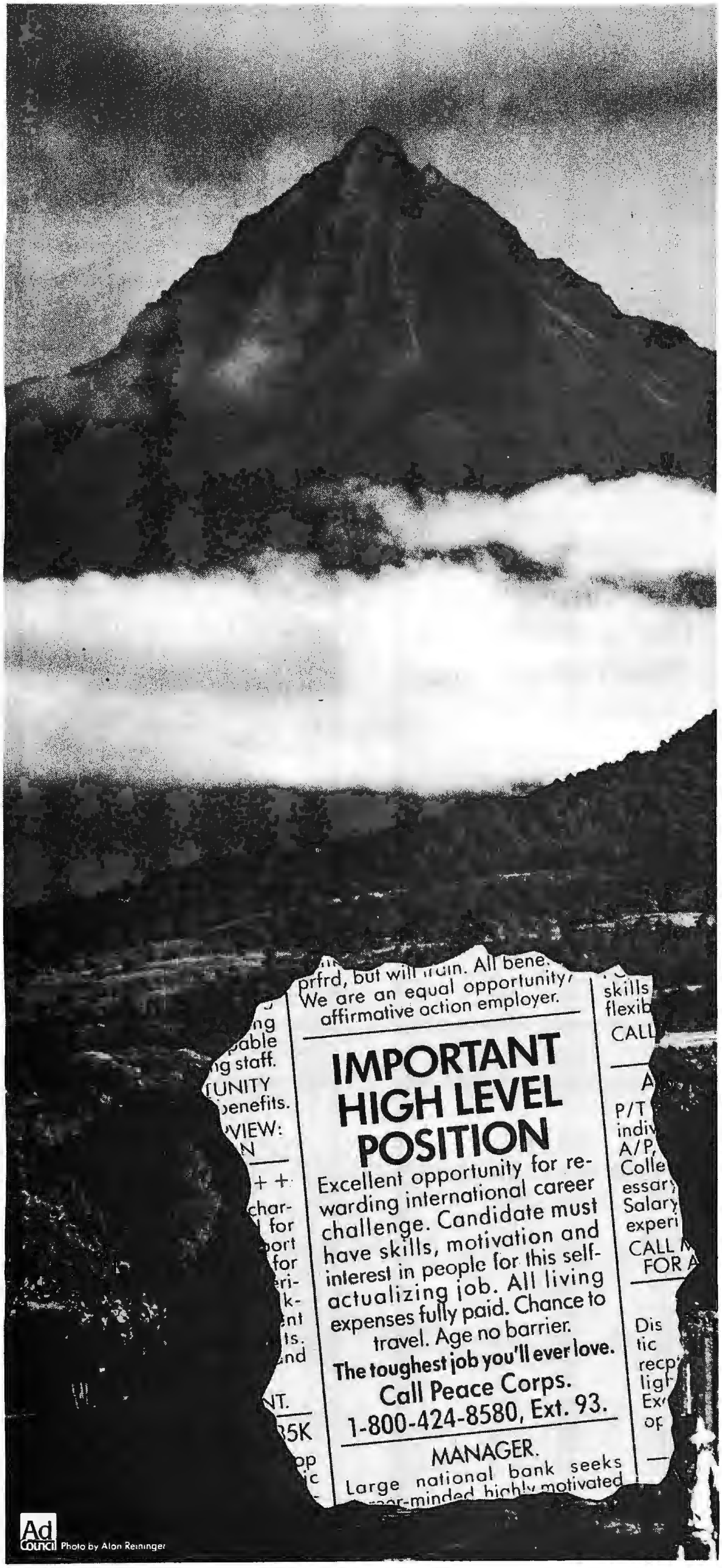
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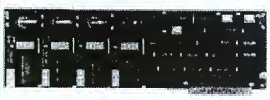

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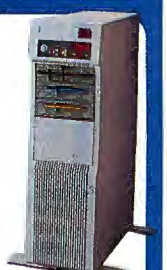

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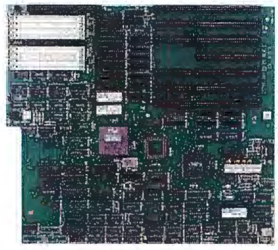

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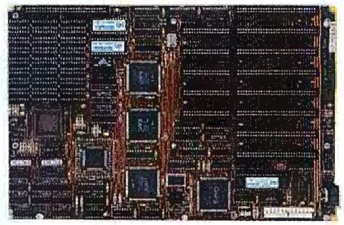

