BYTE

A McGRAW-HILL PUBLICATION

Zenith's Z-486/25E: 5 Times Faster than VGA

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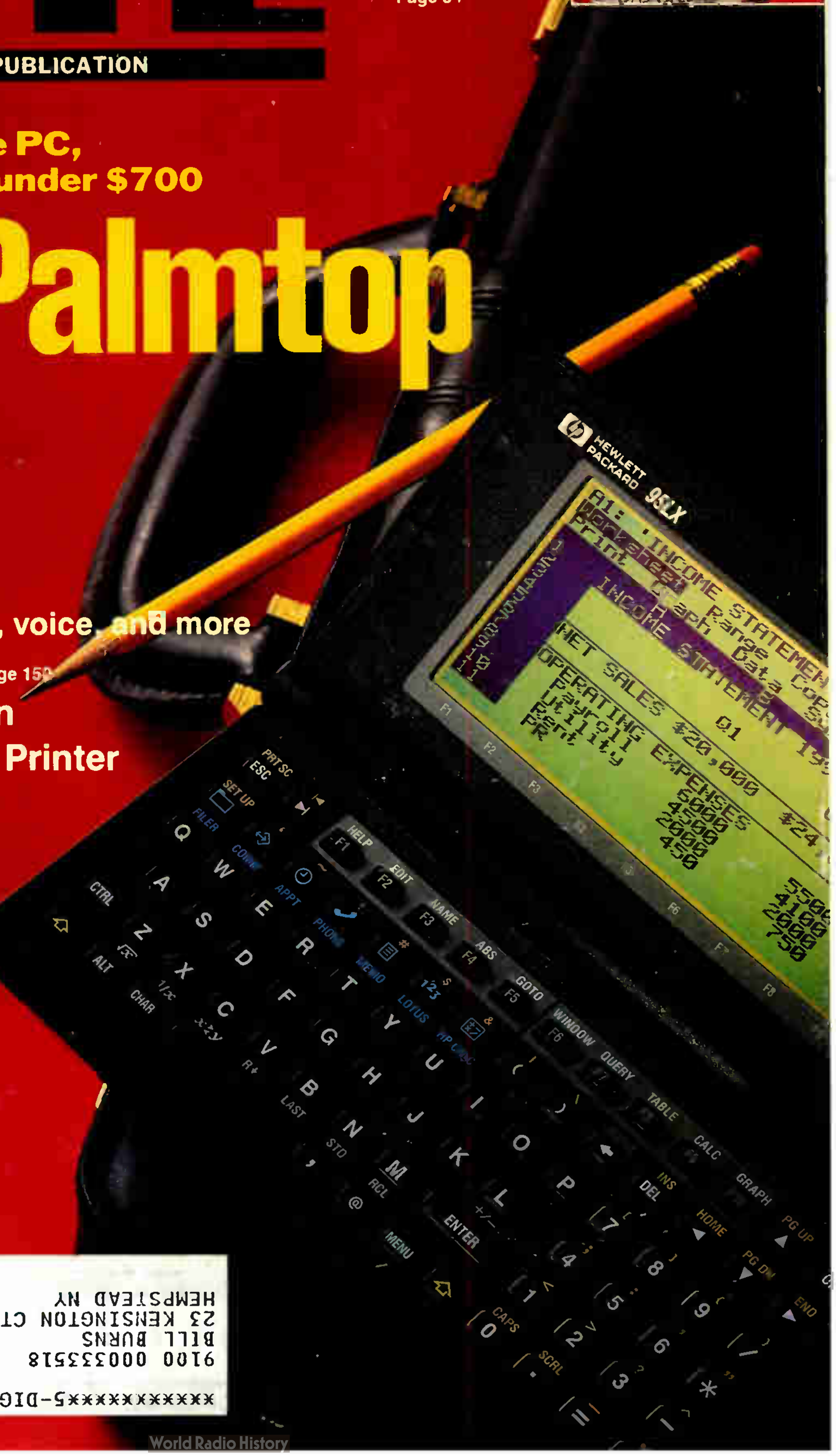
HP 95LX: A complete PC, plus Lotus 1-2-3, for under $700

Best Palmtop Ever?



Future Documents: Combining text, graphics, voice, and more

Drowning in Data? See page 15?

Borland's ObjectVision

Low-Cost Apple Laser Printer

Mac 3D: Infini-D

Two Portable Printers

PLUS

- 5 X Terminals
- 3 LAN UPSes
- QEMM vs. 386Max
- Mac Image Compression
- MultiScope Debuggers
- PC Image-Editing Software
- Printer Sharing Devices
- Color Printers

R THAN COMPAQ.

THE
DELL SYSTEM 320LX.
ONLY $2,599
*Lease $47/month***

• Intel 80386SX microprocessor running at 20 MHz.
40 MB VGA Color Plus System $2,599
Price listed includes 2 MB of RAM.*
80, 100, 190, 330 and 650 MB hard drive configurations also available.

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DELL SYSTEM 316LT.
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*Lease $79/month***

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ONLY $3,399
*Lease $127/month***

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30 MB, 1 MB RAM*
60 MB configurations also availab the Dell 212N 12 MHz 286 also a starting at $2,399.

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*Lease $56/month***

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20 MB VGA Monochrome System $1,499
Price listed includes 1 MB of RAM.*
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And if your problem can't be solved over the phone, a trained service technician will come to you with a solution. Usually by the next business day.△

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A down economy is not the time for Compaq dealer mark-ups. Which makes Dell computers look even better these days. And, to loosen those tight budgets even more, you can take advantage of a wide variety of credit, lease and lease-to-buy programs.

For instance, you can lease◇ Dell computers for as little as $56 a month. Or use the lease-to-buy plans and own the computer at the end of the lease term. There's even a Dell Direct Advantage MasterCard with up to a $15,000 credit limit and a way to earn points toward Dell products with everything you buy. Either way, you'll get all the credit you deserve. So if you were planning to buy a Compaq PC, take a deep breath, count to ten and call Dell.

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325D, 333P, 325P, 320N and 212N) 384 KB (320LX, 425E, 433E, 425TE and 433TE) of memory is reserved for use by the system to enhance performance. Can be optionally disabled on 433P, 333D, 325D, 333P, 325P, 320N, 212N, 316SX and 210. ased on 36-month, open-end lease ◇ Leasing arranged by Leasing Group, Inc. In Canada, configurations and prices may vary. Dell and Dell System are registered trademarks and SmartVu is a trademark of Dell Computer Corporation. Intel etary interest in trademarks and trade names other than its own △ Service provided by Xerox Corporation. On-site service may not be available in certain remote locations. Shipping, handling and applicable sales tax not included in the price Computer Corporation. All rights reserved

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As for ensuring data integrity, the Dell Drive Array uses parity checking techniques. So a single disk can guard all the data on up to 4 other disks.

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THE DELL® 433TE 33 MHz i486 EISA SYSTEM AND THE DELL 425TE 25 MHz i486 EISA SYSTEM.

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- 12-month On-Site Service Contract.

VGA Color Plus System with Array of 5 200 MB hard drives

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TEN TIMES BETTE

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- i486 microprocessor running at 33 MHz with 128 KB external cache.

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DELL SYSTEM 325P.

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If we've said it once, we've said it ten times. You can get a custom-configured Dell® computer with better service for up to $12,500 less than a similarly configured Compaq system.† Everything from the award-winning 386SX laptop PCs to workgroup-sized i486 network servers. With a virtually limitless number of choices of monitors, hard drives, RAM sizes and peripherals.

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Which means you get a technical support staff that can solve 90% of all problems over the phone. Usually in 6 minutes or less. You also get an electronic bulletin board that lets you see other users' questions about Dell systems. And more importantly, Dell's answers.

The Dell System 433TE and 425TE are class A devices sold for use in commercial environments only. *Performance Enhancements: Within the first megabyte of memory, 128 KB (316SX, 320LT, 316LT and 210) 96 KB (433P, 33
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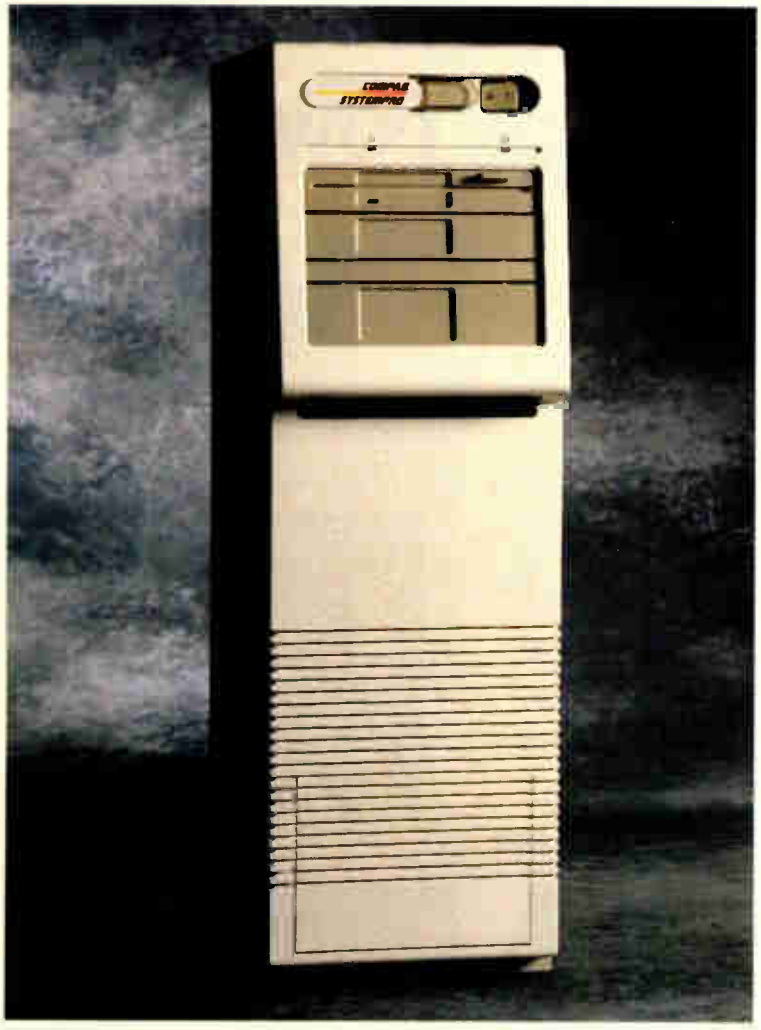

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VGA COLOR MONITOR, 1 ARRAY OF 4 210 MB HARD DRIVES, 8 MB OF RAM, 512 KB CACHE

Maintaining servers can be beyond most Compaq dealers. If a server goes down, your whole company can go down.

With a Compaq system, you may have to trust the dealer who sold it to you to fix it. With Dell, you deal directly with us, the company that designs and manufactures your servers.

Which means you'll be working with a telephone support staff that can solve 90% of all problems over the phone. Generally in 6 minutes or less.

And because Dell is an AT&T UNIX® source code licensee and validates compatibility under Novell and Banyan, you can be sure your Dell technician knows quite a bit about networking too.

But on those rare occasions we can't solve it over the phone, a trained service technician will be sent to your office with a solution in hand. Usually by the next business day.△

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If you've got the money, Compaq's machine will do just fine. But if you're looking for a server that will soup-up your network without blowing your budget, call Dell.

Unless, of course, you like being overcharged and underserviced.

DELL COMPUTER CORPORATION

Circle 93 on Inquiry Card.

Compaq® SystemPro™ Compatible

There's An Double Your

Introducing The ALR POWERPRO

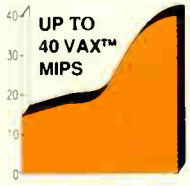
CRN EDITORS' CHOICE

With the POWERPRO's advanced modular system architecture, the choices you make today won't limit your options tommorrow.

Just Upgrade the CPU!™

Strapping two traditional PCs together won't give you the dual processing power you need to keep pace with today's growing networks and multi-user environments, but the new ALR®POWERPRO will. It's the affordable, high-performance alternative to the COMPAQ® SYSTEMPRO™.

Whether you need a system for single or multiple users, CAD/CAM, office automation, manufacturing management systems, shared databases or a host of other applications, there's a POWERPRO that delivers. Choose between one or two 33–MHZ i486 processors and up to 1–MB of cache for performance ranging from 14.7 to 40 VAX™ MIPS. Single CPU models can be quickly and easily upgraded to dual processing.



Additionally, all models will be able to accommodate future, faster, processors. With 49-MBs of possible RAM, twelve expansion slots, and accommodations for up to 2.5-GB of internal storage (up to 10-GB of total storage utilizing an external ALR expansion chassis), the POWERPRO has the expandability needed to keep pace with your future needs. The POWERPRO also incorporates a 32-bit EISA bus, so you'll have maximum compatibility with cutting-edge enhancement products while enjoying the affordability of today's low-cost "AT" compatible hardware.

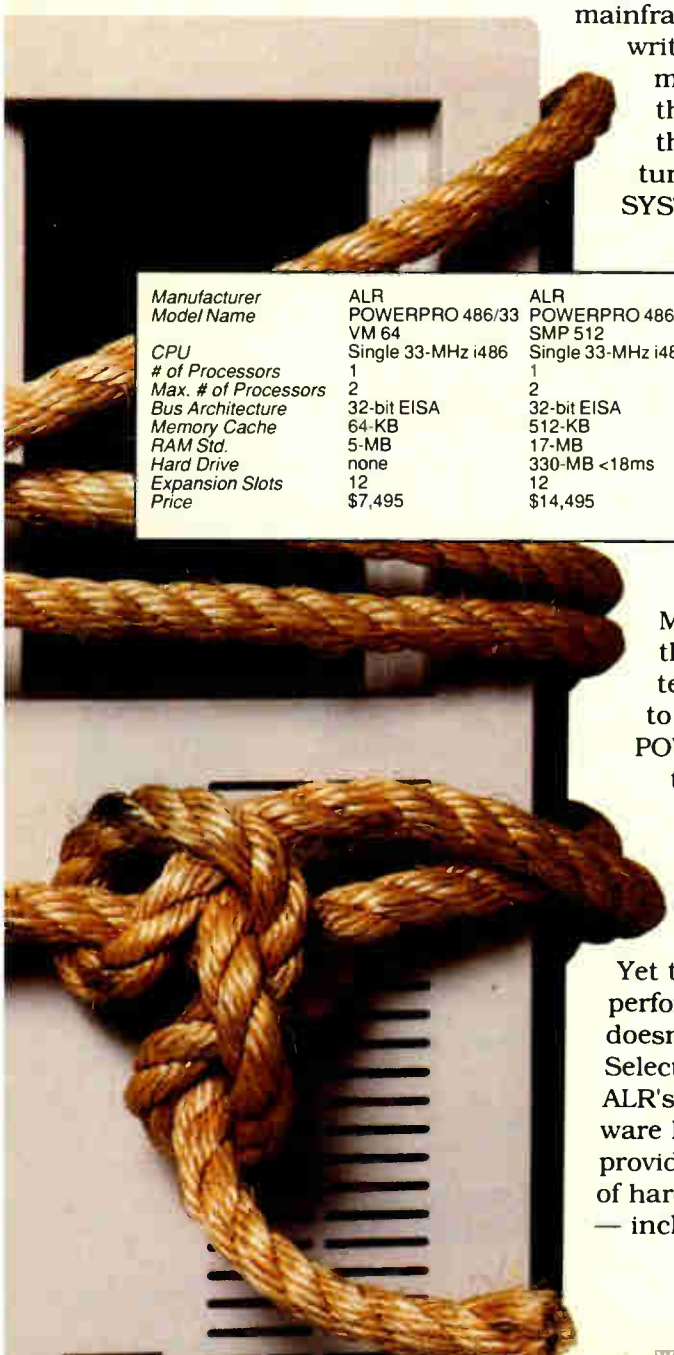
SUPERIOR CACHE

The POWERPRO uses ALR's proprietary

Easier Way To Processing Power.

Single or Dual Processing Performance with Prices Starting at $7495

BANYAN SMP Certified



PROCACHE scalable cache memory architecture. This mainframe-like read-and-write-back design is more efficient than the standard write-through architecture found on the SYSTEMPRO.

Manufacturer	ALR	ALR	Compaq
Model Name	POWERPRO 486/33 VM 64	POWERPRO 486/33 SMP 512	SYSTEMPRO 486/33
CPU	Single 33-MHz i486	Single 33-MHz i486	Single 33-MHz i486
# of Processors	1	1	1
Max. # of Processors	2	2	2
Bus Architecture	32-bit EISA	32-bit EISA	32-bit EISA
Memory Cache	64-KB	512-KB	512-KB
RAM Std.	5-MB	17-MB	8-MB
Hard Drive	none	330-MB <18ms	240-MB <19ms
Expansion Slots	12	12	11
Price	$7,495	$14,495	$20,995

More importantly, this scalable architecture allows you to equip the POWERPRO with up to 1–MB of cache.

ADVANCED DISK PERFORMANCE AND SECURITY

Yet the POWERPRO's performance edge doesn't stop there. Selected models use ALR's SCSI SDA (Software Disk Array) to provide the capabilities of hardware disk arrays — including disk striping, spanning and mirroring — with greater flexibility and higher performance. ALR's SDA protects your data while helping to eliminate hard disk bottlenecks.

OFF THE SHELF COMPATIBILITY

The SYSTEMPRO-compatible ALR POWERPRO runs off the shelf dual-processing versions of SCO® UNIX™ with SCO MPX as well as Banyan® Vines™ SMP. And it's positioned for use with future dual processing versions of Novell® NetWare™, OS/ 2™ and LAN Manager 2.0™.

Only ALR can deliver a dual-processing system that's more powerful than the COMPAQ SYSTEMPRO for a price that's up to 30% less.

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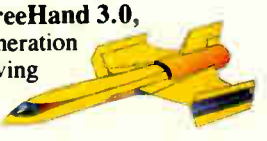

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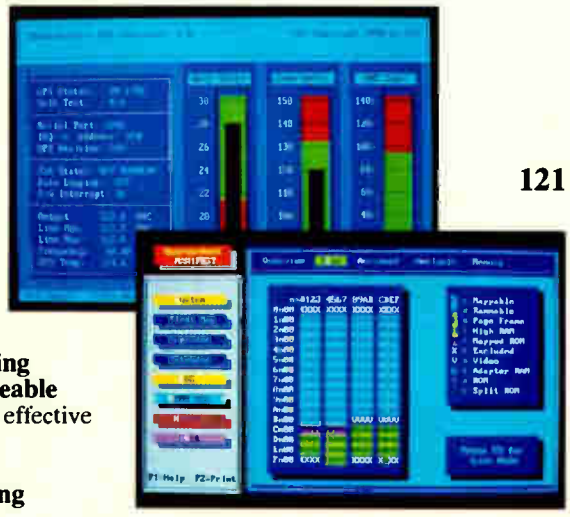

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INSIDE BYTE

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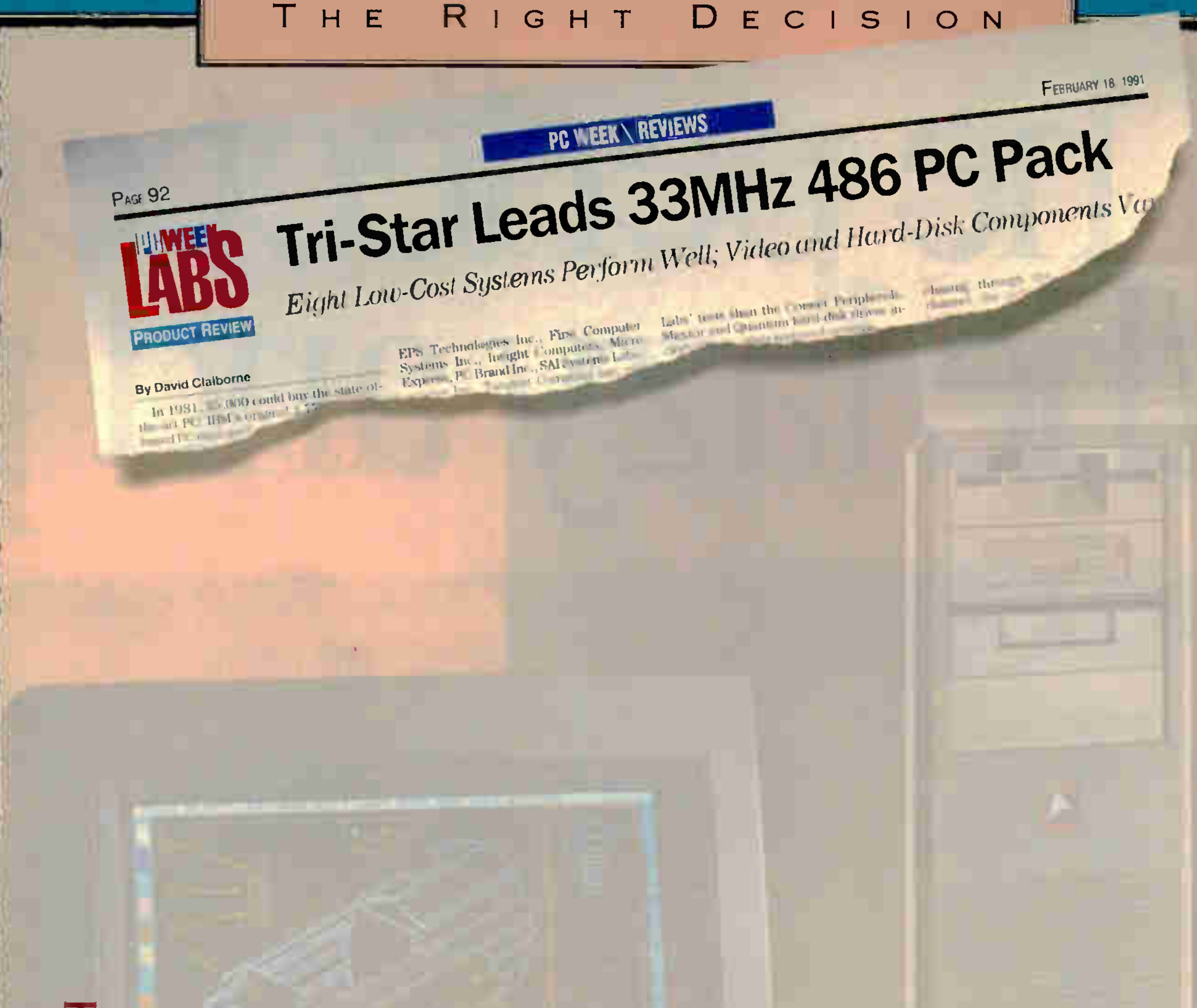
THE RIGHT DECISION



Tri-Star Computer continues to outdistance the pack as America's preferred supplier of high-end 486 Workstations. Read the reviews and you will understand why Tri-Star is the undisputed 486 champ.

"Tri-Star is king of the 33MHz 486 Mountain." PC WEEK
Analyst's Choice, February 18,1991

"Tri-Star's 486/25 rates honorable mention for its thoughtful design touches, two year warranty and excellent service program." PC Magazine
Editor's Choice Honorable Mention, September 11, 1990

"Tri-Star's edge is its good documentation and excellent service policy." PC Sources
486/33 Lead Review, February 1991

FLASH CACHE 486 COMPUTERS

FEATURES INCLUDE:
Intel 80486 Processor
8MB RAM (Expandable to 64MB On Board)
64K High Speed Static RAM Cache
210MB 15ms Hard Disk Drive
1.2MB 5.25-inch Floppy Drive
1.44MB 3.5-inch Floppy Drive
1024 x 768 SVGA Adapter w/1MB RAM
14" Non-interlaced SVGA Color Display
Microsoft DOS 4.01 & Windows 3.0
High Res 400 DPI Three Button Mouse
Quality 101-Key Tactile Keyboard
Two Serial Ports and 1 Parallel Port
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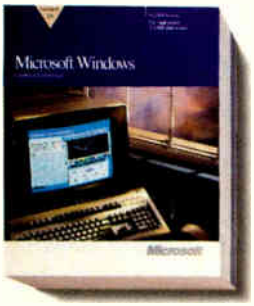

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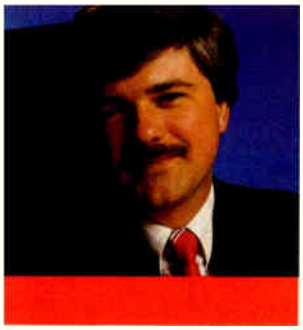

EDITORIAL

FRED LANGA

CeBIT '91

CeBIT at Germany's Hannover Fair is huge, easily the world's largest computer trade show. When CeBIT opened in mid-March, the organizers expected 580,000 attendees. However, war jitters reduced the count to a "mere" 400,000, about four times the size of Fall Comdex, North America's largest computer exhibition. The Fair is virtually a city unto itself: large enough to have its own rail stops, heliport, post office, pharmacy, florist, restaurants, police station. . . .

The world's largest computer trade show causes "the agony of the feet"

The Fair's logo is the head of Mercury (god of communication), with his mouth wide open. I assume the designers meant him to look as if he was heralding news, but after days of pounding CeBIT's endless aisles, BYTE staffers decided he was screaming because his feet hurt.

Here's a quick summary of some of the most interesting items we saw.

Kyocera's Refalo

Kyocera has been a behind-the-scenes player in portable computing ever since it built the Model 100 for Tandy. Now, Kyocera is rolling out a complete line of PCs under its own nameplate, including a fascinating pen-based notebook computer.

Refalo is an ultraminiaturized PC compatible running DOS 3.2 at 9.5 MHz: The circuitry is built into the covers of a very compact loose-leaf six-ring binder. You can use Refalo as either an electronic notebook or as a traditional paper-based notebook.

When you open Refalo, the inside left cover contains a 240- by 320-pixel screen, which is both an input and output device. You can write on the screen, storing your notes either as bit maps or as standard ASCII characters processed via built-in character-recognition software.

The character-recognition software works best on numeric data—phone numbers and the like. Text entry is possible, but it's faster and more reliable to tap it in via a membrane keypad on an electronic "leaf": a rigid touchpad tablet. The leaf is six-hole punched, and it's about as thick as 15 sheets of paper; it clips into the loose-leaf binder rings. The leaf communicates with the CPU using electromagnetic inductance through the metal binder rings—there are no wires.

The notebook can operate for up to 4 hours on either a built-in rechargeable battery or three ordinary, replaceable AAA dry cells.

Refalo comes with the standard megabyte of PC RAM, although the suite of always-available, built-in programs (e.g., schedule, memo, phone list, and telecommunications) eats up some user memory. The off-the-shelf configuration leaves you about 256K bytes to run standard DOS programs, which can be loaded through the serial port or, more conveniently, through two JEIDA-standard IC cards. You can also use the IC card slots to boost memory up to an amazing 16 MB. (EMS 4.0 support is built in.)

Refalo has been selling for several months in Japan. It will be sold this summer in Europe, and although plans for sales in the U.S. are not yet firm, Kyocera is working on it. Stay tuned.

Siemens-Nixdorf

At the other end of the spectrum, Siemens-Nixdorf International (SNI is Germany's largest computer company) announced a 105-million-instruction-per-second, 36-gigabyte multiprocessor Unix box that uses up to seven i486 CPUs: It's as big as a full-size refrigerator.

SNI also showed us a new version of ComfoWare, a complete suite of network-based Windows 3.0 applications that offers an attractive and easy way to get an office up and running on Windows. SNI has opened offices in North America and plans to reach out beyond its home turf. It's a company worth watching.

And More

Amstrad broke its low-end mold with a 20-MHz SX color laptop that will sell for about $8000 and is due out later this summer. NEC and Canon broke their "printers are us" molds, the former with a new line of PCs, the latter with a palmtop multilingual dictionary/thesaurus that can simultaneously translate 600,000 words among three languages. East Coast Software, a tiny Irish company, tried to break out of its start-up mold with powerful file transfer software, including a new version of Trax, which is like PC-Anywhere on steroids. CSA Interprint, an Israeli company, broke the antiviral mold with new V-Care software that claims to be the "world's first generic all-virus protection."

Well, you get the idea. We'll be featuring the best of CeBIT products in future issues of BYTE. It was a great show—despite my sore feet.

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

Make Powerful Connections with Borland's New Paradox

By any standard, Paradox® is the most powerful database. That's why it's been rated #1 by every leading computer publication, and why hundreds of thousands of users worldwide have switched to Paradox.

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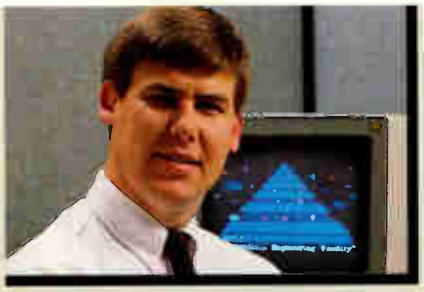

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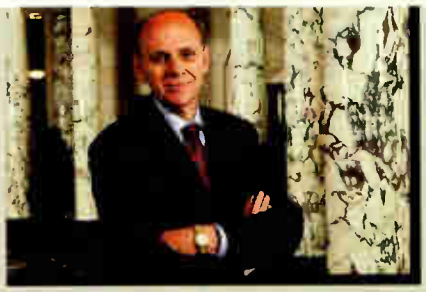

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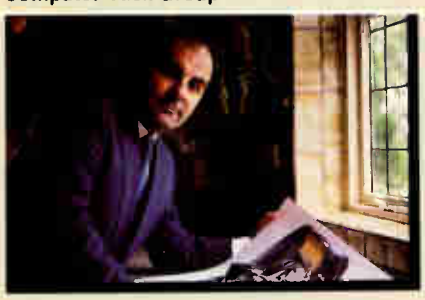

"We are using the IEF to develop a new generation of manufacturing systems replacing over 300 existing systems. We estimate that IEF will increase our productivity by between 2-to-1 and 3-to-1 for new systems development.."

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Study shows zero code defects.

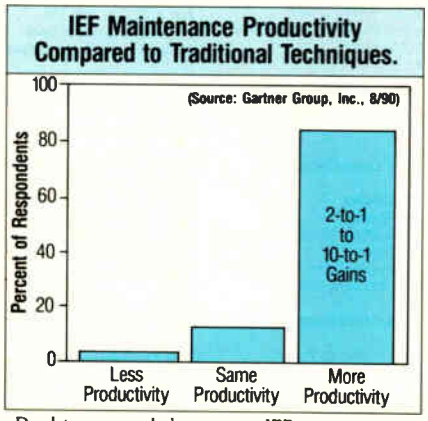
The quality of IEF-developed systems is remarkable. In recent CASE research by The Gartner Group, application developers were asked to report the number of abends they had experienced. (An "abend" is a system failure or "lock-up" caused by code defects.) *IEF developers reported zero defects—not one abend had occurred in IEF-generated code.*

Maintenance productivity gains of up to 10-to-1.

In this same study, developers were asked to compare IEF maintenance productivity with their former methods. Of those responding, *more than 80 percent had experienced gains of from 2-to-1 to 10-to-1.* (See chart.)

Specifications always match the executing application.

With the IEF, application changes are made to diagrams, not code. So, for the life of your system, specifications will always match the executing application. The Gartner Group research showed that *all* IEF users who reported making application changes made *all* changes at the diagram level.



Developers were asked to compare IEF maintenance to former methods. Of those responding, more than 80% reported productivity gains of from 2-to-1 to 10-to-1.

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We are committed to standards.

IEF tools and IEF-generated code will comply with standards as they emerge. We will adhere to CUA standards and to the principles of IBM's AD/Cycle and DEC's COHESION—and we will support Open Systems environments centering around UNIX. In any environment, the COBOL, C and SQL we generate adhere closely to ANSI standards. Our presence on standards committees helps us keep abreast of ANSI and ISO developments affecting the CASE world.

Full-service support.

Of course, our technical support, consultancy, training courses, satellite seminars, and other informational assistance will continue apace. We also offer re-engineering and template services. This full-service support will remain an integral part of the IEF product.

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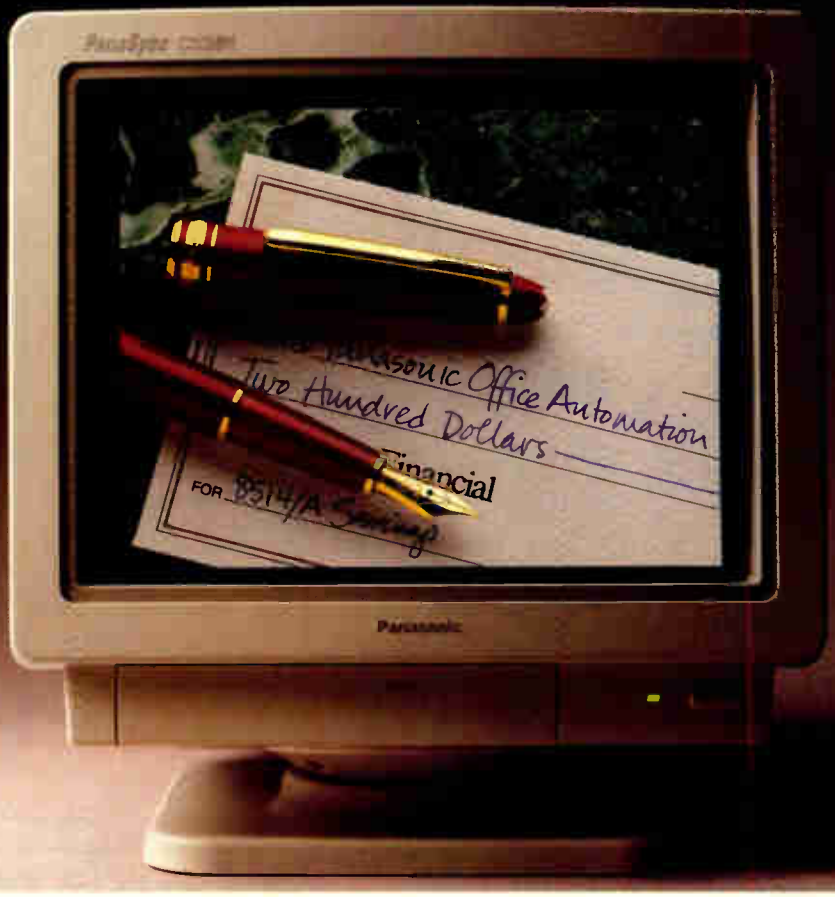

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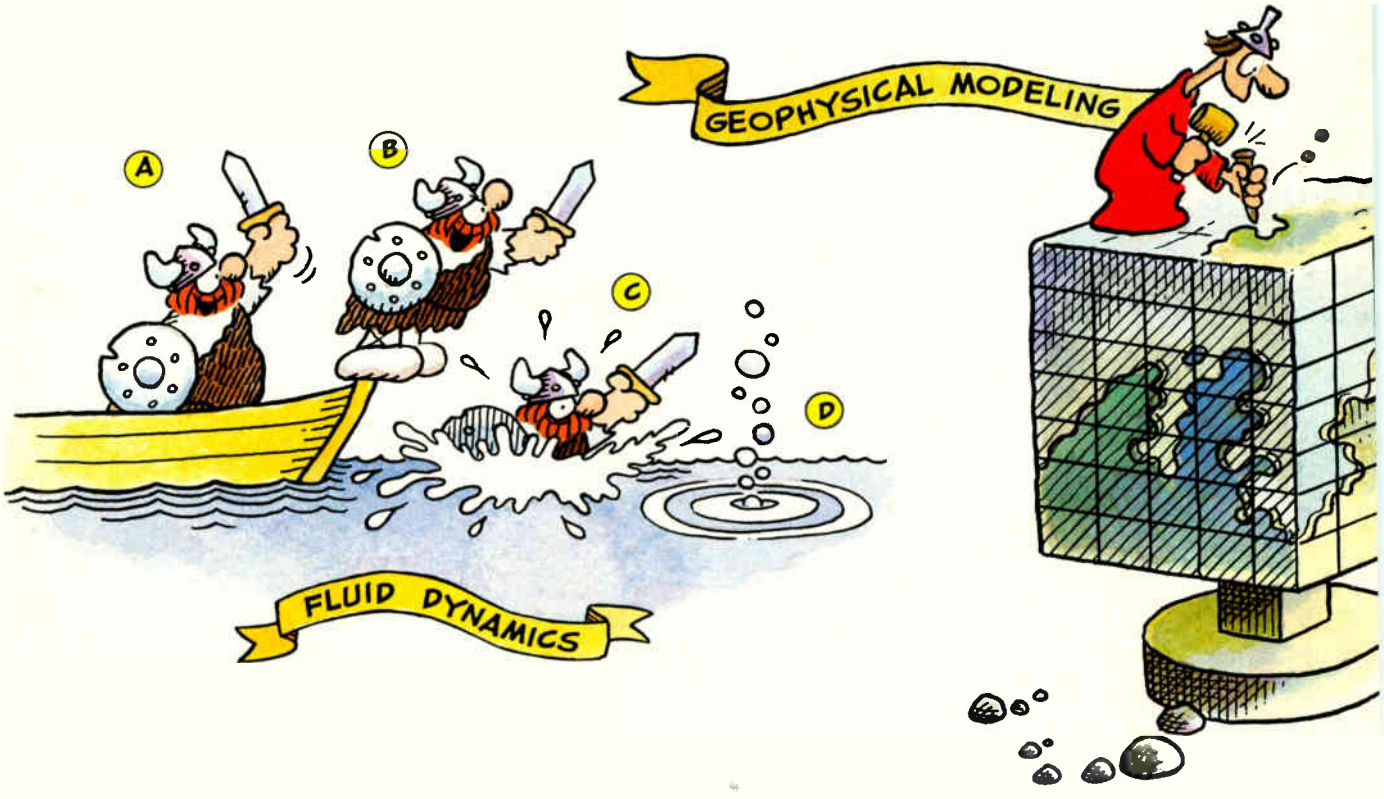

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	MFLOPS	MIPS	SPECmark™
POWERstation 320	8.5	29.5	24.6
DECstation 5000-200	3.7	24.2	18.5

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MFLOPS are the results of the double-precision, all FORTRAN Linpack test 100x100 array suite. The Dhrystone Version 1.1 test results are used to compute RISC System/6000 Integer MIPS value where 1,757 Dhrystones/second is 1 MIPS (Vax 11/780). SPECmark is a geometric mean of ten benchmark tests. All performance data are based on published benchmark information.

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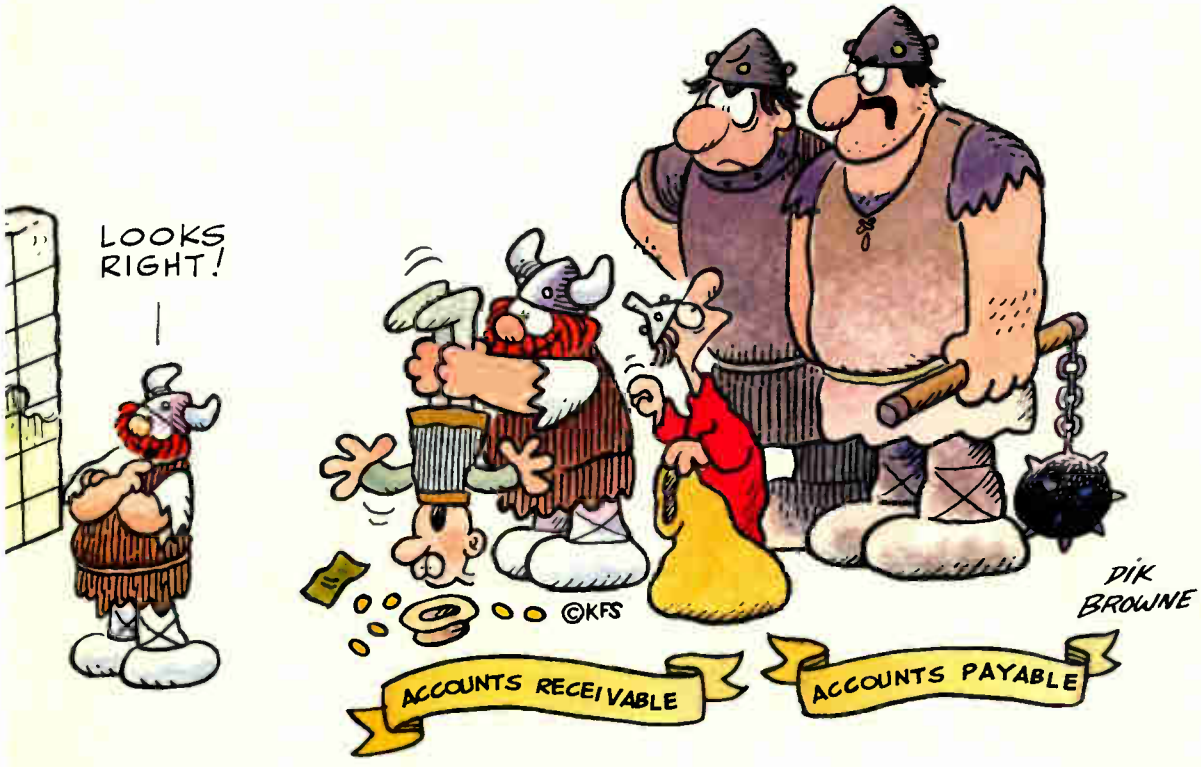

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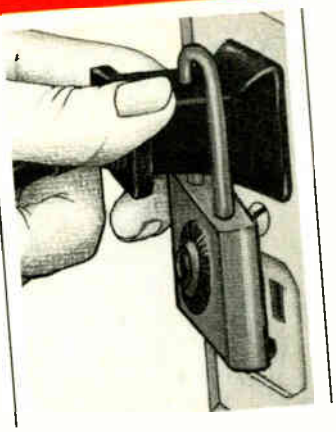

Power Insurance

Wayne Rash Jr.'s column in January ("The Power Man Cometh") failed to mention the most compelling reason for using an uninterruptible power supply (UPS).

Using high-quality surge suppressors to protect computer equipment is an accepted standard. However, transients, wave-shape disturbances, dips, sags, and brown-outs can pass through even the best surge suppressors. In fact, the incidence of these types of disturbances is increasing as more and more utilities tie into ever-larger networks or grids.

In our experience, the use of a high-quality UPS reduces hardware failures by about 50 percent. To us, the ability to ride out power interruptions is merely a side benefit. During a complete outage, power is interrupted (and restored) in the middle of a cycle, again jolting power supplies and potentially weakening the power supply or other components. Some computer and UPS manufacturers design their systems to switch on or off when the alternating current is between states. In this way, no stress is felt by the equipment.

Although we can expect computer equipment to become more reliable and better able to tolerate power disturbances, we can also anticipate that the quality of utility power will to continue to degrade. To operate efficiently, utilities will probably become even more interconnected. Furthermore, increasing economic pressures could lead to reductions in the maintenance of existing lines, causing more interruptions and disturbances.

The point is that a UPS not only enables a computer to make the "soft landing" described by Wayne Rash, it also protects equipment from any small disturbances that can, over time, weaken components and cause actual failures.

Charles Smith III
Mid-Illinois Data Services, Inc.
Mattoon, IL

386 Comparisons

I thoroughly enjoyed Fred Langa's January editorial, "The End of Intel's Monopoly?" However, I think that some unfair comparisons were made regarding Intel's new i386SL chip.

Langa points out that AMD's Am386 draws only 1 milliamp of current in sleep mode versus 60 mA for Intel's i386SL. What he fails to mention is that the i386SL is far more than just another 386. Intel's new chip contains a clock, a cache, and bus and memory controllers all built around a 386 core. Intel calls it a "microprocessor superset." With the i386SL (and some related support chips), it is possible to implement a complete AT using just 10 components plus memory. AMD's Am386 will certainly require more support chips than the i386SL—quickly nullifying any power consumption advantages it may seem to have. Langa makes another statement I must take issue with. He says that "some 486 instructions execute in fewer clock cycles, but most common instructions run about the same as on a 386." On the contrary, the common instructions have been sped up significantly on the i486 over its 386 counterpart. Overall, in a "typical" instruction mix, the i486 is twice as fast as a 386 when they're operating at identical clock speeds.

Chris A. Kantack
Bellingham, WA

We focused on different elements of each chip and, not surprisingly, came to different conclusions. You say to-may-to, *I say* to-mah-to. *My comment about the i386SL's power consumption was intended to create a frame of reference in which to understand the Am386's power consumption. I make no claims about the overall power consumption of complete systems built around the chip: only that the Am386 itself is a power miser.*

Regarding typical 486 instruction speeds, it depends on what you define as "typical." The statements in the January editorial about 486 execution speeds were AMD's claims, and they were identified as such. The claims are not obviously outlandish: We have seen some 33-MHz 386 machines turn in better low-level CPU benchmarks than some 33-MHz 486 machines. But your mileage may vary.

And that leads to the most important, although unstated, part of your letter: something I should have stressed in my editorial but did not. Normally, end users don't buy a chip: We buy complete systems. That's why BYTE includes not only low-level benchmark results, but also real-world application benchmarks. The safest bet, as always, is to keep abreast of the new chip technology but wait to see real-world benchmarks of shipping systems before drawing final conclusions. Only then will we see if and how these chips deliver on their early promise.

—Fred Langa

Evolving Networks

I enjoyed "NetWare Troubles" by Barry Nance in January, and I think the article will be very helpful to many NetWare users.

Nance gave the product TXD a very positive review. However, as a TXD developer, I would like to clarify one point. The article implies that TXD provides only IPX/SPX statistics. TXD will provide important adapter-specific information in what is called the "custom variables." For example, some token-ring adapters place

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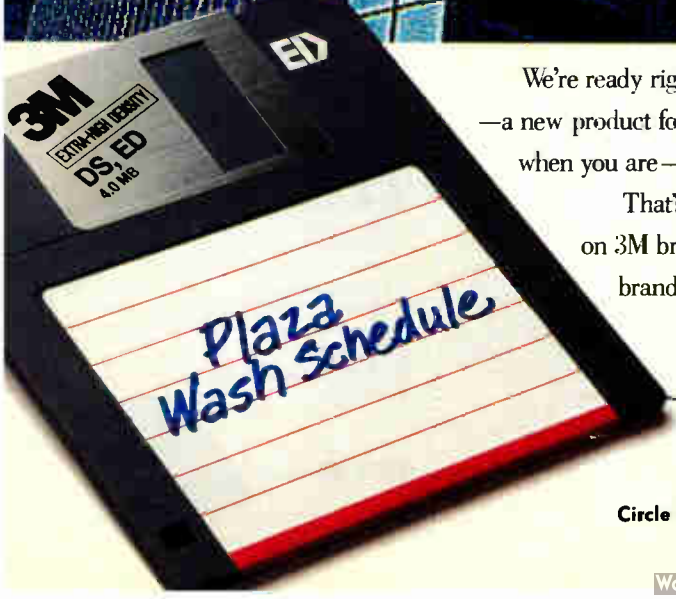

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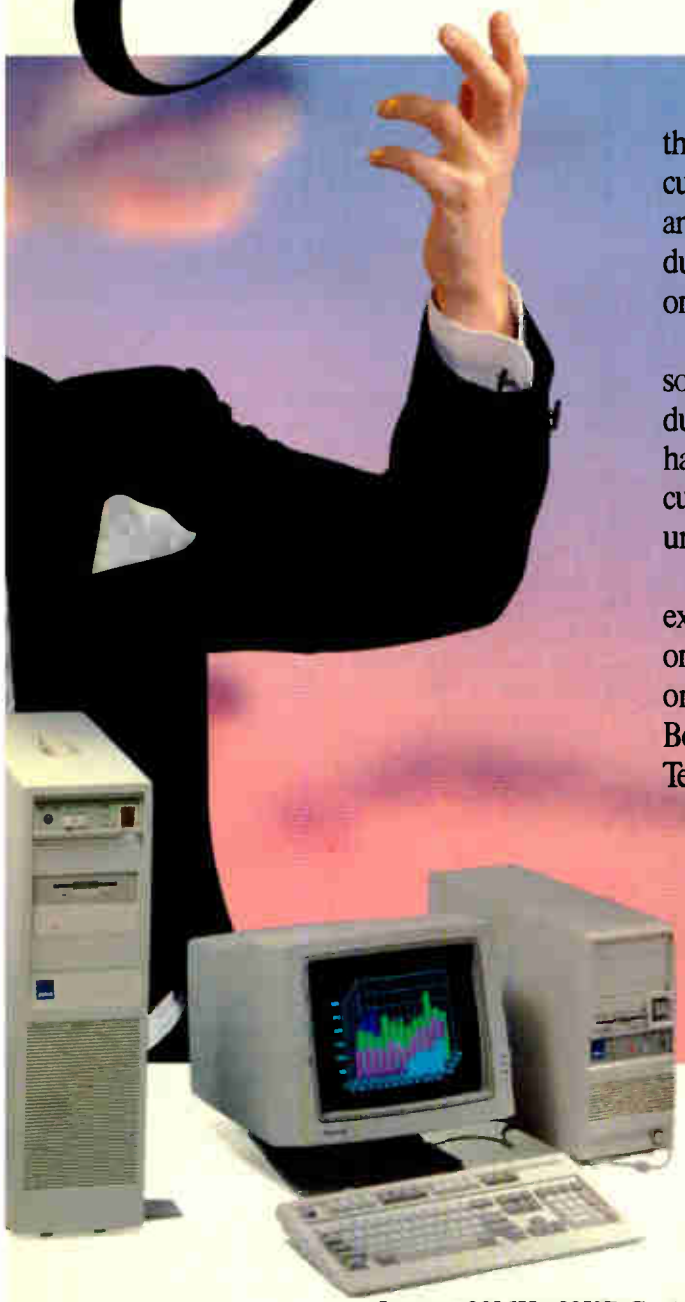

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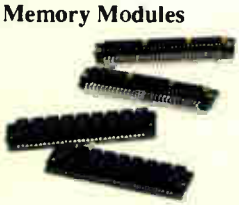

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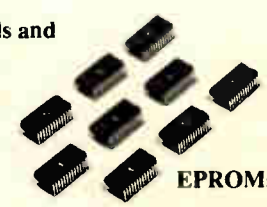

EPROMs

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ring-error monitor statistics in the custom variables. NetWare users can also obtain this physical-layer information through other products, such as IBM's LAN Manager. Also, NetWare shell and bridge information is provided in the TXD product.