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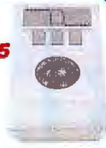

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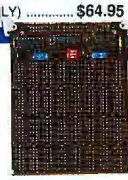

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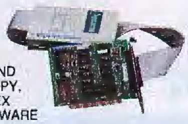

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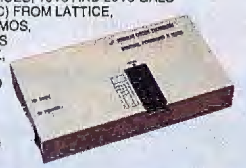

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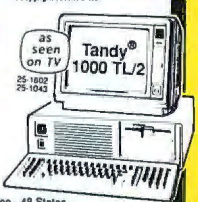

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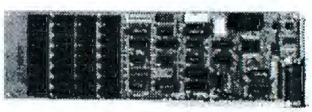

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Rua da Consolacao, 222
Conjunto 103
01302 Sao Paulo, S.P., Brasil
Tel: (11) 259-3811
Telex: (100) 32122 EMBN

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* Correspond directly with company.

Index to Advertisers by Product Category

READER SERVICE

Advertising Supplement included with this issue:
Jade Computer (U.S. and Canada Subscribers)
Circle 316 on Reader Service Card
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2 Check off the answers to questions "A" through "C".

3 Print your name, address, and fax number clearly on the form.

4 Remove this page or copy this page clearly and fax it to the number above.

Fill out this coupon carefully. PLEASE PRINT.

Name ______________________

Title ______________________

Company ______________________

Address ______________________

City ______________________

State/Province ______________ Zip ______________

Country ______________________

(_____)__________ Phone Number (_____)__________ Fax Number

A. What is your level of management responsibility?

1 ☐ Senior-level Management
2 ☐ Other Management
3 ☐ Non-Management

B. What is your primary job function/principal area of responsibility? (Check one.)

4 ☐ Administration
5 ☐ Accounting/Finance
6 ☐ MIS/DP/Information Center
7 ☐ Product Design and Development
8 ☐ Research and Development
9 ☐ Manufacturing
10 ☐ Sales/Marketing
11 ☐ Purchasing
12 ☐ Personnel
13 ☐ Education/Training
14 ☐ Other: ______________

C. Please indicate your organization's primary business activity: (Check one.)

Computer-Related Businesses:

15 ☐ Manufacturer (Hardware, Software)
16 ☐ Computer Retail Stores
17 ☐ Consultants
18 ☐ Service Bureau/Planning
19 ☐ Distributor/Wholesaler
20 ☐ Systems House/Integrator/VAR
21 ☐ Other: ______________

Non-Computer-Related Businesses:

22 ☐ Manufacturing
23 ☐ Finance, Insurance, Real Estate
24 ☐ Retail/Wholesale
25 ☐ Education
26 ☐ Government
27 ☐ Military
28 ☐ Professions (Law, Medicine, Engineering, Architecture)
29 ☐ Consulting
30 ☐ Other Business Services
31 ☐ Transportation, Communications, Utilities
32 ☐ Other: ______________

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Title ______________ Phone (____) ______

Company ______________________

Address ______________________

City ______________ State ______ Zip ______

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APRIL
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NO POSTAGE NECESSARY IF MAILED IN THE UNITED STATES

BUSINESS REPLY MAIL
FIRST CLASS MAIL PERMIT NO. 176 PITTSFIELD, MA

POSTAGE WILL BE PAID BY ADDRESSEE

BYTE

READER SERVICE
PO Box 5110
Pittsfield, MA 01203-9926
USA

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APRIL
IRSD002

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CHAOS MANOR MAIL

Jerry Pournelle answers questions about his column and related computer topics

WordStar Supporter

Dear Jerry,

Your comments on WordStar 5.5 have been great. I switched back to WordStar from WordPerfect 5.0 because WordStar 5.5 does so much more, works so well with other programs, and doesn't tax my memory. I keep hearing about other word processors and the things that they won't do, yet WordStar 5.5 does them. But I've wondered why other reviewers are so adamant about WordStar 5.5 being so bad. I guess it's because they can't change, so they conduct a half-hearted review that makes the product appear ho-hum. WordStar does math; one "in depth" review never mentioned that or that it imports Lotus and dBASE files directly. Another said that the dot commands were outmoded, yet dBASE uses them, and no one is crying about that. I prefer the dot commands so I can see what the thing is doing.

It's nice to read articles from someone who isn't into marketing. BYTE has not succumbed to being a sales catalog for Lotus 1-2-3 or WordPerfect. I'm not cheering for WordStar International; I'm cheering that someone finally looked closely enough at this product.

Mike Gautier
Woodbridge, VA

Thanks. We do try to look at everything. And chances are it will be a long time before BYTE is a sales catalog for anything—we can't get four editors to agree as it is!—Jerry

Orange Aid

Dear Jerry,

I commiserated mightily when I read of your orange-soda-in-the-disk experience in the October 1989 Chaos Manor. The same thing happened to me, to a disk that contained an already late paper I was due to deliver in Kyoto. That experience led me to conduct some experiments as reported in my paper, which is due to be published in *Library HiTech*. (Isn't it amazing what we spend our time doing in library schools?)

Working with 5¼-inch 360K-byte disks, almost nothing—from Chinese food to rye to cat urine—destroyed data. Mess 'em up, wash 'em off, use 'em again. Your event led me to sacrifice more disks: some Dysan high-capacity 5¼-inchers formatted in a 1.2-megabyte IBM drive, and some Verbatim 3½-inch ones, formatted double-sided in a Mac II. I didn't have any orange soda (we're hard-drinking buckaroos out here in Honolulu), but I did pour Pepsi over them, along with some other unpleasant substances. Result: no data loss. I actually had less trouble than I did with the 360K-byte samples (of course, the fact that these were new might have been significant).

The only difficulty that I experienced was in opening the 3½-inch case. I found that the best approach was to pry off the metal read-write slot protector (it's not really needed, anyway), slip a knife blade (tested to make sure it wasn't magnetized) into the edge away from the write-protect switch, and then twist it open like an oyster. I popped open three sides, leaving the left side (with the write-protect switch) attached. This did take a little effort—the things are glued together—but allowed the cookie (i.e., the floppy media proper) to be slipped out. After I washed the crud off the cookies, I dried them—first with a paper towel, then under hot air from the forced-air hand drier in the men's room. (I have never managed to get my hands dry under one of those things, but they work pretty well on disks.) Once the cookies were clean and dry, I put them into a new disk case. Every one of them read perfectly the first time.

I hope this little bit of advice helps you if you ever mess up a disk again. The secret is to take the cookie out before you wash it off, and then put it back in a clean case.

Larry N. Osborne
Honolulu, HI

Thanks. I'm not sure where to get new disk cases, although I suspect that I could find them with some effort. I also wonder if disk cases come with the little felt-like cleaner thing that goes between the cookie and the hard shell?

Mostly I hope it won't happen to me again, but it probably will.—Jerry

Dear Jerry,

Here's what to do when you pour orange soda over your irreplaceable 3½-inch floppy disks:

1. Carefully (so as not to damage the disk itself) disassemble the shutter assembly of the drenched disk and break open the case.
2. Do the same for a discarded disk, this time taking care not to damage the case too much.
3. Wash the drenched disk under running water with any mild dishwashing detergent, and dry with a clean, soft, lint-free cloth.
4. Reassemble the washed disk into the new case. Forget about the shutter unless you really can't copy the data off the disk.

I followed the four steps outlined above with complete success for a disk that I had been carrying in a pocket of my new stone-washed jeans; stone-washed denim contains a good deal of fine sand even after the first few washings, and the disk made unfortunate grating noises when I turned it by hand. Nonetheless, I managed to retrieve all the data.

In general, if a liquid is suited for human consumption (with the possible exception of tequila), it should leave the magnetic coating of the disk intact.

Christopher Ferebee
Königstein, Federal Republic of Germany

Thank you for the instructions; next time I have a disk disaster, I'll be sure to try it!—Jerry ■

Jerry Pournelle holds a doctorate in psychology and is a science fiction writer who also earns a comfortable living writing about computers present and future. He can be reached c/o BYTE, One Phoenix Mill Lane, Peterborough, NH 03458, or on BIX as "jerryp."

1.5 DECADES OF APRIL FOOLS

All right, maybe you can fool some of the people some of the time

Kenneth M. Sheldon

What do Hindsight Engineering, Soycure Systems, and the Famous Programmers' School have in common? Well, for one thing, they're all enterprises that have existed only in the minds of BYTE editors. Over the years, as we've wrestled to keep on top of the fast-moving microcomputer world, we've occasionally taken time out to poke a little fun at ourselves and the industry that we love.