Peter E. Chandler
Austin, TX

I took a personal interest in your December 1990 column "Kicking and Screaming into the Present" by Mark L. Van Name and Bill Catchings. I found it typical of the PC mentality that has surfaced in recent years.

I wholeheartedly agree with the authors' statement that DEC has been "slow." The company has made serious blunders over the past decade. However, I don't think that networking is an area in which it shows weakness. DECnet may be a proprietary networking protocol, but its roots started long before PCs ever existed. DEC has truly been a leader in the networking arena. Competition from the PC marketplace has so driven prices down that up-front hardware costs for networking solutions, PC or larger, are very comparable. And since these costs are only the tip of the iceberg when implementing PC networks, a DEC solution is looking better every day.

DEC (along with IBM, Hewlett-Packard, Sun, and others) is many years ahead of microcomputer networking developers when it comes to security, data integrity, and resource management. All of a sudden, these issues have become important to PC users.

PC networking vendors are reinventing the wheel to a certain extent. Sometimes it appears that PC groups reject any technology proposed by "mainframe" hardware vendors through fear of being forced into proprietary situations. Many people have learned computers from a microcomputer perspective that sometimes serves to limit, for them, the range of possible solutions.

I'm not against PCs—they're great tools when used appropriately. Every once in a while, it would be refreshing to hear comments from a broader perspective of the computing world. When this happens, everyone benefits by seeing the "big picture."

Kevin O'Malley
Park Ridge, IL

I was pleased to read "Making the Micro-to-Mainframe Connection" by Sharon Fisher and "Don't Worry, Use HLLAPI" by Mike Fichtelman in the BYTE *IBM Special Edition* (Fall 1990). Here in Australia, the Australian Gas Light Co. has been investigating these topics for two years, with the following issues in mind.

With the gradual move to distributed processing and databases, personal computers will not be accepted as serious by the custodians of the mainframe until they can exhibit comparable features in terms of security, backup, and resource monitoring.

Many companies have a large investment in System Network Architecture links back to a centralized mainframe and are reluctant to discard these hard-wired links for the sake of what appears to be a moving target (e.g., 4 megabits per second, 16 Mbps, and Fiber Distributed Data Interface).

Assuming that these companies will slowly migrate to distributed LANs centrally connected to a host system, there are no products available that readily allow data transfer from a LAN on one side of the network to a LAN on the other without actively invoking a process on the mainframe. Seamless integration is unavailable.

These and other issues will become of major importance over the coming years as it is realized that the world revolves around neither the mainframe nor the LAN and that, accordingly, concessions must be given on both sides to ensure that users can get on with the job in a way that enhances their business function.

D. C. MacKinnon
AGL Information Systems Pty., Ltd.
North Sydney, Australia

Virus Verification

I just had another virus false alarm, and I thought Jerry Pournelle and his readers might want to know that not everything that goes wrong is due to a virus. Recently, I was downloading some files from a local BBS using Procomm Plus in a Desqview window while doing some editing in another DOS window. After terminating Procomm and Desqview, I couldn't access anything on my E drive. Because I had been getting a lot of files off a BBS, I immediately suspected a virus.

When I looked at the directory of the E drive using The Norton Utilities, the information there looked like some of the stuff that I'd been downloading from the BBS. Then I remembered using my editor to edit the PCPLUS.LOG file in the second window. The trouble was that Procomm was still using that log file. When I resaved it, Procomm obviously lost the file handle.

I used Norton Disk Doctor to repair the destroyed directory, and Norton Change Directory to rename the directories back to their original names. (NDD didn't know what the root directory names were, so it renamed them DIR0000, etc. But NCD still knew what the names were, so I recorded the old NCD tree structure and used it as a map to the new DIR0000 names.)

To summarize, if you think you've contracted a virus, the first thing to do is sit back and try to remember what you were doing with the system and what you recently did to it. You may be surprised to find that it was you, and not a virus, that scrambled your machine.

Steve Nelson
Mansfield, TX

Thank you for the story, which makes a very important point. I, too, have odd things happen to my machines and can usually trace them back to something I have done. My virus protection is never to move anything from the "test" machine to anything else—a remedy, I fear, that is not available to everyone.—Jerry Pournelle

An Idea Dawns

The feature article "Genetic Algorithms" by Peter Wayner (January) turned on lights and set off bells for me. The subject of genetic algorithms is entirely new to me, but after I read the article, it occurred to me that this just might be the solution to one of my biggest programming headaches.

For a number of years now, I have been working in

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We totally agree with Apple.*

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But more important than the specs themselves, is the way the T2000SX lets you use them. Which is more often.

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Welcome to the next generation in personal computing.

Because the T2000SX can fit easily into a briefcase (it weighs a scant 6.9 pounds), you can take it anywhere you go and use it in more ways than you can imagine.

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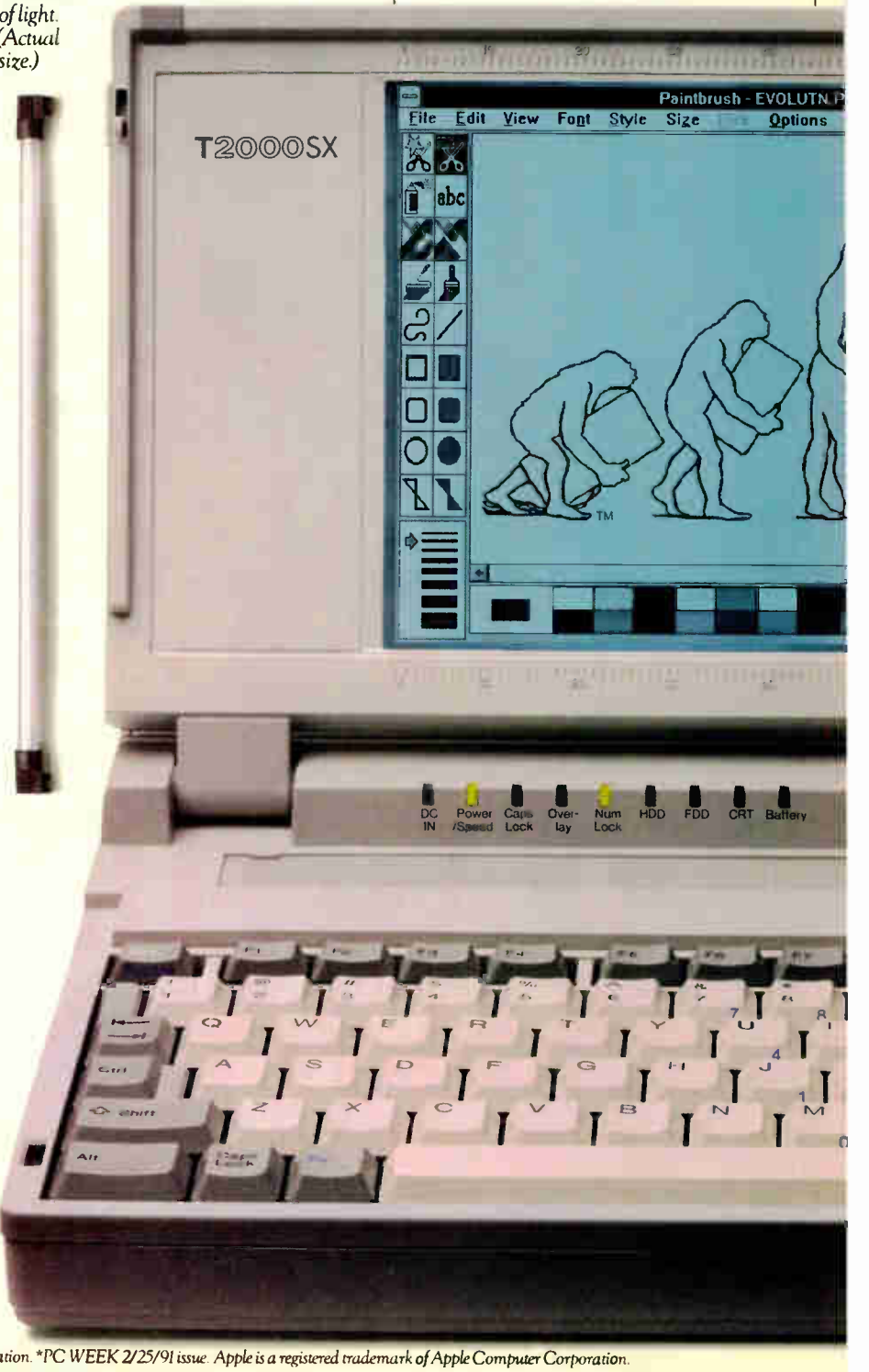

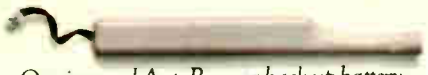

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business proposal? The T2000SX gives you the freedom to do it from a train. The client wants an estimate on costs? You can give it to him right then and there—wherever there is.

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But just in case there's something back at the office you still need, you can get back to it with our optional built-in modem. Which supports industry standard error correction and data compression (CCITT V.42, V.42bis, MNP® 5 and 10). It even supports cellular data communications via our optional smart cable adapter.

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The T2000SX also has a unique feature you won't find on any other computer in the world. It is called AutoResume.

AutoResume: Think of it as a bookmark for your computer.

AutoResume automatically saves whatever you're working on whenever you turn the computer off. And it lets you go directly to the program you were using last when you're ready to start up again. So you don't have to reboot, restart your application and reload your files.

AutoResume also helps save on battery life and it allows you to change batteries without losing an ounce of information.

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Okay, let's wrap this thing up.

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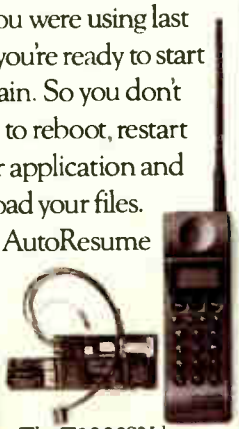

The T2000SX has an optional modem that allows data communications via a cellular phone.

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number theory—random-number progression, in particular. I am trying to determine if there is any way, with any reasonable degree of accuracy, to predict the suit of a group of random numbers within a defined subset of integers. I haven't had much success up to now. I have been trying to apply statistics of past outcomes to predict the future. Wild guessing gives me about the same degree of success. Genetic algorithms seem to have some promise.

I would like to add that I think yours is the best computer magazine on the market.

Fred Hirschfelder
Aubagne, France

Flex Appeal

I just read Ben Smith's informative feature article "FlexOS's Muscle" (January). I couldn't believe what I was reading. Here is an operating system for the PC that is surprisingly similar to the one I use all day long.

I live in the VAX/VMS world and make frequent trips to the PC environment. The similarities between the VMS operating system and FlexOS are heartwarming.

VMS can protect files by allowing or disallowing read, write, execute, and delete privileges to the following user classes: owner, group, world, and system. This is similar to FlexOS. VMS can spawn and create attached processes similar to FlexOS's spawned concurrent and subroutine processes. Spawned processes that retain their parents' ID is another feature that VMS and FlexOS have in common. In addition, many of FlexOS's supervisor class are very similar to VMS's Digital Command Language commands. VMS makes extensive use of logicals using the Define or Assign statements, as does FlexOS's Define supervisor call.

For an operating system on a PC to be this similar to a mainframe takes a major step toward blurring the difference between the PC and the mainframe.

Norman G. Coder
Sulphur Springs Valley Electric Cooperative, Inc.
Willcox, AZ

Award Caveat

Your award in January to Digital Research for DR DOS 5.0 is not totally justified. I bought DR DOS 5.0 with the sole purpose of relocating most of my TSR programs in the upper memory of my AT clone, fitted with 2 megabytes of expanded memory. That did not work. A series of faxes to the company resulted in an explanation: My AT is not fitted with a Neat or Leap chip set. That caveat is not mentioned in Digital Research literature and flyers.

About Quattro Pro, you should know that it does not allow the retrieval of read-only files. Lotus does it. Would you call that a bug or just an oversight? Besides that, Quattro Pro is supplied in the U.S. and Europe with Bitstream fonts that are restricted to the first 128 ASCII characters—that is, without any accented letters. That makes them almost useless in Europe.

Emmanuel de Broux
Leignon, Belgium

Mac Connectivity

As an MIS manager, I find all the current hoopla over Windows 3.0 and OS/2 Presentation Manager very puzzling. The experience of my organization has been that the Mac offers far greater connectivity to more environments than any other platform. We work in the Windows, Macintosh, and OS/2 PM environments. I spend half my time with a group of about 25 people now using Windows 3.0 on IBM PS/2 70s with 5 megabytes of RAM who were previously straight DOS users. We also have two PS/2 70s running OS/2 1.2.

The rest of the time, I work with about 35 people using 15 Mac SEs, 15 Mac IIcxs, 2 Mac IIcis, and 3 Mac IIs. The Mac II family machines are equipped with 4 MB of RAM and the SEs with 2.5 MB.

In the DOS-Windows-OS/2 group, we spend a lot of time poring over manuals, trying to kludge together installations and struggling with the underlying DOS. Users still wind up dealing with weird and wonderful filename restrictions and utilities with instructions like "Always exit Windows before running CHKDSK with the /F option, never run CHKDSK from within Windows, loss of data may result." Or this statement: "Run disk compaction utilities directly from MS-DOS, after exiting Windows; damage to the files on your hard disk might result." Can you appreciate how counterproductive this all is?

In the Mac group, we simply discuss the work at hand. Rarely do we talk about or worry over computer installations or support. We need our workstations to help us do our work, not to be technical toys for people to tinker with endlessly.

Robert Corley
Mississauga, Ontario, Canada

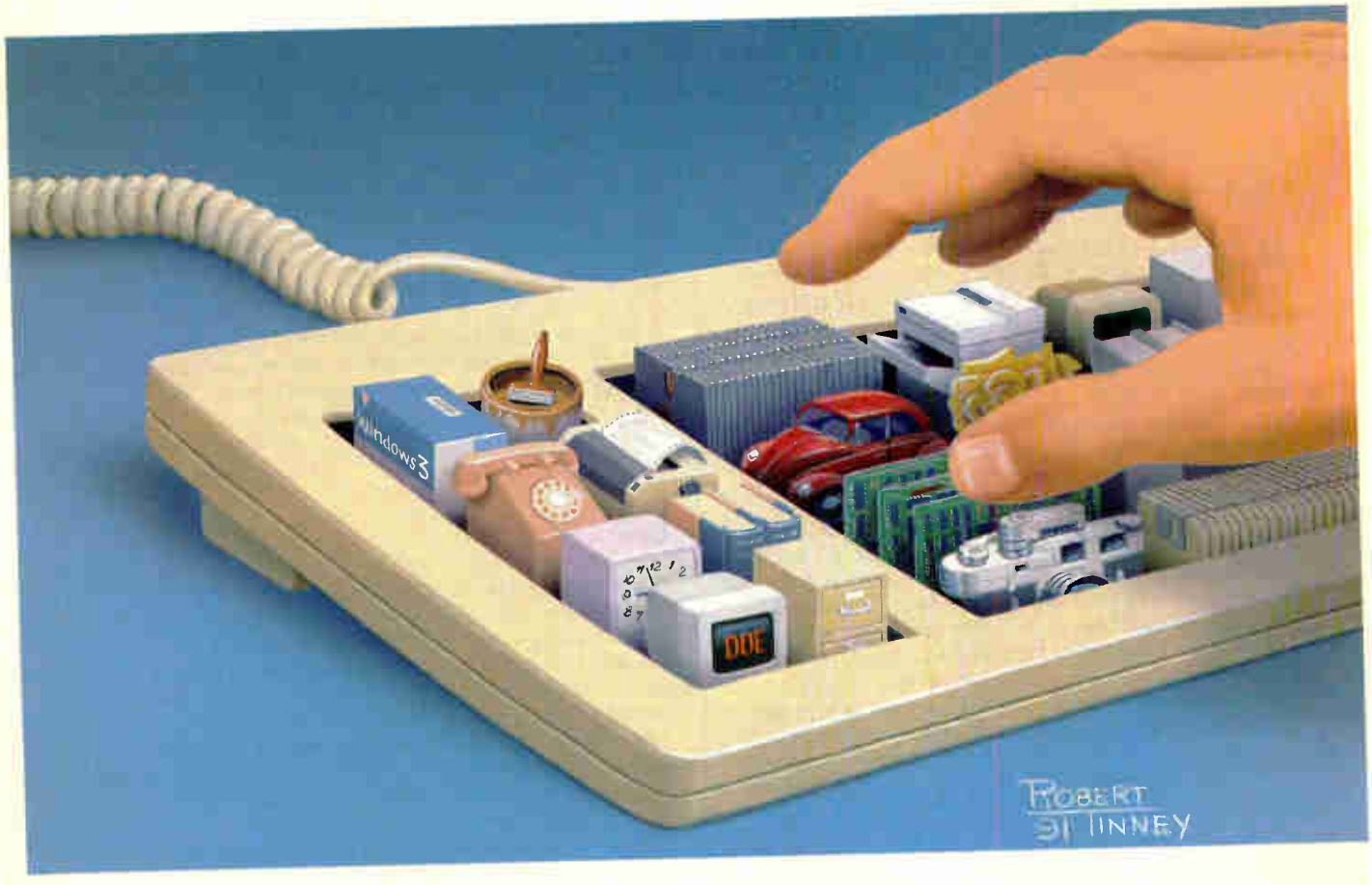
Recycling Software

Brad Cox missed the mark in "There *Is* a Silver Bullet" (October 1990). Most software professionals agree with Cox that reuse is the key to software productivity. But object-oriented programming probably isn't the royal road to software reuse. The oldest practice of software reuse goes back to the 1940s, when the IBM Share library was established primarily to exchange mathematical software. Although the Share collection never got much of a reputation for reliability or efficiency, other libraries have become quite reliable. The tradition in the mathematical software community has long been to reuse software. Mathematical software remains the only discipline in which reusing existing software is the rule rather than the exception.

What has led to this success? It certainly wasn't a flashy new language or programming discipline: Essentially, all mathematical software is written in FORTRAN. We conjecture that barriers to reuse are not on the producer side, but on the consumer side. If a software engineer, a potential consumer of standardized software components, perceives it to be too expensive to find a component that meets his need, he'll write one anew. Notice that I said *perceives*. It doesn't matter what the true cost of reconstruction is.

Until we have adequate notations, nomenclatures, and, possibly, tools on the consumer side, no amount of

Objects At Your Fingertips.



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flashy new glitz on the producer side will make software reuse commonplace.

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Pasadena, CA

Computing Compromises

Robert L. La Fara (Letters, October 1990) wrote, in response to Ben Smith's May 1990 article "Around the World in Text Displays," that the answer to collating problems in unusual names (the examples cited were a name with an apostrophe and his own two-word-both-capitalized name, La Fara) is to ease the programmer's burden by making the name fit a more standard pattern. In the first case, he removes the offending apostrophe; in the second, he makes his name a single word—Lafara.

He misses the boat. It need be axiomatic for everyone working throughout the computer field that computers exist to serve people, and not that people exist to serve computers. Every time people must compromise their desires to better fit the capabilities of a computer system, that event must be seen as a system design flaw, one that should be reviewed for correction in the next iteration. This attitude is critical to the continued and increasing usefulness and efficiency of computers in every segment and stratum of society, and it is also critical to any hegemony the U.S. yet enjoys in computer technology.

Leland V. Lipman
Republic of Korea

AutoCAD Correction

Your mail bag has probably been full over an error in the May 1990 Computing at Chaos Manor. AutoCAD is written in C, not Lisp, and includes a Lisp interpreter. The AutoLisp interpreter, which is also written in C, is based on XLisp, developed by David Betz of Peterborough, New Hampshire.

AutoCAD release 10 for OS/2 and most versions of release 11 include the AutoCAD Development System. The ADS is a C programming environment that allows advanced users and developers to write more sophisticated programs than AutoLisp can support. The ADS is accessed through the AutoLisp interpreter. It is easy to understand your confusion over this point.

AutoCAD runs under DOS, Extended DOS 386 (Phar Lap), SCO Xenix and Unix 386, Sun Microsystems' SunOS (Motorola 68000, Intel 386, and SPARC architectures), DEC Ultrix and VMS, Apollo's Aegis, OS/2, and Mac OS. It would be quite a feat to port a program as complex as AutoCAD to so many environments if it were written in Lisp.

Christopher James DeLucchi
Solana Beach, CA

Legal Breakdown?

I read about the Gilbert Hyatt controversy with fascination and horror ("Micro, Micro: Who Made the Micro?," January). It is ridiculous that the microprocessor is just now being patented. Our patent system has broken down.

The idea behind the patent is that society gets full disclosure and documentation of a useful device or process in exchange for granting the inventor exclusive marketing rights for a certain time period.

An alternative to the patent is the trade secret, with which there is no disclosure. The peril of the trade secret is that knowledge can be lost forever in any number of ways. The inventor can take the knowledge to his or her grave. The documentation can be destroyed by fire or by simple indifference. And there is a lot of reinventing of the wheel.

Many processes (especially software) in the electronics industry are trade secrets primarily because it is too expensive and time-consuming to get a patent. Our patent system has broken down. It is time to fix it.

Dan Siedelmann
Idaho Falls, ID

Behavioral AI

Your series of articles on AI (State of the Art, January) discussed the cognitive psychologist's search for the "mind" and a replication of "human intelligence." This would leave readers with the idea that the issue of human intelligence is the exclusive domain of the cognitive psychologist when it is not. There is a very lively debate within the field of psychology regarding the view that we must understand the mind to understand intelligence versus the view that intelligence is a label for a certain group of behaviors.

From a behavioral perspective, machines already show some of the behaviors we attribute to human intelligence. We will increasingly consider computers intelligent as the range of machine behaviors increases. But to search for some elusive state of "intelligence" will not succeed, because intelligence is a category of behaviors—not a single, unitary attribute.

B. F. Skinner said that if a machine can be made to think, it will be the best evidence yet that thinking follows rules, and following rules is behavior. I suggest that AI's conception of intelligence is not too shallow; it is too mystical.

Will focusing on behavioral rules, then, make a machine that duplicates human behavior? Only to a limited degree. Human behavior is the behavior of an organism adapting to its environment. Computers, at least in this century, are not organisms, which means they do not respond to natural selection and operant conditioning. Until they do, those who object to creating intelligent machines have nothing to worry about.

David M. Boan
Easton, MD

FIX

- The Mac IIfx from Apple Computer (1990 BYTE Award of Merit, January) uses a 68030 microprocessor. ■

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Ted Waitt, Gateway 2000 President

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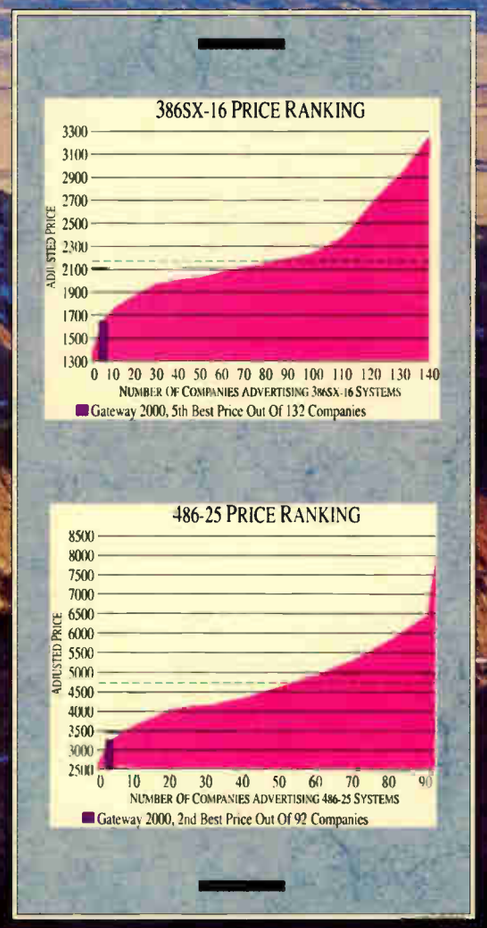

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NEWS

MICROBYTES

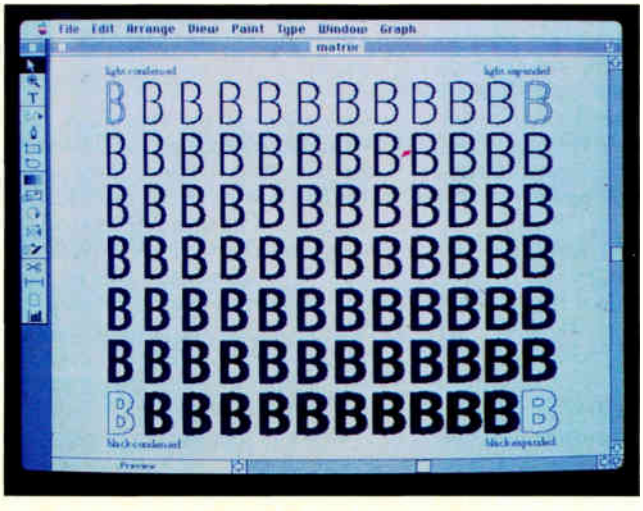
Adobe's New Font Technology Will Give Users More Control Over Type

Adobe Systems (Mountain View, CA) is perfecting new font technology that will give Mac and PC users greater control over computer-generated text. The upcoming Multiple Master typefaces are specially encoded Type 1 PostScript fonts that you will be able to easily manipulate to produce a wide range of type from one core design. You will also be able to control the main design elements of the typeface, including weight (lightness or boldness), width (condensed or expanded), and visual scale (size). As Adobe chairman John Warnock said while demonstrating the technology on a Mac II at the recent Seybold seminars in Boston, Multiple Master font rendering "recaptures the flexibility calligraphers had back in 1400."

A Multiple Master typeface is basically a single spongelike font that can shrink or grow while still retaining its original shape. Working with one scalable font design, Adobe's encoding scheme and related software can generate a character of any size or weight, instead of requiring you to have a whole set of fonts for each typeface (e.g., regular, medium, condensed, expanded, bold, and semibold). With Multiple Master, the one design can generate the whole range. "We design two extremes and get the intermediates synthetically," Warnock said. Adobe intelligently interpolates the points between the extremes to generate all the gradations of weight and width.

Multiple Master fonts will have benefits for "everyone who uses type to communicate information," said analyst Jonathan Seybold. One benefit will be in fitting text in a given space (e.g., trying to squeeze two more lines onto a one-page memo). With Multiple Master typefaces, you could shrink the text so it all fits on one page, without changing the point size, shape, or perspective of the characters.

"One of the biggest advantages to businesses is in font substitution," Warnock said. Say you generate a document using a Bodoni font and then send that document to someone who doesn't have Bodoni on his or her printer. When it comes out, it will be in Courier, the line breaks will be different, and the text won't look like you intended. A system equipped with Multiple Master technology will instead construct a typeface that mimics the one the sender used; it



Think of a Multiple Master typeface as this matrix of character designs, in this case, a sans serif design. The four corner letters each represent the basic, or master, designs: top left is light condensed, and top right is light expanded; bottom left is black condensed, and bottom right is black expanded.

PHOTO COURTESY OF BELL LABS © 1991

NANOBYTES

Apple's foray into **RISC technology** should yield real products soon, a company official reveals. "We do have RISC projects under way . . . in the future product category," said Mike Dionne, senior vice president of sales at Apple USA. "And we're talking to all the major suppliers of those microprocessors and chips. We are very much interested in the technology. I think you'll see it incorporated into Apple products relatively soon." As for other high-end machines, Dionne confirmed that the rumored 68040-based "**Tower Mac**" is "(a) in the plan and (b) on schedule."

As for that so-called battle between the **Mac and Windows-based PCs**, Apple officials are taking a communitarian approach: What's good for one graphical user interface is good for another. About Windows' effect on Mac sales, Mike Dionne said, "We have, in fact, done very well in the environment that Windows has helped to create," because there is now "more awareness around the graphical user interface. We think we have a product and an operating system that is superior to DOS with Windows layered on top, for most applications. And a lot of that is subjective . . . but our sales are brisk."

Lasting memories: **Ramtron International** (Colorado Springs, CO) has brought its first **nonvolatile RAM chips** to market. The company claims that its ferroelectric RAMs, or **FRAMs**, are the first dynamic memory chips that can maintain information after losing power. The CMOS chips hold data in special ferroelectric storage cells. The first FRAMs hold only 4000 bits, but the company says that 256,000-bit versions are in the works.

might not look exactly the same, but it will have identical character widths.

Another example that Adobe officials mentioned is a publication that has to include text in different languages—a user's manual, for instance. French and German versions take up more space than the English version, but Adobe demonstrated how its Multiple Master software shrinks French and German text into columns the same length as the English text. The technology will work equally well with nonroman alphabets, Warnock said.

There's an economic consideration also, Adobe officials said. "If these fonts are bundled with low-cost laser printers, you can have a wide variety of type just from these Multiple Master fonts," Warnock said.

Multiple Master typefaces will work on Macs, PCs, and PostScript printers already out there. They'll install just like any other Adobe typeface, Warnock said, and you can download them into any PostScript printer. "We have it up and running on a Mac and on a Windows PC," he said.

Adobe expects to be shipping its Multiple Master designs—initially, a serif and a sans serif typeface—this summer. (Prices haven't been set yet.) These fonts will come with a version of Adobe Type Manager and a program called Font Creator that will let you generate the type. Whether companies (e.g., Bitstream) will develop Multiple Master versions of their fonts isn't clear yet.

—D. Barker

NEC Says New Design and Process Yields 100-MHz, 200-MFLOPS Processor

Intel wasn't the only company that revealed a revved-up chip at the recent International Solid State Circuits Conference (see the April Microbytes). Researchers from rival NEC described a new design for a 64-bit vector pipelined processor that they say runs at 100 MHz.

NEC says that a processor using its pipelined design can perform five operations in parallel: addition or shift; multiply, divide, or logical; load; supply; and transfer. Since two of these are potentially floating-point operations, the processor is theoretically capable of 200 MFLOPS. Similiar to Intel's approach with its 100-MHz i486, NEC's design uses a 0.8-micron triple-level metal process. It's likely that this type of process will soon become common, resulting in more chip makers capable of producing high-speed ICs.

—Owen Linderholm

AMD's 386 Due Soon in 40-MHz Desktops; Battery-Powered Notebooks to Follow

Cloning the Intel 386 is the easy part. The bigger challenge is designing a chip that offers something that Intel's doesn't. Advanced Micro Devices has managed both by producing a pin-compatible processor that's faster and that consumes less power than any of Intel's 386s. AMD is now shipping its Am386 chips in volume, and systems using the alternative CPU should start showing up soon. Because of its low-power requirements and special "sleep" mode, the chip could be the basis of full 32-bit notebook computers that will run on batteries for as long as less-powerful systems.

AMD has a standard model called the Am386DX (in speeds of 20, 25, and 33 MHz), but the really significant device is the Am386DXL, which not only needs considerably less current than any of Intel's chips but also runs at 40 MHz. This model will give you about 20 percent faster performance than Intel's 33-MHz 386 and twice the speed of the SX, according to AMD officials. AMD's 0.8-micron CMOS process is designed to produce high-speed, low-power chips and "gives us good yields on the higher-speed parts," said Mike Webb, director of marketing for AMD's Personal Computer Products Division. The manufacturing technique could produce CPUs that go faster in the future, he said.

According to Webb, for any given clock speed, an AMD device will need about 30 percent less power than an Intel device; for example, at 33 MHz, the DXL runs on 275 mA, while the Intel 386 needs 550 mA. But, Webb says, in its sleep mode, the Am386DXL essentially stops the clock and the current drain on the battery is 0.08 mA. The DXL also gives off less heat, so computers based on

NANOBYTES

There's 9 million business telephone listings out there, and **Dataware Technologies** (Cambridge, MA) has put them all on one CD-ROM called **Speed Dial**. To obtain all that information (the equivalent of 4800 Yellow Pages books), Dataware has developed a slick search mechanism. You can look for any business by its name or by its directory heading (computer dealer, car rental agency, and so on), either by city and state or by area code. If you've got a modem, the program will dial the number you select; you can pop into the directory from within your application program. That Chinese restaurant you're trying to remember the name of—you could probably find it in seconds. Speed Dial ($399) works with IBM-compatible CD-ROM drives.

New twisted-pair cable from **Belden Wire and Cable** (Richmond, IN) can carry data at speeds of up to **100 Mbps**, the company says. The DataTwist cables work with all LAN topologies and come in shielded and unshielded versions.

Hewlett-Packard has licensed AutoCAD display list drivers from **Panacea** (Londonderry, NH). The drivers will speed up AutoCAD drawing when using HP's IGC-10 and IGC-20 graphics boards. Actix has also licensed drivers from Panacea, for use with its Texas Instruments Graphics Architecture–based graphics boards.

They often call me Speedo: **X Window System** users will someday have slick, scalable fonts now that **Bitstream** (Cambridge, MA) has donated its Speedo type-scaling technology to the X Consortium. X Window users will be able to generate smooth bit-map fonts on the fly, in virtually any size. Bitstream's rasterizer code will be built into the font server of X Window version 11, release 5, which is supposed to be ready later this year.

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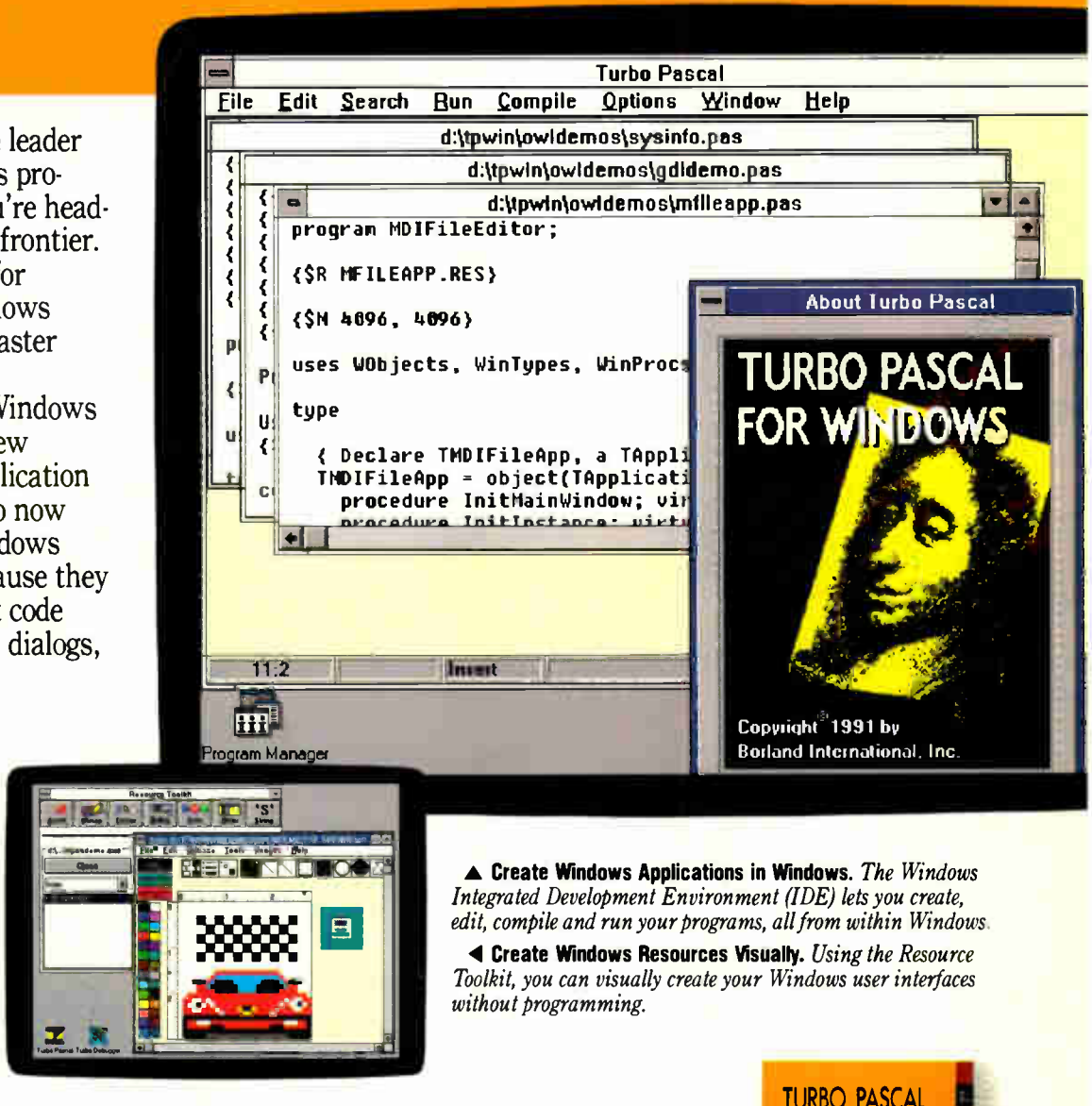

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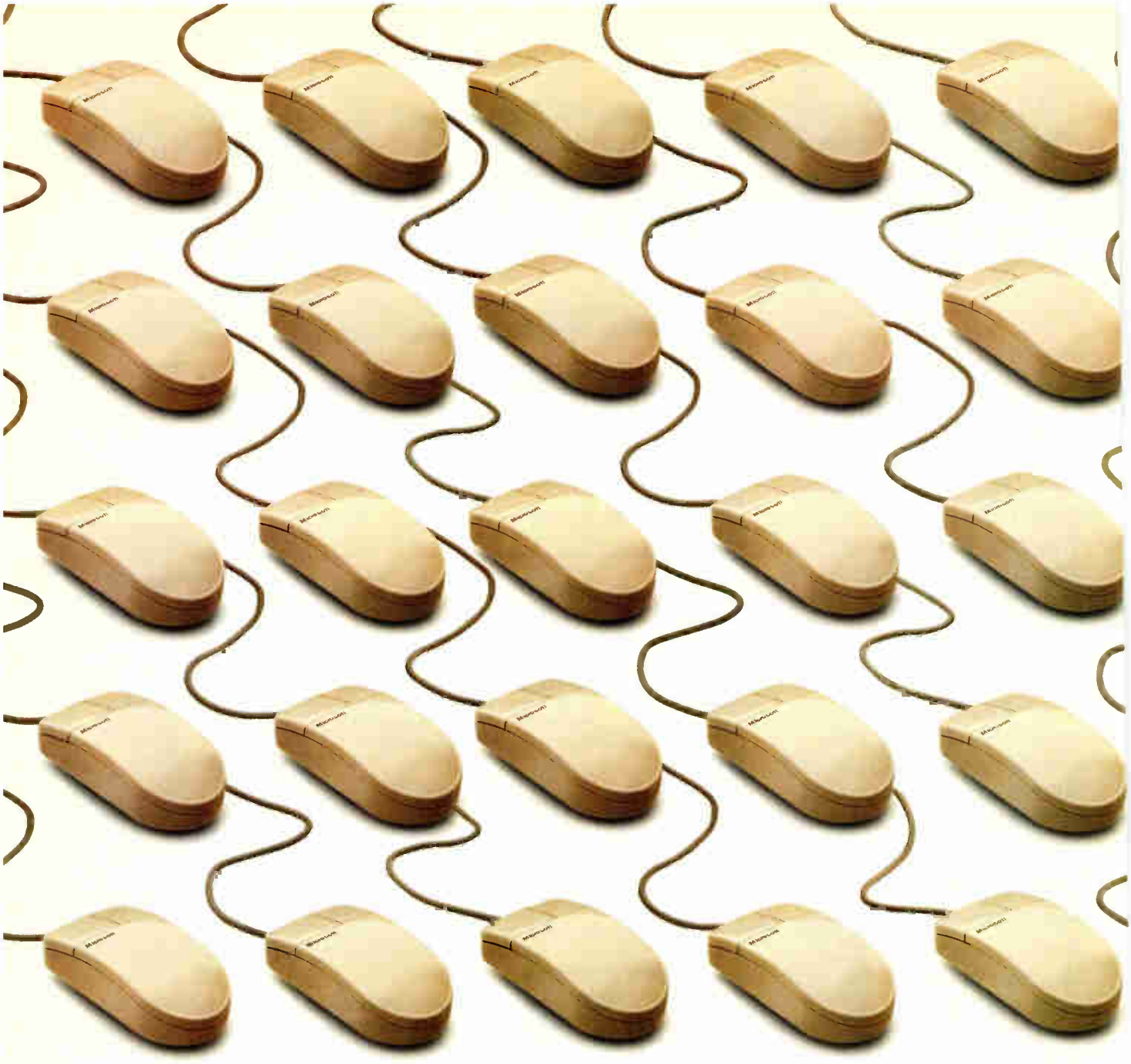

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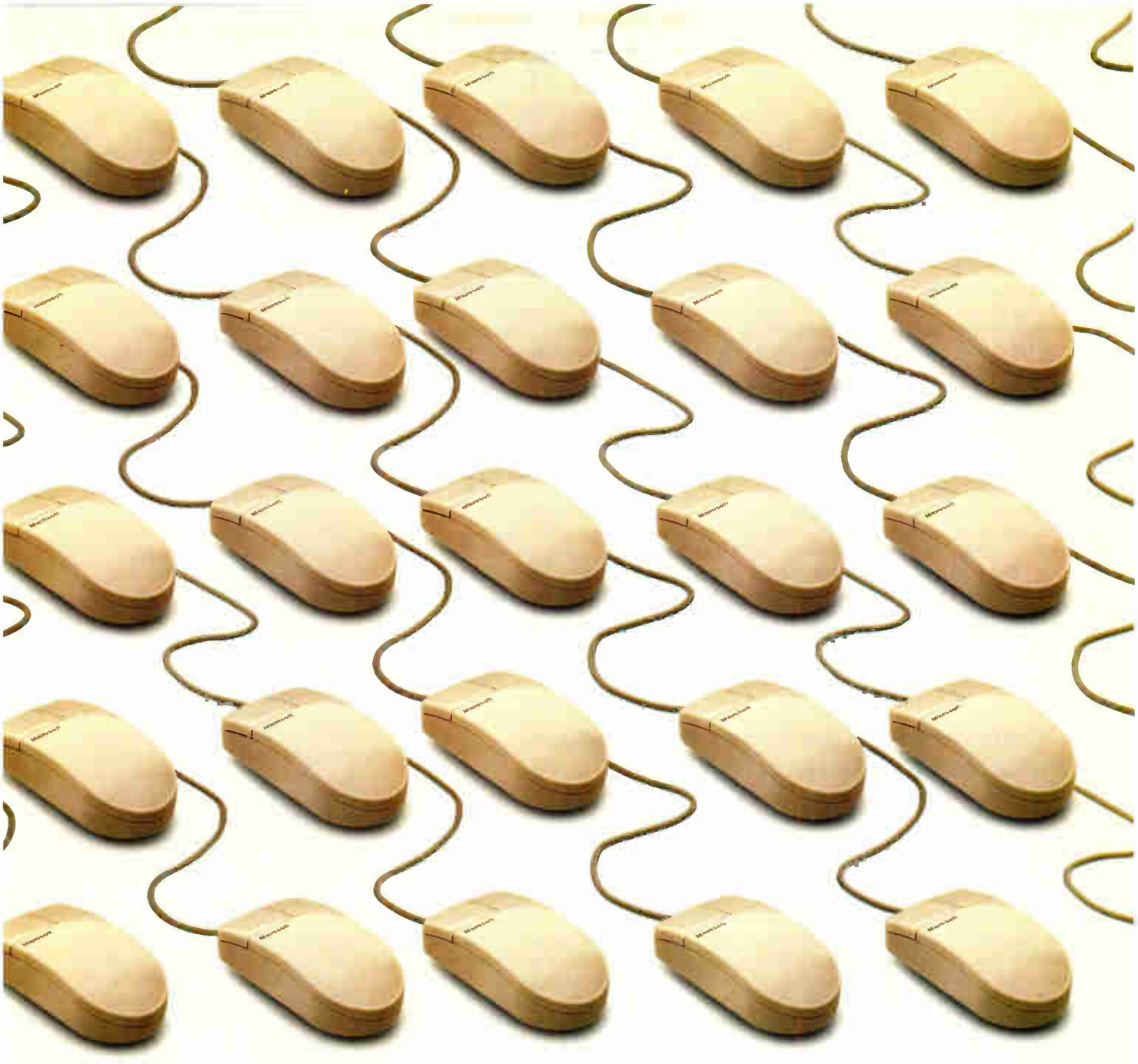

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it won't need as much cooling as current 386s, AMD says.

System designers using the DXL will be able to build 32-bit portables that are the size and weight of current SX notebooks and can run on batteries for 3 to 4 hours, Webb said. "It'll be very possible to have TravelMate-size machines with the DXL in it," he said. (Texas Instruments' TravelMate is a 5-pound SX-based machine.) Chip sets that support the DXL's clock-stopping standby mode will be available soon, Webb said.

Computers based on the high-speed AMD chip will cost "within $50 at the system level" compared to Intel 33-MHz machines, Webb said. "A 40-MHz 386 with a 64K- or 128K-byte direct mapped cache will be very cost-effective," he said. The 40-MHz systems will require fast (at least 25-ns) static RAM chips, but their cost difference is negligible, he said. The 40-MHz DXL costs $306 each in bunches of 100. Prices of the other chips are subject to negotiation.

The first computers to use the Am386 will be desktop models, such as Bell Computer Systems' already announced 40-MHz system, which costs $2995. Those should reach the market soon. "Battery-operated, full 32-bit DXL systems" will follow by a quarter or two, according to Webb. At Comdex, expect to see DXL machines with enhanced power management features in their BIOS, he said. "One of the advantages we offer is that the system company can pick its own power management scheme," Webb said.

BYTE Lab test results have shown the Am386 to be completely compatible with the Intel chip. The legal wrangling between AMD and Intel continues, but AMD says that it's confident its rival won't stop it from selling its version of the popular CPU. Although no major PC manufacturers have yet committed to using the AMD chip, several say they're interested.