The tradition started in our first April issue (1976), with a Technology Update on the first practical Touring Machine—a bicycle—with a unary relocatable-based operator (i.e., the person on the bike).

Later items detailed such arcane procedures as refolding the fanfold instruction card that came with the MC6809 microprocessor. In 1981, our What's New column featured a new addition to the small components market, the 7N-∞ BHD (black-hole diode), useful mostly for GI (garbage-in) applications. Unfortunately, due to the light-absorption characteristics of the device, we were not able to provide a photograph of the BHD.

Sometimes, items that seemed funny at the time have become, over the years, amazingly prescient: Take the 5-megabyte hard disk drive for the tiny Sinclair ZX81 (marketed in this country as the Timex/Sinclair 1000) that we announced in our April 1982 issue. Hundreds of readers wrote to Hindsight Engineering in "Peanutbutter, New Hampshire" for more information. (Credit the local post office for figuring out where to send the wacky mail.) Nowadays, you can buy a portable as small as the Timex/Sinclair with hard disk drives of up to 100 MB!

Our April 1982 issue also saw the birth of an institution: the Famous Programmers' School. In a full-page "advertisement" that asked, "Do you have a restless urge to program?," readers were offered the rare opportunity to study with such software greats as Bennett Lisp, Bruce Fortran, Red Basic, and the immortal Ignatious "Call Me Blaise" Pascal. Interested parties were asked to take a free aptitude test, with such challenging questions as, "Write down the numbers from zero to nine and the first six letters of the alphabet." Numerous readers took the challenge and responded by sending the required $1000 in small unmarked bills. (Unfortunately, the bills were always Confederate, Monopoly, or homemade money.)

So successful was the Famous Programmers' School that we offered, in the April 1983 issue, a follow-up seminar on pocket-computer local-area networks. The accompanying photo showed the school's stellar staff with pocket computers in hand (and pocket), strung together by a wide ribbon cable.

That seemed pretty funny at the time, but now, with the advent of Xircom's Pocket Ethernet Adapter—a device that lets you attach portable computers to an Ethernet LAN—it seems eerily prophetic. (Note that we considered filing a "look and feel" lawsuit against Xircom but opted instead to give them a BYTE Award of Excellence in our January issue. It's still a good idea, even if we thought of it first.)

The Famous Programmers' School (and most of its instructors) had a last gasp in April 1984, with a plea to "Help the Old Programmers' Home." Situated in a large brick building that looked oddly reminiscent of BYTE's headquarters, the home was founded to provide a calm, tranquil shelter for programmers who were "too old or too burnt-out or have to pay too much alimony." Residents were provided with "good hearty fast food, and an unlimited supply of cola and fanfold paper." Age was of no concern; in fact, some of the residents were "over 35 years old."

Continuing the tradition, our April 1985 issue featured a special "What's Not" section that described several innovative products, such as MacKnifer, a peripheral that attached to the original single-disk Macintosh and let you sharpen knives, scissors, and lawn-mower blades while waiting for files to open.

After that issue hit the stands, we received a call from a woman who said that she'd checked every computer store in town trying to find the Parasoya Disks (made of processed soybeans) that we'd written about. The disks, which were supposedly readable, writable, and edible, were for people who were *really* concerned about protecting sensitive data. Needless to say, she was embarrassed when we explained that the disks (from Soycure Systems) were an April Fools' item.

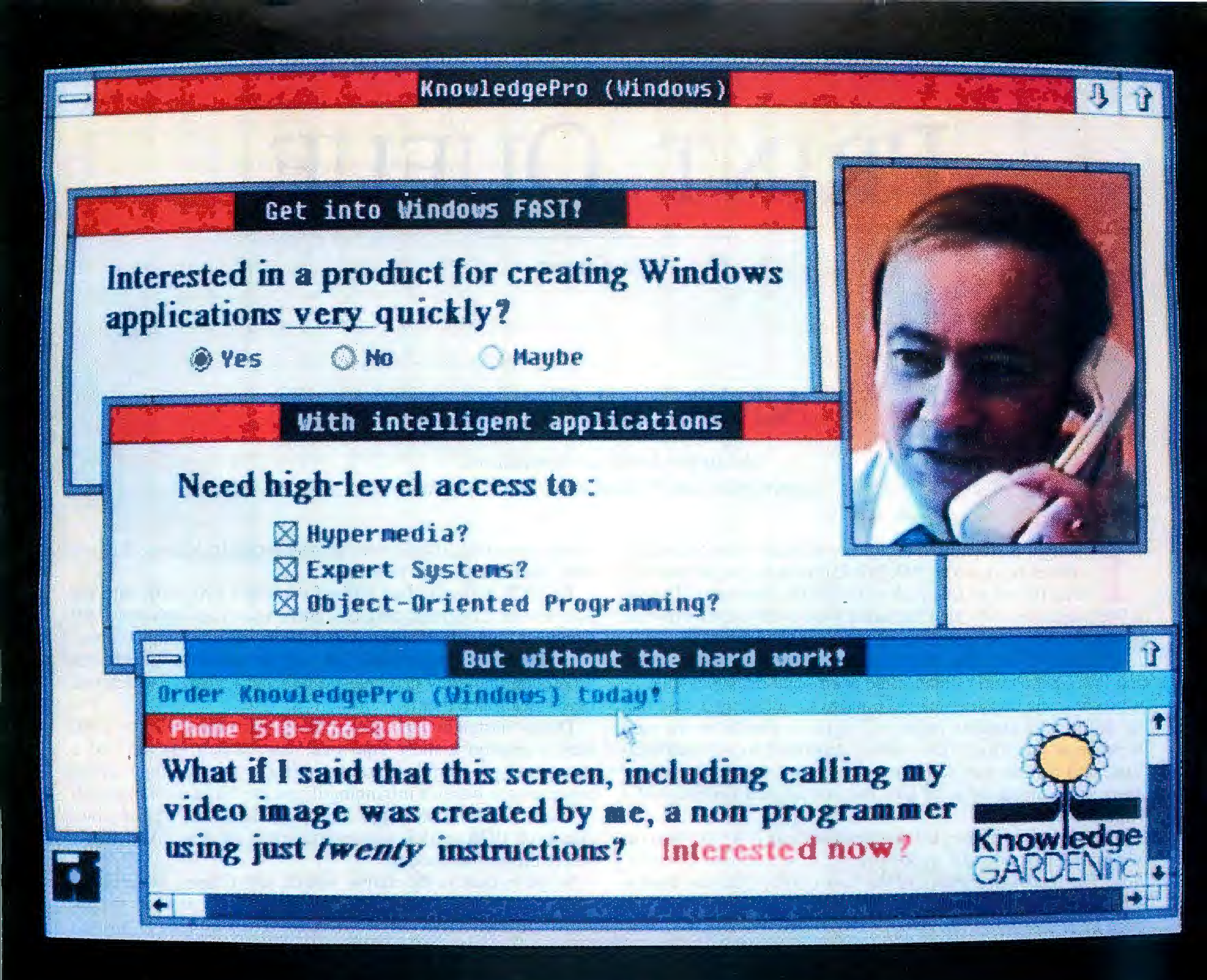
The very next day, a reporter from *USA Today* called us. He wanted more information about the Transporter, a portable computer that, with a few simple twists, transformed into a single-passenger automobile. They were thinking of running an article about it in their newspaper, but he thought he'd better call first, just to check. Needless to say, that item never appeared in the paper.

As a result of all this, you will find no bogus products in this issue of BYTE. Anything that looks odd or funny—intentionally or not—is thanks to the manufacturer of the product or its advertising agency.

We've learned our lesson. ■

Kenneth M. Sheldon is a senior technical editor for BYTE. He can be reached on BIX as "ksheldon."

ILLUSTRATION: FRANK BOZZO © 1990



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PRINT QUEUE

Hugh Kenner

Advise and Compute

A lawyer looks at computers, copyrights, and "look and feel" lawsuits

Thought is structured around certain absolutes: that light moves in vacuo at 299,792.458 kilometers per second; that the mean free path of molecules between collisions is 905 angstrom units; that the worst food in the known universe is on sale in the "A" terminal of the Newark airport.

Human interactions, though, are partly governed by law, and law's benchmarks tend to be prior legal decisions–that is, what someone once persuaded a judge to decide in a case that we are hoping another judge will agree is similar to the case we are now litigating. Trace such a chain back to a primal decision, and behind that you'll expect to find statute law. However, some unclarity as to how the law applied necessitated a first decision.