—D. Barker

PC Makers Sign On to Use PenWindows; Portables Due Later This Year

More than 20 companies have committed publicly to designing hardware that will work with Microsoft's PenWindows operating environment, the extended version of Windows geared to understand commands from a pen or stylus. Some of the first PCs to use PenWindows will be hybrid portable computers: part typical laptop with a keyboard and part electronic clipboard with a tablet-like screen. The systems will open up like a clamshell, but the keyboard will be detachable; the CPU and storage devices will be housed in the tablet module, so you will be able to work with just the tablet and pen, according to Microsoft.

The PenWindows roster now features some of the biggest electronics companies in the Far East, including the leading laptop makers: Toshiba, NEC, and Seiko-Epson. Other PC manufacturers on the list are Sharp, Mitsubishi, Sanyo, Kyocera, Fujitsu, and Samsung. Canon, Hitachi, and Oki also say that they're planning pen-based systems using PenWindows. NCR, Wang, and Grid had already disclosed their PenWindows support. Momenta, which started up specifically to develop pen computers, is also planning software and development tools based on PenWindows.

In the U.K., the Eden Group already has a prototype tablet-style PC running PenWindows (it will also work with PenPoint, when that's ready). Eden's Papertalk VPi386, designed around a 16-MHz 386SX CPU, is a 2.4-kg device built in the tablet style. Its top surface holds a backlit, black-on-white LCD that emulates a 640- by 480-pixel VGA display. You can "write" on this coated screen or, with the right overlays, use the metal area framing the screen as a function-key zone. Eden doesn't plan to sell the Papertalk system under its own name; instead, it will offer it to OEMs.

Conspicuously missing from the PenWindows list are major U.S. computer makers, such as IBM (a PenPoint supporter), Compaq, Tandy, and Hewlett-Packard, as well as leading PC cloners such as Dell, AST Research, and ALR. Some observers say that these companies are waiting to see how the pen-computing market shapes up.

Microsoft recently issued copies of a beta PenWindows software development kit. The real product is supposed to be ready later this year, a spokesperson said. PenWindows PCs—which will probably cost about $500 more than their conventional counterparts—will be announced before the end of the year, Microsoft officials say. But when they'll ship is anybody's guess.

—D. Barker

NANOBYTES

Intel has announced a second generation of **EISA support chips**. The new 82350DT EISA chip set is a superset of Intel's existing 82350. It allows considerably more integration, reducing total EISA-compatible motherboard space to about one-third of that required with the older 82350 chip set. It is a six-device chip set with DRAM control and peripheral I/O support. The chip set costs $200 in 1000-unit quantities. Intel expects the chip set to be used in modular designs, where the CPU resides on a daughterboard and can be upgraded by adding a faster CPU module.

A survey of managers at sites using Hewlett-Packard computers found some of their **top "strategic concerns"** to be database technology, application development environments, and getting their HP systems to work with other types of computers. Personal computers were low on the Unix user's list of priorities, while they were high on the list of MPE users. The International Association of Hewlett-Packard Computer Users (Sunnyvale, CA) conducted the study.

Areal Technology (San Jose, CA) says that it has started high-volume production of its **2½-inch 60-MB hard disk drives**. Areal uses a different technique than its competitors: Instead of aluminum, it uses a glass disk substrate; this makes a smoother surface so that read/write heads can fly closer to the platter, says the company, and the drive mechanism can deal with denser data on the disk. Areal hopes to have 100-MB hard disk drives available this summer.

The Electronics Industry Association (Washington, DC) has drawn closer to finalizing CEBus, the proposed **"home automation standard"** for letting appliances and devices talk to each other. The EIA has approved interim standards for sending signals using infrared beams and for connecting communications devices using twisted-pair wires.

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NEWS

MICROBYTES

Beyond ASCII: Group Promoting "Global Code" for Information Exchange

In the increasingly interconnected global village, with computer users trying to send data from one country to another, ASCII, as its name says, is just too American. The American Standard Code for Information Interchange has always lacked the characters to express the written words of most of the world's peoples. Now a consortium of major computer companies says that it has the solution: a new "global computer code for storage and transmission of text around the world." The Unicode group says that its proposed standard (currently in final draft form) will make it easier to write multilingual software and simplify international information exchange.

Like ASCII, Unicode basically assigns a number to a character, but Unicode tries to cover every printed character in use today. Unicode's fixed 16-bit code set will allow 65,000 characters, which supporters say will accommodate "all major living languages," including ideographs used in Japan, China, Taiwan, and Korea; Cyrillic; Hebrew; Arabic; Greek; Sanskrit; and many others. The character set also has math and technical symbols, subscripts and superscripts, accent marks, control codes (carriage return and linefeed), and codes that mark the direction of the text (left to right or vice versa). The whole set now consists of 25,000 characters, which means that there is a lot of room left.

Unicode isn't the only one trying to formulate a universal language for computer code, however. The ISO has been working for years on its own multibyte universal character set. The proposed ISO Draft International Standard 10646 takes the opposite approach from Unicode's "unification," which saves space by eliminating duplicate characters; in an attempt to maintain compatibility with current sets, the ISO system instead maintains the character codes from the many existing national and international character sets. Since there is substantial duplication, the total number of characters is much larger. In the ISO method, every character in its basic form requires 32 bits, or 4 bytes, to be represented.

One important thing Unicode has that could help it become a widely accepted format is the backing of major (American) computer companies. Work on the character set began in 1989 at Xerox and Apple, and the group has since been joined by representatives from IBM, Microsoft (which says it will support Unicode in its upcoming "portable" OS/2), Sun Microsystems, Novell, Aldus, Metaphor, GO Corp., and Next. If these companies actually implement Unicode in their systems and software, users of popular personal computers and Unix workstations could soon be downloading Unicode files instead of ASCII.

—D. Barker

Swordfish Could Speed Up Imaging Operations

National Semiconductor (Santa Clara, CA) has developed a new RISC chip that could radically crank up the speed of imaging devices such as laser printers and graphics boards. The company's new "Swordfish" is a 50-MHz 64-bit RISC chip with a built-in digital signal processor (DSP). The company claims that the device can perform 100 MIPS, putting it ahead of other embedded processors.

Swordfish builds on the architecture of the company's 32CG16 and 32GX32 embedded processors (and will be delivered with translators to migrate code from the older devices). The new processor uses a superscalar design with two independent integer units, an FPU, on-chip data and instruction caches (1K byte and 4K bytes, respectively), and the DSP. The internal architecture is 64 bits wide, and the external interface can be 8, 16, 32, or 64 bits. Like other high-performance processors, Swordfish is a 0.8-micron CMOS device. It contains about 1.1 million transistors, the designers say.

Operating at 50 MHz, the chip can perform 2 integer instructions per cycle, or 100 MIPS, National Semiconductor says. The company also says that Swordfish executes 115,000 Dhrystones per second, which is about 10 percent faster than Intel's i860.

Swordfish is aimed at processing-intensive embedded applications such as controlling printers, recognizing patterns, compressing/decompressing data, and processing video. The company says that it has already lined up significant partners, including Adobe, Microsoft, and Canon.

—Andy Reinhardt

NANOBYTES

Sales forces say that they've gained profit, time, and productivity by using **laptop computers**, according to a new study. After surveying sales managers at 3000 manufacturing companies, researchers at Texas Christian University (Fort Worth) concluded that "the benefits of the laptop appear to be very positive." Salespeople use laptops mostly for correspondence, E-mail, access to data on mainframes, and presentations. But laptop makers should note: One of the reasons cited for not using laptops was the cost of the machines.

If you're keeping R&D records and notes on your hard disk drive or on a bunch of floppy disks, you might look at a **new pamphlet** from the American Chemical Society's Committee on Patents & Related Matters. "Electronic Record-Keeping for Patent Purposes: Cautions and Pitfalls" discusses using computer equipment to **maintain records**. To obtain the free pamphlet, contact the ACS at (202) 872-4479.

X Window software developers may have to start paying license fees to **AT&T** if it turns out that they're using what AT&T says is patented technology. AT&T has notified some X Window implementers of its patent #4,555,775, issued in 1985, that is entitled "Dynamic Generation and Overlaying of Graphic Windows for Multiple Active Program Storage Areas." AT&T says this technique, invented by Bell Labs researcher Robert Pike, is used in the X Window System "backing store" function, which is basically a means of redrawing a window on the screen. However, the backing store function is not always implemented in X Window software. At press time, the X Consortium had not yet officially responded to AT&T. Meanwhile, "Those of us who sell X in small volume are keeping our heads down and hoping DEC or somebody big can slug this out with AT&T," said one X Window developer.

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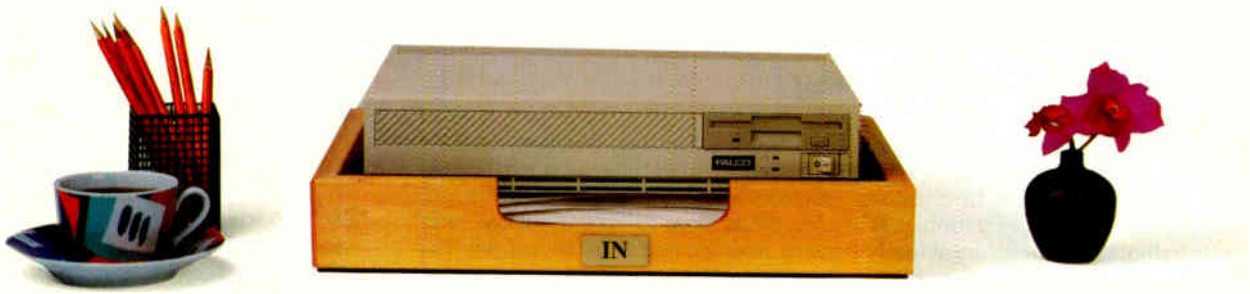

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NEWS

MICROBYTES

This Should Be the Month for System 7.0

The System 7.0 era should begin this month, as Apple is expected to finally release its overhauled Macintosh operating software. Apple sent "near-final" beta versions to most developers in late February, hoping they'd have "System 7.0–ready" programs available by the expected official May 13 launch date. (May 13 is the first day of the Apple WorldWide Developers Conference.) This public release date could be changed to June if unforeseen bugs show up before then.

System 7.0–compatible programs will support core AppleEvents (messages that are passed from application to application and from application to System); Balloon Help (hypertext-like help messages that can be turned on and off); and the Publish/Subscribe mechanism for hot-linking creators and viewers of information. Apple watchers say they expect there could be as many as 200 or so System 7.0 programs at the time of the official rollout. Major Mac software houses will all update their applications to tap into System 7.0.

The company is expected to also release to developers the new QuickTime "media manager." QuickTime is an operating-system extension for dealing with multimedia input and output and with coordinating devices such as videotape machines, video cameras, scanners, CD-ROM drives, and audio gear. Users could see QuickTime by late summer, some Mac insiders say.

—Larry Loeb

Windows Selling Big, But How Many Are Running?

Microsoft says that it has sold more than 2.75 million copies of Windows 3.0, but some people involved in developing Windows applications say that only half of those copies are actually being used. Brian Conte, CEO of hDC, which makes Windows utilities, said at a recent conference that only "one-half to one-third of Windows buyers are actually using it."

Brad Silverberg, Microsoft vice president for DOS and Windows, said that over 2.25 million copies of Windows were sold through retail channels, over half a million were sold bundled with hardware, and more than 40,000 copies were sold to software developers. That makes a total of more than 2.75 million copies sold since the introduction of Windows 3.0. But if Conte is right, there are only about 1.5 million Windows users.

Perhaps part of the reason for the suspected lag is that corporate users are sometimes slow to accept change, and many microcomputer managers say that they've had to provide hard evidence of productivity gains to justify large-scale migration to Windows.

Corporate Software (Canton, MA) and Microsoft conducted a pilot project to study the use of Windows at 14 corporate sites. Despite Microsoft's participation, the project could document only a 10 percent productivity gain during the first year of Windows use. Still, Corporate Software says, Windows 3.0 offers "intangible benefits" such as improving worker morale and encouraging users to "explore" their software environments.

—Ellen Ullman

Low-Cost Chip Holds Analog Speech

In a development that could lead to low-cost speech capabilities inside computers, Information Storage Devices (San Jose, CA) has developed a new chip that is able to hold analog samples of speech and sound. ISD's first chip, the ISD 1016, can store up to 16 seconds of recorded voice that the company says sounds better than what you hear over a telephone.

Direct Analog Storage (DAS), as the technique is called, uses a modification of EEPROM design and puts the sound in what is essentially a 128K-byte cell EEPROM. Although it stores the sound in sampled form, the chip does not store it digitally. The samples are analog.

The heart of DAS is a floating-gate EEPROM. The floating gate turns the EEPROM cell on or off depending on whether it is strongly positive (on) or strongly negative (off). The charge on the gate modifies the conductivity of the underlying transistor. In DAS, the floating gate is charged only moderately, and the conductivity of the transistor takes an

NANOBYTES

GCC Technologies (Waltham, MA) has **dropped the price** of its Personal LaserPrinter II for the Mac from $1399 to $999. The PLP II is a QuickDraw-based machine that prints 4 ppm, at a resolution of 300 dpi. (GCC cut the price of the 8-ppm model, the PLP IIS, from $1899 to $1499.) The unit comes with 22 scalable Bitstream fonts. "We see this primarily as a laser printer for Mac Classic owners who would otherwise have to settle for an ink-jet printer," said Jonathan Hurd, vice president of marketing. GCC also lowered the price of its PostScript-based Business LaserPrinter II, from $2399 to $1999. This 4-ppm machine lists for less than HP's LaserJet IIP for the Mac ($2195) and Texas Instruments' microLaser PS17 ($2144 with AppleTalk).

IBM has shaved 5 percent to 20 percent off the prices of certain PS/2 models: 30 (286-based), 55 and 60 (386SX-based), and 80 (386-based); for example, IBM's least expensive SX machine, the Model 55 SX–031 (a 16-MHz SX with 2 MB of RAM, a floppy disk drive, and a 30-MB hard disk drive), now lists for $2995, down from $3495. At the higher end of the PS/2 line, the Model 80-081 (a 20-MHz 386 with 2 MB of RAM, a floppy disk drive, and a 80-MB hard disk drive) is now $5495, down from $6845. Prices might vary from dealer to dealer, an IBM spokesperson pointed out.

In a much bigger price cut—a veritable buzz-sawing, really—**Computer Associates** (Garden City, NY) mowed its SuperCalc5 spreadsheet program from $495 to $149. The company said that the "new pricing strategy reflects CA's commitment to the needs of PC users." Be that as it may, SuperCalc is in a market segment that's getting more competitive, with leaders Lotus, Microsoft, and Borland all trying to woo each other's customers. CA plans a SuperCalc5 upgrade this spring, and a Windows product is likely.

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A DAS chip also contains amplifiers, clock filters, and just about everything else needed for a speech system. A designer building a talking device would only have to add batteries, a microphone, a loudspeaker, and a few other parts.

ISD is selling the chips for about $20 each (in lots of 1000), making the ISD 1016 less expensive than other solid-state sound-recording devices.

—Rick Cook

Bellcore Uses Laser Beam to Beat the Clock

Researchers at Bellcore (Livingston, NJ) have prototyped a new device that could help overcome one of high-speed computing's big bottlenecks: the clock. While CPUs can process data at lightning speeds, they still have to wait for the signal from the clock—they'll always be bound by the physics of electrical connections.

The scientists are speeding up the timing signal by using laser beams and strands of optical fiber. Inventors Peter Delfyett and Davis Hartman connected a semiconductor laser beam, which generates the master timing pulse, to a strand of optical fiber. A device called a star coupler splits the laser light into 1024 beams, which then shoot down separate strands of fiber to 1024 computer circuit boards (containing receivers). The laser beams' pulses are more accurate than those generated by electronic components, Delfyett said. When zapping the 1024 circuit boards, the accuracy of the timing signal is "true to within 12 trillionths of a second," he said. The researchers say their technique could allow a computation rate of one command every 120 trillionths of a second (compared to a current desktop machine's execution rate of about one command per one-millionth of a second).

That red beam of light comes from Bellcore's semiconductor laser, which researchers have used to send timing signals to computer circuit boards. The laser-based clock could someday be the master timing device inside superfast computers. The experimental technique could also crank up data transmission to warp speed. The dot of laser light is smaller than George Washington's eye on the dollar bill.

Semiconductor lasers have been used as timing devices, but their clock signals were slower because the laser beam had to be turned on and off, researchers said. Bellcore's "mode-locked" laser works like an oscillator, flipping constantly between on and off. The pulses are so precise that they keep the optical clock essentially free of signal variations, or jitters, Delfyett said.

The Bellcore system now sits on an optical workbench, but it could be squeezed into a case the size of a shoe box.

Bellcore's technology is geared toward large, high-speed machines, like supercomputers, where signals have to travel to hundreds of boards. One practical application of the work of Delfyett and Hartman will be in high-speed data transmission. "With the advent of optical communications, switches will look more and more like computers and will need to be able to do processing on packets of data just like a computer has to process data," commented Ken Young, district manager of Interconnection and Access Technology Research at Bellcore. "And they'll need to do it much faster." The Bellcore scientists say their technique will give data communications the kick into warp speed.

—D. Barker

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NANOBYTES

Modems burn less gas: The number of workers who **telecommute** instead of drive to the office two or more days a week will continue to increase, according to a new survey of managers in the San Francisco Bay Area. Of those surveyed, 41 percent said that they think the number of telecommuters will climb 10 percent to 15 percent in two years. Most of those surveyed currently have staffers who telecommute, and the pollsters said "a significant number of the managers supervising telecommuters cited their increased productivity as a key benefit." The survey was taken by the Northern California Telecommuting Advisory Council, sponsored by the University of San Francisco and the Pilot Group.

Micro Computer Resources (Oakland, CA) has compiled a database of more than 6500 quotes, called **Wisdom of the Ages**. The $79 package, which works with DOS PCs, contains apt phrases from both the Western and Eastern traditions, which you can view side by side for comparison. You can search and filter quotes by author, subject, or keyword.

WordTech Systems (Orinda, CA) says that its Quicksilver/Unix dBASE compiler has been certified by the Unix System Laboratories to be compliant with Unix System V release 4. Quicksilver/Unix ($1495) compiles DOS-based dBASE language applications to run without modification under Interactive Unix 386, SCO Unix 386, and other compatible operating systems.

IBM is now reselling **Novell NetWare** on an equal basis with its own LAN Server. James Cannavino, general manager of IBM's Personal Systems division, said that IBM and Novell are developing version 3.2 of Novell NetWare for OS/2 2.0, AIX, and the NetWare kernel. The products will be available by mid-1992, claims Novell CEO Ray Noorda.

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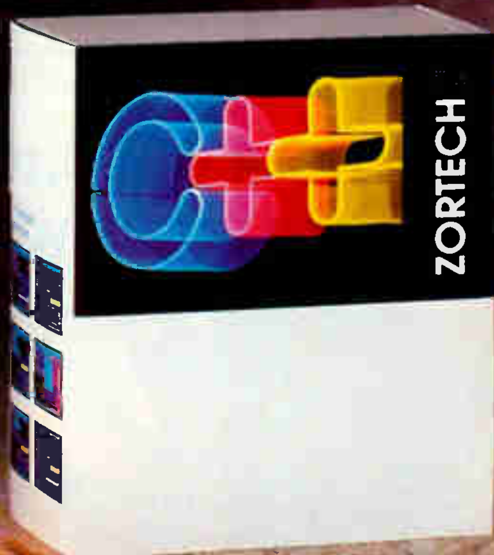

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A PC and 1-2-3 in the Palm of Your Hand

DAVID ANDREWS AND ANDREW REINHARDT

Hewlett-Packard and Lotus make palmtop computing more meaningful

Although notebook computers are becoming commonplace, you can still create quite a stir when you use one on an airplane. But pull out the new Hewlett-Packard 95LX, and you probably won't get any reaction at all. That's because at first glance, the 95LX looks more like an overweight checkbook than a PC. Its diminutive size belies its true nature: The 95LX is a complete DOS computer based on an 8088-class processor.

Like an electronic organizer (e.g., the Sharp Wizard), the 95LX includes a suite of personal productivity applications designed to replace the traditional Day-Timer Planner. It also doubles as an HP financial calculator. But what really sets the 95LX apart is that it comes standard with Lotus 1-2-3 release 2.2 built into its ROM. Including the software, 512K bytes of RAM, DOS 3.22 in ROM, an industry-standard solid-state memory-card slot, and some remarkable communications options, the whole pocket-size package sells for a suggested retail price of less than $700.

When combined with the tiny Touchbase WorldPort modem and the Kodak Diconix printer, which HP will remarket to 95LX customers, this new palmtop may once again alter people's definition of the portable office. The 95LX could become a must-have item for mobile executives or people who crave the latest electronic gadget.

A Micro Micro

HP and Lotus jointly developed the 95LX in close consultation with Intel, Microsoft, and Phoenix Technologies. The tiny, shall we say, "toeprint" of the machine is due to a remarkable feat of miniaturization by Intel: a PC-compatible motherboard measuring only 2½ by 3⅛ inches—not much larger than a credit card—with performance about 2½ times that of an IBM XT, according to HP.

The HP palmtop not only fits in your pocket, it's also small enough to get lost in your briefcase. It weighs a mere 11 ounces and measures 6⅓ inches wide, 3⅖ inches deep, and 1 inch high. This is a little more than half the size of the 1-pound Poqet PC.

Along with the small size come some trade-offs. The 95LX has a 16-line by 40-character, nonbacklit supertwist LCD screen, so it shows only a few columns of a typical spreadsheet. However, we found the display highly readable in a variety of lighting conditions. The company says that it achieved this readability by driving the display at 12 volts, instead of the usual 5 V. The other and more serious drawback is the keyboard. Even though it uses a standard QWERTY layout and includes function keys and a numeric keypad, it is too small for serious typing.

The 95LX runs on two AA batteries or an AC adapter. HP says that a pair of batteries will power the machine for two months, but we weren't able to test this claim. To prolong battery life, the system relies on power-saving tricks that are used in HP calculators: The processor rests between keystrokes, and after 5 minutes of nonuse, the system shuts down. When reactivated, the 95LX re-

PHOTOGRAPHY JAMES SCHERER © 1991

turns to the state it was in when it left off. A commonly available (CR2025) lithium backup battery on the underside of the 95LX keeps your RAM alive when you change the AA batteries.

Canned Applications

The 95LX comes with seven built-in applications: 1-2-3, an appointment book, a telephone book, a memo pad, a file manager, a communications program, and HP Calc, an advanced financial calculator. On-line help is available with the F1 key. The programs share a similar Lotus-like user interface, including the common use of "soft" function keys and the ability to share keyboard macros. They also support cutting and pasting of data from one program to another, which

One of the most convenient aspects of the 95LX is that all the built-in applications are always open.

is especially useful for transferring data between 1-2-3 and the calculator's back-solving HP Solve utility.

One of the most convenient aspects of the 95LX is that all the built-in applications are always open, so you can instantly access them by pressing one of seven buttons labeled with icons near the top of the keyboard. When you switch from one application to another, or when you turn off the 95LX, you always return to exactly where you left off.

DOS applications on solid-state cards or downloaded from another PC can be run from the DOS prompt. The 95LX includes one slot for memory cards that comply with the PC Memory Card International Association standard, and HP has lined up several third-party vendors to deliver software cards for the system.

continued

These cards include Meca Software's Managing Your Money, Houghton-Mifflin's dictionary and thesaurus, Contact Software International's Act! contact management package, and Globalink's phrase-translation packages.

An open application programming interface will let developers customize their DOS applications for the 95LX by adding support for the desktop manager, clipboard, or soft keys. HP says that even without writing to the API, standard DOS programs won't lose any functionality running on the 95LX, except that their interfaces will shrink to 40 columns.

By putting DOS, 1-2-3, and all the applications in ROM, HP has freed up most of the 95LX's standard 512K bytes of RAM for data files. A setup utility lets you allocate available memory between the C drive RAM disk and space needed by the operating system to run programs that reside in ROM; for our evaluation, HP recommended setting aside about 126K bytes of RAM for the system.

Linking

Because it has no floppy disk drive (and since few applications now exist on memory cards), the primary means to get data in and out of the 95LX is via one of two interfaces available with the system. The most familiar is a small bidirectional serial cable that is supplied, along with software for the host PC, in an optional HP connectivity pack.

The connectivity pack is a complete copy of the organizer applications included with the 95LX. Once loaded on the host PC, the applications can be run just as they are on the palmtop, which means that you can keep the same memos or telephone log on your desktop machine as you do on your 95LX.

Updating the files is easy: you just connect the machines, select the communications application on both, and then transfer or share files—at 57,600 bps—using a split-window interface. For modem users, the 95LX includes built-in terminal emulations and a variety of transmission protocols.

The other interface option is a two-way infrared connection, a technology borrowed from earlier HP calculators. With the infrared link, two properly aligned 95LXes within 8 inches of each other can transfer files at 2400 bps without using cables. The infrared link also works with the HP 48SX calculator. HP says that it is exploring other uses for infrared technology, such as a print link that would let you beam files to a printer for hard-copy output.

Later this year, HP expects to introduce a third interface option for the 95LX, an RF module being developed by Motorola that uses the company's alphanumeric paging technology.

Alas, the Keyboard

It seems there's always a catch, and in the case of the 95LX, it's the keyboard. When we first looked at the palmtop, we joked that nobody would use it to write the Great American novel. Unfortunately, after using the system for a while we have to revise our assessment: Even the Great American short story would be difficult to pull off.

The problem is twofold: First, the keyboard is simply too small for touch typing, and the layout is just strange enough that two-finger typing seems to involve more hunting than pecking. Second, the keys aren't really keys, but rather calculator-type buttons. For entering meetings into a calendar, the buttons are fine, but using them to write more than a few sentences is tedious.

HP readily acknowledges this problem and makes a point to characterize the 95LX not as a replacement for a PC but as an adjunct. The literature suggests that appropriate textual applications would include reading E-mail, proofreading documents, or composing short memos. And if you need to do number crunching, the 95LX, unlike the Poqet PC, has the advantage of a numeric keypad. In a nutshell, if you use a mobile computer for writing long memos, the 95LX may not meet your needs, but if you want a souped-up organizer and calculator, you're in luck.

Impressions

The 95LX invites comparison with the Poqet PC and, to some extent, with the Atari Portfolio. The differences are worth exploring. If you're looking for a full-time laptop, the Poqet may be a more realistic option than the 95LX, because its display is 80 characters wide and its keyboard is much bigger—large enough for entering text. On the other hand, the Poqet requires not only larger pockets but also deeper ones: Even with its price reduced from the original $2345 to the current $1450, it costs twice as much as the 95LX, and it doesn't include Lotus 1-2-3.

The Portfolio costs only $300 and is comparable in size to the 95LX, but it's much less capable. The display shows only eight lines of 40-column text, and the standard RAM configuration is only 128K bytes—not enough to run 1-2-3 or much of anything else these days.

HP's 95LX is an engineering triumph, incorporating amazing advances in miniaturization and connectivity. Coming from HP, the 95LX is unlikely to have the bugs that have afflicted some other palmtops, and even the prototype units felt solid and durable.

Of course, there are weak points. We were a bit disappointed by the built-in organizer applications, which didn't seem very intuitive to use, especially when compared to some of their desktop cousins. Ideally, the 95LX could be a bit flatter, and we might have been willing to accept a slightly larger footprint in exchange for a bigger screen and a less challenging keyboard. But these seem like minor points compared to our overall positive impression.

It's simply amazing to be able to put all your appointments, telephone numbers, and other necessary information into your shirt pocket, inside a machine almost one-hundredth the size of an IBM PC that can run the same software as that PC. If you've ever wanted to unobtrusively run a spreadsheet model while flying on an airplane, your moment has finally arrived. ■

David Andrews is BYTE's associate news editor for What's New and Andrew Reinhardt is a BYTE news editor in New York. You can reach them on BIX as "dave.-news" and "areinhardt," respectively.

THE FACTS

HP 95LX
$699; connectivity pack, $99.95;
128K-byte RAM card, $199.95;
512K-byte RAM card, $399.95

Hewlett-Packard Co.
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Once again, editors rave about the Tangent 486.

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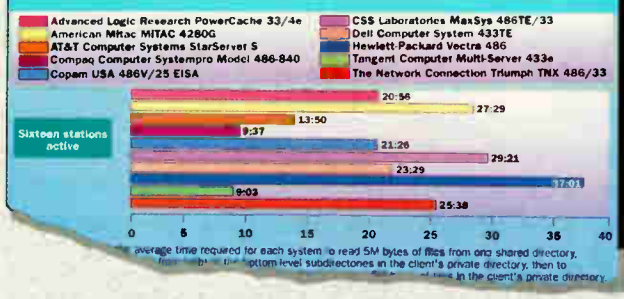
PC Week 1/7/91

PC WEEK

Tangent Server Maintains Performance Lead As LAN Size Increases



"A consistently strong performer across all tests, the Tangent model 433e stands out in this group." PC Magazine April 16, 1991

PC MAGAZINE EDITORS' CHOICE
April 16, 1991
Tangent 433e

PC Magazine, April 16,1991

TANGENT COMPUTER INC.

Tangent Model 433e

by Bill O'Brien

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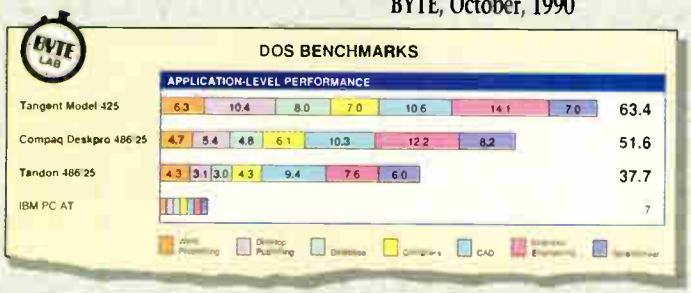
BYTE, October, 1990



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Circle 295 on Inquiry Card.

Apple Introduces Low-Cost Laser Quality with Style

OWEN LINDERHOLM

Apple's low-cost printing solutions to complement its new inexpensive systems

When Apple introduced its new systems last year, it immediately increased its sales and answered critics who had been claiming that Apple computers were too expensive. Nevertheless, Apple neglected to provide a solution in one important area: printing. Until now, the Apple printer lineup has consisted of a range of laser printers, from the Personal LaserWriter SC to the LaserWriter IINTX, as well as the ImageWriter II dot-matrix printer. Third parties have taken the opportunity to fill in the gaps with cheaper laser and ink-jet printers. However, Apple has now come out with two low-cost printing solutions to complement its new inexpensive systems.

The Personal LaserWriter LS is a carefully designed printer that's based on QuickDraw rather than PostScript. It's almost identical to the Personal LaserWriter SC in capability, but it costs considerably less.

The StyleWriter is more unusual. It's an ink-jet printer that's based on the Canon Bubble-Jet, but it's been completely redesigned by Apple. It has a resolution of 360 dots per inch and is also a QuickDraw-based printer.

Both printers work with TrueType, the new font-scaling technology being developed by Microsoft. These two printers are the first ones available that work with TrueType, and Apple is including TrueType system software with the printers, as well as the basic 13 Apple system fonts.

Personal LaserWriter LS

The Personal LaserWriter LS is based on the Canon LBP-LX engine. It has a serial connector and the usual Personal LaserWriter paper handling with a 50-sheet paper feeder. It is 8 inches tall, 15 inches wide, and 18½ inches deep; it weighs 31 pounds. The design is similar to that of the Personal LaserWriter SC, except that it's smaller and has a different paper path.

The printer is controlled by a custom application-specific integrated circuit (ASIC), which decompresses data received from the system. It also includes an additional oscillator that's used to externally clock the Mac's serial port at a higher rate to transfer data to the printer at a higher rate. The serial port usually transfers data at up to 57,000 bps. Apple says that Macs can pass data to the LS at up to 900,000 bps.

This printer uses only 512K bytes of RAM, one of the ways Apple has been able to keep the price down. Nevertheless, it is still able to print a full page of text and graphics, because the data is compressed by the printer driver in the Mac and then decompressed in strips by the custom ASIC in the printer, so that the 512K bytes can hold the compressed form and the uncompressed strip at the same time. In addition, the memory is managed so that the next page can be sent to the printer and stored while the first is still printing as enough memory space is freed. Thus, the Personal LaserWriter LS is faster than the Personal LaserWriter SC.

The Personal LaserWriter LS also comes with a printer driver that spools printing to the hard disk and then prints the document in the background. This lets Mac users get back to work more quickly than they otherwise would.

The one major failing of this printer is that it's a QuickDraw printer. This means that Encapsulated PostScript (EPS) files don't print properly; instead, a coarser bit-map version is printed. However, the addition of TrueType fonts into the system software for this printer means that it is capable of printing high-quality fonts at any point size.

The Personal LaserWriter LS is now Apple's least expensive laser printer. It essentially replaces the Personal LaserWriter SC, with which it compares favorably. It's mostly intended as a single-user laser printer, for someone who needs the

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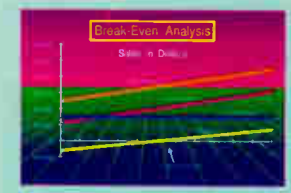

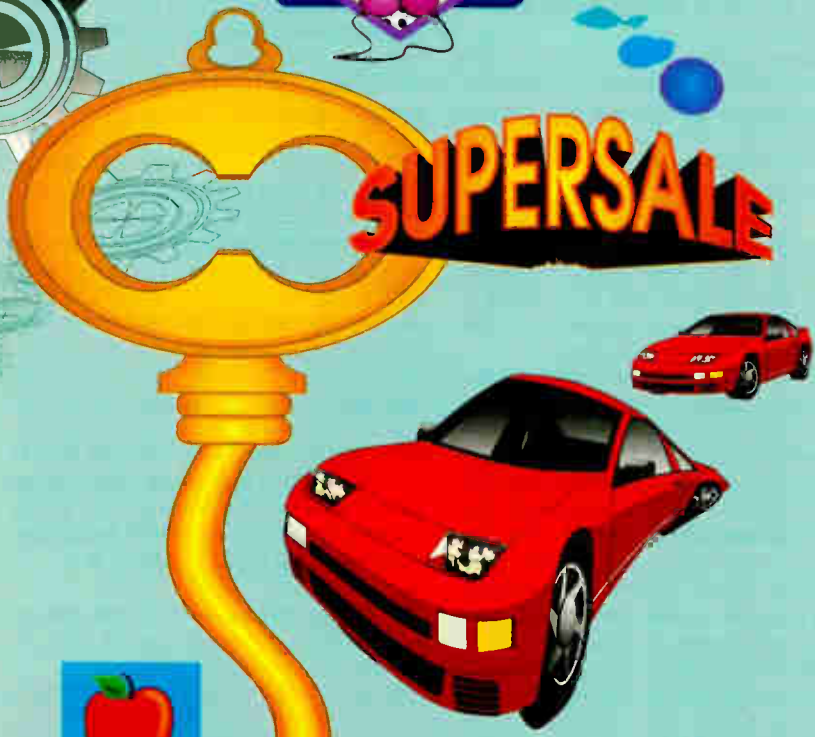

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NEWS

FIRST IMPRESSIONS

convenience, quality, and speed of a laser printer but hasn't much money.

StyleWriter

The most immediately striking feature of the StyleWriter is the way it looks. On its own, without the accompanying sheet feeder, it looks like an elongated, inverted *T*. In this form, it can print manually fed single sheets. The printer also has a clean, straight-through paper path, which makes it ideal for printing envelopes. However, it does come with an automatic sheet feeder that holds 50 sheets. This clips directly to the back of the printer.

Another striking feature of this printer is that it's almost silent in operation. The print quality is incredibly good at 360 dpi. Not surprisingly, the StyleWriter produces output similar to that of the Bubble-Jet. The ink used is formulated to dry quickly. Thus, by the time a page drops into the paper holder, it's dry. The trade-off for fast drying is that the ink is water-soluble and will smear if water is spilled onto a page. Each ink cartridge prints about 500 pages.

The StyleWriter is considerably slower than a laser printer. It prints a page in approximately 2 minutes in its letter-quality mode. It has a draft-quality mode of 180 dpi, which lets it print one page per minute. It also receives compressed data from the computer. However, the StyleWriter doesn't have as much built-in intelligence as the Personal LaserWriter LS. Therefore, it receives one strip of data from the computer at a time, decompressing and printing it before receiving the next strip. The printer works faster when attached to faster Macs, because they're able to compress the data and send it faster.

The StyleWriter is also a QuickDraw printer and has trouble printing EPS images. However, the 360-dpi resolution happens to be exactly five times that of a standard 72-dpi screen-based bit map, so these images look somewhat better than on a laser printer. Also, since it prints at 360 dpi, it's able to produce high-quality gray-scale images, in some cases noticeably better than a 300-dpi laser printer.

The StyleWriter comes with TrueType and produces excellent-quality text. I tried it with a wide variety of fonts, including a full kanji TrueType font, and got legible output in sizes from 4 points to over 100 points.

The StyleWriter is a high-quality printer that does, however, operate slowly. It is intended to be a low-cost alternative to a laser printer that is still able to print with good quality. The addition of TrueType fonts makes it an excellent printer for high-quality document printing where single- or low-copy volumes are required. It isn't suitable for printing large batches of documents. Its main importance is that it lets the Apple family have a convenient laser-quality printer for a low price. In some ways, it's intended to replace the ImageWriter II, since it costs the same but has far superior quality and somewhat superior speed. However, the ImageWriter II still has some niches left, notably in printing multiple-copy forms.

With these two printers, Apple finally moves into the low-cost arena. Their design shows some of the excellent technical expertise available from Apple at its best. Apple has done a good job of taking these printer designs and pushing their performance as far as possible. The Personal LaserWriter LS is a worthy contender for the crown of best inexpensive laser printer; the StyleWriter sets new standards for ink-jet printing. The street cost of a Mac Classic with a hard disk drive and the StyleWriter will be $1600 to $1700, which makes the combination an extremely competitive one when stacked up against less well integrated solutions based on the IBM PC. ■

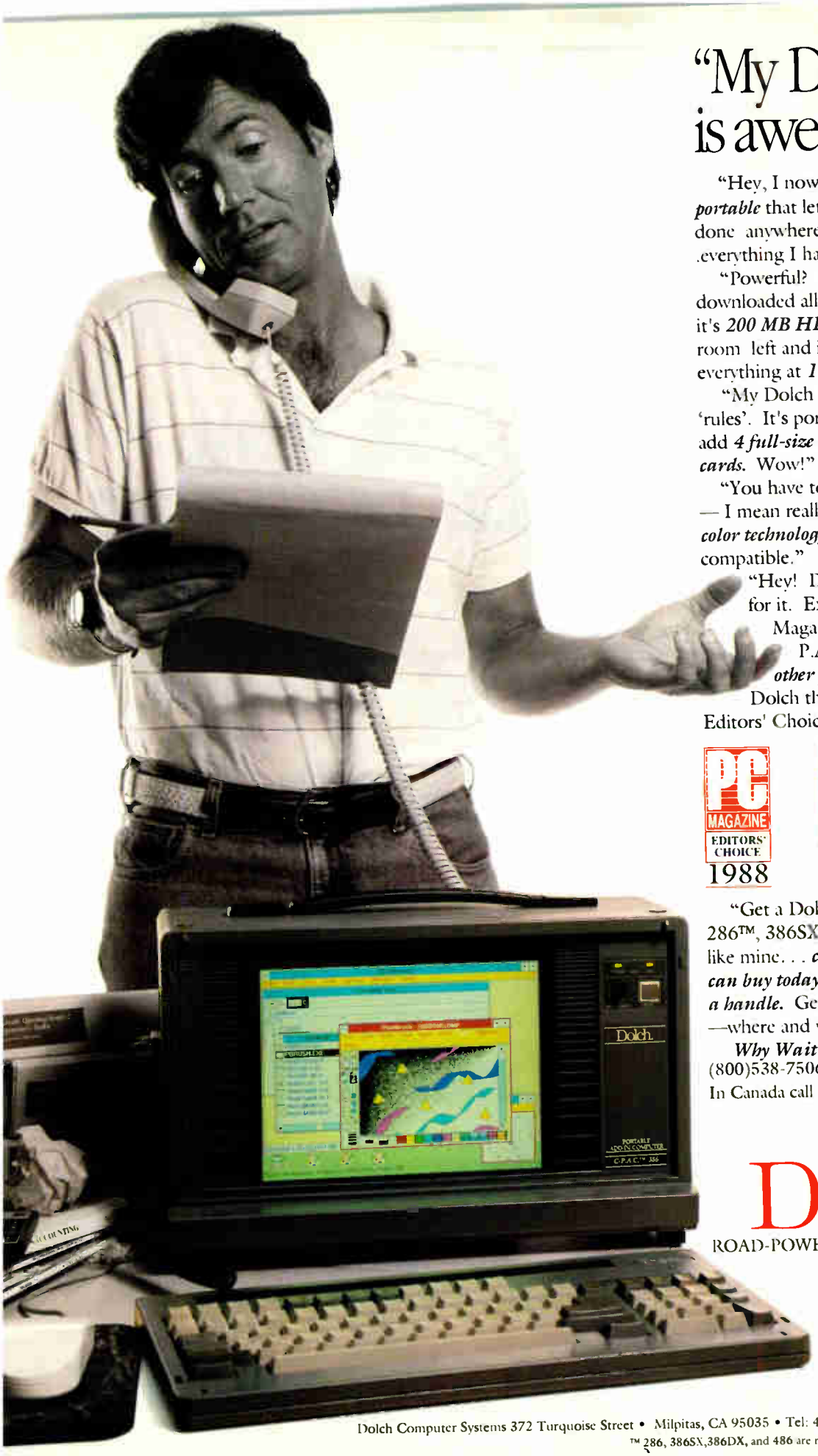
Owen Linderholm is a BYTE senior news editor. You can reach him on BIX as "owenl."

THE FACTS

Personal LaserWriter LS
$1299
(includes driver software, TrueType fonts, and System 6.0.7 required to run it)

StyleWriter
$599 (includes driver software, TrueType fonts, and System 6.0.7)

Apple Computer, Inc.
20525 Mariani Ave.
Cupertino, CA 95014
(408) 996-1010
Circle 1165 on Inquiry Card.



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POPULAR PRAISE FOR THE PORTABLE DESKTOP

This new generation PC is remarkable for the performance and practicality it provides. Carry it from the office, to home, to multi-site locations so all your programs and files travel conveniently with you.

Customers and critics alike are praising the Brick for its portability, elegant design, whisper quiet operation and screamingly fast power. This diminutive PC with the unforgettable name is designed for the way you always wanted to do computing.

Here's a sampling from recent articles on the Brick.

"Every once in a while a PC product comes along in which the performance, design and concept are so uncommon that a little voice inside you says you really want to have one."

Jon Pepper,
PC Sources, *11/90*

"Engineered with the way people actually work in mind. It answers the question of how to transport an entire environment to and from several work sites, something no other product handles elegantly."

PC/Computing, *12/90*

"Overall the Brick represents a clever counter to conventional notebook designs. It solves the fundamental problem of two-location computing. You get to keep your home and away files in sync because they are the same."

Tracy Licklider
BCS UPDATE, *7/90*

"Ergo's Brick maintains the functionality of a desktop PC within a small form-factor...the Brick is a real performer, consistently outperforming both Compaq's and IBM's 16 MHz SXs on PC Labs computer benchmark tests."

Matt Ross,
PC Magazine, *9/25/90*

"The Ergo Brick—that delightfully small, full-featured 386SX™ machine. It's almost silent, it's fast... a great personal computer in every other respect too."

Bill Machrone,
PC Magazine, *1/15/91*

"The Brick is the first real innovation in DOS based computers in a long, long time."

Computer Shopper, *1/91*

"The philosophy behind the Brick is so obvious that I'm surprised that no one has thought of it before...you can keep a monitor and a keyboard at each work location, carrying only the computer guts (and your own data) between locations...in a world of boring and utilitarian PCs, the Brick stands out for both its elegance and its technological sophistication."

Stan Miastkowski,
BYTE, *6/90*

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Ergo Brick
Ergo Computing, Inc

PC Computing MVP MOST VALUABLE PRODUCT FINALIST 1990

THE BRICK

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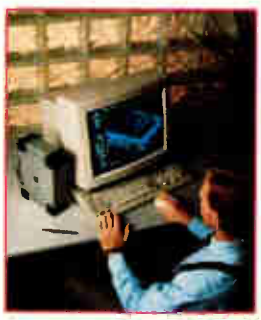
Jon Pepper,
PC Sources,
11/90

"An ideal system for those who split their working time between home and office...The stylish "black granite" and beige cases look as if they came straight from the pages of a Sharper Image catalog."

PC Week, *9/24/90*

"The Brick is first class all the way. Its appearance and feel suggest even higher quality than that of the Toshiba and Compaq... This system provides an amazing amount of features and support for the price."

Peter Varhol,
Personal Workstation
11/90



Hi-res video drivers are included for over 25 major applications including Windows 3.0, WordPerfect, Ventura, Autocad, Cadkey, and Lotus. The Docking Terminal ($349) permits instant hook-up of all cables and adds another 16-bit 3/4 length slot.

"...everyone who sees it falls in love with it... Recommended."

Jerry Pournelle,
BYTE, *1/91*

"Using the Brick is a pleasure. In fact, several things about the Brick are terrific. By any standard it's a well equipped and competitively priced 386SX desktop; when you add the appeal of its diminutive size, it becomes adorable."

Eric Grevstad,
Portable Office, *12/90*

"The beauty of this arrangement is that you never have to worry about the consistency of your data files... you just take it all with you."

Henry Fersko-Weiss,
PC Magazine, *3/91*

"Only slightly larger and heavier than a college dictionary, the Brick is a faux-granite-finished portable CPU that explores the middle ground between desktop PCs and portable computers."

Fred Paul,
PC/Computing,
8/90

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Ergo COMPUTING

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Zenith 486/TIGA Combo Packs Plentiful Processing Power

With many of today's newest i486-based computer systems being built and marketed as network file servers, it's easy to feel left out if you're an individual user who needs cutting-edge processing power for heavy-duty number crunching or serious graphics work. With the **Z-486/25E** from Zenith Data Systems (ZDS) on your desk, you won't feel left out.

The high-end Model 170 that I tested can only be characterized as a serious workstation for serious work indeed. As its name implies, the Z-486/25E is based on a 25-MHz i486. The *E* stands for EISA, and three open EISA slots are ready and waiting for future expansion.

The Model 170 has a 170-megabyte Intelligent Drive Electronics (IDE) hard disk drive. Matching the speed of the system, the drive sported a fleet 19.7-millisecond access time running the BYTE disk benchmarks.

But the speed and power don't stop there; the Model 170 also has a Texas Instruments Graphics Architecture (TIGA) video board that is based on TI's potent 60-MHz 34010 graphics processor. To say that it makes a difference in graphics speed is an understatement. The 34010 takes all the graphics processing away from the system CPU, resulting in BYTE video benchmarks that were 5½ times faster than a comparable VGA-based system.

More and more common applications are supporting the TIGA standard, and TIGA-product manufacturers are also supplying drivers for other applications. ZDS supplies several drivers with the Z-486/25E, including a high-resolution driver for Microsoft Windows 3.0. Couple it with ZDS's new ZCM-1650 16-inch high-resolution monitor, and you end up with a Windows 3.0 desktop with a resolution of 1024 by 768 pixels. And because it's a noninterlaced image, it's rock-steady. Windows 3.0 is an entirely new and eminently useful tool when you couple this resolution with the speed of the graphics board and the CPU power. There's virtually no waiting; things appear to happen instantaneously.

Plunking the humongous ZCM-1650 monitor on top of the system unit results in an interestingly incongruous juxtaposition. The Z-486/25E's case is surprisingly small, with a paltry 14- by 15-inch footprint, and it's just 6 inches high. I expected to find the case packed with equipment and cables, but it wasn't. The system unit has *lots* of free space on the inside. It's a triumph of careful design and mechanical engineering. The 64-bit memory board (which uses a proprietary slot) can take up to 16 single in-line memory modules without cramping. If you use 4-MB SIMMs, you can have a desktop PC with 64 MB of RAM—a true workstation.