Concerning software, law has been unclear from the start, as Anthony Clapes details in *Software, Copyright, and Competition: The "Look and Feel" of the Law* (1989, Quorum Books, Westport, CT, $39.95). On page 11 of his highly readable book, Clapes notes that the Founding Fathers in 1788 were at their deliberations nine years before J. M. Jacquard would unveil "the first programmable machine in history," the loom that took an artist's instructions from punched cards. So Article I, Section 8, Clause 8 of the Constitution had no programs in mind when it gave Congress power "To promote the progress of science and the useful arts, by securing for limited times to authors and inventors the exclusive right to their respective writings and discoveries."

In 1790, Congress enacted the first copyright statute; it covered maps, charts, and books. In 1802, printmakers and graphic artists got included. In 1831, composers of music. In 1865, photographers. In 1870, makers of "paintings, drawings, chromos, statuettes, statuary, and models or designs of fine art." In 1912, the newfangled motion pictures. In 1971, sound recordings (tapes were getting pirated). You see the pattern. Technology kept pushing.

By 1976 it finally had pushed computer programs into the purview of Congress, and Congress was most unhappy. All Congress found itself able to say in 1976 was that computer programs were, yes, protected. But they were to have "no greater protection than they had enjoyed under prior law," which had never mentioned them.

Do not hasten to acclaim our Congresscritters. For by 1980 they'd enacted a most equivocal law, which (1) defined a "computer program"; (2) said that if you owned a copyrighted program you weren't infringing if you used it in a computer (!) or made an archival copy; and (3) deleted the "prior law" clause of 1976, which was meaningless anyhow. And that's where things stand today.

So we're back in the courts, where, says Clapes, lawyers fall very neatly into four categories: They either (1) haven't got time to learn what programming is all about, and don't; (2) decide not to take the time to learn, because judges and juries will never figure it out either, and don't; (3) being Luddites at heart, are constitutionally incapable of learning about programming, so don't; or (4) think they, yes, understand programming, but don't.

Which sets the stage for the generic case, *Apple* v. *Franklin*, 1982. The Franklin Ace, if you recall, was an Apple clone, back when Apple was synonymous with personal computing. And at Franklin, the company had simply copied the Apple operating system into ROM, so clumsily that one Apple programmer's name was left embedded in the code, as was the word *Applesoft*.

Franklin never denied the copying. The company's argument was this: For a machine to run existing Apple software, it needed to have

continued

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the operating system just about exactly as it was, since the operating system offered so many "entry points" that various software writers were using. The governing ideas, true, Apple couldn't copyright those; but compatibility with all that software—the only reason for a clone—had tied Franklin to nearly line-for-line specifics.

A Philadelphia judge named Newcomer nearly bought that; or rather, he bought something far more sweeping, the idea that programs, since their binary code isn't meant to be read by humans, aren't covered by any statute governing "expression." He feared a step "into the world of Gulliver, where horses are 'human' because they speak a language that sounds remarkably like the one humans use." Do such sequences as 00101001 00110000 merit the protections we accord to *Moby Dick*?

This book clarifies why court decisions are not intuitive.

(Thought experiment: Pascal, for instance, is plainly meant to be read by humans. Might someone claim exemption from infringement after merely translating Pascal code, line by line, into C, a process so straightforward it's been automated? In 1978, a judge named Higginbotham ruled that no, someone couldn't. He even said it would "probably" be a violation to translate a flowchart into a computer language.)

Apple carried Judge Newcomer's ruling to the Court of Appeals, where on August 30, 1983, Judge Dolores K. Sloviter upheld Apple. She brushed aside what had given Judge Newcomer pause, the question whether a machine or a person was the destined reader of the code. Utilitarian? Aesthetic? The Copyright Act, she held, did not distinguish. What she did zero in on was whether Franklin could have simulated the Apple operating system without copying it line by line; for if idea and expression merge, Apple has no valid copyright, because that would amount to copyrighting an idea, which can't be done.

The line between the two, she said, must be "pragmatic," legalese for "what follows is a hunch." For "many of the courts which have sought to draw the line between idea and expression have found difficulty in articulating where it falls." Judge Sloviter wasn't presented with a case of "not copying except where necessary," hence didn't decide such a case. She was presented with a case of line-for-line copying, and Apple and Franklin took her hint to settle out of court. So "except where necessary" remains undefined, likely only addressable, says Clapes, "on a case-to-case basis." Case by case, though, *Apple* v. *Franklin* won't go away.

For here's another nugget from Judge Sloviter. There may be, as Franklin alleged, only a limited number of ways to write an Apple-clone operating system. Fine, that says there's more than one, so over at Apple idea and expression haven't merged, and copyright holds. But if Franklin got hemmed in by its desire for a clone that would run *all* available Apple software, that was "a commercial and competitive decision," and they should have had the wit to scale it down.

(Analogy, from me, not from Clapes: If you want a script that will produce in a theater *exactly* the effect of Shakespeare's *Hamlet*, then you've no recourse save to copy out Shakespeare's *Hamlet*. But you've made a commercial, not an artistic, decision. On the other hand, Tom Stoppard's *Rosencrantz and Guildenstern Are Dead*, though arguably parasitic on *Hamlet*, is a piece of artistry that infringes nothing.)

And Clapes argues throughout that programs "are literary works," and "not just in a copyright sense but as a matter of social taxonomy." They are literary works "in the way that a musical score or the 'shooting script' of a movie are literary works: One doesn't read them through like a novel, but they have the attributes common to all literary works." These include "structure, flow, logic, design, naming conventions, commentary, and resultant style."

Which brings us to look and feel, which apparently derives from the phrase "total concept and feel" in "a twenty-year-old case involving the copying of thematic and stylistic features of a line of greeting cards." The dashboard analogy has been popular lately; if you can drive one car you can drive them all, because controls and gauges are in pretty well standard locations. Judge Higginbotham even alleged 12 years ago that the gearshift *H*-pattern was "idea," not "expression," and hence not protected at all.

But the law doesn't work (as I've noted) from absolutes like the *H*-pattern gearshift or the velocity of light; it works tortuously, through a maze of decided cases, and chapter 20 of Clapes' book ("The 'Look and Feel' Cases") brings no easy comfort. Look-and-feel defendants will be spared liability "if, when everything is eliminated except the expression that may not be copied in the plaintiffs' user interfaces, it is found that they have not copied that expression." That seems to mean, if you take away everything except what looks like an elephant, and the elephant wasn't really copied, you're clear. Lawyer Clapes will perhaps forgive me if I say that the progress toward such a finding resembles the passage of a ball through a pinball machine (bounce, bounce; left? right? What did Judge A make of question X? Judge B of question Y?).

The man who stood up after a Clapes presentation to say "I disagree with everything you say" was understandably impatient. Your right in what you're doing seems very clear as you program. But you program out in a world where other programmers have been weaving trails that their employers may have protected. "Because the look and feel of a program is the part with which the user most clearly identifies, and the part that cannot be hidden from competitors, there would be absolutely no point in the development of innovative user interfaces if the results of those investments could be freely copied by others."

True. But the dashboard analogy? Is it simply that no one thought to sue when clutch left, brake right—the *H*-pattern for that matter—got copied and recopied? I've not been able to find a historian of these automotive matters. Clapes, I may as well tell you, is "a Senior Corporate Counsel at IBM," although he's careful to deny giving things an IBM slant. What his book clarifies is why court decisions are not intuitive, the way programmers would like them to be. Law works its uneasy way through precedent, precedent. *Software, Copyright, and Competition* may, at the very least, teach us all patience. ■

Hugh Kenner is a professor of English at Johns Hopkins University. His reviews have appeared in publications like the New York Times *and* Harper's. *His recent books include* A Sinking Island *and* Mazes. *He can be contacted on BIX as "hkenner."*

Your questions and comments are welcome. Write to: Editor, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458.

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Source: Byte Magazine

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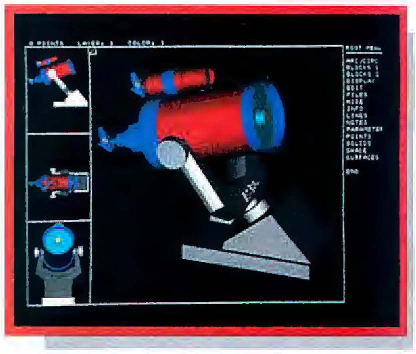
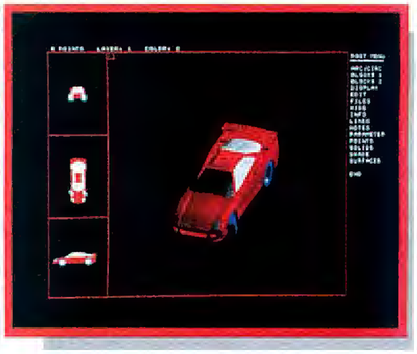
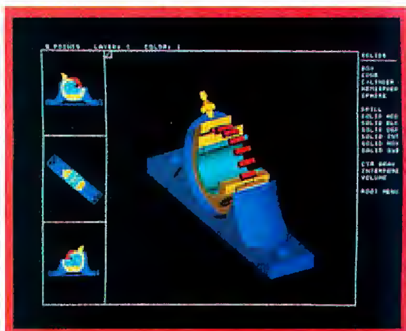
May 1989, page 178