There's even room inside the case to slip in an extra half-height 5¼-inch floppy disk drive. The Z-486/25E comes standard with a 3½-inch 1.44-MB floppy disk drive, and you can fill that extra space with a 5¼-inch 1.2-MB drive, an additional hard disk drive, or ZDS's pricey ($1299) 150-MB SCSI tape backup unit. The SCSI controller is already on the controller board, along with the floppy disk drive and IDE circuitry. There's even a SCSI socket on the rear of the computer's case for hooking up external SCSI devices (e.g., a CD-ROM drive).

From all its features, it's not difficult to see that the Z-486/25E is a system that's designed to not become quickly obsolete. That's especially true of the unit's EISA expansion capabilities. Neither of the two included boards takes advantage of EISA's bus-mastering capabilities and 33-MHz bandwidth. And you'll pay a hefty premium for having the "EISAbility."

Make no mistake: This is not a low-priced clone. The top-of-the-line Model 170 the I tested, complete with the 16-inch monitor, tips the price scales. It retails for $11,998.

For smaller budgets, the Model 80 has an 80-MB hard disk drive and a VGA (instead of TIGA) board. At a retail price of $8599, it's still costly, and you'll still need a monitor. (The TIGA board is available by itself for $899.)

ZDS systems are superbly engineered and ruggedly built for full-time work on critical projects. And the finely tuned combination of components in the Model 170 results in a system that delivers every last ounce of performance. Obviously, not everyone needs this type of system. It's overkill for day-to-day, mundane word processing or telecommunications applications. But it's all too easy to become accustomed to this system designed for the ultimate power user. I certainly wished that I had a real reason to keep it.

—Stan Miastkowski

THE FACTS

Z-486/25E
with 170-MB hard disk drive and TIGA card, $9999; with 80-MB hard disk drive and VGA card, $8599

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Filing vs. Archiving

Document image processing is a new technology which has just begun to evolve. The myriad of hardware devices on the market, and the lack of an industry standard protocol for communicating between them, make the integration of an electronic filing system a formidable task. And without intelligent software to control all aspects of the storage, management, and retrieval of documents, the filing system will be nothing more than a micro-fiche machine in disguise.

With these considerations in mind, EEF was designed as a turn-key solution which relieves the clients of all the intricacies involved in integrating a truly functional electronic filing system. Yet its flexible design allows continuous and smooth upgrade as the users needs grow and change.

Open Architecture

EEF is designed as a totally open architecture system. Rather than being a closed package, EEF is composed of individual building blocks defined by their area of electronic filing functionality. These blocks are not bound to specific hardware/software limitations. As such, they can be combined in a variety of forms on each of the following operating platforms, to achieve optimal satisfaction of an application's specific demands:

- A single user workstation under the **DOS** or the **OS/2** operating system.
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Software

The EEF software package, including the document manager, the retrieval engine, the hypermedia interface, and 20 hours of customization services.

Total cost for the pilot system is 30,000 US$.

For further details and literature, please contact:

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65, Rue de Lausanne 1202 Geneva Switzerland Tel. + 41 22 738 11 88 Fax. + 41 22 738 11 90

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125-127 North 4th Street Philadelphia, PA 19106 USA Tel. + 1 215 627 7202 Fax. = 1 215 627 2342.

Borland Hopes to Make Forms Exciting

One of the most mundane items in any office is a form. And few things are so tiresome as finding the right one, filling it out, and processing it. Software for dealing with forms is a big improvement—especially for forms processing. Now, Borland International has come out with a program that may make designing and filling out forms almost exciting.

The new **ObjectVision** is a Windows program that goes beyond most forms packages. Being a Windows program, it naturally includes some good graphics capabilities. These let you create a large variety of forms, including a good replica of an IRS 1040 tax form. ObjectVision can also function somewhat like a spreadsheet because each field in a form can contain a spreadsheet-compatible formula. And it includes a Paradox-compatible database manager, which means that you can access ObjectVision data by using Paradox or any of Borland's Paradox-compatible software.

The most exciting aspect of ObjectVision is its ability to do visual programming. For each field in a form, you can create a graphical decision tree. Such a tree is much easier to design, debug, and maintain than a standard spreadsheet formula.

The best way to illustrate such a decision tree is with an example. Say you are constructing an order form that will automatically determine the credit terms for an order. You can set up a credit terms field that will contain a decision tree. The first branch point will be whether it's a new customer or not (ascertained by checking a new customer check box on the form). If the customer is new, the next branch point may be the customer's credit rating (ascertained from the credit rating field). If the credit rating is poor, the end result of that branch may be to set credit terms at 100 percent down (i.e., the customer has to pay in full up front). The other branches may set up different credit terms. One branch may even require the user to fill out an additional form.

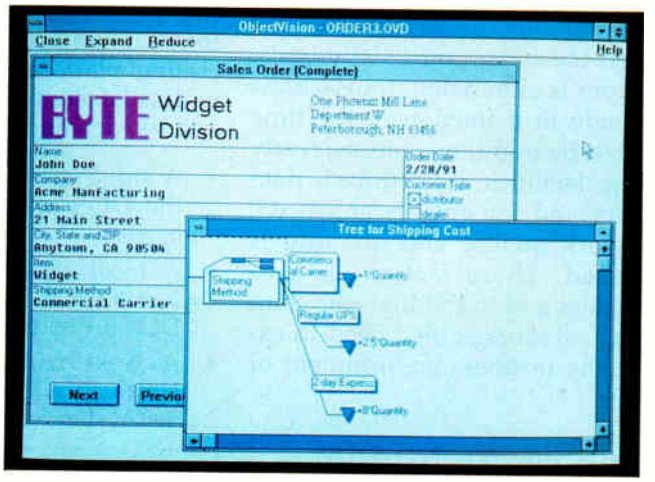
The process for creating decision trees takes some time to get used to, but, once mastered, this capability lets you create and modify trees with relative ease. Even an extremely complex tree can be deciphered fairly easily.

This new forms package is interesting, but it may have a slight problem with certain types of forms. For example, an order form, such as that used by a waiter, may have a table of blank fields that can be filled in with any of several item names, quantities, and prices. In ObjectVision, it is awkward to enter data in such a table because the program will lead the user to each of the many blank fields.

ObjectVision has a list price of $495. But if Borland tradition holds, and you already own other Borland products, you will probably receive an offer with a greatly reduced price. The program also includes a run-time module that lets developers distribute run-time versions of their forms for free.

Borland's forms program is a bold new variation on a mundane theme. Tests performed on an early version of the program suggest it is not only bold but successful. And if you're developing Windows applications for in-house use, ObjectVision will probably be essential as well.

—Rich Malloy



THE FACTS

ObjectVision
$495

Borland International, Inc.
1800 Green Hills Rd.
P.O. Box 660001
Scotts Valley, CA 95066
(408) 438-8400
fax: (408) 439-9344
Circle 1167 on Inquiry Card.

Portable Printing: From the Practical to the Elegant

With smaller and faster battery-powered systems taking to the road, busy writers and executives have the need for a variety of portable peripherals. I looked at two recently released portable printers and was not surprised to find that you get what you pay for. The laser-compatible Mannesmann Tally **MT735** 300-dot-per-inch thermal page printer tops the high end, while the 24-pin dot-matrix Seikosha **LT-20** is about one-third the price—but one-third the printer, as well.

Mannesmann Tally is calling the MT735 the first portable 300-dpi thermal page printer. But whether it's first or not, what is most impressive about this little printer is its speed, print quality, and portability—all in one.

The MT735 produces laser-quality text and graphics at up to 6 pages per minute at 300 by 300 dpi. It weighs about 8 pounds and measures 11½ by 8¾ by 2⅓ inches. It comes with a built-in 80-page sheet feeder, a built-in 150-page-capacity rechargeable battery (and charger), and 1 megabyte of memory for full-page graphics. The printer can handle normal photocopier paper and transparencies. However, for high-quality graphics,

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Mannesmann Tally suggests laser-quality paper.

The four resident fonts include Courier, Helvetica, Times Roman, and Math in various sizes. The printer also accepts downloaded fonts in Hewlett-Packard Series II LaserJet format. The MT735 can print in both portrait and landscape modes, accepts up to legal-size paper, and emulates the HP Series II LaserJet, DeskJet, IBM Proprinter X24, and Epson LQ-850. A copy feature stores the last page printed in memory and lets you make multiple copies.

Seikosha's LT-20 is called a laptop printer because it has been designed to fit under your laptop. It's also a cut-sheet printer and prints 100 pages on a single nickel-cadmium battery charge. It weighs about 5 pounds and measures 14½ by 11⅓ by 2 inches. It comes with an AC adapter with optional 12- and 24-volt adapters, so you can run it from a cigarette lighter.

The LT-20 has one built-in font (Courier). You can add an optional font ROM with eight other fonts. In graphics resolution, the LT-20 does 360 by 180 dpi and prints at 10, 12, and 15 characters per inch. Its cut-sheet feeder handles up to letter-size paper. Unlike the MT735's four standard emulations, the LT-20 emulates just the IBM Proprinter X24.

These two printers do an admirable job printing basic text. The MT735 is far superior in printing graphics, both in speed and print quality (compare about 0.6 ppm on the LT-20 to the MT735's 6 ppm). The LT-20 is priced for a system on the go, and it is, after all, essentially a dot-matrix printer housed in a unique package. Its sleek design makes it both attractive and useful, and it prints well enough to compete with the Canon, Kodak, and Toshiba portables in the same price range.

The MT735, on the other hand, would have to earn its keep by running as a full-time office printer as well as a print machine for the road. I found it sophisticated enough to suit my everyday printing needs, and its light weight and battery power only make it that much more appealing.

—Anne Fischer Lent

THE FACTS

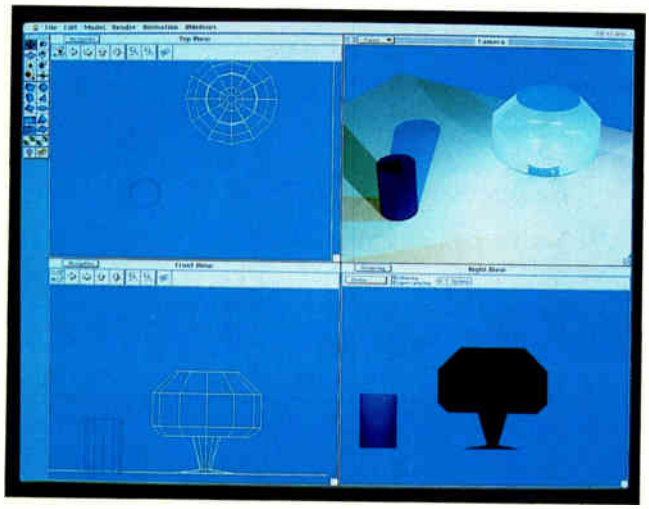
MT735
$1295

Mannesmann Tally Corp.
8301 South 180th St.
Kent, WA 98032
(800) 843-1347
(206) 251-5500
fax: (206) 251-5520
Circle 1168 on Inquiry Card.

LT-20
$499

Seikosha America, Inc.
10 Industrial Ave.
Mahwah, NJ 07430
(800) 338-2609
(201) 327-7227
fax: (201) 818-9075
Circle 1169 on Inquiry Card.

Animating Down the Line with Infini-D



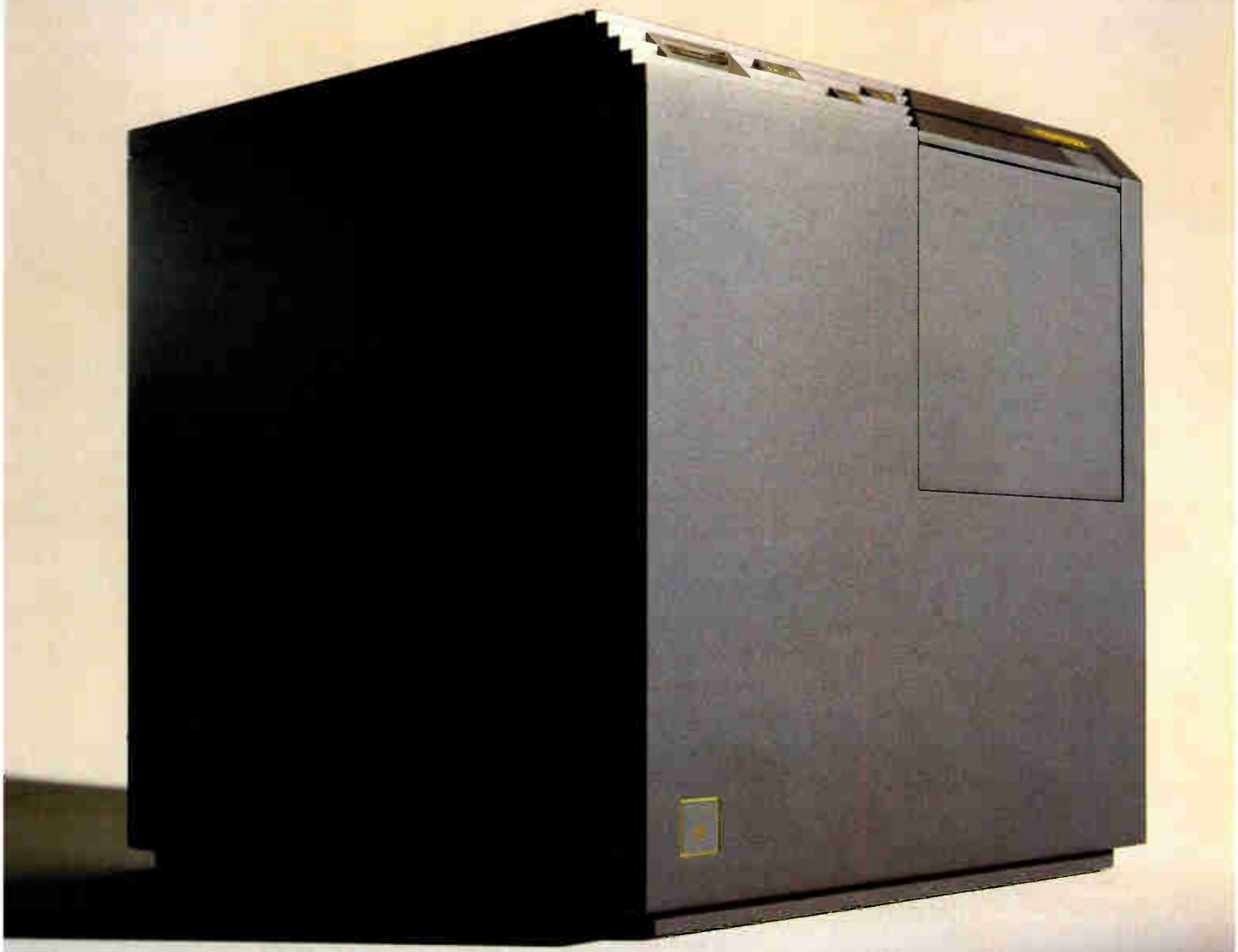
A new modeling, rendering, and animation program called **Infini-D** opens the door to a three-dimensional world that, once you enter, you won't want to leave. The program provides a variety of tools for creating wireframe models. It also lets you apply surface textures, light, and reflection to the models with proprietary rendering, and you can animate the images through an intuitive and powerful sequencer.

When you launch Infini-D, you see four view windows—top, front, right, and camera—which together provide a scene through which you view the 3-D world. If you like, you can look at the scene through back, left, or bottom views. But whatever one you choose, when you change an object in one view, the program provides immediate visual feedback in the others.

Unless you have already created a wireframe model in AutoCAD, the first step is to create a 3-D object. Infini-D provides six building blocks (e.g., cube, cone, and cylinder) called *generic primitives*. To place a primitive in the 3-D world, you click on its icon in the tool palette and then click once in any open window. Each view window shows the generic primitive from a different point of view.

The primitive tools provide a quick way to build basic models. Three other tools—lathe, extrude, and free-

This is what the world's most powerful 486 system looks like.



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ETMS. Everex Thermal Management System, makes this the first system to solve the high temperature and related reliability problems of current and future processors. A partition separates the cube into two compartments, independently cooled by SmartFans.* One contains the CPU, one the drives. Baffles funnel cool air where it's most needed. Even the power supply is cool, because at 400 watts, it runs at a fraction of its capacity.

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AMMA, a 256KB write-back caching architecture, forming "two-tier" caching in combination with the 486 chip's 8KB internal cache. It improves the cache hit ratio from 90% to as much as 99%.

Space for four quick release, half-height drives. They're front accessible, behind a hydraulically dampened door—which makes sure your drive heads are reading disks and tapes, not dust, smoke and humidity.

The entire interior of the cube is accessible in seconds through side panels, using thumbscrews.

The 486/33 CPU chip. Intel's hottest. But when hotter chips come around, the cube will be cool enough to handle them. And that includes multiprocessors.

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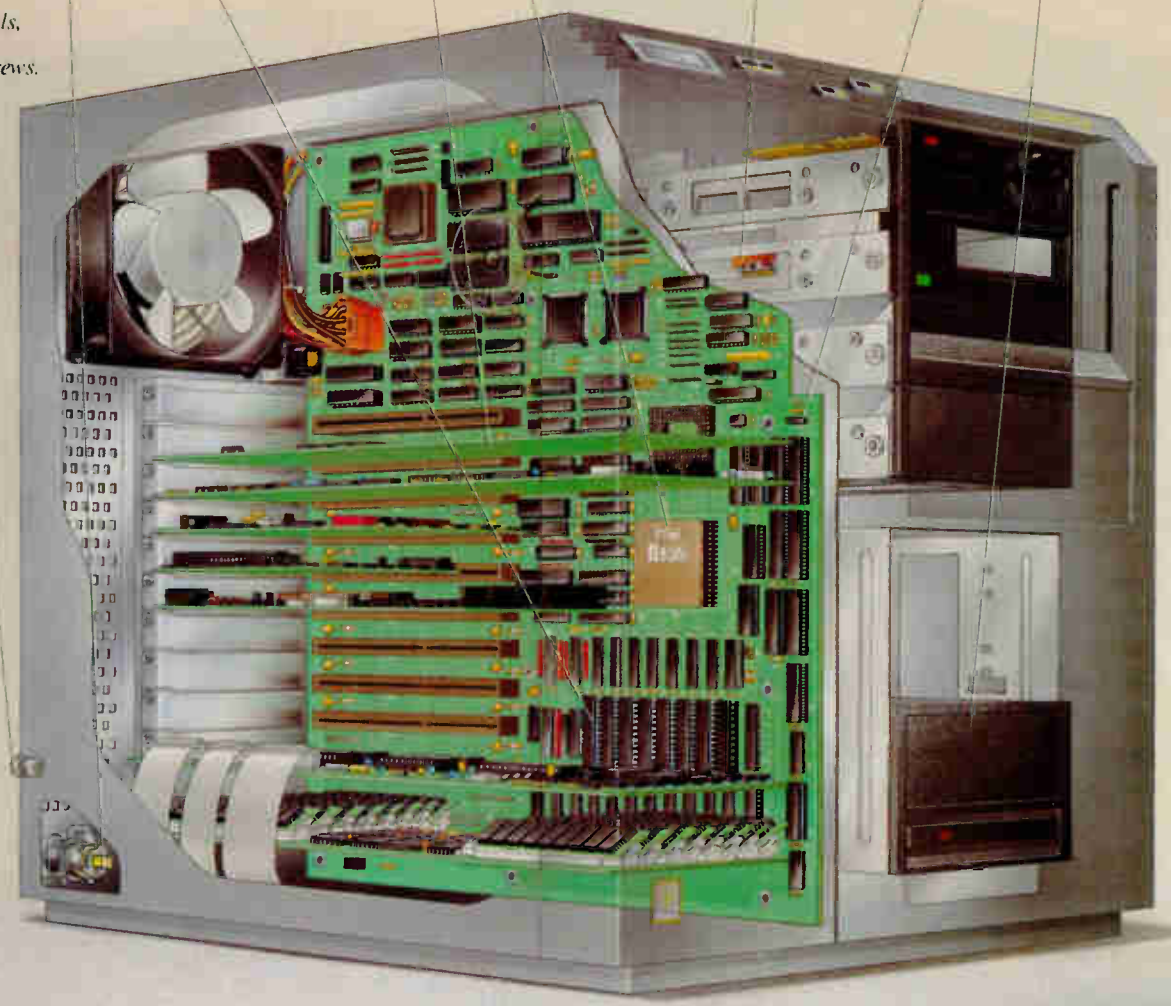

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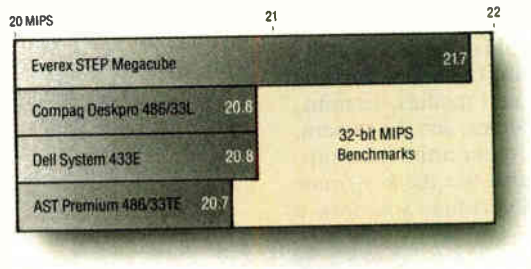
Performance-wise, this is a machine that will be hot long after others are cold and buried. In fact, as of now, there's no end in sight to the STEP Megacube's upgradability path.



But really, that shouldn't be much of a surprise. After all, at Everex, our mandate is "Always innovate, never compromise." And that's exactly the approach we took when we built the STEP Megacube.

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form—let you create much more complex models. I found the first two quite easy to use. It takes some practice to master the free-form tool.

When you create complex models, it's best to think of them as collections of basic objects. If you want to model an adjustable chair, think of it as a collection of seat, stem, wheel, and back objects, each of which has a relationship to the others. Infini-D lets you establish hierarchical links between the basic chair objects, so that if you pull at the seat, the rest of the chair follows. By establishing parent-child relationships between the objects and applying constraints to their motion, you can create models that move as they would in the real world.

Infini-D lets you animate any object: models, terrains, light sources, and the camera. Unlike other animation programs that use the *key-frame* technique (where you draw a starting position and an end position, and the program calculates the intermediate positions), Infini-D takes a different approach. The program's animation sequencer tracks events for each object. An event occurs each time you change the position, orientation, or other characteristic of an object.

Infini-D tracks every event for each object on an individual time line. Every object has its own time line. Every time line shows a complete history for each object. This approach has a number of advantages in animating a scene.

Most important, the sequencer lets you easily manipulate events in the animation for individual objects. If you are animating a runner and you don't like the position of the arm in the second frame, you simply change the position of the arm object at that point on the time line.

The sequencer lets you easily change events in the animation and adds nice touches for creating inertial effects with the Ease-In and Ease-Out functions. Although the program's modeling and rendering capabilities are noteworthy, I believe the animation portion is its real strength.

My only complaint with the program is that it doesn't yet include a real-time animation player. To see your animation play at regular speed (you can see it play only in slow motion in the sequencer), you'd have to export the animation as a PICS file to another application.

You need time to become oriented when you're working in the 3-D world. Although the program offers tear-off palettes for displaying the *x*, *y*, and *z* boundary parameters of an object, tick marks showing the three axes would help.

—Dave Andrews

THE FACTS

Infini-D
$895

Requirements:
Minimum: Mac II with System 6.0.4, 32-Bit QuickDraw, 4 megabytes of RAM, an 8-bit video card, and a hard disk drive.
Recommended: Mac IIfx with System 6.0.5, 32-Bit QuickDraw, 8 MB of RAM, a 24-bit video card, and a hard disk drive.

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fax: (413) 549-1531
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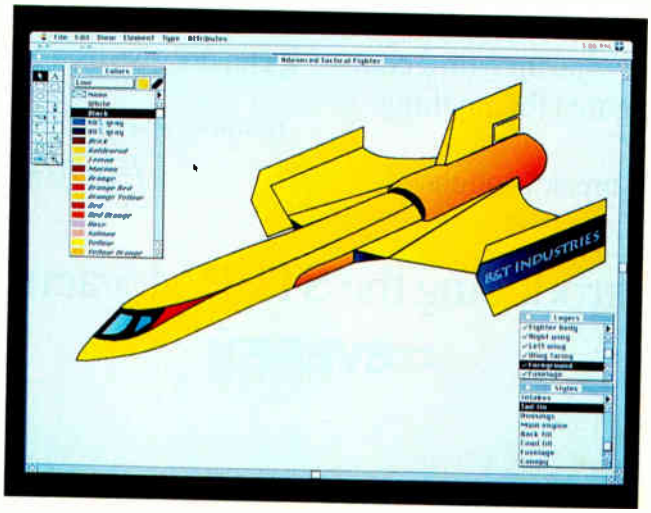
Artwork Gets Easier with an Improved FreeHand

Aldus FreeHand is one of two major object-based drawing applications for the Mac. With the release of Illustrator 3.0 from Adobe, Aldus has countered with improvements to FreeHand. If my glimpse of the beta **Aldus FreeHand 3.0** is any indication, it will easily hold its own in the drawing arena with its new features and user-interface enhancements, including several types of built-in arrowheads for use with lines, better control of text alignment to lines or curves (especially ellipses), and the ability to import, display, and print 24-bit TIFF images.

FreeHand can create and manipulate *composite paths* (i.e., objects that have openings or holes in them so that background objects can show through). For example, in an aircraft drawing, the canopy could be drawn as a composite path to allow cockpit details to show. Text that uses either PostScript Type 1 or Type 3 outline fonts can be converted to composite paths, making sophisticated text shading and overlays possible.

A strength of FreeHand is its layers feature, which arranges the order of appearance of a drawing's elements. FreeHand 2.0 was limited to 200 foreground (printing) layers and one background (nonprinting) layer; in FreeHand 3.0, the number of layers is limited only by memory.

FreeHand's tool palette sports three new tools: a tracing tool (which can generate



THE FACTS

Aldus FreeHand 3.0
$595

Requirements:
Mac Plus or higher with 2 MB of RAM and a hard disk drive; 4 MB of RAM is recommended.

Aldus Corp.
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Seattle, WA 98104
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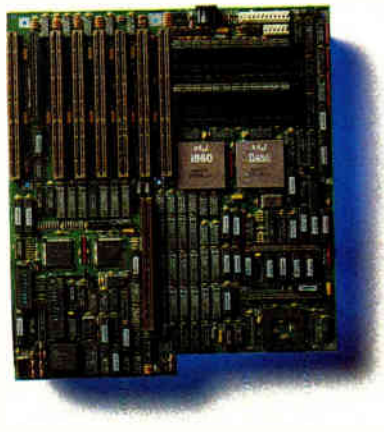

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paths from the edges of a high-contrast scan), a knife tool (to cut lines or curves into two separate paths), and a magnifying tool (to zoom into or out of a point of interest on the drawing).

FreeHand's enhanced interface lets you manage complex drawings easily. Three new palettes—colors, layers, and styles—provide quick access to an element's attributes. Each palette lets you modify the element's attributes on-screen without having to move around in the menu bar.

The colors palette uses small swatches of colors to show an element's actual fill and line colors. The layers palette shows what layer the element belongs to, and it lets you add and rearrange layers by simply clicking and dragging. The styles palette shows what colors, shading, and patterns are used to fill the element, although you must open a dialog box to view the actual colors. These three palettes conveniently display the fills, colors, and layer of each element as you select it with the mouse.

I used FreeHand 3.0 on a Mac IIci with 8 megabytes of RAM and equipped with an AppleColor 13-inch monitor and a SuperMac Technology 19-inch monitor; I also used it on a Mac Plus with 2 MB of RAM and an HD-20 hard disk drive. Both computers ran System 6.0.5.

On the IIci, color blends displayed superbly at 24-bit screen depths. FreeHand capably handled multiple screens: I could place the palettes on the smaller monitor while expanding the drawing full-size on the larger monitor. I was able to import a 24-bit color TIFF image created by a Sharp JX-100 scanner, add text, and print the result.

As I expected, FreeHand was much slower on the Mac Plus, especially if it had to display colors as dithered patterns. However, these same patterns appear in the colors palette, which allows limited color work on Macs that have black-and-white screens. The Mac Plus's performance was adequate on less complex artwork, but serious drawings require a Mac II–class computer.

I was able to open and edit Illustrator 1.1 and Illustrator 88 files with FreeHand 3.0. Illustrator 3.0 was able to import and display FreeHand drawings saved as encapsulated PostScript files, which augurs well for sharing information between the two applications. FreeHand EPS files include Open Prepress Interface comments, which contain descriptive information that's used by certain high-end prepress systems.

Will FreeHand 3.0 eclipse Illustrator 3.0? Not likely, but neither will FreeHand lurk in its shadow. Illustrator can deal with larger amounts of text and can generate graphs. But FreeHand easily wins over Illustrator as the master of creating color blends, and its layers feature makes complicated artwork practical. Nor should the enhancement to FreeHand's interface be dismissed casually: It goes a long way toward making a sophisticated drawing application less intimidating and quite usable. Check it out. ■

—Tom Thompson

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DOS and Unix As One

The Voyager, a workstation based on an i486 microprocessor, concurrently runs Unix and DOS applications. Able to take full advantage of both environments, according to Tyan Computer, Voyager includes 8 MB of RAM (expandable to 64 MB) and a 64-bit data bus.

Voyager features integrated I/O ports, a built-in Ethernet interface, and an 8514/A-compatible graphics adapter. Options for the 3½-inch internal hard disk drive range from 210 MB to 500 MB. Preinstalled software includes Unix, X Window System version 11, and Motif.

Price: Starts at $9999.

Contact: Tyan Computer Corp., 612 North Mary Ave., Sunnyvale, CA 94086, (408) 720-1200; fax (408) 720-1584.

Circle 1287 on Inquiry Card.

Tyan's Voyager unites Unix and DOS on a single workstation.

A 486 in a Choice of Speeds

A 25-MHz and a 33-MHz model of the Systems Integration Associates 486 SF desktop computer are available. Both configurations accommodate three half-height drives or one full-height drive and one half-height drive.

The 486 SF in both versions incorporates an Intelligent Drive Electronics controller and 64K bytes of cache memory. Its 2-MB main memory is expandable to 32 MB. Cooling is via a front-mounted and a rear-mounted fan. Other standard features include one parallel and two serial ports, a 600- by 800-pixel VGA card, and a 200-W power supply.

Price: SIA 486/25 SF, $3495; SIA 486/33 SF, $4347.

Contact: Systems Integration Associates, 222 East Pearson, Suite 502, Chicago, IL 60611, (312) 440-1275.

Circle 1288 on Inquiry Card.

The SIA 486/33 SF functions as a stand-alone or in a network.

Gas-Plasma Display and Battery Power

A 16-MHz 386SX PC that runs on 4-hour nickel-cadmium batteries or on conventional power, the Lyte-Byte 5300 has 1 MB of RAM (expandable to 4 MB), a 640- by 480-pixel VGA gas-plasma display, a 40-MB hard disk drive, and a 3½-inch floppy disk drive. The unit uses an AMI BIOS and an Intel 80387SX-16 math coprocessor. Hard disk drives with capacities of up to 200 MB are available.

Additional features of the Lyte-Byte 5300 include an expansion slot for a 16-bit short card, one parallel and two serial ports, and ports for an external 5¼-inch floppy disk drive, a VGA color monitor, and an 101-key keyboard. You can plug the computer into conventional power and use it with or without the battery pack in place.

Price: Starts at $2195.

Contact: Micro Express, 1801 Carnegie Ave., Santa Ana, CA 92705, (800) 642-7621 or (714) 852-1400; fax (714) 852-1225.

Circle 1289 on Inquiry Card.

The Latest Triumphs for Arche

Arche's latest additions to its Triumph line of PCs are the 386SX-16 and 386SX-20. Both incorporate the company's integrated motherboards containing Presto, a single 5000-gate application-specific IC. Also on the boards are an Intelligent Drive Electronics/FDC interface and a Tseng Labs ET4000 graphics chip set.

The basic 386SX includes a 16- or 20-bit Intel 386 microprocessor with keyboard-selectable 8-MHz or 16-MHz clock speed, a socket for an 80387SX math coprocessor, and 1 MB of single in-line memory module RAM (expandable to 8 MB on the motherboard). Other features include one parallel and two serial ports, two 8-bit and six 8-/16-bit expansion slots, and a 150-W power supply. The 386SX-20 includes 1 MB of video RAM with a graphics resolution of 1024 by 768 pixels in 256 colors and 2 MB of base RAM (expandable to 16 MB on the motherboard).

Price: Basic Triumph 386SX-16, $1395; with onboard VGA and expandable RAM, $1595. Triumph 386SX-20, $1830.

Contact: Arche Technologies, 48881 Kato Rd., Fremont, CA 94539, (800) 422-4674 or (415) 623-8100; fax (415) 623-8171.

Circle 1290 on Inquiry Card.

A Printer to Consider

In support of the TrueImage page description language, the TrueLaser printer uses the Am29000 32-bit RISC microprocessor. The printer comes with 2 MB of DRAM (expandable to 6 MB).

Compatible with the Mac and any standard PC with a parallel or serial interface, the TrueLaser is bundled with 35 TrueType fonts. It is compatible with PostScript and provides Printer Command Language emulation. With a print speed of 6 ppm, the TrueLaser prints graphics and text. The printer can automatically switch among its AppleTalk, Centronics, and RS-232 ports.

Price: $2695.

Contact: Microtek Lab, Inc., 680 Knox St., Torrance, CA 90502, (800) 654-4160 or (213) 321-2121; fax (213) 538-1193.

Circle 1291 on Inquiry Card.

A Cursor Controller for the Road

The Icontroller, a cursor controller that attaches to the side of your laptop, notebook, or PC, is Microsoft and Mouse Systems compatible. In addition to fingertip cursor control with optional speeds, the unit has three function buttons.

Other features of the laptop Icontroller include a signal selector, a 25-pin adapter, and required software. Its protective storage case attaches to the laptop case. For times when you want to use the Icontroller with your desktop PC, an extension cord is packaged with the controller.

Price: $99.95.

Contact: Suncom Technologies, 6400 West Gross Point Rd., Niles, IL 60648, (708) 647-4040; fax (708) 647-7828.

Circle 1292 on Inquiry Card.

Microtek's RISC-powered TrueLaser printer.

A Hard Disk Drive That Fits in Your Pocket

The PocketDisk, a self-contained, removable hard disk drive for PCs, is available in two models. The PD20-1, for desktop PCs, weighs 13 ounces; the PDH20-1, just over 1 pound, works with desktop PCs and any laptop that accepts a half-card expansion board.

Each disk drive has a 20-MB capacity with a 23-ms access time. Besides using the PocketDisk as your primary drive, you can use it as a secondary or fast backup device.

Price: PD20-1, $895; PDH20-1, $950.

Contact: Tradewinds Peripherals, Inc., 2633 East 28th St., Long Beach, CA 90806, (213) 595-7272; fax (213) 595-6446.

Circle 1293 on Inquiry Card.

Use Your Hard Disk Drive While You're Printing

The Export T series of external hard disk drives offers high-speed backup for laptop and desktop computers. Running from the parallel port, the devices let you simultaneously operate your hard disk drive and your printer.

You bring the Export online via a device driver that you add to your CONFIG.SYS file. The capacity of the 3½-inch drives ranges from 20 MB to 207 MB; speeds range from 28 ms to 15 ms. The supplied device driver works with removable cartridge and magneto-optical drives, Bernoulli boxes, and CD-ROMs.

Price: $595 to $1795.

Contact: Systems Peripherals Consultants, 7950 Silverton Ave., Suite 107, San Diego, CA 92126, (619) 693-8611.

Circle 1294 on Inquiry Card.

Comfort on a Keyboard

Resting on a three-position nested stand, the ergonomically designed K-156-H Klik keyboard creates less stress than other keyboards, according to Hertz Computer. The small-footprint, lightweight keyboard features sculptured, cylindrical key caps by the German firm Cherry. Hidden underneath the board is an AT/XT switch.

PC and Novell ELS NetWare compatible, the Klik includes a separate inverted-T cursor control, 12 function keys, dedicated screen control keys, and a separate numeric keypad. Nonskid rubber grips prevent the keyboard from sliding away while you're typing.

Price: $79 through June; $89 thereafter.

Contact: Hertz Computer Corp., 325 Fifth Ave., New York, NY 10016, (212) 684-4141; fax (212) 684-3658.

Circle 1295 on Inquiry Card.

The ergonomically designed K-156-H Klik keyboard.

Speed on a SCSI Solid-State Drive

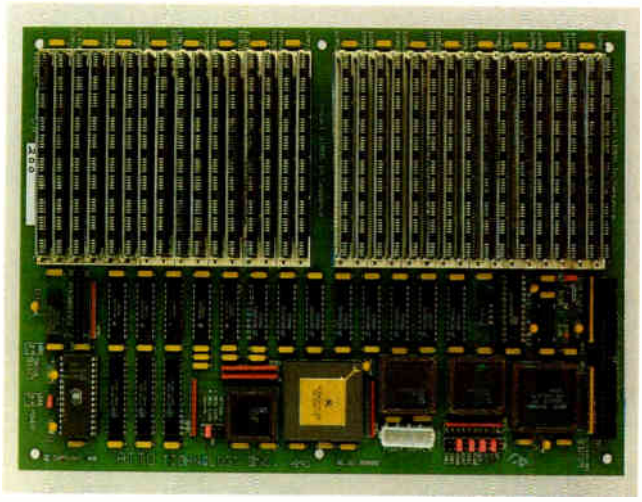
The SiliconDisk Plus SCSI solid-state disk drive, with an access time of 0.05 ms, emulates conventional disk drives but without mechanical delays such as seek and rotational latency. By using a Motorola 68020 32-bit processor and a dedicated 25-MHz SCSI processor, the drive achieves a data transfer rate of 5 MBps on your PC or Mac, according to Atto.

Included in the SiliconDisk Plus is Atto's Auto Format feature, which lets you use the device without having to format it or install software drivers. With 32 single in-line memory module sockets, the unit has the capacity to hold up to 128 MB of memory.

Price: $2995.

Contact: Atto Technology, Inc., Baird Research Park, 1576 Sweet Home Rd., Amherst, NY 14228, (716) 688-4259; fax (716) 636-3630.

Circle 1296 on Inquiry Card.



Atto's SiliconDisk Plus has a 0.05-ms access time.

Learn Multiprocessing from a Kit

The Transputer Education Kit includes a ready-to-use PC add-on board with a 20-MHz 32-bit transputer, a T400 C cross compiler, a T400 Occam compiler, an assembler, and documentation. The kit is geared toward users who know how to program serial machines and want to learn multiprocessing and parallel computing.

The kit is available with factory-installed options, such as up to 4 MB of local DRAM and a T425 or floating-point T800 transputer. You can link kits within a single PC or between PCs and expansion chassis.

Price: Introductory price, $236; 1 MB of DRAM, $110; add-on processor boards, $150.

Contact: Computer System Architects, 950 North University Ave., Provo, UT 84604, (800) 753-4272 or (801) 374-2300; fax (801) 374-2306.

Circle 1297 on Inquiry Card.

Learn parallel computing with the Transputer Education Kit.

Grab and Print the Picture

Two video image-capture systems from IDEC, the Supervision/8 and the Supervision/16, are available to users of AT-compatible computers. The Supervision/8 also works with XT compatibles. Both boards let you capture video images from a camera, videotape, or a live broadcast.

The Supervision/8 has a resolution of 256 pixels by 256 lines by 256 shades of gray. It is compatible with Hercules monochrome, CGA, EGA, and VGA monitors. Printer compatibility is with dot-matrix and laser printers.

The resolution of the Supervision/16 is 512 pixels by 488 lines by 256 shades of gray. You can display the picture on any VGA monitor and many Super VGA monitors. It is laser-printer compatible.

Price: Supervision/8, $269.95; Supervision/16, $369.95.

Contact: IDEC, Inc., 1195 Doylestown Pike, Quakertown, PA 18951, (215) 538-2600; fax (215) 538-2665.

Circle 1298 on Inquiry Card.

VGA on a Budget

Two $98 VGA boards that are free of DIP switches and jumpers are available for your PC. Both boards include drivers for Windows, Word, GEM, Ventura Publisher, AutoCAD, WordPerfect, and Lotus 1-2-3.

Boca's new 800- by 600-pixel version of its Basic VGA by Boca board includes 256K bytes of RAM. The board supports 16 colors in the 800- by 600-pixel graphics mode and 256 colors in a 320- by 200-pixel mode for VGA, EGA, CGA, and Hercules Graphics.

Price: $98.

Contact: Boca Research, Inc., 6401 Congress Ave., Boca Raton, FL 33487, (407) 997-6227; fax (407) 997-0918.

Circle 1299 on Inquiry Card.

Everex's Viewpoint Standard VGA card automatically configures itself for an 8-bit or a 16-bit bus and includes 256K bytes of RAM. Its 800- by 600-pixel resolution supports 16 colors. The board provides extended VGA resolution without using disk-based drivers.

Price: $98.

Contact: Everex Systems, Inc., 48431 Milmont Dr., Fremont, CA 94538, (800) 628-3837 or (415) 498-1111.

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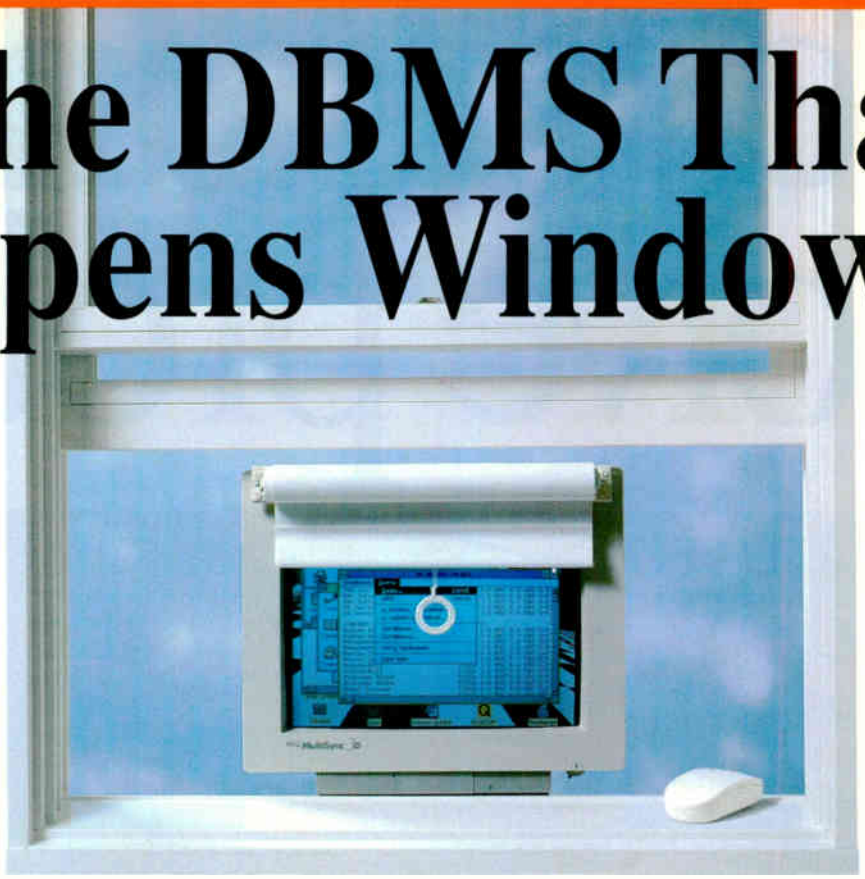

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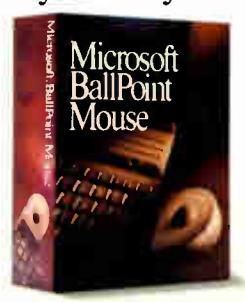
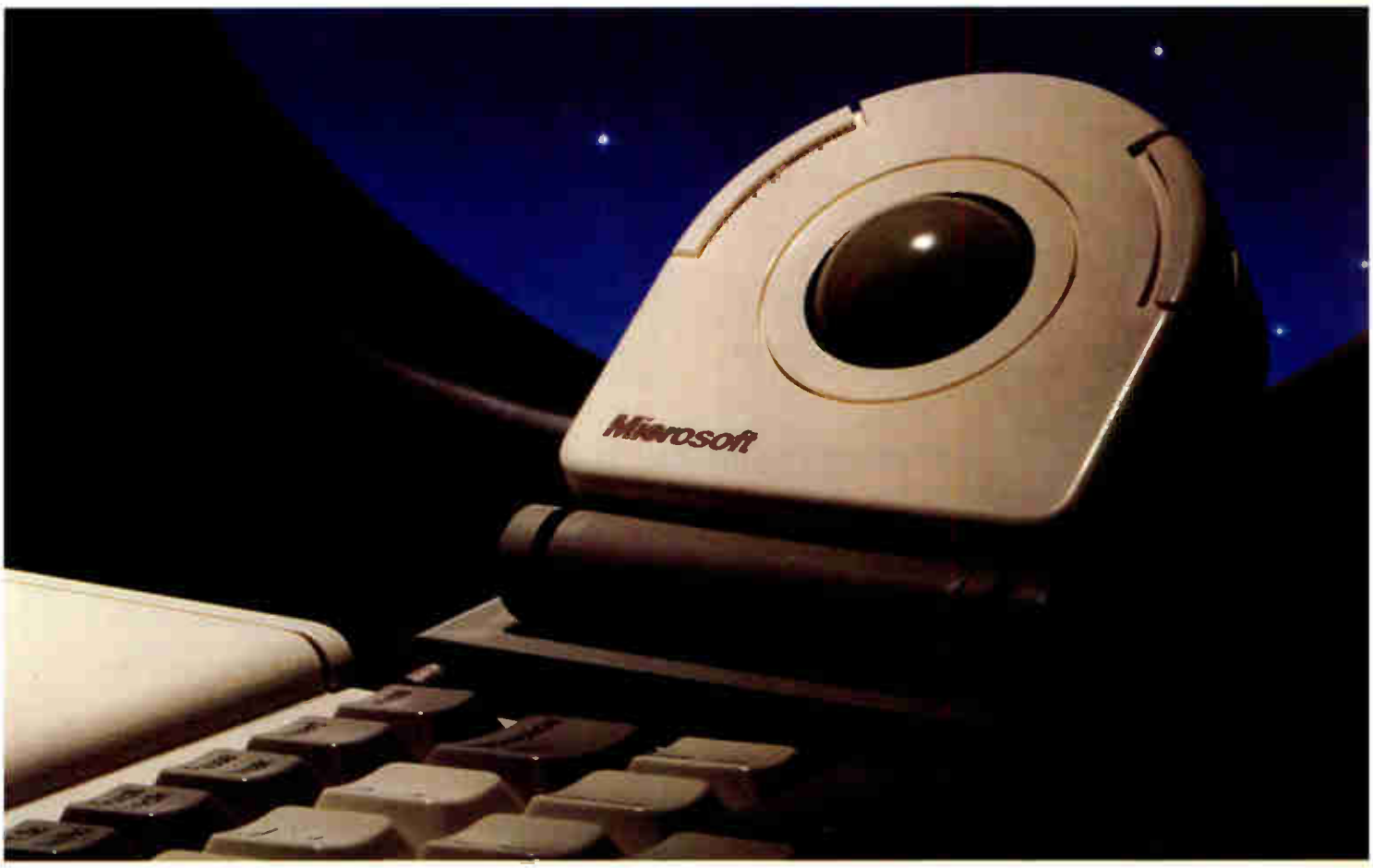
The new Microsoft® BallPoint™ mouse represents one giant step for you and your laptop computer.

That's because new BallPoint is the first and only mouse specifically developed for laptops. It's compact, yet includes all the features that made the



ed a mouse to ms in space.



Microsoft Mouse the industry leader.

Simply attach it to either side of virtually any laptop keyboard, and adjust it to the most comfortable angle. Then thumb your way through Microsoft Windows™ graphical environment version 3.0 and all your favorite mouse-driven applications.

And for a limited time, you can get a free BallPoint mouse when you purchase a COMPAQ notebook or laptop PC.

Just call (800) 541-1261, and ask for Dept. P40. They'll send you everything you need to know about the mouse designed to go where no mouse has gone before.

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Making it all make sense™

Intelligent Power Backup

During a power failure, the Intelligent Power System on a Card provides 4 minutes of DC battery power to automatically store data onto your PC's hard disk drive. When the power returns, the IPS Card reloads your PC to its state prior to the interruption.