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TO BOLDLY BENCHMARK

A giant leap in our 15-year mission to seek out new means of testing computers

Over the years, BYTE has pioneered the use of benchmark tests as a means of evaluating which computer system is right for you. Just last month, we rolled out our latest suite of benchmarks, designed to test and compare Unix-based systems.

But our most exciting project to date is one that could change forever the way benchmark tests are conducted. Until now, security precautions and the sensitive nature of the project have prevented us from discussing it. However, starting in September, with our fifteenth anniversary issue, BYTE will add an entirely new suite of tests to its benchmark series.

The Final Frontier

In the days to come, exploiting new opportunities in space will become increasingly important to maintaining our economic position in the marketplace. Computers will become an even greater part of business and technology. But present-day tests are useless for evaluating the kinds of conditions under which computers in space will have to operate.

To address these new considerations, we've designed a series of tests to be conducted on each new system reviewed in BYTE. Beginning in September, we'll report the results of the tests, which will be carried out through a special arrangement with mission specialists on regular flights of NASA's space shuttle. Developed with the assistance of Dr. Thomas Fulery of the Wisconsin Institute of Technology, the tests will subject review systems to conditions that we can expect to be operating under in the days ahead.

The Tests

As we venture farther into space, we may find that gravity is a luxury that we can't always afford. How will this affect your new computer's ability to perform sensitive calculations? To test this, the BYTE *nul-grav* benchmark will measure a system's ability to perform floating-point operations in a zero-gravity environment.

The *hatch-activation-loop* test will measure each system's ability to perform extensive repetitions of ordinary tasks. This HAL test will determine how many times the system can open and close the space shuttle's pod-bay doors in one hour and whether the system loses track of whether the door is open or closed.

Of course, not all computing will be done in a human-friendly environment. Thus, we have designed several benchmarks for extra-vehicular execution. The *totality-rad* test, for example, will measure the length of time that the review system can withstand exposure to cosmic radiation without producing computation errors.

Another extra-vehicular test will analyze a system's susceptibility to stresses and strains caused by breeches of security that might affect its operation and thereby present a threat to life-support systems. Based on our now-classic Sieve of Eratosthenes benchmark, the *Strain of Andromeda* test (named for the mythical goddess who was rescued from a monster) will analyze systems for possible infection by computer viruses.

During the (of necessity) final benchmark test, the review system will be ejected from the shuttle and allowed to reenter the earth's atmosphere. For this *burn-in* test, each unit will be equipped with a radio-transmitter modem and will transmit signals back to earth, where BYTE editors will record the exact time and height at which the system ceases to operate. Any system that continues to operate until it reaches the ground will automatically receive a BYTE Award of Excellence for endurance.

On the outside chance that a review system might spin off into space rather than come back to earth, we have written the new benchmark tests in BASIC. In the unlikely event that the system is intercepted by extraterrestrial life forms, we believe that BASIC is the language most likely to run on any given alien system.

Now It Can Be Told

As you might expect, developing the new BYTE benchmarks has required months of negotiation with the administration of our nation's space program. Unknown to the general public, the most recent flight of the space shuttle carried a preliminary test machine on which shuttle personnel conducted the new BYTE benchmarks. According to mission specialist Irving M. Kidden, the tests were almost a complete success. "The only problem came when one of the guys was making some Tang during the nul-grav test," he said. "Some of the powder got into the disk drive and really gummed up the works." This mishap, however, provided an opportunity for the new benchmarks to display their user-friendly, plain-English system of error messages: The affected machine promptly displayed the message, "He's dead, Jim."

It is with great pleasure that we announce the new BYTE On-Going Utility in Space tests. For more information on our new benchmarks or to receive a copy for your own use, please see the box on page 343. ■

Stop Bit is an open forum for informed opinion on topics related to personal computing. The opinions expressed are those of the author and not necessarily those of BYTE or its staff. Your contributions and comments are welcome. Write to: Editor, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458.

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