The card requires a PC, DOS 3.0, 512K bytes of RAM, a 5½-inch floppy disk drive, and a 10-MB hard disk drive or access to a file-server network. Compatible software includes Windows 3.0, Lotus 1-2-3, and WordPerfect. The IPS Card supports graphics, a mouse, and expanded and extended memory.

Price: $249.

Contact: Elgar Corp., 9250 Brown Deer Rd., San Diego, CA 92121, (800) 733-5427 or (619) 458-0250; fax (619) 458-0267.

Circle 1301 on Inquiry Card.

Cushioning the Job

Silicon Sports' Wrist Pad combines comfort with utility in a move toward preventing repetitive stress injury caused by long hours at your computer. The Wrist Pad creates a resting surface that maintains your hands in a neutral position while you're typing, alleviating the strain on your arms and wrists, the company says. Composed of two layers of neoprene and one of nylon, the Wrist Pad is three-quarters of an inch high and 19½ inches long, and it fits snugly along the edge of your keyboard.

Price: $19.95.

Contact: Silicon Sports, 1180 Sherman Ave., Menlo Park, CA 94025, (800) 243-2972 or (415) 854-1456.

Circle 1302 on Inquiry Card.

Intelligent Power System on a Card provides on-line battery backup for your PC or workstation.

Put Your Laptop in a Hardshell

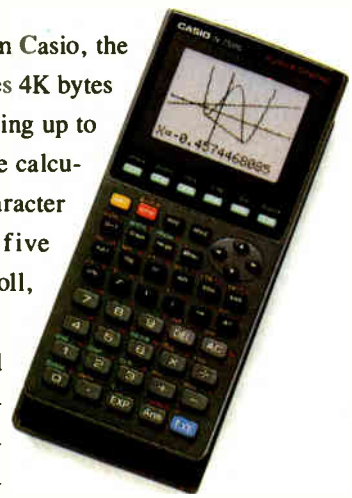
The Hardshell Laptop Case is the latest addition to Underwater Kinetics' line of cases. As are all Kinetics cases, the new cases are made of injection-molded ABS/polycarbonate and are waterproof to a depth of 30 feet. Guaranteed not to chip, dent, or become discolored, the Kinetics cases include a cushioned, fold-down handle and a full-length hinge. The case interiors are of custom foam.

Price: $29 to $200.

Contact: Underwater Kinetics, 1020 Linda Vista Dr., San Marcos, CA 92069, (619) 744-7560; fax (619) 744-7320.

Circle 1303 on Inquiry Card.

Advanced Technology on a Calculator



A graphing calculator from Casio, the Model FX-7700G, includes 4K bytes of memory capable of storing up to 38 separate programs. The calculator incorporates a 16-character by 8-line display with five zoom modes, trace and scroll, parametric graphing, shading, inequality, and integration. With the FX-7700G you can create matrices, do fractional calculations, and replay function and enhanced statistical abilities. The calculator includes menu keys and a memory-protection system.

Price: $109.95.

Contact: Casio, Inc., 570 Mt. Pleasant Ave., Dover, NJ 07801, (201) 361-5400; fax (201) 361-3819.

Circle 1305 on Inquiry Card.

Print Forms and Labels Quickly

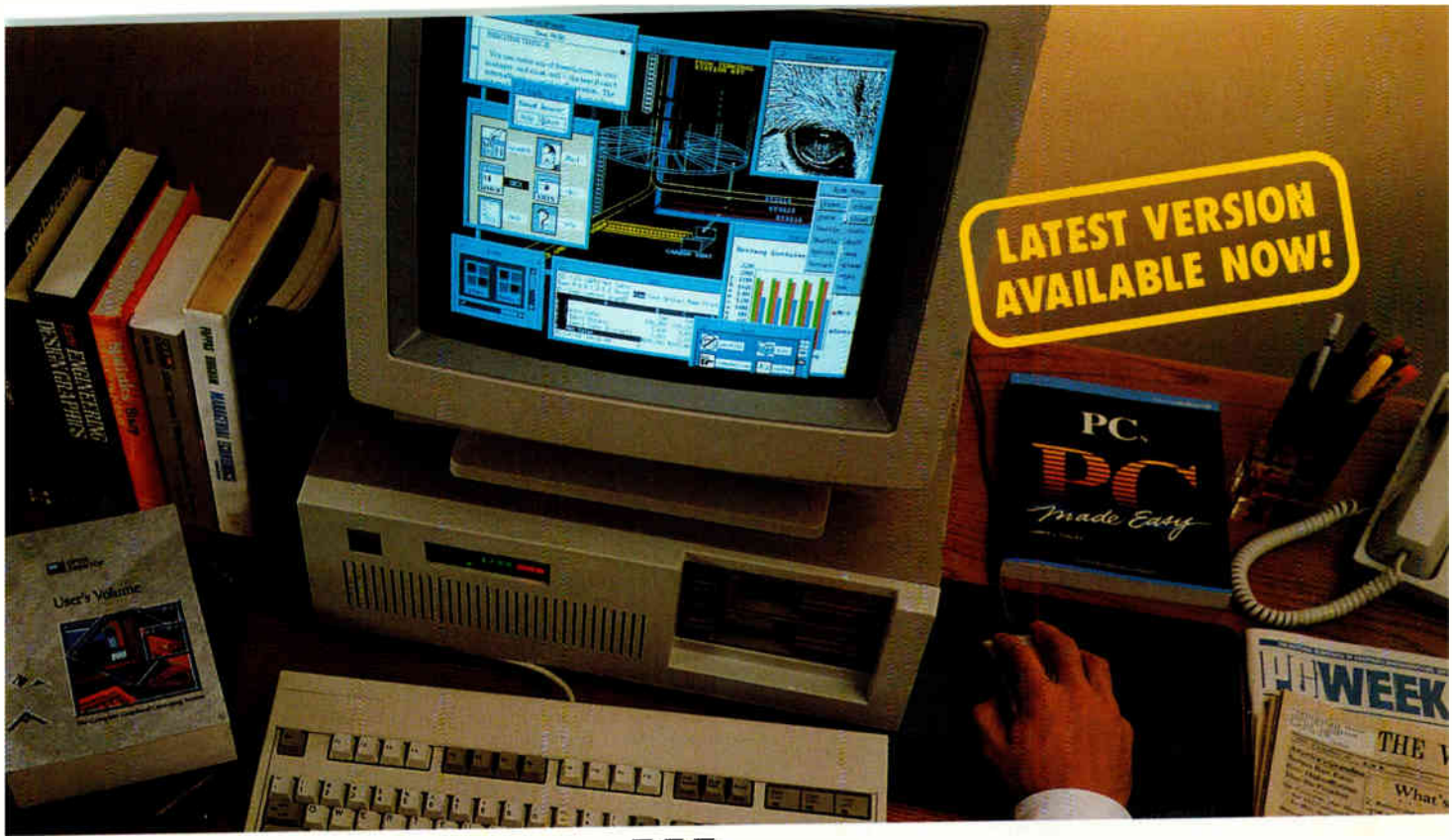
The Facit E7650 forms and label printer automatically adjusts to each form's thickness. Its FormFinder system senses the top, right, and left edges of the form.

Able to print in near letter quality at 100 cps and QuickPrint at 600 cps, the Facit E7650 advances forms at 16 inches per second. It features automatic paper-parking and paper-loading controls and lets you tear off a form immediately after it is printed; printing resumes at the top of the next page without wasting paper. The wide-carriage impact printer can print text and graphics in as many as seven colors on up to nine-part forms and supports pressure-sensitive labels.

Price: $2549.

Contact: Facit, Inc., 400 Commercial St., Manchester, NH 03108, (800) 733-2248 or (603) 647-2700; fax (603) 647-2724.

Circle 1304 on Inquiry Card.



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Take a look at the vast majority of graphical workstations developed over the past decade and you'll see something they all have in common:

An integrated UNIX® System environment.

Now take a look at the vast majority of businesses that have put computing power directly onto their office desktops over the past decade, and you'll see something they all have in common:

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It doesn't take a computer to forecast the platform that's going to put graphical workstations on the vast majority of business and engineering desktops in the next decade:

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Open Desktop is the complete graphical operating system that's built on the most popular UNIX System platform of all time—SCO®. And it lets you create your own networked, icon-driven workstation environment using the industry-standard 386 or 486 computers and peripherals of your choice.

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Circle 308 on Inquiry Card (RESELLERS: 309)

Blazing a Trail for Network Users

Telebit's NetBlazer, a dial-up and leased-line IP router, provides remote users with access to TCP/IP networks and services. A bidirectional network device, NetBlazer enables dial-up users to access multiple hosts during a single session. A network of Unix machines can share the modems connected to the NetBlazer for outgoing connections.

The NetBlazer supports as many as three Ethernet ports, up to 26 connections to modems and other RS-232 devices, and one port for a V.35 connection to a 56K-byte leased line. The unit's 2 MB of memory is expandable to 8 MB. Its software provides three levels of network security. The NetBlazer is available in a number of configurations, letting you customize its functions.

Price: Starts at $2995.
Contact: Telebit Corp., 1315 Chesapeake Terrace, Sunnyvale, CA 94089, (800) 835-3248 or (408) 734-4333; fax (408) 734-3333.
Circle 1306 on Inquiry Card.

Telebit's NetBlazer acts as a terminal/modem server and also offers dynamic dial-up TCP/IP connectivity.

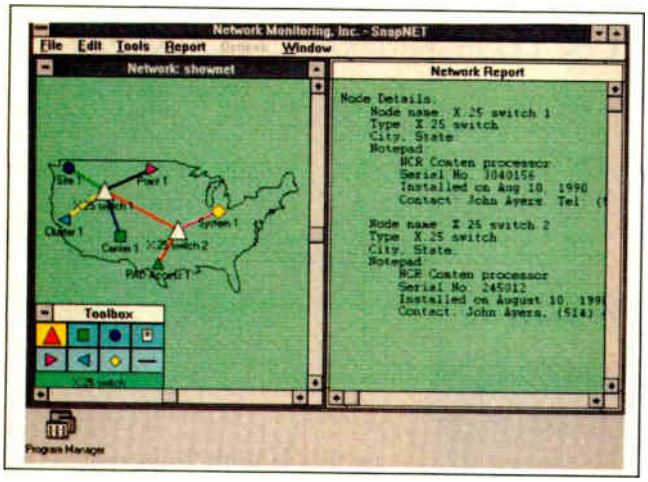
Making Network Management a Snap

A desktop management and control system for LANs and wide-area networks, SnapNet operates as an application under Windows 3.0. The program helps you build, display, track, and modify the topological layout of your network. You can also create network databases, directories, and graphical displays.

With SnapNet you can view high-resolution topological displays with or without maps. SnapNet lets you move from a national network down through regional displays into a LAN within a single location. At any stage, you can store and print the display, including hardware and software configuration notes, on any printer supported by Windows 3.0. SnapNet automatically creates the database and directory that let you identify and track each node and link by name, type, and location.

The system requires 1 MB of RAM, a hard disk drive, a floppy disk drive, a color monitor, and a mouse.

Price: $995.
Contact: Network Monitoring, Inc., 2365 Paragon Dr., San Jose, CA 95131, (408) 453-6430; fax (408) 453-1210.
Circle 1307 on Inquiry Card.



SnapNet works under Windows 3.0 to let you build, display, track, and modify topological layouts.

Macintosh to Novell Through Mosaic

Mosaic for Macintosh lets you use your Mac to print documents to a Novell network from any application on Hewlett-Packard LaserJet and DeskJet printers. The program does not require additional hardware or add-on printer adapters.

Mosaic for Macintosh requires 1 MB of memory and System 6.0. The software is compatible with NetWare ELS II, Advanced NetWare, and Advanced NetWare SFT file servers. Included with Mosaic for Macintosh is Novell's NetWare Desk Accessory utility.

Price: $395 for three users; $595 for 10 users.
Contact: Insight Development Corp., 2200 Powell St., Suite 500, Emeryville, CA 94608, (800) 825-4115 or (415) 652-4115; fax (415) 652-9857.
Circle 1308 on Inquiry Card.

Token Ring Adapter Card for Mac IIs

Cabletron's Desktop Network Interface (DNI) card for the Mac II NuBus provides built-in network management and diagnostic capabilities. The card lets Mac II users connect to 4- or 16-Mbps Token Ring networks over shielded or unshielded twisted-pair cabling.

The card incorporates Cabletron's Lanview status monitoring and diagnostic system, which lets you quickly determine if you have accessed the network. Lanview also lets you determine your data-distribution speed and whether your computer is transmitting or receiving data.

Price: $1295.
Contact: Cabletron Systems, Inc., 35 Industrial Way, Rochester, NH 03867, (603) 332-9400; fax (603) 332-7386.
Circle 1309 on Inquiry Card.

CARRY-I

The New Standard

The Carry-I 9000 series comes complete with 80386SX/80286-16/80286-12 microprocessor (Co-Processor optional). 1024 × 768 VGA/MGA & CGA display interface, 1/2/4 MB RAM, one 3.5" 1.44 MB FDD or one FDD plus one 40/80 MB HDD, one 8 bit expansion SLOT, one parallel and two serial I/O ports, and one 30W auto range switching power adapter, all in the traditional 240mm × 185mm × 45mm (9.4" × 7.3" × 1.8") casing of Carry-I. Each package includes two mini-tower stands and a carry bag. The 81 key mini keyboard with 101 functions and 9 inch color or monochrome VGA monitor are optional.

Other Carry-I products include the 8000 series XT & AT book-size personal computers and the 6000 series XT and AT book-size LANstations. All Carry-I product lines are bundled with DR DOS 5.0

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Circle 123 on Inquiry Card.

The Next Gets a Fax Modem

The InterFax NX fax modem for the Next computer combines 9600-bps fax capabilities with a 2400-bps Hayes-compatible data modem. The unit provides MNP level 5 data compression for data throughput as high as 4800 bps and built-in MNP data correction.

Jointly developed by Abaton and Next, the InterFax NX comprises software built into Next's newest operating system and Abaton's hardware. InterFax works by converting your document from Display PostScript to fax format and immediately sending it to the specified destination. You receive visual status of the progress of your fax or data call via the LEDs on the unit. A built-in speaker informs you of additional status information. The machine supports automatic data-to-voice switching.

Price: $595.

Contact: Abaton, 48431 Milmont Dr., Fremont, CA 94538, (800) 444-5321.

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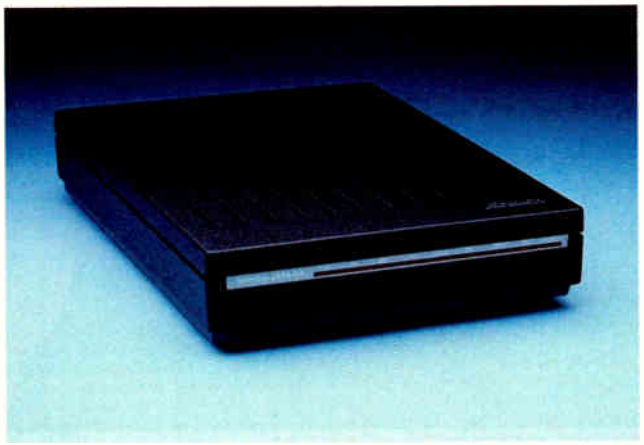


The InterFax NX's software is built into the latest Next.

Fax/Modem for Macintosh Portable

An internal V.42 and V.42bis fax/data modem for the Macintosh Portable, the Comport 5/42 gives you an effective throughput of 9600 bps using a 2400-bps modem. Hayes compatible, the modem works with all Macintosh portables.

The Comport 5/42 wakes the Mac from sleep mode when it detects an incoming call and lets you schedule transmissions to take advantage of nighttime rates. The software includes the QuickFax desk accessory, which lets you send faxes from within any application.

Price: $699.

Contact: PSI Integration, Inc., 851 East Hamilton Ave., Suite 200, Campbell, CA 95008, (800) 622-1722 or (408) 559-8544; fax (408) 559-8548.

Circle 1311 on Inquiry Card.

Network Flexibility

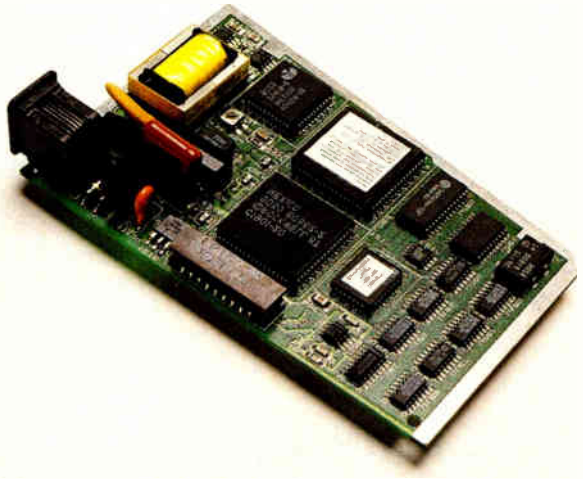
The FlexiHub, a modular internal 10Base-T hub, features modules called HubSimms. Each HubSimm provides connectivity for two ports, giving you the flexibility of installing a hub with 6, 8, 10, or 12 ports.

The FlexiHub is capable of full repeater signal regeneration, as well as automatic and independent port partitioning and reconnection. A BNC connector provides thin Ethernet connectivity and lets you cascade FlexiHubs for larger networks.

Price: $600 for 6 ports; $150 each additional 2 ports; $950 for 12 ports.

Contact: Pivotal Technologies, Inc., 18240 Purdue Dr., Saratoga, CA 95070, (408) 374-7887; fax (408) 374-8074.

Circle 1312 on Inquiry Card.



PSI's Comport 5/42 fax/modem wakes sleepy Macintosh portables when it detects an incoming call.

Poste Your Unix Message

Poste, an E-mail program for Unix users, is designed to let technical and nontechnical users send multipart, multimedia messages across a number of different mail networks. A graphical application, Poste has an OSF/Motif interface that includes multiple windows capable of accepting input simultaneously.

The open architecture of Poste lets you easily integrate new applications as they become available. The program aids message delivery by providing recipient address templates for X.400 and Internet addressing. Message management features include hierarchical file folders, cross indexing, and message query and sorting on multiple fields.

Price: $395.

Contact: Alfalfa Software, Inc., Suite 4200, 185 Alewife Brook Pkwy., Cambridge, MA 02137, (617) 497-2922; fax (617) 876-2523.

Circle 1313 on Inquiry Card.

You should buy a multi-user BBS for one simple reason:

Return On Investment

How much money do you pay to overnight courier services every month? How much to the U.S. Postal Service? Are you interested in making the most productive possible use of your business resources?

A BBS (Bulletin Board System) can improve your bottom line in several ways:

1. Cut costs by transferring computer files over telephone lines, instead of paying courier charges. With modems, you can send files to or from your home office at speeds up to 38,400 bits per second. A 60-second telephone connection costing less than a dollar can take the place of a diskette via overnight courier costing $11.50 or more.
2. Improve your overall business responsiveness by doing business faster. Why wait for that spreadsheet file overnight, by courier, when you can receive it instantly, by modem? Send and receive software, purchase orders, databases, and word processor files right away, rather than waiting a day. Sometimes an extra day can make the difference between success and failure.
3. Eliminate mailing costs by offering files (updates, newsletters, CAD files, whatever your business may provide) to your customers for download, rather than mailing them diskettes or printed matter all the time. The phone call is on their nickel, and they'll love it because they're getting the information right away, not several days stale.
4. Gain a competitive edge by offering your customers round-the-clock service – but without increasing your staff hours! 24 hours a day, your BBS can provide prices, refer people to your dealers, and act as a Q & A clearinghouse, all unattended. Your own people can log on for a few minutes a day, any time it is convenient for them.

Depending on your particular business, you may be able to harness this technology in even more productive ways. If you have a field sales force, for example, or a dealer network, your BBS can host both public discussion areas and private one-on-one E-Mail. If you're in the software business, you can offer technical support, user-group "forums", application examples, and downloadable "demo disks" to your prospects instantly. If you do market research, you can use online questionnaires to gather vast amounts of data without ever picking up the phone or hiring a single telephone interviewer.

Circle 126 on Inquiry Card (RESELLERS: 127).

You can calculate Return On Investment (R.O.I.) as the ratio between the annual "payoff" of your BBS, minus expenses, and the initial cost of setting it up. The "payoff" may not be known exactly, but you can approximate it as a certain amount per hour of usage. One method of analysis, illustrated below, shows that various reasonable assumptions can yield exciting results:

# of lines	PC (386+ harddisk)	multi-modems	software (ML+src)	lines per mo.	payoff per hr.	# of users	av.#hrs use/day	hrs/day /line	payoff per mo.	R.O.I.
4	$2500	$2090	$1280	$200	$1.00	30	0.50	3.75	$450	51%
					$2.00	40	0.60	6.00	$1440	253%
					$3.00	50	0.75	9.38	$3375	649%
8	$3500	$2840	$1580	$400	$1.00	60	0.50	3.75	$900	76%
					$2.00	80	0.60	6.00	$2880	376%
					$3.00	100	0.75	9.38	$6750	962%
16	$5000	$3688	$1880	$800	$1.00	120	0.50	3.75	$1800	114%
					$2.00	150	0.60	5.63	$5400	522%
					$3.00	200	0.75	9.38	$13500	1442%

The figures shown here do not include overhead, set-up expenses, or ongoing maintenance. Software costs shown are for the popular combination of the Menuman and File Library editions, with C source code. If you prefer to do your own spreadsheet, the formulas here are (assuming columns lettered A through K): E=A*50, I=G*H/A, J=F*G*H*30, K=12*(J-E)/(B+C+D).

You can get started with all of this for as little as $59. This buys our complete 2-line software package, The Major BBS®, which includes E-Mail, file upload/download, teleconferencing, questionnaires, an Audit Trail, a "user registry", and much more. Initial set-up is quick and easy – 15 minutes on the average – and unlimited technical support (within reason) is just a phone call away. There's even a 30-day money-back satisfaction guarantee.

We're hoping that you'll like the $59 package so much that you'll want to expand it. Our main business is a wide variety of hardware and software add-ons, such as multi-modem cards, multi-port serial cards, the GalactiBox, "extended editions" of The Major BBS, C source code, The Major Database, the X.25 software option, the Ergo OS/286 protected-mode toolkit, the Dial-Out package, Search-and-Retrieve™, and an assortment of multi-user games and amusements.

None of these add-ons approach the cost effectiveness of the $59 package, of course, but they all represent excellent value. Operate your own BBS for a few months, and find out for yourself just how useful a BBS can be.

To order, just call **305-583-5990** and say, "I'd like to place an order!" We accept VISA, Mastercard, and American Express... or, we can ship C.O.D. if you like. We also accept Purchase Orders from major corporations and government.

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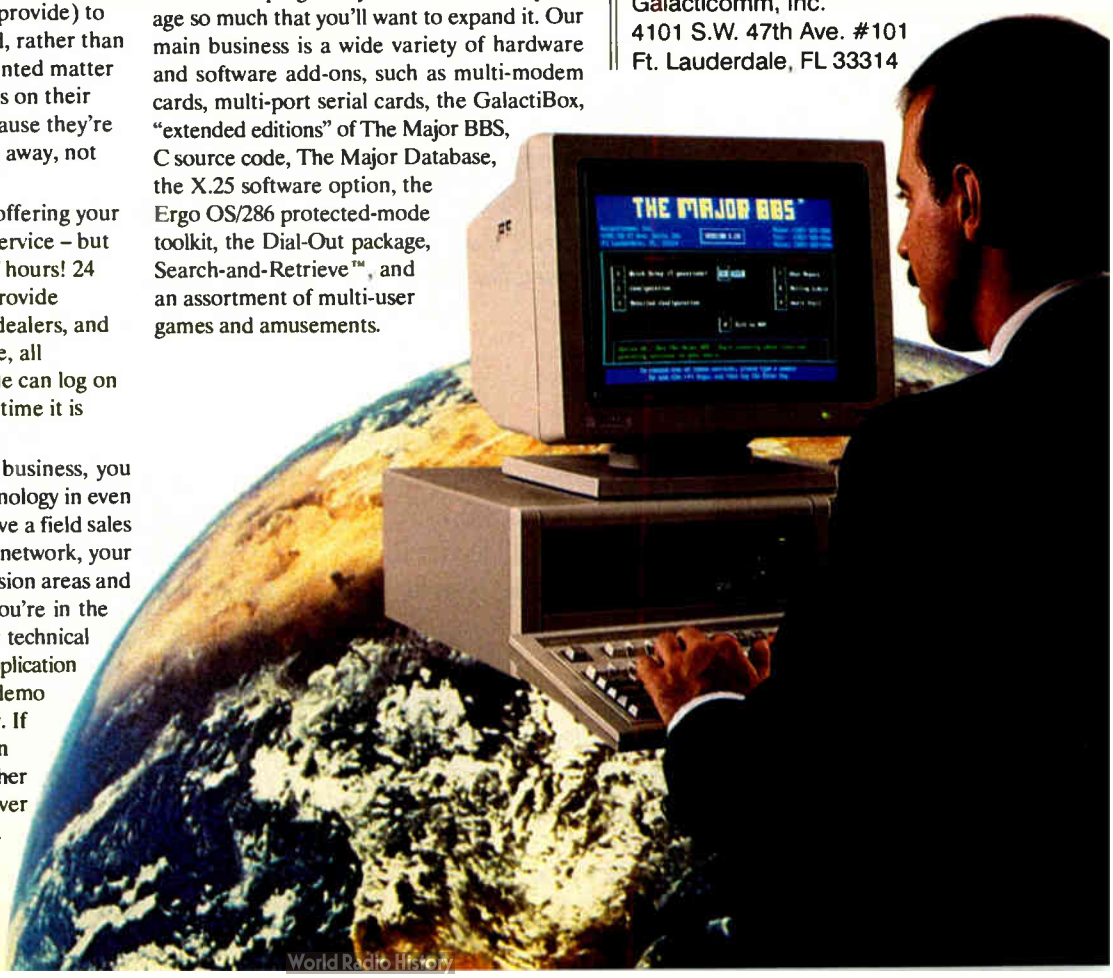
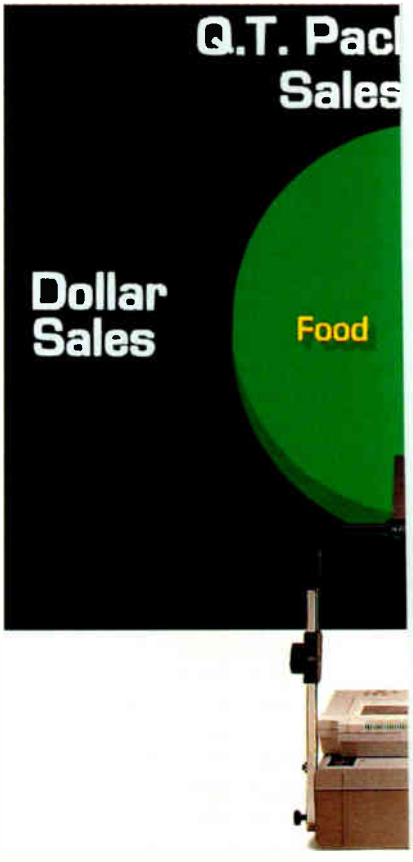


How to make accommodate every T



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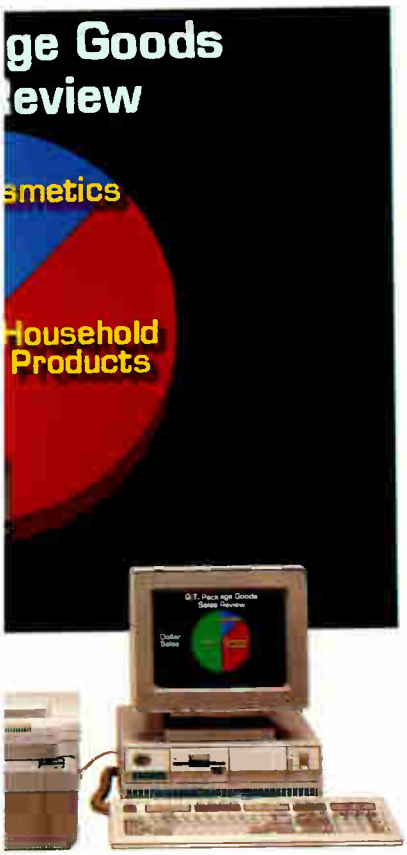
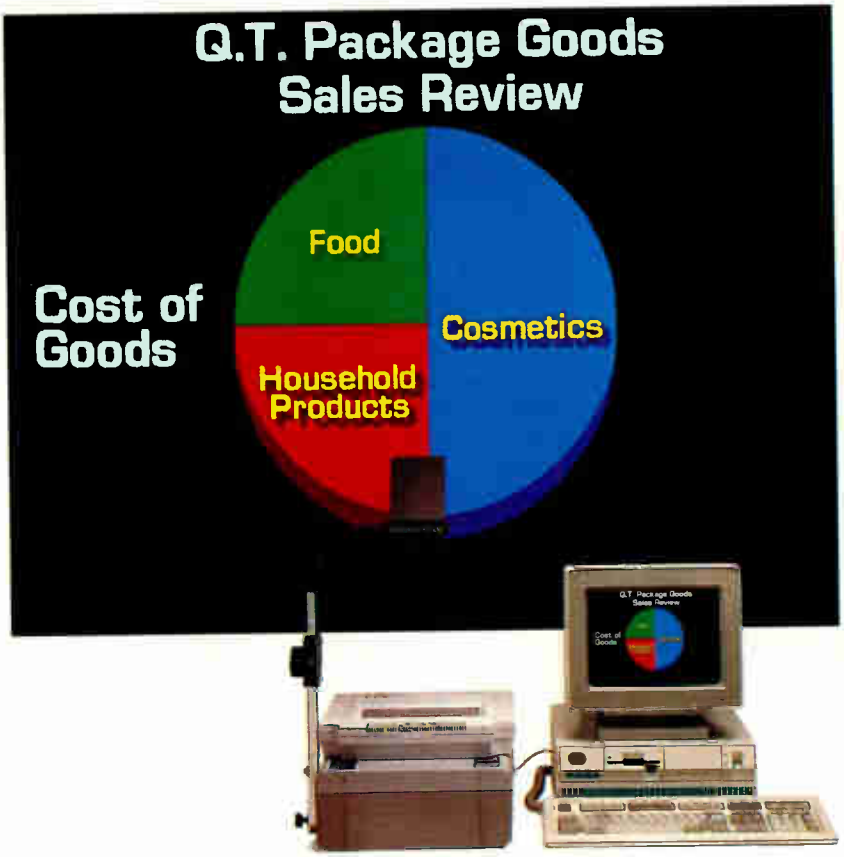


DICK: "That was certainly quick. Have you got any data on the actual costs of goods?"



HARRIET: "That's not a pretty picture for the cosmetics division. By the way, do you think you could help me out on this presentation I'm giving tomorrow...."

date every member of your audience. On the spot.

What's more, you'll never again have the cost or hassle of preparing slides. Or the boredom of presenting yet another set of dull, black and white overheads.

The 5000CX is just one of a complete line of high-performance, portable In Focus color and monochrome projection panels.

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Circle 167 on Inquiry Card.

A Mightier Look & Feel

The new version of the C-scape Interface Management System and Look & Feel Screen Designer, a library of C routines for creating user interfaces, now offers support for several DOS extenders, allowing you to write applications that break the 640K-byte barrier. Version 3.2 of the system also supports the X Window System for Unix and VMS.

Supported extenders include the Phar Lap 386| DOS-Extender, Rational Systems' 16/M DOS Extender, and Ergo Computing's OS/286 DOS Extender. The C-scape library of routines lets you add text-entry features such as word wrap, search and replace, and block commands to your applications. You can also add menuing systems, mouse support, data entry, help, graphics compatibility, and other interface elements.

Price: DOS version, $499; Unix version, $1499; QNX version, $599; VMS version, $2499.

Contact: Oakland Group, Inc., 675 Massachusetts Ave., Cambridge, MA 02139, (800) 233-3733 or (617) 491-7311; fax (617) 868-4440.

Circle 1272 on Inquiry Card.

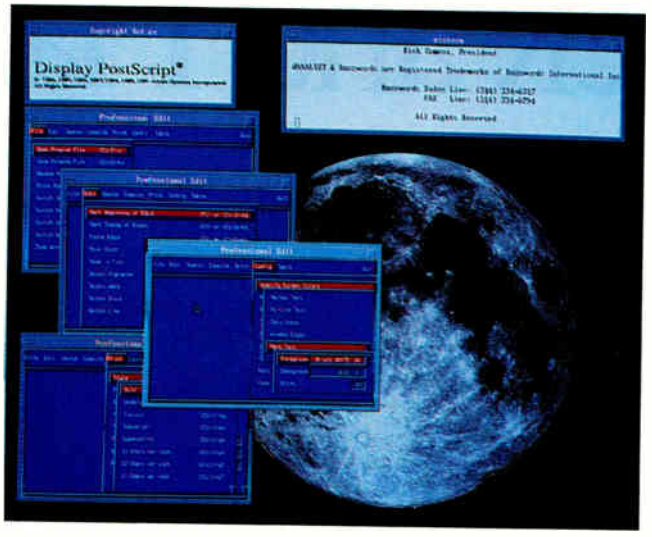
C++ Library for dBASE

A new multiuser database management library for C++ lets you work directly with the data, memo, and index files of dBASE IV and build dBASE IV–compatible applications. By using C++ and the class library, you can program applications with code that is faster, more flexible, and more portable than programming in a dBASE language.

Price: $295.

Contact: Sequiter Software, Inc., Suite 209, 9644 54 Ave., Edmonton, Alberta, Canada T6E 5V1, (403) 448-0313; fax (403) 448-0315.

Circle 1274 on Inquiry Card.



The graphical versions of Professional Edit for Unix include printer drivers for more than 450 printers. Buzzwords' Screen Shooter captured the moon bit-map image.

Unix Development in Motif and Open Desktop

A new programming and desktop publishing environment for Unix takes advantage of Motif, Open Desktop, and Open Look, letting you open multiple windows with files of up to 1 MB each. The new graphical versions of Professional Edit let you cut and paste columns and blocks between windows while providing a workbench environment for linkers, make tools, and C compilers. The editor is WordStar and SideKick compatible; you can remap the keyboard to support your favorite editor interface.

Price: Any platform running X Window System, $550 (includes character-based version for terminals); DOS, $95; Windows, $195; any Unix character-based version, $295; Screen Shooter, $95.

Contact: Buzzwords International, 2879 Hopper Rd., Cape Girardeau, MO 63701, (314) 334-6317; fax (314) 334-0794.

Circle 1271 on Inquiry Card.

A New Look to Portable Interfaces

Aspect, a set of graphical user interface creation tools and libraries for writing portable graphics-based applications, includes a C-callable application programming interface and an interactive design tool. You can port applications written to the Aspect API to each supported run-time environment. An OSF/Motif and a Unix-character run-time environment should ship by the end of May. Other versions will follow later this year.

The design tool produces a portable resource file that allows changes to the interface without recompiling the application. Each Aspect run-time environment implements elements such as menus, push buttons, and scroll bars in the underlying native toolbox. An application with an Aspect user interface, when linked to the Aspect Motif run-time, results in a native Motif implementation. Likewise, the same application, when linked to the Mac run-time, results in a native Mac application.

To solve the dilemma of Unix developers who want to offer software in an X Window–based user interface as well as a character interface, Aspect developed a character run-time.

Price: Character-based SCO Unix and Interactive, $995; Motif, $1495; introductory price for Mac and Windows (when they become available), $795.

Contact: Open, Inc., 655 Southpointe Court, Suite 100, Colorado Springs, CO 80906, (719) 576-8967; fax (719) 576-7246.

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PostScript solutions for LaserJet printers haven't exactly set records for speed.

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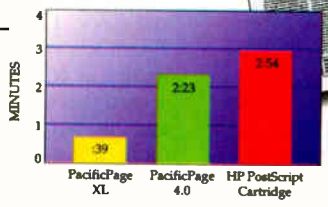

Compare it to the Hewlett-Packard PostScript solution. For their cartridge and 2 MB of printer memory you will spend $1085. PacificPage XL provides the newest version of our PacificPage P•E cartridge and a high speed accelerator board that installs easily into the LaserJet's printer memory slot. It includes an Intel i960™ KB RISC microprocessor and 2 MB of memory which produces output 2 to 8 times faster than the HP cartridge solution. All for the low price of $999.

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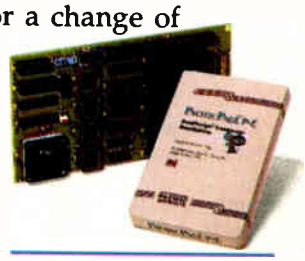
If you're looking for a change of pace in PostScript solutions for the LaserJet printer, call your nearest dealer or contact Pacific Data Products, 9125 Rehco Road, San Diego, California 92121, USA. **(619) 597-4644**, Fax (619) 552-0889.



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All prices are U.S. list effective 2/15/91. For time comparisons, PostScript solutions installed on LaserJet III printer connected via parallel cable to NEC 386 25 Mhz personal computer. All printer times measured from hitting "Enter" key to engine start-up. PacificPage XL and PacificPage P•E are trademarks of Pacific Data Products, Inc. i960 is a trademark of Intel Corporation. PhoenixPage is a registered trademark of Phoenix Technologies Ltd. Copyright 1987, 1988 Phoenix Technologies Ltd. HP, LaserJet and Resolution Enhancement are registered trademarks of Hewlett-Packard Co. PostScript is a registered trademarks of Adobe Systems Inc. **EUROPEAN SALES OFFICES: The Netherlands**, Tel (31) 20-475566, Fax (31) 20-453329 **France** Tel (33) 1-42669075, Fax (33) 1-42661560 **England** Tel (44) 442-231414, Fax (44) 442-236540 **Switzerland** Tel (41) 22-412650, Fax (41) 22-410682.

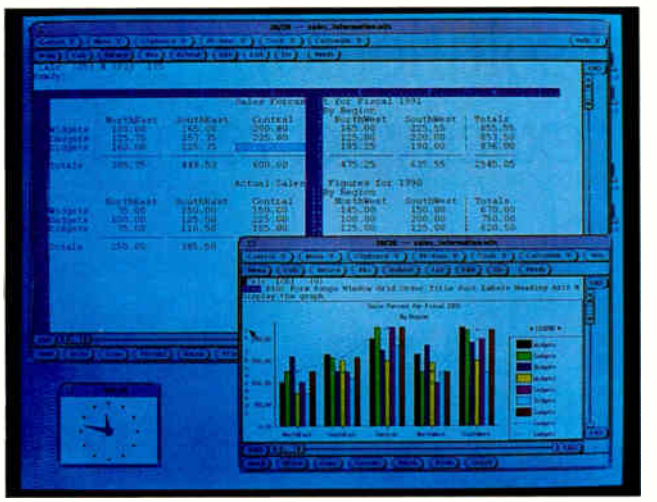
Spreadsheets for Motif, Open Look

Access Technology's newest version of its 20/20 spreadsheet supports OSF/Motif and Open Look graphical interfaces. The graphical 20/20 takes full advantage of the X Window System environment, responding automatically to window modification such as resizing, repositioning, and cutting and pasting data between windows.

Developed in tandem with Sun, the Open Look version uses that environment's pushpin facility to make dialog boxes (which normally pop up and disappear) remain on-screen. It also lets you drag and drop icons representing 20/20 files from the Open Look file manager into 20/20 for automatic loading. 20/20 is also available for SunView, as a character-based interface product, and in a real-time version for market traders who need the automatic updating of spreadsheets as information changes.

Add-in products for 20/20 include OpenLink, a bridge to applications written in traditional programming languages, and Database Connection, a DBMS retrieval mechanism that draws information into the spreadsheet for processing. Access says the connection lets you transparently integrate 20/20 with Oracle, Ingres, and Sybase databases without knowing Structured Query Language or requiring an intermediate temporary file.

Currently, 20/20 runs on more than 25 different Unix platforms.



20/20 supports screen graph types including pie, comparison bar, overlay, and x,y graphs.

Price: 20/20 prices start at $600 per workstation; 20/20 real-time prices start at $1800; OpenLink and Database Connection prices start at $240 each.
Contact: Access Technology, Two Natick Executive Park, Natick, MA 01760, (508) 655-9191; fax (508) 651-3788.
Circle 1275 on Inquiry Card.

The Exclaim! graphical spreadsheet for the X Window System and Motif now supports a live link to the X version of FrameMaker, allowing a document to contain WYSIWYG spreadsheet images and business graphics. The program also supports the ISO8859 character set, allowing you to store information in French, German, Spanish, and other languages. The program runs on a variety of Unix platforms.
Price: $695 per floating license.
Contact: Quality Software Products, 5711 West Slauson Ave., Suite 240, Culver City, CA 90230, (213) 410-0303; fax (213) 410-0124.
Circle 1276 on Inquiry Card.

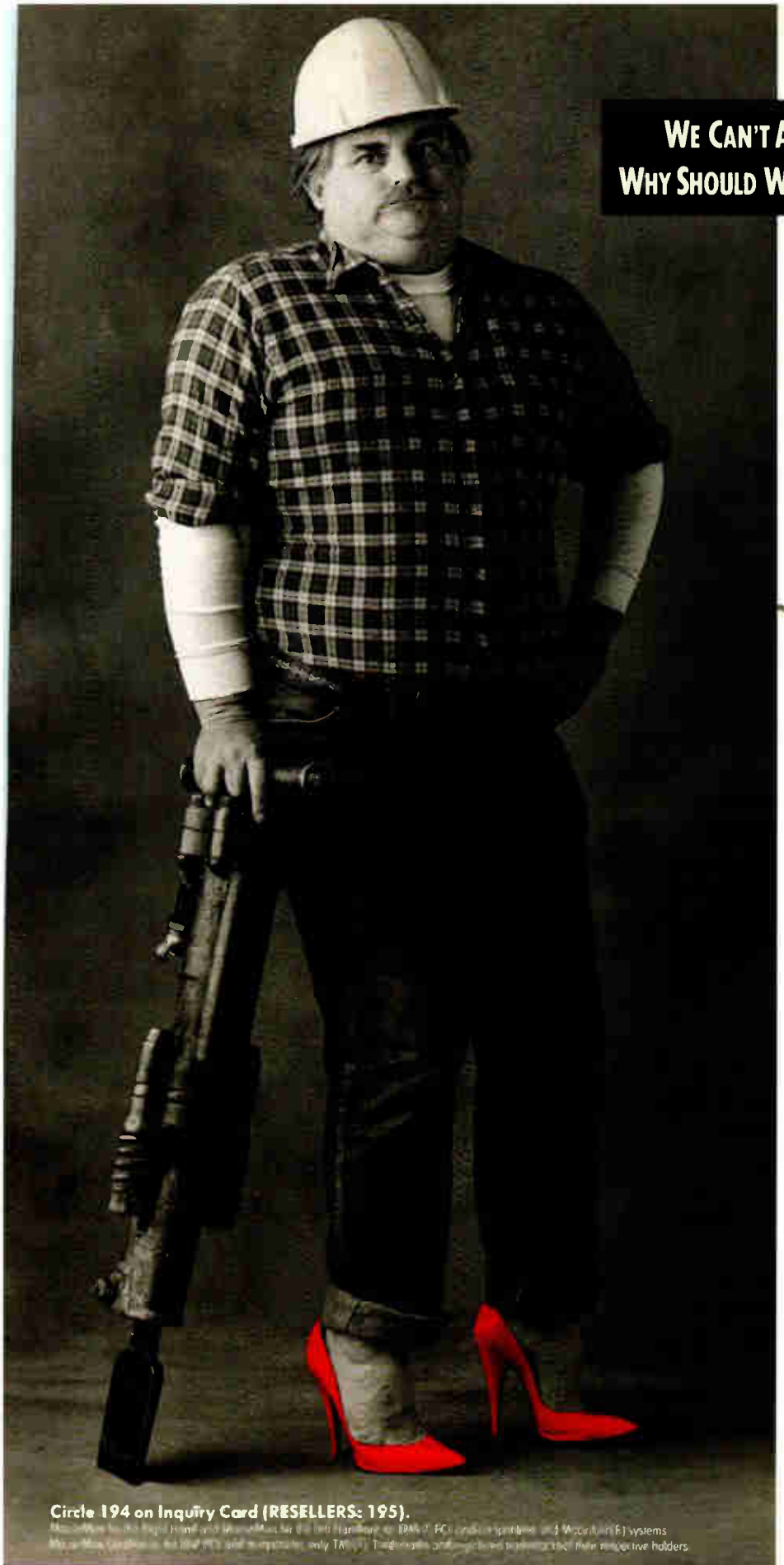
What You See Is What You Get with Quattro

Borland continues to add features to its Quattro Pro (QP) spreadsheet without requiring a hardware upgrade from an 8088-based PC with 512K bytes of RAM. Version 3.0 of the program adds a WYSIWYG display for working with typefaces, styles, colors, and sizes. The WYSIWYG Zoom lets you proportionally reduce or enlarge your screen (between 25 percent and 200 percent) to see more or less of your spreadsheet. A handy print-to-fit feature automatically shrinks or enlarges a print block to fit it into a single page, and the program has built-in banner-printing capability.

Unlike the Impress add-in for Lotus 1-2-3 release 3.1, which has its own menu structure and creates modified versions of the underlying spreadsheet, QP's WYSIWYG is totally integrated into the program. According to Borland, this lets you work with any aspect of the program in WYSIWYG mode without requiring you to learn another command set. QP 3.0's backward compatibility lets you share files among previous versions of the spreadsheet, and it runs on everything from an 8088 to a 486 system.

The ProView Power Pack provides additional clip art, fonts, macros, and other presentation capabilities to augment those already in QP 3.0 (e.g., transitional effects). The pack, which comes with QP 3.0, includes a macro library for streamlining the process of creating graphs and presentations. It also has two headline typefaces, clip art, graph and text chart templates, and a collection of digitized sound effects for use during slide-show transitions. The three effects are fanfare, thank you, and applause. If your company's fortunes have been colored red, you can get a boo and other sound effects from a Borland third-party developer.

QP 3.0 is part of Borland's strategy to provide a continuum of products that provide for an easy upgrade to Windows. The company says it will deliver a full Windows version of Quattro this year.
Price: QP 3.0 with ProView, $495.
Contact: Borland International, Inc., 1800 Green Hills Rd., P.O. Box 660001, Scotts Valley, CA 95067, (408) 438-8400.
Circle 1277 on Inquiry Card.



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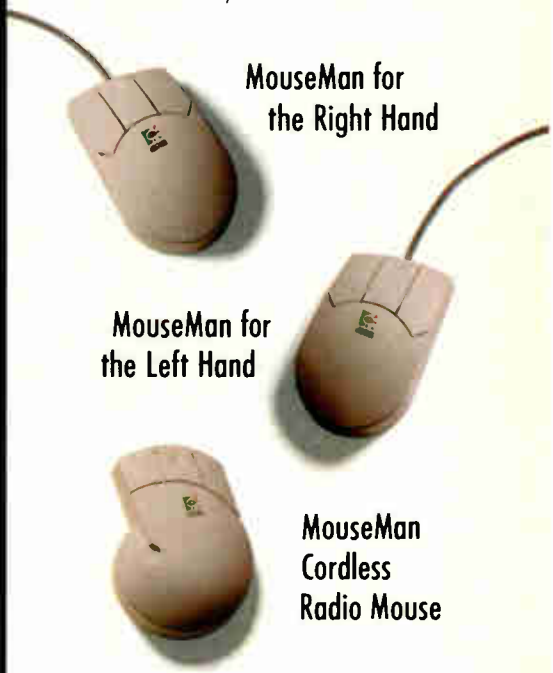

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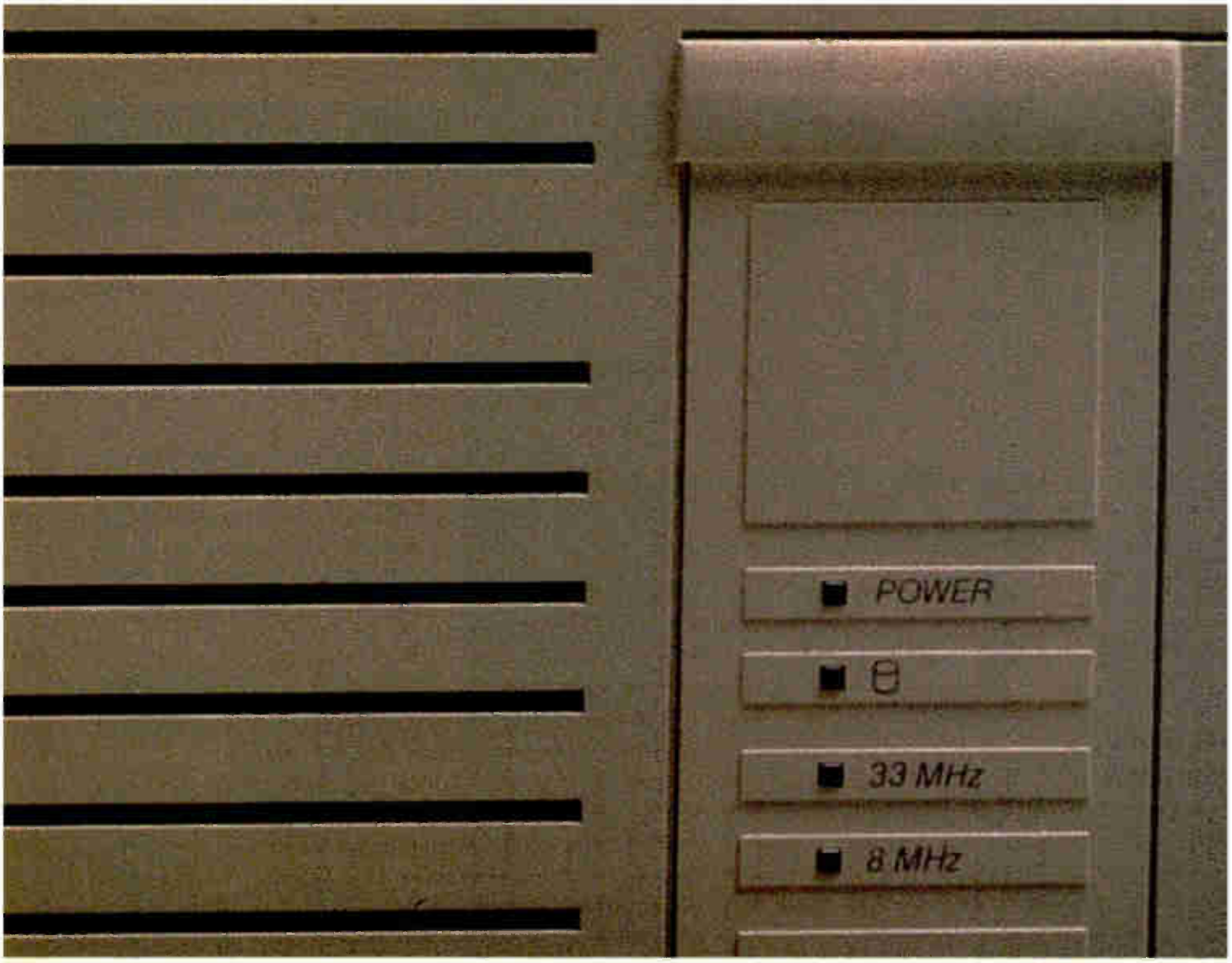

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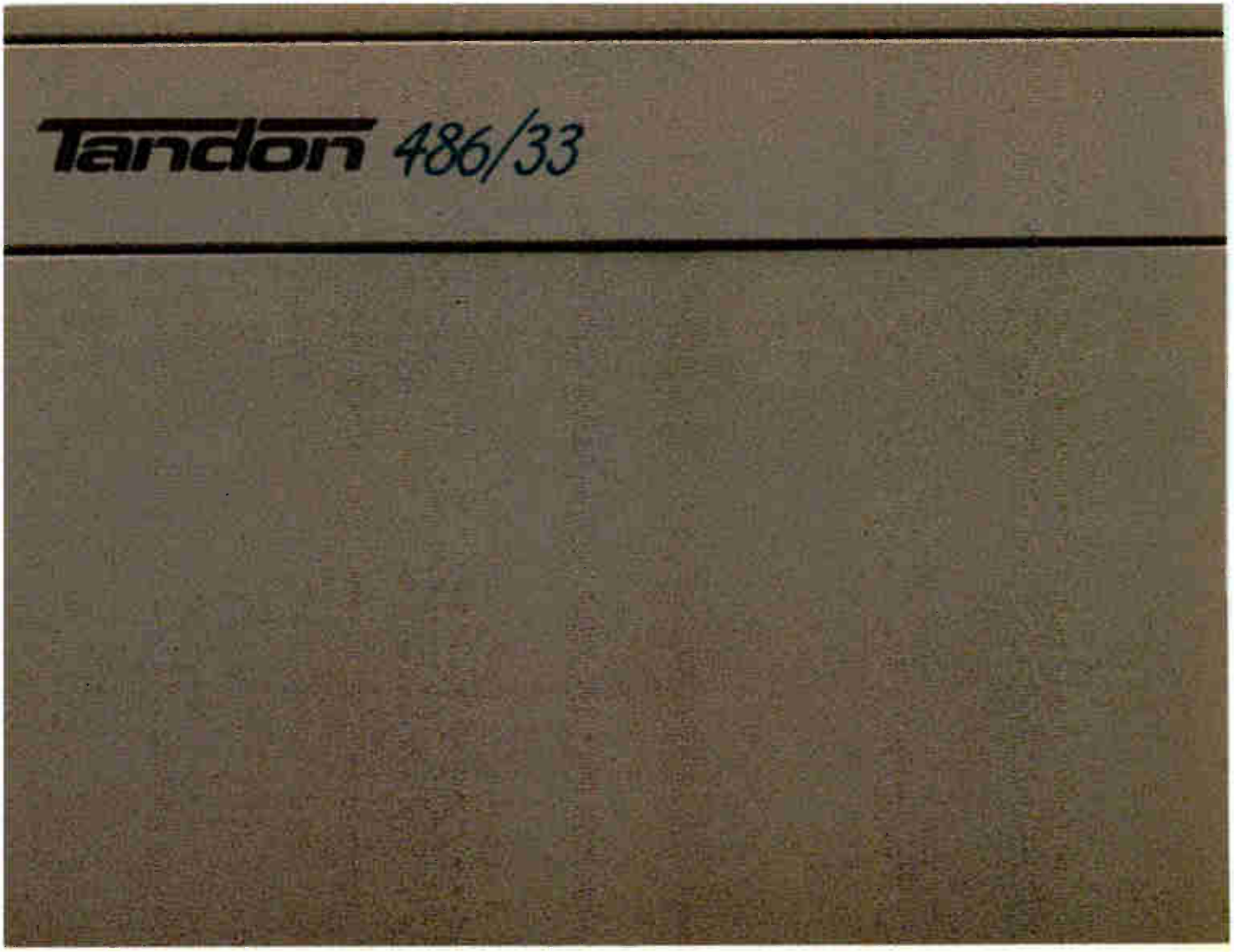
So if you're interested in what has to be considered one of the fastest personal computers in the world call us today about our Tandon 486/33. Or ask about our 386/33 for $3399 or 386/25 for just $3099. And be treated to one of three top performances daily.



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Tandon 486/33 • Price includes: System unit, 4MB RAM; 200MB IDE hard drive; 1.2MB or 1.44MB diskette drive; VGA monochrome monitor; 16-bit video card; keyboard; power cord; Microsoft® Windows™ 3.0, and serial mouse; operation and installation manual; Tandon MS-DOS software and manual. • **Upgrade options:** 2MB and 8MB memory upgrade kits (to 64MB); 330MB, 600MB, and 1GB SCSI hard disk drives; 650MB ISO-approved optical drive and cartridge; VGA and Super VGA color monitors; graphics accelerator card; 2400 baud modems; network cards; laser printers. **Tandon 386/33 and Tandon 386/25.** • Price includes: System unit; 4MB RAM (Tandon 386/33); 2MB RAM (Tandon 386/25); 110MB IDE hard drive; 1.2MB or 1.44MB diskette drive; VGA monochrome monitor; 16-bit video card; keyboard; power cord; Microsoft® Windows™ 3.0 and serial mouse; operation and installation manual; Tandon MS-DOS software and manual. • **Upgrade options:** 1MB and 4MB memory upgrade kits (to 16MB); 80387 math coprocessor; additional 1.2MB and 1.44MB diskette drives; 200MB IDE, 330MB ESDI hard drives; VGA and Super VGA color monitors; graphics accelerator card; 2400 baud modems; network cards; laser printers. Tower models available. **Please call for information.**

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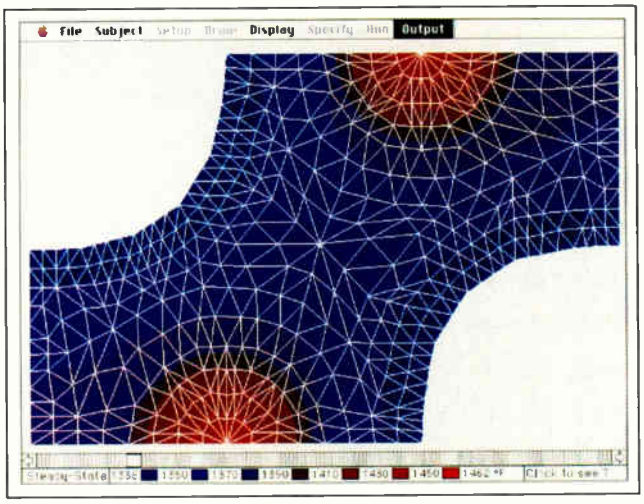
FEA for Engineers on the Mac

FEHT, a finite element analysis program originally designed to solve heat-transfer problems, is now available for solving problems in electrical engineering and civil engineering. It gives numerical solutions to the governing partial differential equations that describe conduction heat transfer, electromagnetic fields, potential flow, and other phenomena. The program provides a drawing environment for entering the 2-D problem, the finite element calculation procedure, and the ability to graphically display the results.

The program runs on any Mac with 1 MB of RAM.
Price: $400.
Contact: F-Chart Software, 4406 Fox Bluff Rd., Middleton, WI 53562, (608) 836-8536.
Circle 1278 on Inquiry Card.



FEHT generated this contour plot of temperatures of a nuclear reactor on the Mac. The program lets you assign varying degrees of fine meshing to your problem.

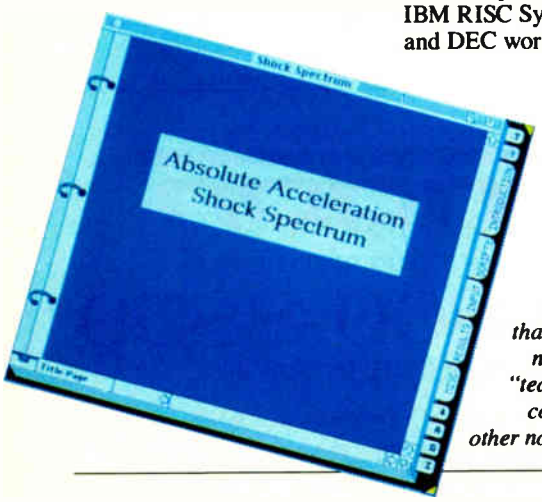
Engineering Notebooks for the Mac, Unix

HiQ is designed to replace all the functions of an engineer's notebook as well as provide all the tools that an engineer would normally use. The program integrates management, design and graphics, programming, engineering analysis, and data reduction.

The HiQ core includes more than 500 math and graphical algorithms and more than 100 problem solvers. Word processing, advanced numeric calculation capabilities, powerful scripting, 2-D and 3-D graphing, and networking facilities are included with the program.

The program is available for the Mac SE/30 or higher and Sun workstations. Versions are planned for the IBM RISC System/6000 and DEC workstations.

Price: Prelease price, $495; $695 thereafter.
Contact: Bimillennium Corp., 101 Albright Way, Los Gatos, CA 95030, (800) 488-8662 or (408) 866-2010; fax (408) 866-2305.
Circle 1279 on Inquiry Card.



The interface of HiQ resembles that of an engineer's notebook. You can "tear out" pages and combine them with other notebook elements.

Estimate Natural Radiation Effects in Space

Space Radiation lets you model the effects of natural radiation in space on digital electronics and humans. It estimates single-event error rates, radiation dose, and dose equivalent in any orbit, Severn Communications says.

Version 1.1 of the program handles cosmic rays, trapped protons, and solar particles. For satellite and communications design, the program can model the effects of trapped electrons.

Space Radiation runs on DOS-based systems with 640K bytes of RAM. A math coprocessor is recommended.
Price: $2495.
Contact: Severn Communications Corp., 223 Benfield Park Dr., Millersville, MD 21108, (301) 987-5236; fax (301) 987-3113.
Circle 1280 on Inquiry Card.

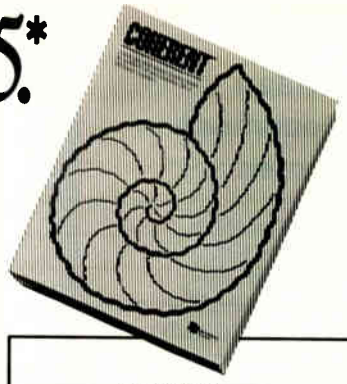
Mathematica's Multiplied Capabilities

Mathematica 2.0, a new version of the mathematical analysis program for the Mac, Unix workstations, and Windows, adds 283 functions, bringing its total to over 800. The program now solves numerical differential equations and has new programming capabilities, sound, and a faster compiler.

A new set of functions relates to linear programming to solve optimization problems in operations research. Some of the new features work only on certain platforms; for example, the Mac, Sony, Next, and Sun computers, which have built-in sound capabilities, let you render data and functions in audible form; publishing extensions to the Mac and Next let you create on-line books; and Mac, PC, and Windows users can simulate multitasking with Mathematica's concurrent processing feature.

The programming language now includes tracing and debugging features and direct file manipulation. A new compiler can significantly increase execution speed.
Price: $595 to $30,000.
Contact: Wolfram Research, 100 Trade Center Dr., Champaign, IL 61820, (217) 398-0700; fax (217) 398-0747.
Circle 1281 on Inquiry Card.

Everything You Ever Wanted In UNIX. And Less. $99.95.*



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Everybody appreciates a good deal. But what is it that makes small so great?

For one thing, Coherent gives you UNIX capabilities on a machine you can actually afford. Requiring only 10 megabytes of disk space, Coherent can reside with DOS. So you can keep all your DOS applications and move up to Coherent. You can also have it running faster, learn it faster and get faster overall performance. All because Coherent is small. Sounds beautiful, doesn't it?

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LESS IS MORE!	Coherent For the IBM-PC/AT and compatible 286 or 386 based machines.	Santa Cruz Operation's XENIX 286, Version 2.3.2
No. of Manuals	1	8
No. of Disks	4	21
Kernel Size	64K	198K
Install Time	20-30 min.	3-4 hours
Suggested Disk Space	10 meg	30 meg
Min. Memory Required	640K	1-2 meg
Performance*	38.7 sec	100.3 sec
Price	$99.95	$1495.00

*Byte Exed benchmark, 1000 iterations on 20 MHZ 386. Hardware requirements: 1.2 meg 5¼" or 1.4 meg 3½" floppy, and hard disk. Does not run on Microchannel machines.

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Like the original UNIX, Coherent is a powerful multi-user, multi-tasking development system. With a complete UNIX-compatible kernel which makes a vast world of UNIX software available including over a gigabyte of public domain software.

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"Mark Williams Co. seems to have mastered the art of illusion; Coherent comes so fully qualified as a UNIX clone, you find yourself thinking 'I can't believe it's not UNIX.' "
–Sean Fulton, UNIX Today!, November 26, 1990

"...(Coherent) may be the best thing that has happened to UNIX yet."
–William Zachmann, PC Week, November 5, 1990

"If you want to come as close as you can to real UNIX for a low price, COHERENT can't be beat."
–Warren Keuffel, Computer Language Magazine, November 1990

"If you want a UNIX-like development and learning system for less than $100...I don't see how you can go wrong with Coherent."
–David Fiedler, BYTE Magazine, November 1990

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NEWS

WHAT'S NEW • OTHER SOFTWARE

Two Image and Document Databases

Symsoft's HotShot ImageBase uses a TSR image finder/previewer to eliminate the frustrating and slow task of blindly loading images into Ventura Publisher and most word processors.

The program supports WordPerfect, Microsoft Word for DOS, Harvard Graphics, other applications, and 10 graphics file formats.

Price: $149.

Contact: Symsoft Corp., 924 Incline Way, Call Box 5, Incline Village, NV 89450, (702) 832-4300.

Circle 1282 on Inquiry Card.

The PixSure File Document Imaging System lets you electronically capture, store, manage, and retrieve files, including letters, handwritten notes, forms, and all types of paper documents. You can retrieve documents with user-defined keywords such as names, dates, customer numbers, or other information.

The program is designed for the Novell network environment.

Price: $1495.

Contact: The Norick Companies, 5400 Northwest Grand Blvd., Suite 450, Oklahoma City, OK 73112, (800) 527-5764 or (405) 947-7560; fax (405) 946-7559.

Circle 1283 on Inquiry Card.

Easy Backup for OS/2 PM

Irwin Magnetic Systems' new OS/2-based backup software for stand-alone and networked PCs takes advantage of Presentation Manager and OS/2's multithreading and multitasking capabilities to launch background sessions.

You can select files while the software loads a backup tape. An integrated library gives you on-line access to directory information from all your tapes and backups.

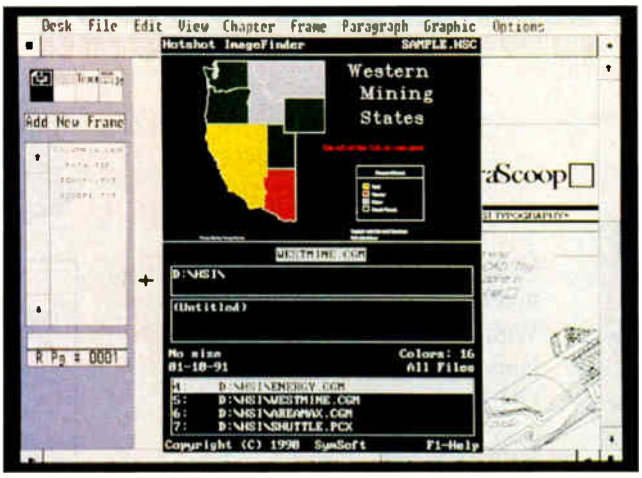
EzTape PM incorporates the Stac Electronics algorithm for increasing the capacity of a tape drive and supports all versions of OS/2, including High Performance File System supporting OS/2.

Other features include automatic unattended backup, multiple hard disk volume backup, and two levels of data protection (password and encryption).

Price: $329.

Contact: Irwin Magnetic Systems, Inc., 2101 Commonwealth Blvd., Ann Arbor, MI 48105, (313) 930-9000; fax (313) 995-8287.

Circle 1284 on Inquiry Card.



The HotShot ImageBase displaying a Harvard Graphics chart prior to auto-loading into Ventura Publisher.

Recover from Unix Crashes

With the new Veritas File System (VxFS) and the Veritas Volume Manager (VxVM), Veritas provides a flexible, high-performance commercial file system for Unix. VxVM provides on-line reconfiguration, striping, spanning, and disk mirroring. VxFS provides fast recovery from crashes.

The Veritas system maintains a log of intended changes to the descriptive data that accompanies Unix files, clearing entries from the log as they are written to disk. If, after a system crash, the Veritas software finds leftover entries in the log, it simply writes them to disk. As a result, the maximum time to restore even a disk drive of 1 gigabyte is about 15 seconds. Traditional Unix restoration methods might require 30 minutes.

The system lets you reorganize file systems into contiguous blocks while the disk is being used. When used together with the logical volume manager, you can expand file systems while they're still active.

At a lower level, the file system's behavior can be tuned by applications when a certain type of I/O is expected. This mechanism allows database managers and other disk-intensive applications to avoid the direct-to-disk approach that is commonly taken to work around the file system.

Price: Prices depend on system. VxFS, from $1200 to $18,000; VxVM, from $1000 to $15,000.

Contact: Veritas Software Corp., 4800 Great America Pkwy., Suite 420, Santa Clara, CA 95054, (408) 727-1222; fax (408) 562-4334.

Circle 1285 on Inquiry Card.

DOS Memory at 952K Bytes

Memory Commander, a DOS memory management utility for 386 and 486 computers, lets you free up memory by moving TSR programs and device drivers into high memory between 640K and 1024K bytes. Depending on your system's video configuration, the utility can provide up to 952K bytes of contiguous memory for use by your application.

The program lets you configure up to five memory models. Once you install Memory Commander, it selects the best model for the application without requiring rebooting.

Price: $99.95.

Contact: V Communications, Inc., 4320 Stevens Creek Blvd., Suite 275, San Jose, CA 95128, (408) 296-4224; fax (408) 296-4441.

Circle 1286 on Inquiry Card.

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For additional information, ask for Dan Kalata

Circle 594 on Inquiry Card.

NEWS

BICC's Wireless LAN Sees Red

One of the advantages of wireless LANs, compared with their cabled cousins, is quick setup and dismantling. BICC takes that a step further with its InfraLAN system, based on infrared technology. It says the advantage of an infrared LAN over a radio alternative is the signal is less prone to fading, distortion, and timing problems. Also, FCC involvement isn't required.

InfraLAN is transparent to the user and meets the IEEE 802.5 Token Ring standard. The product consists of a base unit that supports up to six terminals and two optical nodes, one for incoming and the other for outgoing data signals. The Token Ring version supports 4-Mbps and 16-Mbps speeds and works with off-the-shelf network interface cards, servers, and bridges, the company says. If the signal path is blocked, the token ring automatically reverses direction and uses a backup signal path.

Price: One six-port hub and two transceivers, $2995.

Contact: BICC Communications, 103 Millbury St., Auburn, MA 01501, (508) 832-8650; fax (508) 832-8689.

Circle 1000 on Inquiry Card.

Instead of requiring you to run cables through your office, InfraLAN relies on an infrared base unit that supports up to four computers and two optical nodes for sending and receiving signals from other base units. Optical range lists at 80 feet.

RadioLink Hops Down the Trail

California Microwave's wireless LAN uses spread-spectrum technology, but with a twist: Instead of using the direct sequence spreading, it employs frequency hopping, a technique the company says improves immunity from interference. The RadioLink network, which operates at 250,000 bps, permits eight subnetworks to operate in the same area.

RadioLink transceivers offer up to eight ports for connecting any device with a RS-232, RS-449/422, RS-485, LocalTalk, Ethernet, or V.35 interface. The system can broadcast omnidirectional signals in a 500-foot radius indoors and as much as 5 miles across unobstructed space, the company claims.

Frequency hopping is an alternative technique for modulating signals within the same frequency bands allotted by the FCC for spread-spectrum communications. Unlike direct sequencing, which encodes transmissions by spreading a low signal across the band according to a prescribed code, frequency hopping causes the signal to jump around from one frequency to another.

One version of the product operates in the 902- to 928-MHz band, while the other runs at 2400 MHz to 2483 MHz.

Price: From $3450 for a one-port lower-frequency transceiver to $5280 for an eight-port higher-frequency unit.

Contact: California Microwave, Inc., 985 Almanor Ave., Sunnyvale, CA 94086, (408) 732-4000; fax (408) 732-4244.

Circle 1001 on Inquiry Card.

Terminal Emulation for Windows

OpenConnect Systems (formerly Mitek Systems) and Future Soft Engineering have jointly developed DynaComm/OpenConnect 5250, an IBM 5250 terminal-emulation software package that runs under Windows 3.0.

IBM 5250 is the terminal protocol used for AS/400 midrange systems. The package allows full 5250 emulation across TCP/IP and includes full color support, a keyboard mapping facility, font scaling, and an application programming interface and scripting language for developing graphical front ends.

Price: $495.

Contact: OpenConnect Systems, Inc., 2033 Chennault Dr., Carrollton, TX 75006, (214) 490-4090; fax (214) 490-5052.

Circle 1002 on Inquiry Card.

Eicon Technology's Interactive Terminal Interface lets Windows 3.0 users on a NetWare or NetBIOS LAN access remote ASCII hosts through an X.25 packet assembler/disassembler.

ITI works with the EiconCard, an X.25 gateway that is installed in a LAN communications server. ITI is loaded into client computers along with Eicon's Access X.25 software and the Windows Terminal program or another ASCII terminal-emulation package.

Price: $50 for a stand-alone computer or $200 per network.

Contact: Eicon Technology Corp., 2196 32nd Ave., Montreal, Quebec, Canada, H8T 3H7, (514) 631-2592; fax (514) 631-3092.

Circle 1003 on Inquiry Card.

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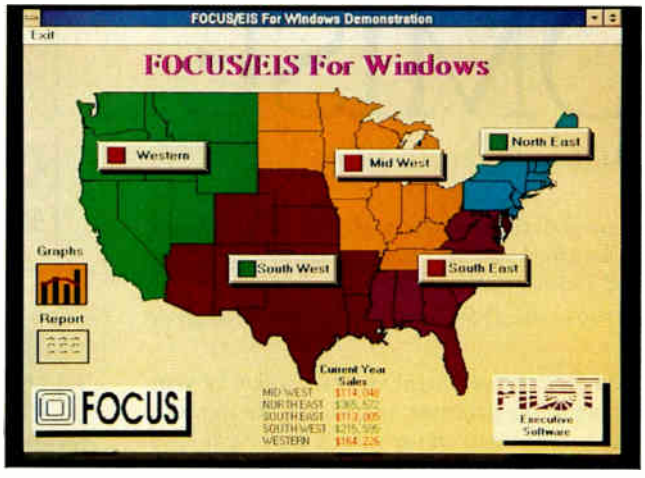
NEWS

Executive Information Under Windows

Pilot Executive and Information Builders have combined forces to provide Focus/EIS, a Windows executive-information interface for presenting data collected by IB's PC/Focus application-development delivery environment.

PC/Focus offers user-interface functions, a screen painter, a report painter, file-description generators, utilities, and communications capabilities. With PC/Focus 5.5, you can perform cooperative processing with data stored on DB2, SQL/DS, IMS, and VSAM mainframes. The program can also access dBASE, 1-2-3, word processing, and Symphony files.

On the client side, IB offers several products for running the system on Novell, IBM, 3Com, and Ungermann-Bass networks. You can also run the system on OS/2 and, with the Focus for SQL Server interface, read and write SQL Server data. Focus/EIS requires PC/Focus or PC/Focus Plus, a 386 with 2 MB of RAM, and a VGA monitor.
Price: Focus/EIS, $895; PC/Focus, $1298.
Contact: Information Builders, Inc., 1250 Broadway, New York, NY 10001, (800) 848-8683 or (212) 736-4433; fax (212) 967-6406.
Circle 1005 on Inquiry Card.



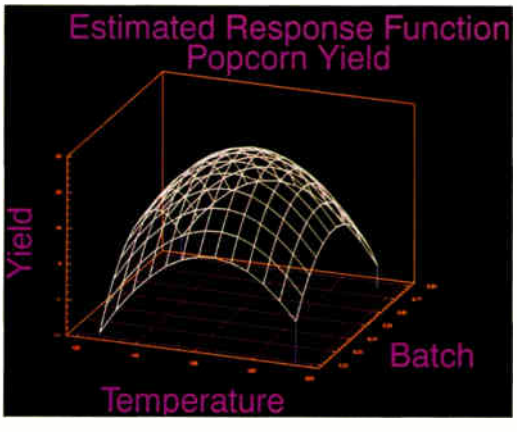
Focus/EIS lets you manage your business using data from a variety of mainframes and databases under Windows 3.0.

Interactive PC Statistics and Graphics

Statgraphics, STSC's PC statistics package for academicians and executives with at least a basic understanding of statistics, offers integrated statistics and graphics modules and the ability to interactively manipulate and edit data through the graphs.

Version 5.0 of the program incorporates design screening and response surface methods for helping you complete all phases of a study or experiment, from design selection and setup to analysis and future augmentation of the experiment. After you've completed the initial marketing or science experiment, the program can tell you which, if any, factors do not have significant effect on the outcome. The next time you perform the experiment, you can achieve accurate results without having to account for as many factors, the company says.

Statgraphics 5.0 has more than 250 statistical, mathematical, and quality-control procedures. New graphs include surface and 3-D contour plots.
Price: $995.
Contact: STSC, Inc., 2115 East Jefferson St., Rockville, MD 20852, (800) 592-0050 or (301) 984-5000; fax (301) 984-5094.
Circle 1004 on Inquiry Card.



Statgraphics 5.0 can now display data in contour and surface plots.

Check Your Attitude

Apian Software's new Survey Pro program helps you manage customer, marketing, membership, and other types of survey projects. You enter the questions you want answered into the program, choosing from a variety of questionnaire styles, answer scales, and layout options; the program generates a professional-looking survey form. Once you've designed the survey, the program automatically generates a data-entry application for storing the acquired data.

Survey Pro runs on the IBM PC and supports the LaserJet III. It can import TIFF and PCX files for incorporating logos into surveys and reports.
Price: $195.
Contact: Apian Software, Inc., P.O. Box 1224, Menlo Park, CA 94026, (800) 237-4565 or (408) 562-9680; fax (408) 562-9683.
Circle 1006 on Inquiry Card.

Easy Gen helps you design, administer, and analyze employee-attitude surveys. A database of more than 500 questions covers more than 41 topics, such as benefits, service, and career development. The program requires DOS 3.3 or higher. The program presents reports via graphs, showing trend analyses and breakdowns by demographic categories.
Price: $150.
Contact: E. F. Wonderlic Personnel Test, Inc., 820 Frontage Rd., Northfield, IL 60093, (800) 323-3742 or (708) 446-8900; fax (708) 446-9492.
Circle 1007 on Inquiry Card.

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Circle 579 on Inquiry Card.

PC, Mac, and Unix Project Management

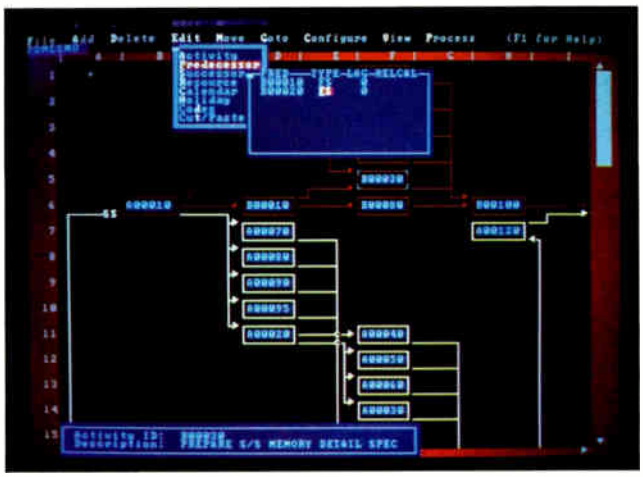
Open Plan, the high-end project management program for the IBM PC, has a new graphical interface that lets you examine project data in three views. The Project Executive interface affords you Work Breakdown structure, project-network, and bar-chart and histogram views of the data. You can also cut and paste groups of activities with the interface.

Welcom has also added support for PostScript in version 4.0. WSTView, a new screen painter, is designed to help you create custom entry screens for underlying database products. The program is dBASE- and FoxPro-compatible and runs on the IBM PC.

On the Mac platform, the company's Open Plan/Mac runs on AppleTalk or EtherTalk, using AppleShare or TOPS, NetWare 2.0 or higher, or any other AppleTalk Filing Protocol compliant networks. Open Plan/Mac stores its data in FoxBase/Mac format. If you have the PC and Mac versions of Open Plan on your network, you can share data files and report files, the company says.

Price: Mac and PC standalone versions, $4200 each; four-user licenses, $14,000 each.
Contact: Welcom Software Technology, 15995 North Barkers Landing, Suite 275, Houston, TX 77079, (713) 558-0514.
Circle 1008 on Inquiry Card.

Metier, developer of high-end project management programs for the IBM PC and Unix, has released versions of its project management development systems for the Hewlett-Packard 9000/800 and a management planning tool for the IBM PC.



Open Plan 4.0's Project Executive interface lets you see project data in three views, including project-network view.

Artemis 7000, a project management system with a fourth-generation-language relational database, a graphics generator, and a report writer, and Artemis Project, a ready-to-use project management application, both support the X Window System interface and Structured Query Language interfaces to Oracle, Ingres, and RDB databases.

Artemis Planner 2.0 for the IBM PC lets you build work and activity plans for export to a larger Artemis system for more detailed planning.

Price: Artemis 7000, $20,000; Artemis Project, $9500; Artemis Planner, $865.
Contact: Metier Management Systems, Inc., 12701 Fair Lakes Cir., Suite 350, Fairfax, VA 22033, (703) 222-1111; fax (703) 222-8203.
Circle 1009 on Inquiry Card.

PC-File Gets 14 Applications and a Browser

ButtonWare's 14 applications for its PC-File flat-file database include accounts payable, address book, business contacts, checkbook, church records, home inventory, and purchase order invoicing.

Other custom applications include books, coins, music inventory, personnel records, photo log, prepay invoicing, and video library.

The company's db:Crayons utility lets you search and browse PC-File data from other programs, allowing you to cut and paste data or print mailing labels and envelopes. It also lets you dial a telephone number from a PC-File database.

Price: Custom Applications, $19.95 each; db:Crayons, $49.95.
Contact: ButtonWare, P.O. Box 96058, Bellevue, WA 98009, (800) 528-8866 or (206) 454-0479; fax (206) 454-1838.
Circle 1010 on Inquiry Card.

Help for New GUI Users

Although Windows and the Mac's graphical user interface are designed to be easy to use and intuitive, companies are often surprised to encounter training problems. Some people have never used a computer, while others are comfortable with the command line but have trouble mastering GUIs.

Individual Software's Professor Windows and Professor Mac help people learn at their own pace the intricacies of pull-down and tear-off menus and other aspects of the interfaces.

Price: $49.95 each.
Contact: Individual Software, 125 Shoreway Rd., Suite 3000, San Carlos, CA 94070, (415) 595-8855; fax (415) 364-0820.
Circle 1011 on Inquiry Card.

Test 1-2-3 Proficiency

The Judd Test allows an employer to determine the proficiency of a prospective employee in using and understanding 1-2-3. The program can test in 20 skill groups and is designed to prevent you from passing over a qualified candidate for one that will require extensive training.

The Judd Test runs in the background of the 1-2-3 application. Supported versions of 1-2-3 include 1A up to 2.2.

Price: $495 for one-year license; $295 for each year thereafter.
Contact: Mentrix Corp., 103 Providence Mine Rd., Suite 201, Nevada City, CA 95959, (916) 265-4000; fax (916) 265-0359.
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Microcom 286/12 Systems (1 MB RAM)

Microcom 286/16 Systems (1 MB RAM) — Add $50

Standard System · Hard Drive · Monitor & Video Card

Hard Drives:	IDE	IDE	IDE	IDE	ESDI
MB/Ms	42/25	80/18	105/18	205/15	340/16
Mono VGA	$799	$999	$1,049	$1,349	$2,149
Hires	$999	$1,199	$1,249	$1,549	$2,349

286/12 Hires Package — $999

286/16 Hires Package — $1,049

- 286/12 or 286/16 Standard System
- 42 MB Hard Disk w/25 ms Access Time
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Microcom 386SX/16 Systems (1 MB RAM)

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MB/Ms	42/25	80/18	105/18	205/15	340/16
Mono VGA	$1,099	$1,299	$1,349	$1,649	$2,449
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Hires	$1,499	$1,699	$1,749	$2,049	$2,849

386/25 Hires Package w/42 MB Hard Disk — $1,499

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- 42 MB or 105 MB Hard Disk
- 16-bit Hires 1024 x 768 Graphics Card
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Microcom 386/33C Tower Systems (1 MB RAM/64K Cache)

Standard System · Tower Case · Hard Drive · Monitor & Video Card

Hard Drives:	IDE	IDE	IDE	IDE	ESDI
MB/Ms	42/25	80/18	105/18	205/15	340/16
386/33C Hires	$1,749	$1,949	$1,999	$2,299	$3,099

386/33C Hires Tower Package — $1,999

- 386/33C Standard System w/64K Cache
- 105 MB Hard Disk w/Quick 18 ms Access Time
- 16-bit Hires 1024 x 768 Graphics Card
- 14" Color Hires Monitor (Up to 1024 x 768)

Microcom 32-BIT POWER 386DX

Microcom 486/25C Tower Systems (4 MB RAM/256K Cache)

Microcom 486/33C Tower Systems (4 MB RAM/256K Cache)

Standard System · Tower Case · Hard Drive · Monitor & Video Card

Hard Drives:	IDE	ESDI	IDE	ESDI	ESDI
MB/Ms	105/18	150/18	205/15	340/16	650/16
486/25C Hires	$2,999	$3,399	$3,299	$4,099	$4,499
486/33C Hires	$3,499	$3,899	$3,799	$4,599	$4,999

486/25C Hires Tower Package — $2,999

486/33C Hires Tower Package — $3,499

- 486/25C Standard System w/128K Cache
- 105 MB Hard Disk w/Quick 18 ms Access Time
- 16-bit Hires 1024 x 768 Graphics Card
- 14" Color Hires Monitor (Up to 1024 x 768)
- *** Upgrade to Tseng Labs 1024 x 768-256 Color Video Card for $75**

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Circle 595 on Inquiry Card.

DADiSP Now Runs Under X

DSP's DADiSP technical spreadsheet for scientists and engineers now supports version 11 of the X Window System.

The program tackles tasks in graphics, signal processing, lab automation, and test and measurement in a menuing environment without requiring programming. DADiSP can directly exchange data with instruments based on the IEEE-488 interfaces and A/D boards. Through the interfaces, you can acquire, analyze, and visualize data from oscilloscopes, waveform records, sensors, gauges, and other devices.

DADiSP runs on the IBM RISC System/6000; Sun-3, Sun-4, Sun386i, and Sparcstation; HP 9000 Series 300 and 800; and the Concurrent Series MC5000 and MC6000. The program also runs on the IBM PC.

Price: $895 to $6995.
Contact: DSP Development Corp., One Kendall Sq., Cambridge, MA 02139, (617) 577-1133; fax (617) 577-8211.
Circle 1013 on Inquiry Card.

Capture and Analyze RS-232 Data

DataScope, designed for IBM PC protocol analysis and data capturing, lets you collect up to 8 MB of data and signal information at rates of up to 115,200 bps. The program can also match trigger strings against incoming data and offers archive-parameter control with pre-, center-, and post-trigger positioning, Paladin says.

Price: $189.95.
Contact: Paladin Software, Inc., 3945 Kenosha Ave., San Diego, CA 92117, (619) 490-0368.
Circle 1016 on Inquiry Card.

The DADiSP technical spreadsheet now runs under X Window System for digital signal processing and other applications.

Develop 16-MB Programs with LabWindows

The LabWindows 2.0 programming environment for creating PC-based data acquisition and instrument-control systems now uses Rational's DOS extender technology to support the development in the LabWindows environment of programs that use up to 16 MB of memory.

LabWindows 2.0 for DOS also uses the DOS/16M Virtual Memory Manager, allowing programs that require 16 MB to run in only 2 MB of memory. You can either develop in the LabWindows environment or compile the program using a Microsoft C or QuickBasic compiler.

A new user-interface library to LabWindows 2.0 provides tools that make it easier to integrate graphical front ends with your application.

Version 2.0 also supports dynamically loadable libraries. You can use your own external libraries and C code as if they were a standard LabWindows library; the company says dynamic link libraries use much less memory than a standard LabWindows instrument driver. You can also compile LabWindows drivers into object modules and load them dynamically, reducing memory requirements and increasing execution speed of the application.

A new Create Standalone Program utility helps in converting a LabWindows program into a stand-alone executable program.

On the Mac platform, the LabView 2.1 data acquisition program, which doesn't require the programming knowledge of LabWindows, now has a run-time system for distributing applications while protecting your source code from changes.

Price: LabWindows 2.0, $695; LabView 2.1, $1995; run-time system, $495.
Contact: National Instruments Corp., 6504 Bridge Point Pkwy., Austin, TX 78730, (800) 433-3488 or (512) 794-0100; fax (512) 794-8411.
Circle 1014 on Inquiry Card.

Acquire Data on the PC for Under $200

PC Data Master combines graphics, data sampling, test data, and math routines in its digital signal processing (DSP) system. The program lets you develop from the command line or with pull-down menus. You can create applications that use multiple windows to display data.

The PC Data Master system provides a complete system for DSP; you can also integrate processing modules written in FORTRAN, C, Pascal, and BASIC with the system, developer Durham Technical Images says.

Other features of the program include a macro recorder and a collection of fundamental DSP routines, such as fast Fourier transform, correlation, and many others.

PC Data Master is a block-oriented DSP system and does not support continuous real-time processing. If sufficient RAM is unavailable, the program creates temporary spill files to buffer excess data.

Price: $185.
Contact: Durham Technical Images, P.O. Box 72, Durham, NH 03824, (603) 868-5774.
Circle 1015 on Inquiry Card.

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Circle 581 on Inquiry Card (RESELLERS: 582).

NEWS

A Companion for Your Word Processor

The Complete Writer's Toolkit comprises six editorial tools, five of which you can directly access as you write.

Writer's Toolkit includes Houghton Mifflin's CorrecText Grammar, Style, Punctuation, and Spelling Correction System; HM's Abbreviation Program; the American Heritage Electronic Dictionary; Roget's II Electronic Thesaurus; the Concise Columbia Dictionary of Quotations; and the Written Word III—Principles of Grammar & Style. You can hotkey-access all but the grammar checker from within most word processors.

The program runs on DOS systems.

Price: $129.

Contact: Systems Compatibility Corp., 401 North Wabash, Suite 600, Chicago, IL 60611, (800) 333-1395 or (312) 329-0700; fax (312) 670-0820.

Circle 1018 on Inquiry Card.

Symantec Ships New Norton Editor

The new version of the Norton Editor features pull-down menus and mouse support to make it easier to searchz, mark blocks, and lay out text. The Norton Editor 2.0 is a full-screen ASCII text editor.

In the new version, Symantec adds several features to streamline programming efforts, including a `Matching Bracket` command for finding missing or extra brackets. While searching for a bracket's match, the command recognizes and accounts for nested punctuation, such as a math equation, in a string.

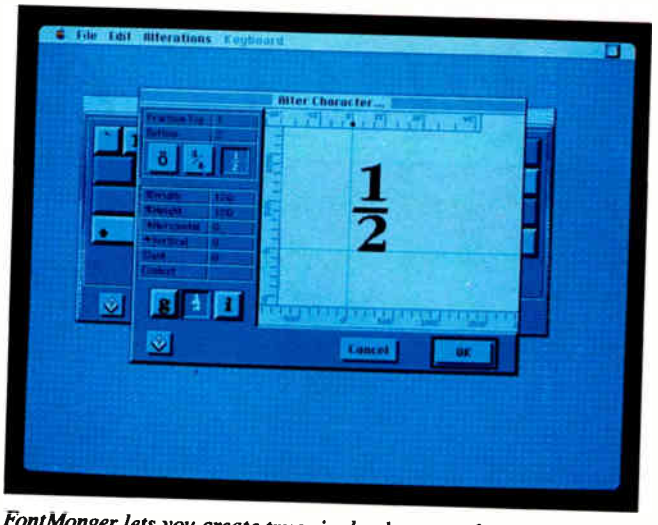
Along with the split-screen editing capabilities, a `Window Differences` command shows you the first line in which two documents differ. An outline-display feature shows only those lines that begin with a letter or number in the first column—helpful for C and Pascal programmers.

The Norton Editor 2.0 requires 256K bytes of RAM and DOS 2.0 or higher. It includes the Norton Classic Editor, which requires only 50K bytes.

Price: $99.

Contact: Symantec Corp., 10201 Torre Ave., Cupertino, CA 95014, (800) 441-7234 or (408) 252-3570.

Circle 1019 on Inquiry Card.



FontMonger lets you create true single-character fractions that you can map back to the keyboard.

Utility to Stir Up Your Fonts

FontMonger provides type-format conversion in any direction for PostScript Type 1, PostScript Type 3, and TrueType fonts. FontMonger converts type to Adobe Illustrator and Encapsulated PostScript language files. You can modify the font outline in Illustrator or another EPS application and reinstall it as a new font.

The utility lets you mix characters from various type families and combine them into a single font. You can also create small-cap and oblique typefaces and superior or inferior characters for use in scientific or mathematical equations, pricing, and fractions.

FontMonger runs on the Macintosh.

Price: $99.95.

Contact: Ares Software Corp., P.O. Box 4667, Foster City, CA 94404, (415) 578-9090.

Circle 1017 on Inquiry Card.

PC DOCS Supports Non-WP Files

Unlike the previous version, the PC Docs document management system now supports applications other than WordPerfect. Version 4.0 supports spreadsheets, image files, and other word processors, although without the tight integration available for WP. The program is designed for Novell NetWare LANs.

Running with WP or LetterPerfect, PC Docs intervenes when you save a file and requires you to enter a file profile with the author, job number, keywords, and comments. Under WP, you can retrieve other documents without interrupting your work flow. Integration with WP and LP will remain in PC Docs 4.0.

When used in conjunction with a non-WP file, PC Docs 4.0 has you create a profile first in a template and launch the application along with the document name. PC Docs 4.0 lets you search an infinite number of file servers without requiring you to log into each one. PC Docs also lets you archive documents to an existing on-line volume.

Price: $225 per workstation; $295 per workstation if you buy the full-text search module.

Contact: PC Docs, Inc., Suite 203, 124 Marriott Dr., Tallahassee, FL 32301, (800) 933-3627 or (904) 942-3627; fax (904) 942-1517.

Circle 1020 on Inquiry Card.

THE UNIX MULTIUSER PLATFORM

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If you are looking for an inexpensive XENIX/UNIX multiuser solution for your business, DTS's SOLUTION/16 is the right choice. For less than half the price most companies would charge you, you will have an excellent combination of performance, quality and reliability.

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For $4,999, DTS's XENIX/UNIX host system SOLUTION/16 includes: INTEL's 25MHz 80486 CPU, 128K RAM Cache, 4MB RAM, 1.2MB Floppy, 200MB Hard Drive, 120MB Tape Backup Unit, 14″ monochrome VGA Monitor, 101 Keyboard, SCO XENIX/UNIX V/386 Operating System and DTS SPEEDBOARD II 8/16 users subsystem.

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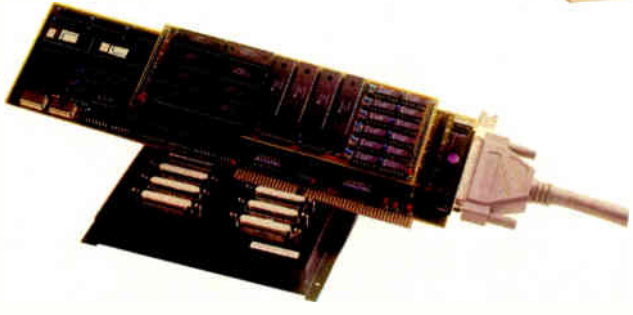

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Circle 583 on Inquiry Card (RESELLERS: 584).

Process Satellite Data on the PC

ComStream's new coprocessor board lets a PC process high-speed data received from satellite links.

The CEK101a has four serial I/O ports and uses a 10-MHz 286 backed up with from 512K bytes to 4 MB of RAM, 64 or 128K bytes of EPROM for self-boot operation, battery-backed static RAM, and eight DMA channels. It supports data transfer rates of up to 512,000 bps on all four ports, ComStream says.

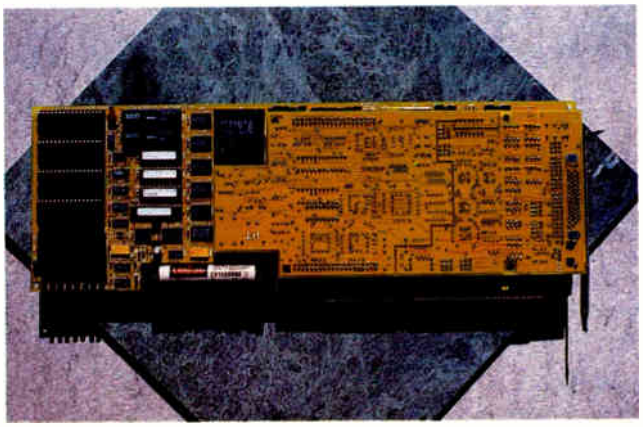
The four data ports are controlled by a daughtercard. You can configure each port for asynchronous or synchronous protocols; RS-232, RS-422, or RS-423 levels; full or half-duplex; and data terminal equipment or data communications equipment operation.

By handling serial data transfers independently of the CPU, a communications coprocessor such as the CEK101a frees up the main processor for other tasks. The board could be used for any high-speed I/O, not just a satellite feed, ComStream says. It requires a 286-based PC or higher.

Price: In quantity, $1000 each; single unit, $1100.

Contact: ComStream Corp., 10180 Barnes Canyon Rd., San Diego, CA 92121, (619) 458-1800; fax (619) 453-8953.

Circle 1022 on Inquiry Card.



The CEK101a add-on card for the IBM PC can turn your computer into a satellite communications receiver and is capable of processing any kind of data received by the host.

Right Hand Man Remote Communications

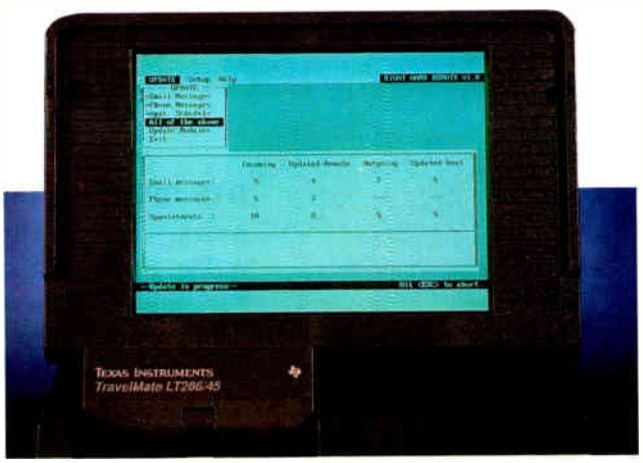
Futurus now offers a remote-access program to complement its E-mail system for Novell LANs. With the Right Hand Remote, you can extend your LAN by providing E-mail, appointment scheduling, and simultaneous full-duplex updating for speed and efficiency on-line.

The remote package works with the new Right Hand Man II program, which now supports fax viewing and sending, archiving, keyword searching, and a new Common User Access–compliant interface.

Price: Right Hand Man II, from $149 to $5000; Right Hand Man Remote, $295.

Contact: Futurus, 3131 North I-10 Service Rd., Suite 401, Metairie, LA 70002, (800) 327-8296 or (504) 837-1554; fax (504) 837-3429.

Circle 1024 on Inquiry Card.



With Right Hand Man Remote, you can access your network and Futurus E-mail system while you're on the road.

The Coordinator Goes to the Tailor

Action Technologies' new Customizer System lets you tailor the company's Coordinator software (see "Please, Mister Postman," March BYTE), a communications program that goes beyond traditional E-mail functionality. The Coordinator manages work among many people or groups of people working on Novell LANs.

With the Customizer, you can modify the Coordinator to reflect the way that you work, incorporating company-specific terminology for specific departments. You can use it to translate the system to French, Dutch, Greek, and other languages and create help screens that explain the operations in a certain environment.

The Coordinator provides for the management of projects, the reading of conversation threads in sequence, and the insertion of messages with a request for a reply into your or someone else's calendar. It also provides for normal E-mail operations.

Price: Coordinator system, $600; 10-pack, $1800; Customizer system, price undetermined at press time.

Contact: Action Technologies, Inc., 1145 Atlantic Ave., Alameda, CA 94501, (415) 521-6190; fax (415) 769-0596.

Circle 1023 on Inquiry Card.

Sight for NetWare, Spooler for LAN Manager

LANSystems has introduced a LAN print spooler for Microsoft LAN Manager and a network monitoring program for Novell NetWare networks.

With LANSpool 2.0 for LAN Manager, you can attach as many as five network printers to a designated print server.

LANSight 2.0 provides remote control, diagnostics, and administrative features for monitoring workstations, file servers, and other servers running NetWare 2.x and 3.1x.

Price: LANSpool for LAN Manager, $495; LANSight 2.0, $395.

Contact: LANSystems, Inc., 300 Park Ave. S, New York, NY 10010, (800) 458-5267 or (212) 995-7700; fax (212) 995-8604.

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The Atron Evaluator makes testing so easy you can even do it with your eyes closed.

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CADRE

Do the Right Thing with This Hot Box

Atari's Hotz MIDI Translator, or Hotz Box, features a radically different keyboard layout that helps musicians orchestrate, rather than simply play, music. When used with an Atari computer, the Hotz Box lets you compose, edit, sequence, and perform creative projects.

When you link several Hotz systems, one unit can serve as a conductor in a jam session. When the Hotz Box is used with MIDI sound modules, one person could play bass, another piano, and another trumpet, yet everyone plays in key. With one button, the person running the master unit can configure each unit to produce notes in the same key. This way, musicians in a jam session can play without fear of hitting the wrong note. This lets you focus on creating rather than playing, Atari says. You can program the system to play chords or notes in any key or combination of keys.

The Atari Hotz MIDI translator, although resembling a keyboard, is completely programmable and doesn't have any moving parts. The pads are touch-sensitive.

The system helps musicians by expanding their musical vocabularies. You can program the system to play complicated chord combinations—not just major and minor chords—and scales flawlessly, Atari says.

The MIDI-compatible system comes with extensive libraries of chords and scales. When used with MIDI sound modules, it can reproduce the sound of any instrument.

Price: $5500.

Contact: Atari Computer, 1196 Borregas Ave., P.O. Box 3427, Sunnyvale, CA 94088, (408) 745-2000; fax (408) 745-2088.

Circle 1026 on Inquiry Card.

A MIDI Maestro for the PC

The Covox MIDI Maestro consists of a card that fits into a slot on your PC, a score print program, and a 64-track MIDI sequencer that samples at a rate of 600 beats per quarter note. Covox says the sampling rate lets you record even a snare drum roll and play it back without it sounding choppy.

The sequencer uses a routine that adds the human factor back to quantized music. This lets your music sound tight, not computerized.

Price: $189.95.

Contact: Covox, Inc., 675 Conger St., Eugene, OR 97402, (503) 342-1271; fax (503) 342-1283.

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Circle 601 on Inquiry Card.

Yamaha's Laptop Music Processor

Laptop and palmtop computers are becoming common tools for working away from the office. Now Yamaha has a new machine for the musician who wants to work away from the studio.

The QY10, which is about the size of a standard VHS tape, lets you compose, arrange, and play music using an 8-track/8-song sequencer, 28-note polyphonic tone generator, drum machine, and keyboard pad. Yamaha says uses of the system include writing and listening to arrangements, composing, ear training, sequencing for single or duo live performance, backing for musical practice, and music education.

For the musician or composer who wants to work away from the studio, the Yamaha QY10 weighs less than 1 lb.

The QY10 provides options of 29 sampled instruments, including pianos, strings, brass, guitars, basses, synthesizer voices, and drums.

The rhythm section has 76 preset backing patterns with memory for 24 more of your own. Patterns include drum, bass, and chord combinations of 1 to 8 measures, many with strings or brass. You can create your songs and arrangements by mixing and matching patterns, or you can play the notes with the system.

When inputting chords, the QY10 supports added ninths, sixths, suspended fourths; diminished, augmented, eleventh, and thirteenth options; and standard major, minor, and seventh chords.

The sequencer/recording portion of the system supports eight songs and eight tracks. Real-time and step-time recording is available, and you can edit what you record. The QY10 also has MIDI-In and MIDI-Out connections.

The unit measures 4 by 7⅞ by 1 inches and weighs 11 ounces.

Price: $399.

Contact: Yamaha Corp. of America, Synthesizer, Guitar, and Drum Division, P.O. Box 6600, Buena Park, CA 90622, (714) 522-9011; fax (714) 522-4023.

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DTC 3280 SCSI cntrl.	$150
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UltraStor ESDI 32K Cache	$175
Ultra EISA/ESDI cntrl.	$795

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Circle 592 on Inquiry Card (RESELLERS: 593).

Three MIDI Programs for the Mac

Passport's latest version of its Master Tracks Pro 4 music sequencer for the Mac supports Apple's MIDI Manager in System 6.0.7 and provides an overdub record mode for recording directly over a track without erasing existing data. Version 4.5's integrated track editor lets you record and play up to 64 tracks of music while providing a graphical user interface that lets you build large works by repeating sections and adding phrases from other sequences, the company reports.

You can view the structure of the song and edit it using `cut`, `copy`, `paste`, and `mix` commands. You can also step input passages you are unable to play live by playing the piece a note at a time using the mouse or a MIDI instrument. Volume faders let you do live mixing.

AudioTrax, an 8-bit digital audio and MIDI desktop recording studio for the Mac, offers the recording and editing features of Passport's Trax sequencer plus the ability to record and play two tracks of digitally recorded dialogue or sound effects in sync with a MIDI composition. The program can use sounds recorded with Farallon's MacRecorder Digitizer, an internal sound-input device like those provided with the Mac LC and SI, or any digital sampler. You can cut, copy, and paste sequenced and audio data throughout a MIDI sequence and record up to 64 tracks of music in real time. AudioTrax lets you incorporate digital audio and MIDI into desktop presentations, complementing a visual production with a multimedia desktop presentation. Once you load the sequence and audio, you can edit them to synchronize precisely with the visual, Passport says. The program's digital audio functions add any sound, digital or prerecorded, that is not available from MIDI instruments. You can then play the sequence and digital audio in sync with the presentation triggered by MIDI commands, via MIDI Manager or Passport's HyperMusic MIDI player.

The company has also released a new version of Encore, the composing and notation program for the IBM PC and Mac. Encore 2.0 includes an expanded symbol library, improved page-layout control, support for guitar chords, automatic beaming, extensive key commands, and the ability to read ASCII text files from other programs.

The program can also transcribe live MIDI input and standard MIDI files. The program supports 64 staves and lets you work on 16 files simultaneously. Improved guessing routines more accurately transcribe triplets and complex pieces, the company says.

Price: Master Tracks Pro 4 version 4.5, $495; AudioTrax, $199; Encore 2.0, $595.

Contact: Passport Designs, Inc., 625 Miramontes St., Half Moon Bay, CA 94019, (415) 726-0280; fax (415) 726-2254.

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WHAT'S NEW AT COMDEX

Springtime in Atlanta

SPRING '91 is a major new international computer industry event dedicated to information technology solutions.

It's two major shows side-by-side in Atlanta this May 20-23, an expanded **COMDEX** now reaching resellers and corporate end-user management, and **WINDOWS™ WORLD**, the first official conference and expo for Windows computing created in cooperation with Microsoft.

Some 1,000 exhibiting companies and 60,000 attendees are expected, including computer resellers, software developers, distributors and OEMs, plus corporate buyers, MIS/communications managers, CIO/IS executives, workgroup and departmental managers, and 1,000 trade and business press.

SPRING will feature a combined Conference program of more than 170 sessions -- the largest and most comprehensive forum ever put together for a computer industry event.

COMDEX Continues to Lead the Way

The 11th Spring version of **COMDEX** will continue to reach every category of reseller, with this year's expanded show featuring a host of reseller-specific educational and training support programs. These will include over 60 conference sessions specifically focused on reseller issues, as well as customized vendor presentations from leading manufacturers and suppliers.

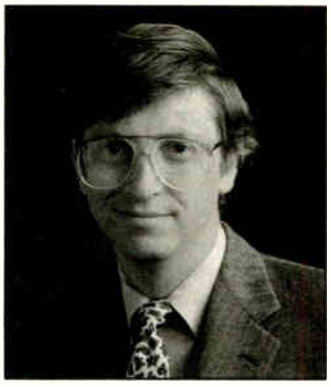
COMDEX '91 at **SPRING** will also be the first **COMDEX** event to offer a separate End-User Conference Program with nearly 60 separate sessions. A wide variety of programs and features will also be available to the corporate end-user, from middle managers to senior information system (IS) executives.

Raymond J. Noorda, President and CEO of Novell, will deliver the COMDEX keynote address. "The spark that Ignites an Industry," an insightful overview of networked computing and its ever-increasing impact on the computer industry.

WINDOWS™ WORLD: The Official Show for Windows Computing

WINDOWS™ WORLD is the official Microsoft-sponsored event supporting Windows, the most influential computing software on the market today.

The show will feature products, support and more than 50 educational conference sessions on Windows computing for corporate users, software developers, system integrators, peripheral designers, value-added resellers (VARs), and other industry professionals.



Bill Gates, Chairman of Microsoft, will deliver the WINDOWS™ WORLD keynote address. "Windows: Changing the Face of Corporate Computing," an inside look at the contributions of Windows to corporate computing and a preview of future enhancements to Windows technology.

Networked Computing

SPRING Networked Computing Focus will include exhibitors demonstrating interoperability along with a comprehensive conference program on networking and communications, including a Corporation for Open Systems (COS) certification program.

Networking exhibits will be on both **COMDEX** and **WINDOWS™ WORLD** show floors, and almost 60 networking sessions topics will be offered in both conferences.

A Multimedia Pavilion

SPRING Multimedia Pavilion will feature an exhibit area of major industry companies, such as IBM, Microsoft Corporation, and others. In addition, **SPRING** attendees will be able to see a variety of products combining audio, video, animation, graphics and more in a separate Multimedia Presentation Theater. Approximately 20 conference sessions will address the status of this emerging technology.

Highlights of SPRING '91

- 1,000+ **COMDEX** and **WINDOWS™ WORLD** exhibitors.
- 170+ conference sessions in the **COMDEX** and **WINDOWS™ WORLD** Conferences.
- **COMDEX** keynote by Novell CEO Ray Noorda addressing critical reseller and user issues.
- **WINDOWS™ WORLD** keynote address by Microsoft CEO, Bill Gates.
- Special focus on Networked Computing and Multimedia.
- Major new programs including Vendor Presentations, New Product Awareness, User Group Meetings.
- Special focus on Networked Computing and Multimedia.

CONTACT: SPRING - featuring **COMDEX** and **WINDOWS™ WORLD**, Atlanta, May 20-23, 1991. For more information on attending call THE INTERFACE GROUP at 617-449-8938. For exhibiting information call 617-449-6600 x4023.

Circle 590 on Inquiry Card

NEWS

Music Clips and a Low-Cost MIDI Interface

Opcode's collection of MIDIclips is a library of professionally composed music stored as MIDI files for use in multimedia presentations on the Mac. The original sound clips, which you can distribute freely through your company, are designed to be played back through a Roland CM32L-compatible MIDI instrument, the company says. However, you can also play them through other MIDI instruments as well. The CM32L is a 32-voice synthesizer tone module featuring linear arithmetic synthesis and sound effects.

Opcode says the sound clips offer to the music and multimedia community what clip art offers to the graphics community. You can incorporate them into multimedia presentations created with Supercard, HyperCard, or MacroMind Director, the company says.

MIDIclips requires a MIDI hardware interface, a MIDI instrument, MIDIplay, and HyperCard 1.2.5 or higher or any MIDI sequencer. MIDIplay lets you play back the sequences of MIDIclips and edit their length and instrument sound while a sequencer lets you record the sounds and graphically edit them. MIDIplay 1.1 now automatically creates programs that are compatible with MacroMind's products.

Opcode's MIDI Translator is a hardware interface that plugs into the Mac's serial port. The Translator doesn't require a separate power supply.

And for developers who want to create applications that process data in real time, Opcode created Max. You can create complex applications by linking simple modules, the company says. The program is written in C and provides a high-level graphical way for you to create applications that compose and improvise music, provide accompaniment as you play, send commands to a synthesizer, and modify synthesizer patches.

Price: MIDIclips, price undetermined at press time; MIDIplay, $59.95; MIDI Translator, $59; Max, $395.

Contact: Opcode Systems, Inc., 3641 Haven Dr., Suite A, Menlo Park, CA 94025, (415) 369-8131; fax (415) 369-1747.

Circle 1030 on Inquiry Card.

A Digital Recording Studio for the Mac

Digidesign's Studio D integrates MIDI and digital audio on the Mac II, letting you produce, record, mix, and master compact disc–quality music.

The system consists of a Mac II with a hard disk drive, Digidesign's SampleCell, Deck, and Audiomedia or Sound Tools.

Price: Audiomedia, $995; Sound Tools, $3285; Deck, $349; SampleCell, $1995 with no RAM, $2995 with 8 MB of RAM.

Contact: Digidesign, Inc., 1360 Willow Rd., Suite 101, Menlo Park, CA 94025, (800) 333-2137 or (415) 688-0600; fax (415) 327-0777.

Circle 1031 on Inquiry Card.

In LAN Times' Workstation Review on October 22, 1990 comparing 17 leading workstation models, Xinetron scores second highest in the 286 category - only after Compaq:

	Xinetron		Compaq
Installation	5	Excellent	5
Features	5	Excellent	5
Quality	5	Excellent	5
Documentation	3	Average	5
Size (height)	2.2"		4"
List price	$985		$2299

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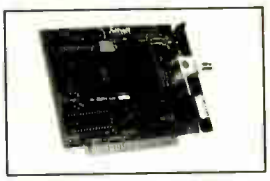

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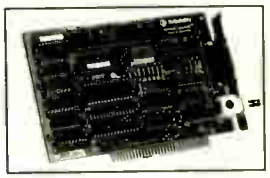

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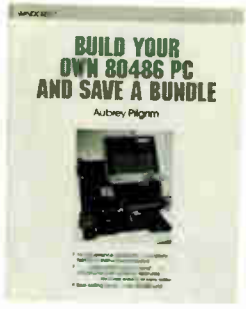

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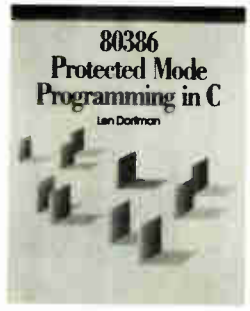

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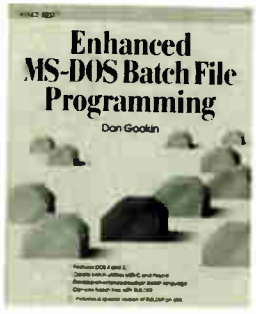

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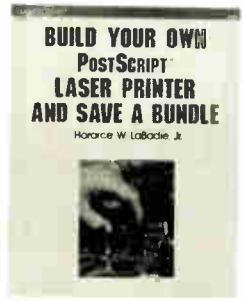

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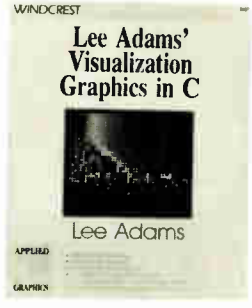

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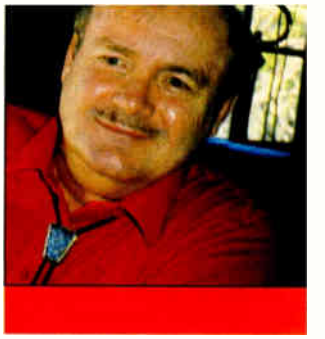


JERRY POURNELLE

ATARI REVISITED

Jerry takes a first look at the new Atari TT030, seeks a GUI word processor, and discourses on typefaces

Well, it's done: Larry Niven and I finished *Fallen Angels* yesterday. It's scheduled for June publication from Baen Books, which means you ought to find it in bookstores in late May.

Tomorrow I catch a plane for Washington, D.C., where the American Association for the Advancement of Science is meeting this year. AAAS is my hands-down favorite conference of the year, even better than the World Science Fiction Convention. Writing takes a lot of output; AAAS is where I get input. This year, I'm also paying my dues by giving a talk on uses of small computers in science, as well as a lecture at George Washington University on technology and society.

Meanwhile, I'm recovering from minor but painful surgery: they had to slice a small skin cancer out of my face. The result is a Heidelberg scar and the world's worst black eye; it's the black eye that's relevant here. Because of it, I wasn't able to get some of the research done that I'd intended for this column. So it goes. As usual, there's still plenty to write about.

Atari TT030

The newest computer at Chaos Manor is the Atari TT030, which, as the name implies, is powered by the Motorola 68030 chip and is a sort of super Atari ST. The 68030 runs at 32 MHz, in tandem with a 68882 floating-point math coprocessor and built-in cache memory. It certainly runs all the old Atari ST software I could find, including stuff written by my Russian friends at ParaGraph. I now have Perestroika, the Game, running on the TT030, and considering how graphics-intensive the game is, that's no bad test. It runs quite smoothly, if too fast.

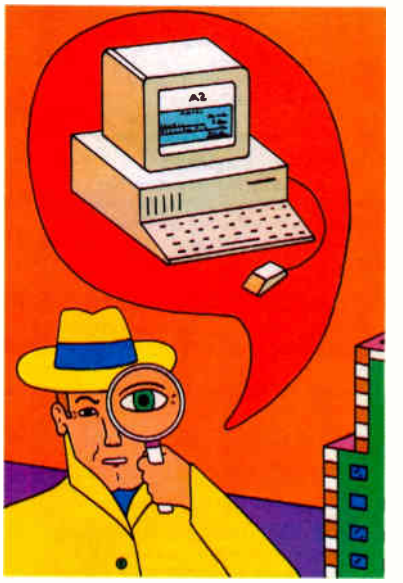
The TT030 is what the Mega 4 should have been: the case is sensibly designed, although still plastic; the detached keyboard looks professional, with normal function keys instead of the cutie-pie slanted function keys on the 1050ST; and, in general, the machine has a solid, professional look and feel.

Like all Atari machines, it has about a zillion ports, including game, mouse, serial, parallel, and a cartridge port into which you can plug your Spectre Cartridge from Gadgets by Small and have the equivalent of a fast Mac. For reasons not clear to me, the keyboard cable connects to the right side of the keyboard but the left side of the computer.

The TT030 is one of the items I'd intended to do more with until my plans were drastically altered by surgery; alas, I've had little time to work with it.

My first impressions are quite favorable. Getting the machine running was no problem: I took it out of the box and set it on a stand. I looked in the manual and found that the machine was said to work with VGA color monitors, particularly multisync, so I connected it to the Tatung 14-inch monitor that came with the Gateway 2000 computer—the TT030 has a 15-pin VGA connector that the Tatung (or almost any VGA monitor) will plug into—and turned it on. The monitor flashed white. Then nothing happened for a long time—so long that I believed something was broken. I turned off the machine, checked the connections, and tried again. Still nothing.

I figured I had done something wrong, so I unpacked the TTM195 monitor that came with the TT030, an enormous TTM195 VGA monochrome gray-scale 19-inch monitor, and connected it up. I turned on the system. The monitor flashed a couple of times and then settled down to a uniform white. Then nothing happened. I retrieved the box the TT030 had come in from the storage shed, since I figured I'd have to be sending the machine back. Then I had to look for the manual. When I came back, the operating system (TOS) was running and GEM was on the screen, looking nicer than I'd ever seen it, and there was no question the system was working.



One of the programs on the TT030's hard disk was Mandelbrot, so I clicked on that; the result in monochrome was interesting but not very pretty, so I decided to give the Tatung monitor another try. I plugged that into the system and reset, and, lo, up it came; it just takes a while.

In fact, the TT030 doesn't take all that much longer

ILLUSTRATION: STEVE TURK © 1991

than a big 486 to power up and do memory tests; the difference is that the Atari TOS shows you *nothing* on the screen until it's ready to go to work, while DOS systems tell you what they're doing on power-up. Also, the TT030 seems to take a lot longer to power up when it's cold than it does when it has been running a while. None of this is any big problem, and once it has been powered up, hitting the hardware reset button gets an instant reboot that takes no more than a few seconds.

The Mandelbrot program runs interestingly, with repeated iterations that smooth out the jagged lines as you watch. It's a good demonstration of the TT030's VGA resolution.

So far, I haven't found any of my older ST software that doesn't work on the TT030, although I do have to change the monitor's resolution. The TT030 has all the ST resolutions plus its own higher screen resolutions: 320 by 480 pixels with 256 colors or 640 by 480 pixels with 16 colors, both from a palette of 4096 colors. The monochrome mode is no slouch either, with 1280 by 960 pixels on the TTM195 monitor. When you change resolutions, the TT030 automatically does the equivalent of a reboot.

I am told, though, that there are some compatibility problems with older ST software. This is particularly true with games and other software that have timing loops, since the 68030 is much faster.

I no longer have a lot of Atari software other than games. Alas, I seem to have mislaid my copies of Sundog and Dungeon Master—doubtless they were put in a "safe place," which means they may not surface for years—but it's not fair to restrict the TT030 to games. This is a solid machine, with a GEM interface and a better keyboard than I started with in this business. I have a copy of Aladdin ST, which is the front-end program for GE's GEnie information service, and that works just fine. So does WordPerfect and a bunch of other standard business software. The TT030 is definitely a lot more than a toy.

The TT030 has a built-in MIDI port, which should interest musicians. I'm told that the Stacy Laptop, which is the portable Atari ST, has become just about the de facto standard interface for keyboard musicians.

I find that many Atari ST "power users" almost exclusively use it with the Spectre Cartridge because Mac software is so much better than Atari software. For instance, they use WriteNow, instead of any of the Atari ST word processors, and Excel as a spreadsheet. I have not tried the TT030 with the newest versions of Dave Small's Spectre Cartridge, but people who have tell me it works fine.

A tentative conclusion: the Atari TT030 system is good enough for almost anything you'd want to do with a computer. It's close to state of the art for music support. There's a wealth of ST software developed in Europe, and quite a lot is available here as well. However, the Atari does remain outside the mainstream of U.S. computer development. It supports a lot of stuff that would otherwise be obsolete, but it neglects advances in the state of the art. You generally can use it to get the job done.

You'll probably be hearing more about the Atari TT030.

Atari PTC1424 "Colour" Monitor

I got this 14-inch monitor today. The manual tells me that it's a multisync monitor for all VGA systems, and it operates on "240 Volt 50Hz mains," as well as informing me that it's a "colour" monitor. In fact, it plugs into the 110-V outlet, but the manual shows its European origins.

It works fine with the TT030, with no discernible difference from the Tatung multisync monitor. It also works with the Premier 9000 in place of the Zenith Flat Technology Monitor, but not very well: the vertical lock is way off, and it flickers. That's all right: when I plugged the 31-kHz Zenith FTM into the TT030, the display was readable, but it flickered. Putting the Atari PTC1424 monitor with the Atari TT030 works fine. Apparently, the PTC1424 and the TT030 really were made for each other.

The TTM195 monitor works wonderfully well with the TT030, too.

Tracker/ST

When I knew I was getting the TT030, I looked for software. One of the first programs to arrive was Tracker/ST, which is a combination database, mail-label generator, and mail-merge program.

Tracker/ST is a near-perfect illustration of the pros and cons of using the Atari computer for business. The good points are that the software is cheap and easy to learn. It does the job in a no-frills, unimaginative way. You really can set up and use this for business correspondence and mailing lists. On the other hand, it is unimaginative; the user interface has the flavor of CP/M during the early days of personal computing.

Example: Tracker/ST includes support for Epson 9- and 24-pin printers, NEC 24-pin printers, Diablo-compatible

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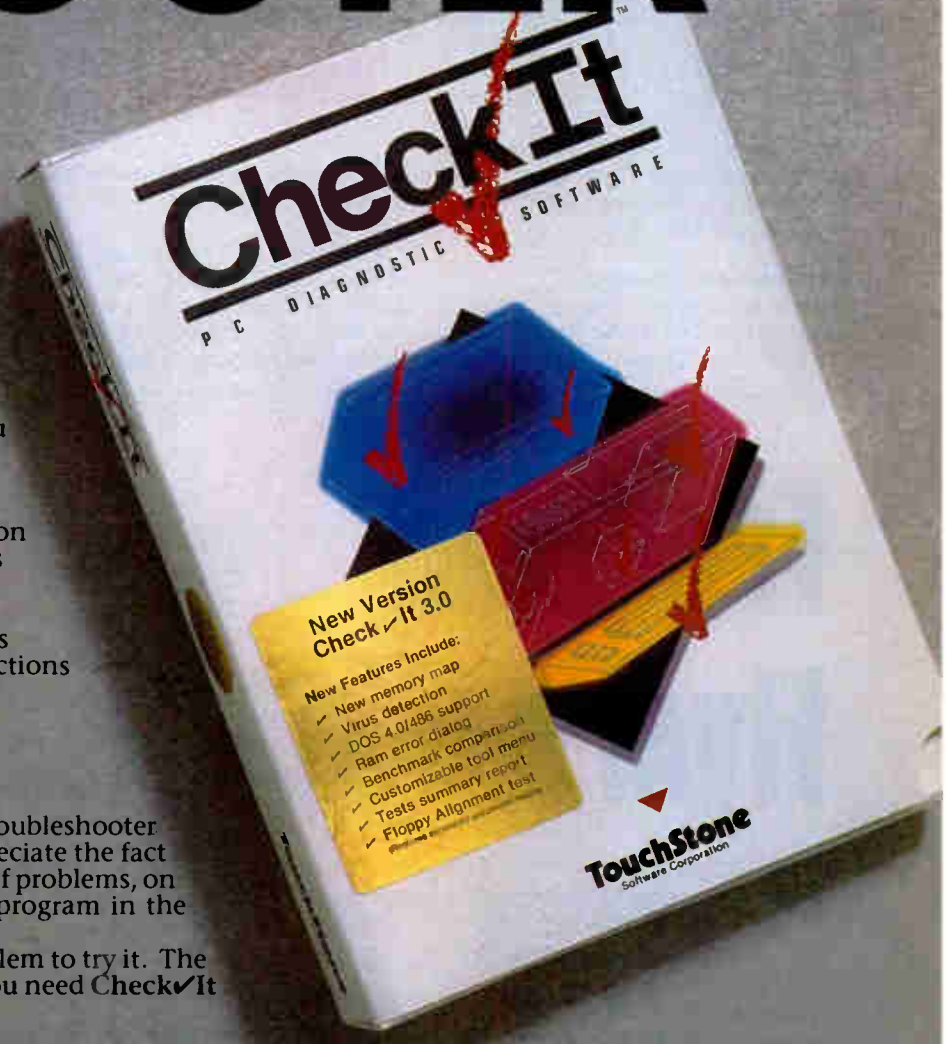

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daisy-wheel printers, and the Hewlett-Packard DeskJet and DeskJet Plus. No laser printers. Of course, you *can* use the Atari SLM804 laser printer, but you must select either the Diablo emulator or the Epson LaserBrain emulator; there's no provision to use the laser printer as itself. They then add, "We feel that the LaserBrain emulator is a better choice, but it currently works only with a monochrome monitor. . . ."

As I said, shades of CP/M days. My original Diablo printer is in the Smithsonian, and while I do bring out an NEC SpinWriter once a month to write the checks, it's only because I have a SpinWriter and a vast supply of pin-feed checks. I wouldn't buy that setup today. On the other hand, there's a lot of older good-enough equipment out there on the used market, and it's nice to know there are still some systems that support it.

More on all this when I get more software and have more time.

Adventures in Musicland

Some of you may remember a wonderful movie called *The 5,000 Fingers of Dr. T.*, with Hans Conried, Mary Healey, and Peter Lind Hayes. Alas, it wasn't a commercial success. It was later chopped mercilessly and released as *Crazy Music*, which wasn't a success, either. If you can find a videotape of the original, rent it or buy it, and watch it with your friends or a bright child, or both. Whatever your interest in music, I doubt you'll regret the experience.

Adventures in Musicland is a series of musical games.

Clearly Dr. T's Music Software takes its name from that film; and while it's hardly an amusement for adults (which the movie was, or so I think), Adventures in Musicland does try to retain the flavor of having fun with music. The program is a series of musical games, which, although billed for "children of all ages," are most suitable for the younger end of the spectrum: 10 and under at a guess, although I could be off a bit. Adventures in Musicland tries to teach musical principles through repetition, games, and fun, with goofy illustrations taken from the old woodcut illustrations of *Alice in Wonderland*. You listen to tunes and try to reproduce them, turn over cards to match them, and build musical symbols—that sort of thing.

This is one I'd recommend you look at before buying: some are going to like it a lot, but some will think it's a bit elementary. The version I have is for the Mac, but there's also an Atari version.

Mac Misgivings

Every time I'm ready to conclude that the Mac is a stable and reliable machine, something happens to make me wonder. Case in point: I'd put Adventures in Musicland up on SuperMac, the big Mac IIfx with the 8•24 GC video card. Adventures worked fine. I played around with it enough that I could write about it,

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came over and wrote that, and went back to shut down the Mac. Pull down the File menu, click on Quit. Wait. And wait. And wait. Eventually it's clear: the machine has hung up, thoroughly and completely. There is no way to get it to respond to anything.

Of course, a Mac II doesn't exactly have a power switch. There is, however, a power cutoff button on the back, and it was either press that or wait for doomsday. Cycling the power did in fact cure the problem: the Mac came up with the Adventures file lying closed on the Desktop, as it would have been had it been able to quit properly when I tried it with software.

This meant I had to take the Adventures program down to Richard's Mac Plus and try it on that; it worked, and I could close the files and shut that down with no trouble. Then I remembered the problems I'd had before with the 8•24 GC video card. I find that the virtual memory expansion program (it swaps from memory to a reserved area of your hard disk) will work with the Mac IIfx, but not if the 8•24 GC card is in it, and this isn't virtual memory's fault at all; Apple managed to violate some of their own standards with the 8•24 GC.

The problem is, suppose I'd had some unsaved work somewhere on that Mac? One answer to that, I suppose, is "don't use MultiFinder," but that sure puts the Mac II at a competitive disadvantage. Another answer is "don't use the 8•24 GC video card," and that makes a fair amount of sense given that even Apple finds the card buggy. A final one is "stick to the devil you know," which in my case is PC compatibles. None of these answers is totally satisfactory.

Grrr!

It has been a long day. It included packing for my trip to Washington. I'm looking forward to the trip because I'll get to visit Ezekial, my wonderful old CompuPro CP/M system that's now on display in the Smithsonian. I sure hope he's happy there. Anyway, before I left, I had to pay the bills for the month. Around here what happens is that as bills come in they are sorted into a huge portfolio. I then use my accounting program to record all the bills, whereupon the checkwriter portion of the program makes out checks. I sign them, and John stuffs them in envelopes and mails them.

It all works fairly smoothly. I should, I know, set up to do it all with Quicken, a home and business finance program. Quicken can keep track of my checking and investment accounts. It works much the same as my accounting program. I could then print out the checks myself or send the electronic output from Quicken to the Checkfree system via a modem. Checkfree would then write the checks and mail them out. I can only plead that my system works reasonably well, and although I don't recommend my accounting program to anyone else, I'm very familiar with it.

Another reason to stay with my present system is that it makes me look at every bill. The accounting program remembers what I usually pay to each account, but it won't skip any. Before it will cut a check, it asks me if the amount is right. I designed it that way.

And every month I find at least one bill that should not be there. Typically it works this way: some PR type works on me to look at a product. I plead that it's too much like something else I've already written about, or it's in a product area that I generally have no interest in;

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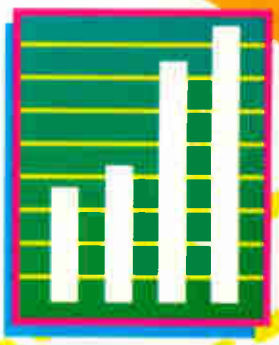

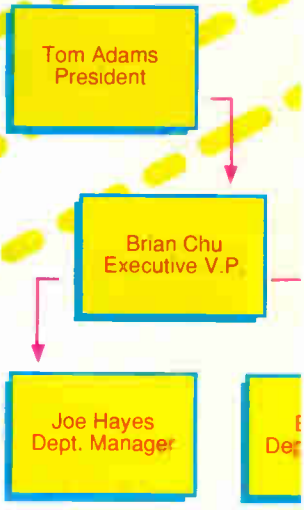

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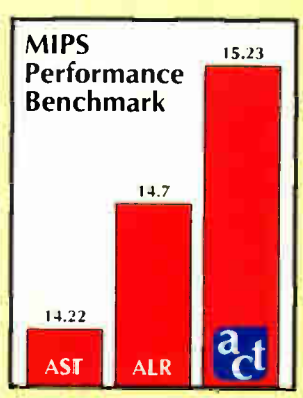

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but that's never good enough. "You've got to look at this, you'll love it, what harm can it do?" Usually I continue to resist, but once in a while they'll wear me down. "All right," I say, "I'll try to look at it, but I probably won't get to it for a while."

"No problem! Thanks!" they say, and in due course a box of software, or a modem or fax card, or some other gadget will arrive at Chaos Manor and be put in the incoming queue. So far, so good: but then, far too often, the next month as I am going through the bill box I will find a bill. Today, for instance, I have two, from two different outfits. One for some software; the other for a PC card that I reluctantly agreed to look at. The software is clearly marked "For Evaluation Only. Resale Prohibited." The invoice says that as well; but there it is, a bill for the full list price.

Two bins down in the bill box is a dunning letter from a company's lawyers. The first time they sent a letter like that I sent a fax to the company asking for a return authorization number so I could ship the stuff back. I then got a flurry of communications—from the company president, the marketing department, and half a dozen other officials—begging me to hang onto it and explaining it was all a mistake. Now they're threatening me with lawsuits.

And yes, I know it's all bureaucratic foul-ups; but I also have to wonder about a company that can't manage their internal affairs any better than that. If they treat me that way, how will they treat their customers?

The truth is that I cannot possibly mention more than about 10 percent of the stuff that comes here, and I don't have a big staff to keep track of it all. I don't run a computer store, I don't sell anything, and I don't give anything away without the owner's permission; but beyond that, I promise nothing.

How Long Can You Tread Water?

As I was writing the above, my son Alex called. I could hear noises in the background.

"Tell your readers to be sure there's good drainage in the computer room," he said.

"What?"

"One of our clients is [a large newspaper]. One of the urinals backed up and then a pipe burst, and the computer room was flooded. We were making cofferdams of books and documents. I finally called the fire department. They are pumping the water out until we can get the plumbing fixed."

I never thought of drainage as one requirement of a computer room, but the lesson here should be obvious. Just because modern tower-configuration microcomputers don't need special air-conditioned rooms doesn't mean you don't have to pay *some* attention to where you put them. Especially if they run your whole newspaper....

To GUI or Not to GUI

Everybody keeps telling me that this is the year of the graphical user interface (GUI). There are times when I believe it myself.

If I'm going to GUI, the absolute first thing I need is a word processor that lets me get my work done. At present, I use Q&A Write from Symantec, just as I use the Q&A Database to take care of my correspondence, including letters I get from readers, preliminary copies of the column for the people mentioned, product inquiries, and so forth. (Actually, Roberta and John use Q&A to record all that; I only get the benefits.) Symantec hasn't updated Q&A in a couple of years, and I keep telling myself there has to be something better; Q&A Write has some annoying bugs that must be overcome in newer products.

So, although Q&A Write isn't exactly broke, there are things about it that need fixing; and there's also some pressure to find a GUI word processor I can live with. A GUI word processor has features such as charting and drawing capability. I do a lot of communication by fax now, and my Intel Satisfaxion board can take files with drawings and charts and send them out. What with Operation Desert Storm and renewed interest in the SSX space shuttle, I do have reason to be able to send sketches and maps and such as part of my letters, so while I don't need drawing and chart capabilities every day, I sure would like to have them around.

Ami Pro, a friend said. Has all the features you could ever want, and it's easy to learn and easy to use. I'd heard others say the same thing, so when a new copy of it arrived, I figured this was as good a time as any to install it. The Arche Legacy 386/33 has an updated beta copy of MS-DOS 5.0 (you're going to like MS-DOS 5.0 a lot), so I thought I'd start with that machine. Of course, I don't have Windows on the Arche, but Lotus sent a run-time (single application environment) version of Windows 2.11, and that looked simple enough to install. After all, if I liked Ami Pro, I'd put it on the Premier 9000, which is the primary Windows machine, and if I liked it a *lot*, I'd consider installing Windows on my main machine and be done with it.

The Arche, like many new machines, has a 5¼-inch A drive and a 3½-inch B

drive. I put the Setup/Install disk in the B drive, logged onto that, and started in. The first few disks clearly have the Microsoft Setup/Install program on them; this has been perfected over the years and works very well indeed. It had absolutely no problem with installing from the B drive. This continued until it asked for the Ami Pro Program Disk One.

When that one came up, the environment changed; I was out of Microsoft Install and into the Ami Pro Install program. It first asked for my name and my company name; then it wanted me to enter the serial number that was written on the disk. Some kind of copy-protection scheme. When it got all that, it wrote to the disk. It demanded that I put Program Disk One into drive A. Since Program Disk One is a 3½-inch floppy disk, it wasn't going to get into drive A. Nothing I could do would convince this wretched Install program to proceed. Moreover, most of the files on the disk are PKZIP-compressed files, so I couldn't just copy the stuff over.

I ended up rebooting. Then, just because I'm thorough, I put the new written-on Program Disk One back in the B drive, logged onto that, and typed Install. It all went fine, no problems. Apparently, it was the need to go play copy-protection games that confused the Install program: when it comes back, it has forgotten what drive it is installing from. Annoying, but not fatal.

Once the installation glitches were done, I could try Ami Pro. The Arche has a Rollermouse trackball installed, so I'd be able to test that, too. The good news is that Ami Pro works fine with the Rollermouse.

The bad news is that I just don't like Ami Pro.

This is a purely subjective opinion; as I've said, others I respect do like it. I can only describe my experiences and what I think is wrong.

First, the screen's too busy. The GUI demands that there be little icons and windows all over the place; certainly, Ami Pro has them, lots of them. There's a Scissors icon, and a Paste Pot icon, and a whole bunch of others. Now, of course, since the program has a ton of features, it needs a way to tell you about them; but I don't need them staring at me when all I'm trying to do is write text! One silly little pop-up style-selection window even covers some of the text. Both the icons and the window can be turned off, but that's annoying.

Still, none of that's fatal. I could probably get used to it if I liked everything else. The trouble is that I don't like everything else. I don't much care for the typefaces as they appear on-screen. The Courier, for instance, looks a lot like the one that was on my IBM Selectric. I wrote a few million words with that, so you'd think I'd like it, but I don't. I just don't.

So I changed to the equivalent of Times Roman, changed the point size from 10 to 12, and looked again; and again, it's just not very pretty. It's not easy to read, and it's unaesthetic on-screen. Printed out, all's well, meaning that Ami Pro is very likely good enough to make documents that you'll print; but in my line of work, I don't make paper copies often, sometimes not at all, while I do spend a good part of my day looking at the screen.

Finally, when I typed words into Ami Pro in WYSIWYG mode, they would sit still for a moment, and then, when I let the keyboard stay idle for long, the words on-screen would jump around like fleas (i.e., they'd rearrange themselves to the proper proportional spacing). This is fine if you're not watching the screen, but it's enough to drive me out of my mind; I'd never be able to write with that going on. And, yes, I know that I can change the display mode from layout to draft.

So, I'm still looking for a word processor to use with Windows, one that won't be too distracting for creative writing. On reflection, what I want is an editor that is character-based for writing, but which I can then zap to rearrange the screen into WYSIWYG. That way I'd have stability, yet be able to cut and paste in pictures, maps, and drawings when I need them. Indeed, Ami Pro would do just fine for that. I didn't have any problems editing with it (although I still think the on-screen typefaces are unattractive); it's when I wanted to do creative writing that the editor seemed to get in the way.

I'll keep looking. More next month.

MoreFonts

There's another way to go: instead of finding a WYSIWYG editor, use a character-based editor and a typescaler, such as MoreFonts from MicroLogic Software. A typescaler is a font generator; it takes a series of typefaces and builds fonts as needed. I expect I had better explain.

In standard typesetter terminology, a typeface is a style (e.g., Times Roman, Helvetica, Letter Gothic, and Schoolbook). Many typeface *names* are trademarked, but the typeface itself has been around long enough that it is in the public domain; thus, MicroLogic has Geneva rather than Helvetica, Tiempo rather than Times Roman, and so forth. To add

to the confusion, some copycat typefaces are not *quite* the same as the originals. In any event, a particular type style is called a typeface.

Each typeface has a series of *faces* and *sizes*. Faces are different variant styles, such as *italic* and **boldface** of the original type style. A *font* of type is a typeface, such as Times Roman, at a particular size, such as 10 point, in a particular face, such as *italic*. In the old letterpress typesetter days, a case of type would be specified by typeface (Times Roman) and size (12 point), and it would consist of a number of fonts of that typeface at that size.

A case usually included the roman or normal font (called medium in sans serif typefaces), *italic*, **boldface**, ***bold italic***, and small capitals; and these would be in both uppercase and lowercase. These were arranged in order so that a typesetter could grab exactly the letters needed to make up a line of type in a given font. Sometimes a letter would get into the wrong bin, and the typesetter wouldn't catch it; that happened often enough that "wrong font" has a standard proofreader's symbol.

Type vendors, particularly the newer ones who have appeared since the computer revolution, tend to use the word *font* when they mean *face*; thus, the claim of "12 fonts" usually means three typefaces, each in four faces, but scalable to a very large number of sizes. Moreover, there are faces other than the traditional ones given above.

A font of type is a typeface at a particular size.

MoreFonts uses yet another terminology: MicroLogic Software advertises 17 typefaces. What they mean is 8 typefaces: their versions of Helvetica (Geneva), Times Roman (Tiempo), Letter Gothic (Financial), Broadway (Showtime), Cooper Black (Burlesque), Coronet (Pageant), University Roman (Opera), and Bodini Bold (Poster). There are the traditional four faces (roman or normal, italic, boldface, and bold italic) of the first three typefaces and one each of the last five.

Alas, like most font packages, MoreFonts doesn't give you a small capital face; but, being a typescaler program, it can generate an almost unlimited number of type sizes of the above, meaning that you can, with a bit of effort, make it generate small capitals to include in text works that need them. This is important to me because I use different faces of type to indicate different activities in my science fiction stories: *Oath of Fealty*, for example, used italic to indicate internal dialogue, block capitals to indicate computer-generated announcements over a loudspeaker, and small capitals to indicate when a computer was "talking" directly to an implanted receiver in a character's head.

The neat things about MoreFonts are that it's simple to use, works with all Windows 3.0 applications, and will also

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work with some character-based word processors, including WordPerfect, XyWrite III Plus, and Microsoft Word 4.0 or higher. It prints on most LaserJet, DeskJet, and compatible printers; and the letters that it puts onto a Windows screen are *much* more handsome than the ugly, jagged things that come with Windows 3.0.

Tiempo is handsome in print. It's not so pretty on-screen; at least I've seen better in the sizes I prefer to work with. However, it's much better than what comes with Windows out of the box; and more important, I can use a character-based editor to create the text and then play around with WYSIWYG by changing over to MoreFonts.

A good typescaler may be one answer to my problems. MoreFonts is the only one I've had a chance to work with so far, so I can't say what others are like; but this one is good enough for much of what I want to do. It's fast, looks pretty good on-screen, and is easy to install. Although it has a limited number of typefaces, there are enough for me. Recommended.

Whither Networks?

I have a question: Isn't it inevitable that someone will write a good shareware network program? I know, I know, very few people make money from shareware, so there's no incentive to write something so complex; but then consider, there's already a shareware Lotus 1-2-3 clone. LANtastic or something like it can do the hardware. There aren't any secrets to file and record sharing, and real hackers write as much to impress each other as for money.

Add it all up, and you wonder: Why is NetWare so expensive?

Just asking.

Systat 5.0

I've written about Systat before; this is a program I wish mightily I had when I was an undergraduate, or in graduate school, or later in postdoctoral work. Put simply, this program will do everything I was ever taught to do in statistical inference, and then a lot more; and better, it will, studied diligently, teach you when to use it, as well as how.

There is an old canard about lies, damned lies, and statistics; but the fact is that everything we know is based on statistical inference. Some things are so overwhelmingly obvious that we treat them as established facts; but most of what we know isn't quite so clear as all that.

One experiment in a high school physics lab is to take repeated measurements of some object. No matter how carefully the measurements are done, there will be a dispersion, but if enough measurements are taken, an average will be close to the true measure.

Close, but how close? If you're measuring a meter stick in inches, for example, suppose you get an average of 39.36. What are the chances that the true value is 39.37? This is a statistical question, and one quite easily answered. Suppose, though, that you can't measure the meter stick directly because you haven't any reliable measuring tapes. Instead, you have to make some sticks that are as near the length of the meter stick as you can make them and measure them. Then you find that these sticks are made of different materials, and thus respond differently to changes in humidity. Can you still find the chances that the true length is 39.37 inches?

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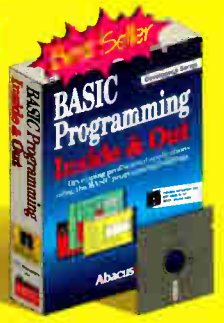

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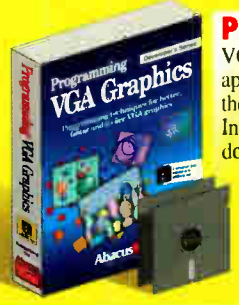

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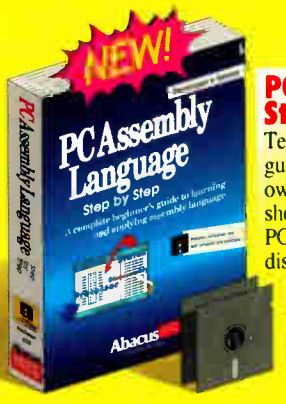

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the case I have described is pretty simple compared with those routinely faced by social scientists, epidemiologists, criminologists, and many others. It may be fashionable to denigrate statistics, but billions of dollars are allocated by statistical inferences.

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I can't claim that Systat will make statistical inference as exciting as *Fallen Angels*; but I suspect you would get more out of studying Systat than reading the book. (Actually, I recommend that you do both.) There are very few professions, business or science, that don't have questions that can be answered only by statistical inference.

Winding Down

Well, I'm now in Washington, finishing this up on the Zenith SupersPort SX, which remains too heavy while traveling, but it's still the best machine to use when I get to where I'm going. It's time to get this on the wire.

The two books of the month are reissues: Jacques Barzun's classic *Teacher in America* and Bertrand de Jouvenel's *The Ethics of Distribution*. Both are available from Liberty Fund (7440 North Shadeland Ave., Indianapolis, IN 46250, (317) 842-0880). Liberty Fund has reprinted a number of classics in history and political science, and it's well worth getting their catalog.

The gizmo of the month is After Dark, a screen saver from Berkeley Systems. This has security stuff like optional passwords to get your screen back, but mostly it's just fun: you can put an aquarium, or flying toasters, on your PC's VGA screen. There is supposed to be a Windows version Real Soon Now.

It may be all over in the desert by the time you read this, but if you're curious about the new wizard weapons, the easiest way to learn is a $10 64-page illustrated book called *Desert Shield Fact Book* (GDW, P.O. Box 1646, Bloomington, IL 61702). I sure wish some of the reporters would read this. They might get fewer things wrong.

The computer book of the month is *Undocumented DOS: A Programmer's Guide to Reserved MS-DOS Functions and Data Structures* by Andrew Schulman, Raymond J. Michaels, Jim Kyle, Tim Paterson, David Maxey, and Ralf Brown. The book, which comes complete with two disks of software, is published by Addison-Wesley. The title says it all. ■

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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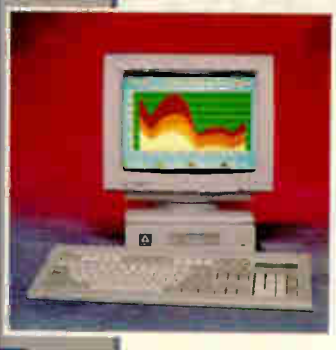

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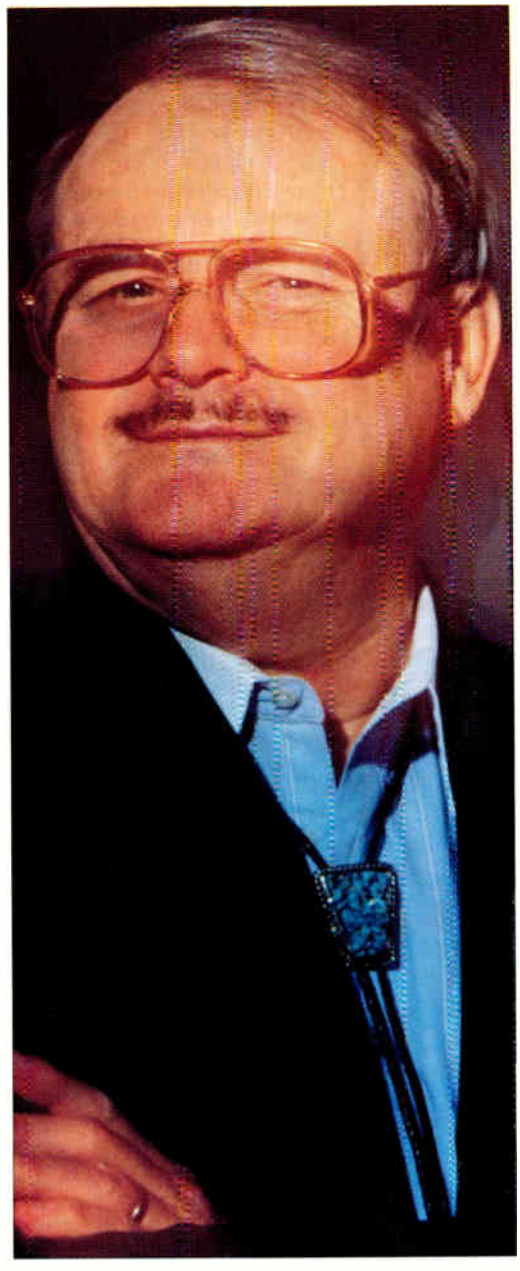

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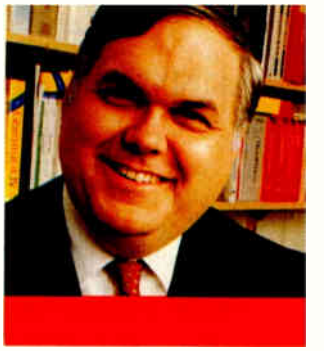

WAYNE
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THE MISSING LINK

I could tell from the despair in the caller's voice that this wasn't going to be a happy conversation. The problem was a LAN installation in a publishing company that had too many standards. Some of the people in the company used IBM PC–compatible computers. Others used Macintoshes for publishing support, while other users had workstations that were linked with Ethernet using TCP/IP. To make matters even more confusing, a few people in the company had a small Token Ring LAN that used LAN Manager, while another group was running Novell NetWare. The company wanted to connect all users together, but it seemed impossible without making a majority of users change to something else.

While a little extreme, the condition that this company found itself in was not all that unusual. Many companies suffer from a LAN implementation strategy that is more accidental than anything. Usually what happens is that some workgroup finds that it needs the services of a LAN badly enough to convince the company to spend money on it. It gets a LAN installed and everything's fine. Somewhere else in the organization, some other group decides the same thing, gets its request funded, and installs a LAN. Since neither group has ever heard of the LAN that the other has, they proceed independently and end up with two systems that are mutually incompatible.

In the end, most large organizations that started out with LANs early ended up with islands of connectivity. People who were in these groups could communicate with each other, but they could not communicate with the rest of the company. Now that LANs have become widely accepted, the organizations involved have begun to move to a corporate enterprise network. The problem is, what do they do about those islands of connectivity that have existed for some time now? Should they find ways to integrate them, or should they make everyone change to a single standard?

Standardization vs. Integration

There are good reasons why some companies opt for standardization instead of working to find a way to integrate a variety of users into an overall heterogeneous LAN. When the Federal National Mortgage Association installed LANs in its headquarters and in its regional offices, for example, the organization chose to go with a Token Ring LAN and to convert any nonconforming LANs to that protocol. Likewise, the company standardized on Novell NetWare. In the case of the FNMA, this made sense, because relatively few LANs existed, and the cost of conversion was less than the cost of having to manage different kinds of LANs.

Unfortunately, this isn't true in every organization. Sometimes there are good technical reasons to have different LAN standards. Unix machines, such as Sun or Apollo workstations, aren't going to run NetWare. A Mac is going to work best with AppleShare. Some Structured Query Language database servers require that they be on a LAN Manager–based LAN. Other applications require Novell NetWare. In those cases, giving up a particular type of LAN would also mean giving up a service you need. If you'd rather not do that, then you need to find a way to integrate heterogeneous LANs.

Getting LANs of differing pedigree talking to one another is no picnic, but it is possible

Heterophobia

The two most common connections between different types of LANs are between Apple and Novell, and between TCP/IP and Novell. This is because Novell owns approximately 70 percent of the LAN marketplace; consequently, the vast majority of communications with different LANs involves Novell NetWare in some way. Fortunately, most of the means for connecting different LANs are available for Novell NetWare, which works out nicely. A few users also need to connect their LAN Manager LANs to NetWare LANs. For those users, the options list is much shorter.

Apple connectivity is becoming quite common now that Apple has lowered the price of Macs so that they at least approach rationality. In offices where there are only Macs, the choice is simple. All you need to do is connect an AppleTalk network to each machine, and you're in business. If you also have some IBM PC–compatible computers, however, you need to have

ILLUSTRATION: RANDY LYHUS © 1991

something more capable.

There are two good ways to connect a LAN of IBM compatibles to a Macintosh LAN. The first, used by Novell, is simply to support AppleShare within the file server. The second, used by Banyan, is to use a bridge to the Macs. Both choices work well, and both have their supporters. I've never noticed any overwhelming reason to use one approach over the other. You should know, though, that as this is written, you can only use Macs with Novell NetWare 286. The software for NetWare 386 is still not yet being shipped, although this may change soon. In any case, Banyan's bridge to Apple is available for all its products and has been for some time.

Installation of a bridge to an Apple network requires you to provide a computer and two network interface cards—one for the protocol you're using on the LAN and the other for AppleTalk—and to install the bridge software on that computer. This means that you must dedicate a computer to the task. With Banyan, this is your only choice; with NetWare 286, you can use a bridge or use the server directly.

Installing the Apple network on the NetWare server requires that you install an AppleTalk card in the NetWare server. This counts as one of the four network interface cards that NetWare can support in the same server. Once you install the card, you have to install a software driver called a value-added process. The VAP allows the Apple network to have access to the NetWare file server. This also means that it can share files with any other computer on the network.

With either Banyan's Vines or with Novell NetWare, the PC-based LAN appears to a Mac user as if it were a standard AppleShare network. Access to the network simply involves clicking on the network's icon. It then appears as if it were any other disk drive. The only real difference is that many of the PC data files cannot be used by Mac software without some conversion. In a few cases, such as with Microsoft Word and with WordPerfect, the conversions are simple.

Uniquely Unix

As the workstation market grows, and as more companies follow the U.S. government's lead into accepting Unix as a standard operating system, the need to connect Unix-based machines to PC LANs grows as well. The government POSIX standard and the GOSIP standard that accompanies it are providing a basis for compatibility that really hasn't been part of Unix before, despite the claims of the Unix believers. POSIX, of course, is really Unix by a different name. GOSIP is the communications standard for POSIX networks, and it includes TCP/IP. The GOSIP standard used to exclude TCP/IP, but users refused to give in, so the standard was changed.

In any case, Unix-based systems and close relatives usually communicate using TCP/IP. Other minicomputer and mainframe systems can also use TCP/IP, as can some wide-area networks. Most LANs, except for those of Unix machines, don't use it. As you can see, these two types of networks are both too important to ignore each other. But right now they do, although a number of vendors have solutions.

As with the Apple networks above, there are ways to connect PC-based and TCP/IP-based networks. These connectivity solutions typically involve bridges, gateways, and routers. When you're connecting with a Unix-based system, you

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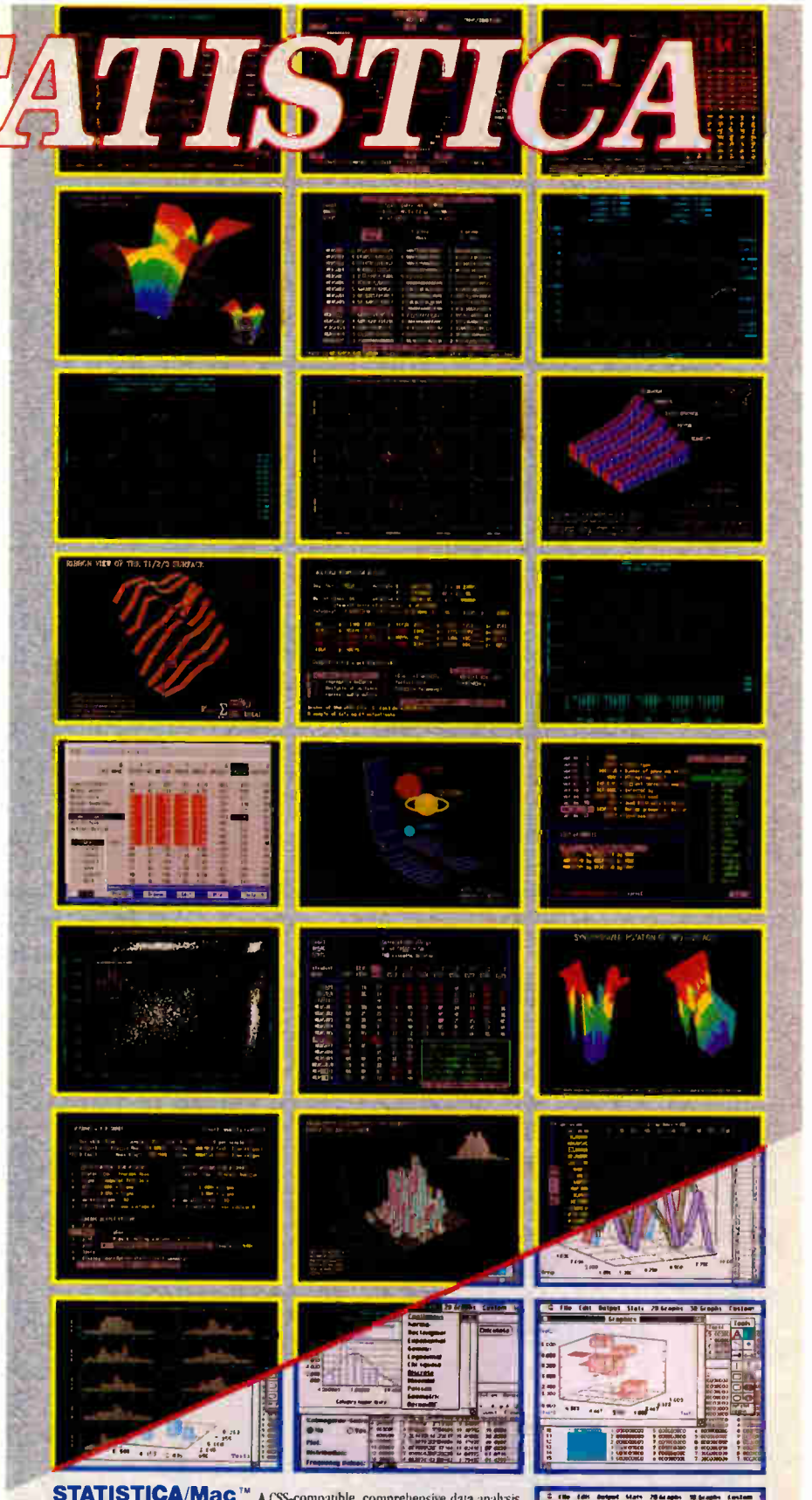

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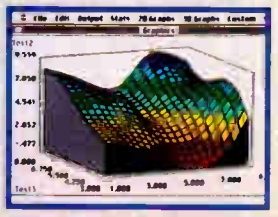

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might find yourself using all three somewhere in the scheme.

Part of the reason for the complexity is that Unix systems and TCP/IP normally use Ethernet as the basis for their LAN systems. While it's now possible to run TCP/IP over Token Ring, it's still pretty rare. PC LANs, of course, can use any of several LAN protocols, although Ethernet, ARCnet, and Token Ring are the most common. This means that you need to connect a PC-based LAN that might be running on nearly anything to another LAN that's running on Ethernet. If your PCs are also using Ethernet, that simplifies the solution, but only partly.

If you're not already using Ethernet for your PCs, you will need to use a bridge to Ethernet. I talked about bridges in my March column, so you might want to check there to find out more about those devices. Once you've solved the Ethernet connectivity, you need to get your network operating system to understand TCP/IP.

Two common approaches exist for connectivity between LANs that involve TCP/IP. One approach, used by The Wollongong Group and others, employs a router. The other, used by Racal-InterLan, uses a gateway. Both approaches work well, although the approach you choose may depend to some extent on what you're already using for a LAN.

The Wollongong approach to TCP/IP connectivity puts a router on the Ethernet that looks for packets addressed to a TCP/IP device and converts them. The router consists of an IBM PC compatible with a network interface card and the company's TCP/IP router software. One connection to the LAN is required for the Ethernet and another for whatever else you're using. The router also looks for TCP/IP packets destined for a device on the PC LAN and converts them. The Wollongong device will support several types of LANs, although its best performance seems to be with Novell IPX-based LANs.

LAN standards have been a moving target for some time now.

For LANs that are already based entirely on Ethernet or that are bridged elsewhere, Wollongong makes a product called WIN/TCP for DOS, which allows communications between a DOS workstation and a TCP/IP device. The DOS workstation can then access the TCP/IP device, and the device can send information to the LAN using TCP/IP's file transfer protocol to copy the file to a workstation. Since the file can be transferred to the virtual drive that appears when you're using the LAN, this means that you can move files from a TCP/IP device to the network file server.

Racal-InterLan uses a hardware solution for connectivity between Novell's IPX LANs and TCP/IP. Its latest product, called TCP Server, is a package of two circuit cards and some software that

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must be installed in an IBM PC compatible. It provides full bidirectional connectivity between NetWare 286 or NetWare 386 and any TCP/IP LAN. The two cards include the company's server card and NP600/XL network interface card. You will need to provide another compatible network interface card. The Racal-InterLan product allows users on the TCP/IP network to have complete access to the NetWare LAN, just as if they were NetWare users. This is a more complete solution than the Wollongong approach, which supports mail and file transfer but not full interoperability.

Racal-InterLan also developed a solution to the thorny problem of providing interoperability between NetWare and LAN Manager networks. Using a product called the LMNS, users with NetWare and version 1.x of LAN Manager could have complete interoperability. Unfortunately, Racal-InterLan found that the rapidly shrinking LAN Manager market wouldn't support the product, so it withdrew it, but the company will still sell it to LAN Manager 1.x users on request. If you have version 1.x and a Novell LAN and have to connect them, LMNS is an excellent solution.

ITEMS DISCUSSED

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The Novell Approach

When Novell announced NetWare 386, the company said that it would provide support for LANs of many types, including AppleTalk and TCP/IP. While this support hasn't appeared as of this writing, the products are expected to appear along with the release of NetWare 3.11 in late March, so you'll probably be able to find them by the time you read this. The Novell solution is to base everything in the file server. To connect your Macs, for example, you will make sure that you have loaded a software driver called a NetWare loadable module, and the Macintosh connectivity should be transparent. The TCP/IP connectivity is supposed to work the same way.

Complete interoperability is still a ways off for TCP/IP. The standard TCP/IP support that's shipped with NetWare 3.11 simply allows NetWare servers to use a TCP/IP backbone to communicate with each other. The LAN Workspace for DOS gives workstation connectivity to TCP/IP LANs. Because Novell has already pledged to support Open Systems Interconnection and GOSIP, there's a good chance that the level of interoperability will increase as time goes by. Right now, though, you're still restricted to third-party products. Fortunately, some of them, including those from Wollongong and Racal-InterLan, are superb.

Putting It All Together

Now that you've seen that some types of interoperability are indeed possible, it's time to see how you'd make it all work. You've probably gathered that nearly any LAN can find a way to communicate with TCP/IP. In the case of otherwise insoluble problems, it's always possible to use TCP/IP as a way of providing limited communications between one type of LAN and another. Unfortunately, you won't always get the full interoperability that you may want, but you will get E-mail, file transfer, and possibly network management. If this is a sufficient level of support, then connectivity between different types of LANs is possible.

Likewise, most network operating systems have a way to connect with Macs. Now that Apple has announced that Macs will come with Ethernet as a standard, this connectivity may become easier. On the other hand, it may not. Apple, as is frequently the case, was confronted with the option of working within accepted industry standards or finding a way to keep the price to its customers up a little, and it opted to ignore industry standards and keep the price up. This means that while you will probably be able to connect your new Macs to an Ethernet LAN, it's not clear whether it will do you any good.

If there is one area of enterprise networking that remains more difficult than it probably should be, it's interconnecting different kinds of LANs. Part of the reason for this is that LAN standards have been a moving target for some time now. Another reason is that most vendors of LAN operating systems would prefer that you stay with their products exclusively. While this may be understandable from their viewpoint, it does little to meet your needs unless the LAN vendors provide a total solution. At this point, no vendors provide that kind of solution, unless your needs are quite simple.

Right now, it looks to me as if the LAN business is still in the process of settling out after the shock from 3Com's abandonment of the network-operating-system market. 3Com was a major vendor of LAN Manager, and the company announced in January that it was quitting that market entirely. This and other moves may indicate that LAN Manager is sinking, perhaps permanently. At this point, it's clear that the LAN Manager market share is shrinking in all segments except those users who insist on a true-blue approach to networking. Even this may not last long, as IBM and Novell are already having serious discussions about an IBM move to NetWare as a standard.

If LAN Manager does indeed suffer another blow, users will find their problems suddenly simpler, because there will be fewer players in the market to consider. Essentially, the PC LAN market will belong to Novell and Banyan. Of course, the fact that it's simpler also means that there's less choice and fewer competitors, and that's not likely to help users in the long run. ■

Wayne Rash Jr. is a contributing editor for BYTE and a principal and technical director of the Network Integration Group of American Management Systems, Inc. (Arlington, VA). He consults with federal and private sector clients on microcomputers and communications, and he is co-author of two books for business network users: The Executive Guide to Local Area Networks *and* The Novell Connection. *You can contact him on BIX as "waynerash," or in the to.wayne conference.*

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

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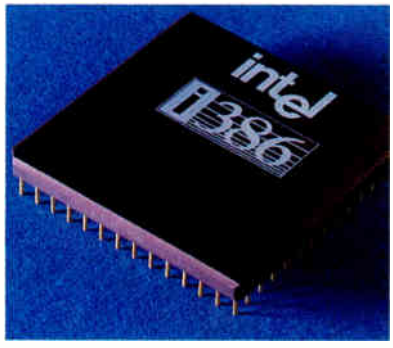

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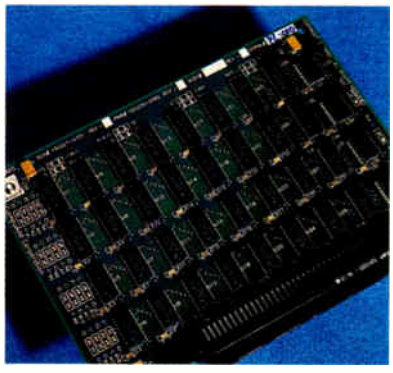

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BYTE columnists, staff, and contributors debate the issues

IS IT TIME TO TELECOMMUTE?

Roundtable is a forum in which BYTE editors, columnists, and contributors debate key issues that affect how you purchase and use hardware and software. The "conversations" take place on BIX.

TOM THOMPSON: The outlook for both the U.S. economy and environment seems grim. According to the Administration, our energy policy is going to promote little conservation.

So we'll still be driving inefficient cars, polluting the air, while domestic oil exploration could damage our environment. But with the network of wires, cables, and fibers, why can't more employees telecommute via modem? If a significant percentage of employees worked via modem out of their homes, we would win in several areas: less oil consumption, less pollution, and less traffic, which would give our crumbling infrastructure a reprieve. But can telecommuting work? Will we miss the synergy of minds meeting around the coffee pot? Will some people simply goof off? Is enough of an "electronic infrastructure" in place for telecommuting to work?

STAN MIASTKOWSKI: From 1982 to 1986, I worked for a company whose entire structure was based on telecommuting. The company had about 150 employees. I was publications manager and had a staff of eight writers and editors scattered across the country.

Telecommuting is tough. Managers have to trust their employees, and the people who work for them have to be those ever-popular "self-starters" who can work independently. I had the most luck hiring people who had spent substantial parts of their careers working as freelancers.

The biggest problem wasn't lack of communication. We had E-mail, daily telephone talks, and weekly conference calls. The biggest problem was being alone in the house most of the time. After a while, you feel incredibly isolated (especially in a rural area). Productivity, however, was very high. People were free from the tyranny of the time clock and could attune their work to their body clocks. Telecommuting also requires top management that's committed to the idea and willing to back it.

BEN SMITH: I spent the year before starting at BYTE telecommuting. At least once a day, I would walk to the neighbors' just to see some human beings. My work was solid, though. Unlike working at BYTE, my phone rang only when there was something important or a scheduled, daily conversation. I found that I worked an easy 10-hour day, because I was able to mix work with doing the household chores, which provided a nice break from sitting at my desk.

OWEN LINDERHOLM: It does work, but telecommuting isn't a good substitute for human contact. I only get to know all of you by way of the rather impersonal conferencing system on BIX, occasional phone conversations, and rare personal meetings. The personal meetings are extremely important. They allow me to add some real images and insights when I am dealing with you all on BIX. I can understand some of the subtleties, crosscurrents, and undercurrents much better than I can with people I've never met.

It is very important to have a conferencing system like BIX. E-mail doesn't work because it is too difficult for more than one person to access a single message and, hence, whatever ideas and thoughts it contains.

JERRY POURNELLE: Arthur D. Little has for years encouraged senior analysts to stay home at least two days a week, but also insists they come to the office for two days. Everyone is supposed to be there the same two days, as I recall.

FRED LANGA: I recently spoke with some laptop designers toying with the idea of bundling something like PC Anywhere or Carbon Copy with their next round of

machines. Those programs allow you to control your work PC from your laptop. It's a great idea that should give telecommuting a boost.

I've found it immensely useful, for example, to phone my at-work PC from some hotel or from home and access the office LAN to use the BYTE archives or to review files for upcoming issues. If I need to, say, send a memo to the publisher, I can create text on my laptop or at home and print it out on the office laser printer where the office manager can grab it and treat it exactly as if I were sitting in my normal office.

None of this replaces face-to-face contact or completely eliminates the need for a central office. But it sure can maximize the work you can do away from your normal desk, and it allows you to stay productively mobile for longer periods than ever before.

LARRY LOEB: The essence of a meeting can be captured on a conferencing system, as this very conference shows. Each message interacts with those that have come before it, extends a thought, and crystallizes it. Body language and subliminal messages get lost over a phone line. But for discrete, task-oriented work (like writing articles), conferencing is the way we will be working in the future.

DON CRABB: Remote telecommuting software that incorporates sampled video (for a sort of Keystone Cops look) displayed on each telecommuter's screen helps to restore that lost body language. I've used the Farallon setup remotely, with nothing fancier than a couple of inexpensive 8mm Sony Camcorders feeding their sampled signal, plus compressed voice, into the text stream of the meeting. It's impressive what the pictures can bring to the mix and the "live real meeting" feel.

WAYNE RASH JR.: Even if not everyone has E-mail, getting such a thing is clearly within the capabilities of those who wish to have such. Actually, even if telecommuting required a fax machine, computer, modem, and E-mail account, it would require far less in financial and energy resources than does the purchase of an automobile. Goofing off isn't a problem, since there are ways to measure productivity that don't require a time clock, and ways of defining a job that don't require a person's presence.

Much work is done in ways that don't lend themselves to telecommuting. Some of the most important ideas in any company come from the dynamics of people

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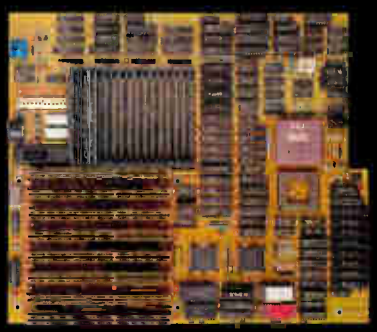

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meeting in the physical presence of others. A great deal comes from a person's words, but a great deal also comes from people's gestures—their body language if you will—and even how they conduct themselves at a meeting while they aren't speaking. Much of this information cannot be carried over the line on a conference call, much less carried in E-mail. The bandwidth of electronic media is still far too narrow for the communications that people actually use.

The result is that in a telecommuting workplace, those who get ahead will still be those who are physically present at least part of the time, simply because it will be their ideas that are presented most effectively. This will limit telecommuting to certain specialities (like COBOL coding) that can be done by solitary workers, and even those will require some physical presence. In any case, while telecommuting is technically possible, I'm not sure that it's socially possible yet, and I don't think it will be until we get communications that work with more than just what we can currently squeeze through a modem.

PETER WAYNER: Everyone has probably heard the apocryphal urban folklore about the young office star who would come in at 4 a.m., get all the work done by 9 a.m., and then spend the rest of the day chatting with everyone. Pleased his boss and knew everything about the company. Electronics don't work for that.

CRABB: Wow! Telecommuting is only useful for certain specialities like COBOL coding? Give me a break, Wayne! A 1989 Department of Commerce survey showed that almost 28 million people either worked at home as sole entrepreneurs or as part of their office job. Another 10 million are expected over the next two years to do more and more of their office work at home as telecommuters. These figures already indicate that the home office and home workplace are far more than just places where speciality workers are and will be working.

MIASTKOWSKI: I see little possibility of full-time telecommuting becoming a reality in the next five years or so. In my experience, the biggest roadblock is old-style management that thinks employees must be watched and controlled. Admittedly, some people do fall into this category. But employees who are trusted and rewarded can give companies incredible productivity. I think telecommuting will ease into reality, with more and more people spending a couple days at home and a couple at the office.

Another problem with working full-time at home is that there's no easy break between home and work. When I worked at home full-time, I often felt as though I never left work, often going back into my office after dinner. It's a habit that's hard to break. Even though I now spend a full-time week at the BYTE office, I often spend my evenings working at home.

LINDERHOLM: People using E-mail and conferencing systems seem to be ruder than they are in person (perhaps to do with "talking to a machine"). I believe that studies show that frequently the same individual will be a lot ruder in communicating over E-mail than in person or by letter. If it is true, then it is a serious hindrance to telecommuting and will be a social issue for telecommuters.

JON UDELL: On the other hand, it's often noted that E-mail exerts a kind of social leveling effect—that is, it flattens a hierarchy and puts participants on a more equal footing than they would be face to face. Some corporations value that. Others, I suppose, would be threatened by it.

KEN SHELDON: It can work, but it sometimes doesn't. Case in point: I came into the office on Saturday before heading out for a business trip, hoping to get a lot of work done. A lot of the things I had to do involved BIX. Guess what? BIX was down for maintenance for the couple of hours that I was in the office. I was extremely frustrated.

CRABB: The inherent unreliability (because of complexity, overstressed systems, and other reasons) argues for everyone who plans to use electronic communications systems to have several backups ready to go. Something like a macro that lets you step through BIX, MCI Mail, and CompuServe until you make a connection and get through.

This kind of intelligent networking (where a background agent runs through the connection possibilities for you, makes the connection, dumps your messages, downloads new mail, and so on) might help ameliorate the inherent unreliability in each service. Remote systems that accomplish this intelligent connection without any user control (the way a good private-branch-exchange switch automatically selects the cheapest and most reliable outgoing long-distance telephone service for each call it will complete) might be the real breakthrough technology in portable computing. ■

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FEATURE

Future Documents

Microsoft's OLE technology and HP's New Wave make it easier to combine text and graphics in "compound documents" for Windows

MARTIN HELLER

When I did my Ph.D. thesis "on the computer," more years ago than I care to admit, I was faced with 2 hours of pasteup every time I produced a draft. The thesis was done on the mainframe, all right, but the text was printed out on a line printer while the figures came off a Calcomp plotter.

My thesis was, in fact, a "compound document": It combined materials from several sources on one page. This magazine article is another compound document: It combines text, screen images, and artwork on the printed page. Corporate annual reports are another good example; typically, they combine text, financial statements, photographs, charts, and artwork in a slick package designed to make investors feel good about a company.

One of the goals of the desktop publishing revolution has been to eliminate the pasteup step from the printing process. For very high-quality documents, the goal is technologically unrealistic: You're just not going to get photographic quality from today's scanners and laser printers—certainly not anywhere near the quality of good four-color lithography. But for less demanding documents—an internal memo on fourth-quarter sales, for instance—the technology is more than adequate.

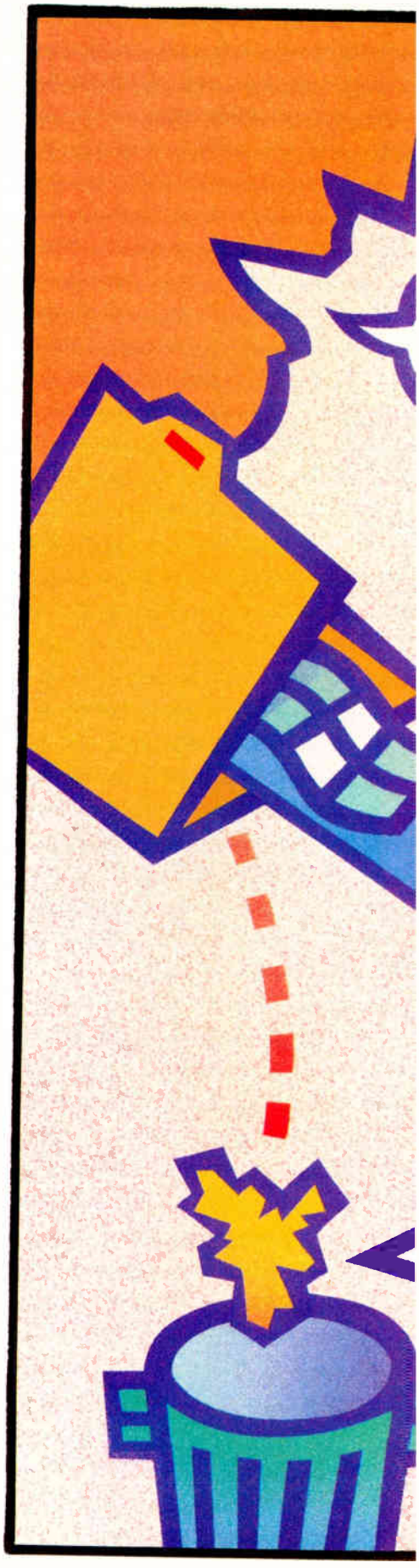
BYTE ACTION SUMMARY

Documents are no longer just static text. HP's New Wave and Microsoft's recently announced OLE are two technologies that let documents contain text, graphics, and spreadsheets that are linked together and automatically update each other.

Out of Data and Missing Links

So why don't more people produce compound documents? Because it's a pain in the neck, that's why. Consider the classic example of a spreadsheet that's used in a word processing document. Say, for instance, that the spreadsheet was produced by Excel and is named SHEET.XLS. You use the Copy command in Excel; then you can either Paste or Paste Link in your word processor, such as Word for Windows.

If you choose Paste in Word, what you'll get is an image of SHEET.XLS as it existed



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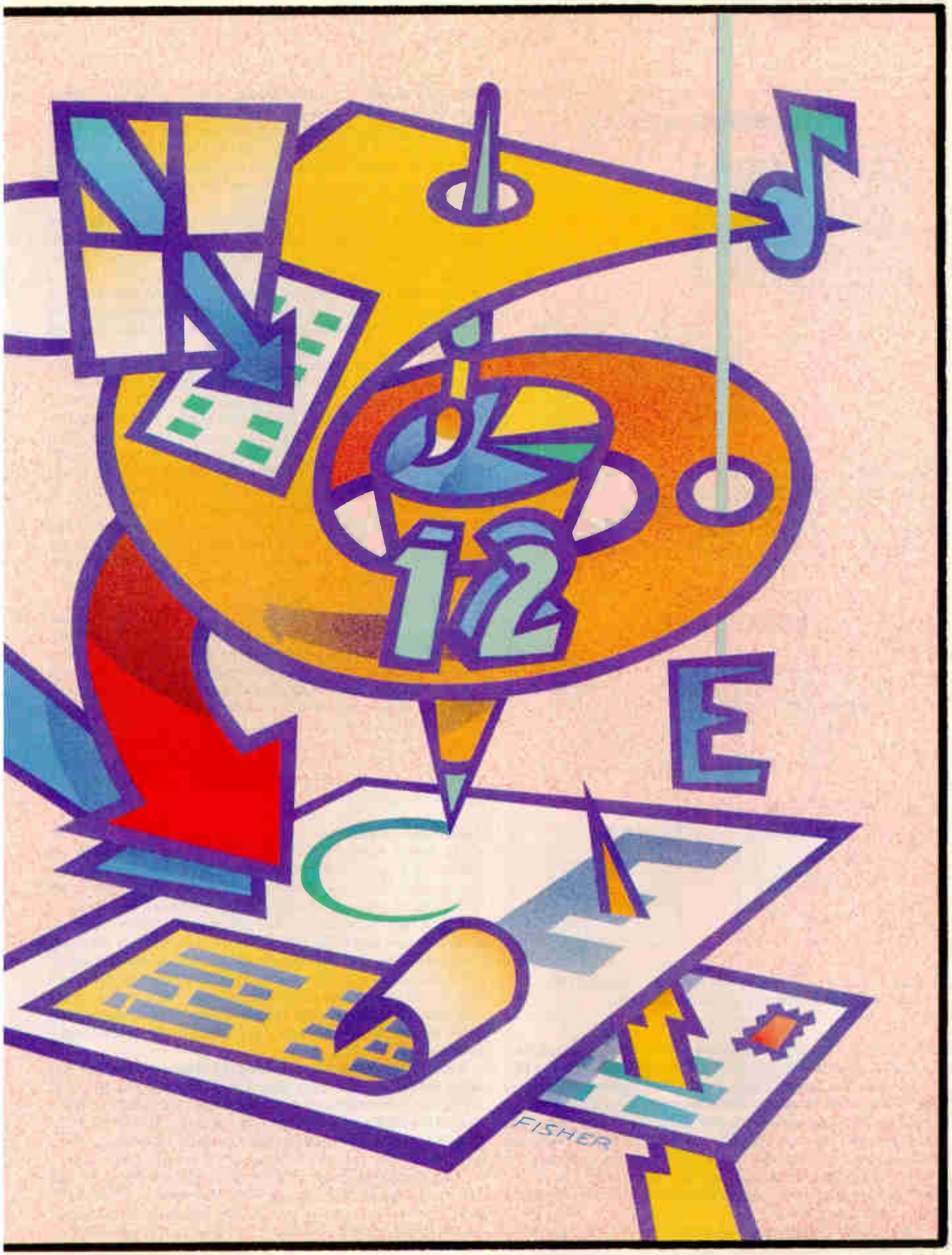

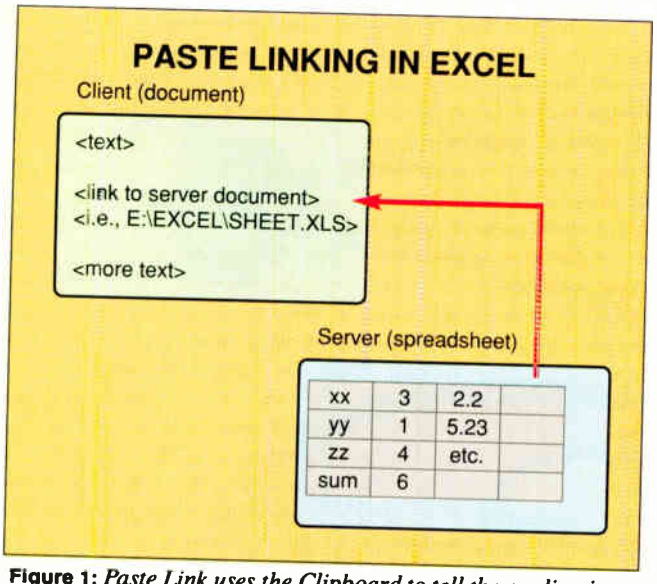

Figure 1: *Paste Link uses the Clipboard to tell the application what to link, and it uses DDE to do the transfer. The document acts as a client requesting the information from the server, the spreadsheet. Behind the scenes, there is a conversation between the client and the server that links the data.*

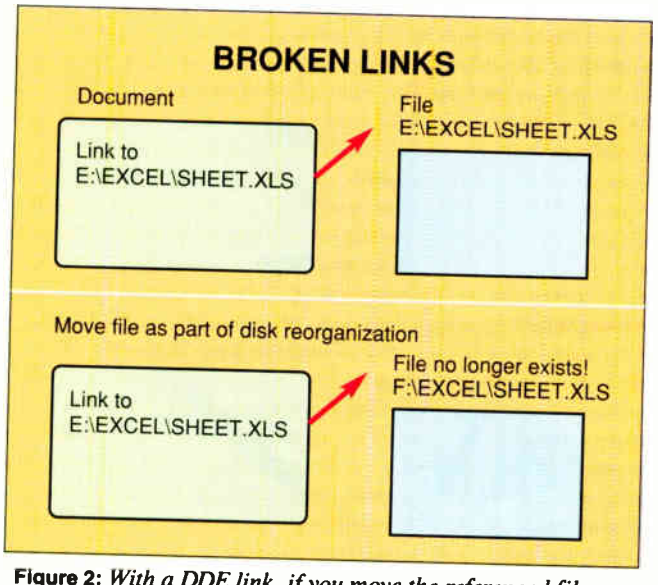

Figure 2: *With a DDE link, if you move the referenced file, the link will end up pointing to a nonexistent file.*

the moment it was created. You can now format the spreadsheet as a table and produce your memo. Pasting doesn't involve Dynamic Data Exchange (DDE); it uses the Clipboard to pass all the information. However, when the spreadsheet changes (e.g., when the new sales numbers come in on the second day of the month), you'll have to Copy the spreadsheet to the Clipboard and Paste it over the old image. If you forget to update the Word document after you update the spreadsheet, you'll have the embarrassing experience of circulating a memo containing last month's numbers.

On the other hand, you could choose Paste Link from Word for Windows. Paste Link uses the Clipboard to tell the application *what* to link; the actual linking is done using DDE. After you choose Paste Link, you'll get a little dialog box asking if you want the link to update anytime the sheet changes; if you say yes, Excel will control when updates happen. If you say no, Word will control when updates happen. You'll also see the specification for the link, which may be something like E:\EXCEL\SHEET.XLS. (See figure 1.)

Assuming that the DDE transfer works (and it might or might not, depending on how you've configured your system), you'll see the spreadsheet information appear in your document, and you'll be able to format it as a table and print it. Next month when you bring up the document it should automatically try to reestablish the link and get the updated spreadsheet. The key word here is *should*—the automatic update doesn't always work, either.

Here's why: Suppose you give a copy of your document to someone else in your company. Inside the document, there will be a field with the information DDE "E:\EXCEL\SHEET.XLS." But SHEET.XLS won't be on your colleague's E drive. That person may not even *have* an E drive and, most likely, won't have an E:\EXCEL directory. Even if you give him or her a copy of SHEET.XLS, that person will have to edit the DDE field in Word to point to the directory in which he or she chooses to place the spreadsheet (see figure 2).

It isn't so bad to update one field. But suppose there were 100 fields and each one had to be manually corrected anytime the file was transmitted. It happened to me—once—when I had to edit a manual someone else had written. Suffice it to say I'd rather not repeat the experience.

Clearly, the broken link problem can be serious—even more so than the obsolete image problem. But there are solutions. HP's solution for both problems is New Wave, which has been around for three years. Microsoft's solution, called OLE, is a specification for integrating information from multiple applications in a single compound document. I have a production copy of New Wave 3.0 installed on my machine, and I'm running it now; I have a beta-test copy of the OLE developer's kit and a handful of OLE applications installed as well. In fact, you can run both at once, and if you are a developer, you can make your programs support both.

Microsoft's OLE

OLE, which stands for Object Linking and Embedding, is Microsoft's open, industry-wide specification for compound documents. "Industry-wide" in this case means that Microsoft incorporated input from other major software developers—Lotus, Aldus, WordPerfect, and Micrografx. *Linking* refers to a process very much like DDE—in fact, it's a process currently built on DDE—that lets one document refer to another document that can also update it in real time. *Embedding* refers to a process very much like clipboard pasting—which *isn't* actually clipboard pasting—that lets one application's document contain information created by a second application in the second application's native format.

I mentioned earlier that DDE doesn't always work because of setup problems. OLE takes care of the setup problems by registering all OLE-aware applications in a central database. It takes care of the DDE problem of one application needing to know the details of another by establishing a protocol of standard topics and procedures with which the applications talk to each other.

An example is in order here. Suppose you're working on that same old sales memo—the one with the spreadsheet numbers. And suppose you want to have, in addition to the spreadsheet, an illustrative graphic and a chart based on the spreadsheet. And suppose that you've got a word processor that supports

OLE, along with a spreadsheet, a chart maker, and a drawing program that all support OLE. You can set up the compound document with embedding, linking, or both. Since you're going to update the numbers every month, you do the spreadsheet and chart with linking. Since the graphic won't change often, you do it with embedding.

You write your memo. When you come to the spreadsheet, you insert a field that links you to the spreadsheet using OLE—as opposed to the DDE field you used to use. The OLE link is pretty much guaranteed to work, because all OLE applications know how to communicate with each other, and the information needed to start each OLE application is kept in a central database. (That isn't true of DDE applications.)

So you see the spreadsheet figures in your document. Only this time, instead of seeing raw numbers that you have to format in Word, you see the spreadsheet as it would be displayed by Excel. This is because, as part of OLE compliance, Excel has provided a spreadsheet "viewer" for use by other applications.

Now things start to get tricky. You want the chart to be based on the spreadsheet, and the chart in turn to appear in the word processing document. Can you do it? Sure enough: You can create the chart within the spreadsheet as an embedded document (Excel knows enough to update internally linked graphics from data) and then link the chart to the word processing document. When you change the numbers in the spreadsheet, the chart changes automatically, and both change automatically in the word processing document (see figure 3).

Finally, you create and incorporate the graphic. You can use an OLE-compliant version of Windows Paintbrush to create the graphic. How? Either from Paintbrush, or directly from the OLE-compliant version of Word. To do the latter, you'd `Insert Embedded Object` (or something like that) in Word and then select Paintbrush as your server. Paintbrush would automatically open up and tell you that you were editing an embedded object. You'd draw your graphic and close Paintbrush. Instead of going into a .BMP file, the drawing would go directly into the compound word processing document.

Anytime you wanted to modify the drawing, you'd double-click on it within Word, and Paintbrush would come up with the drawing loaded. Pretty neat stuff, and not that far out: I have versions of Cardfile and Paint modified for OLE that work in just this way. (Obviously, the drawings go on cards rather than on a Word page, but the mechanism is the same.)

One thing that isn't fixed by the current implementation of OLE is the broken link problem. If you create links and then move the documents, the links will break. If you embed rather than link, you don't have to worry about the connection breaking, but you do have to worry about the copy becoming obsolete. So you have to decide in each case whether to embed or link. Embedding gives you a copy of the document that won't get lost but might become obsolete; linking gives you a connection to the document that won't become obsolete but might get broken.

OOFS: Files as Objects, Objects as Files

OOFS is an acronym for Object-Oriented File System. In programming jargon, the combination of some data and a program that knows how to deal with the data is an *object*. This terminology is widely abused and very confusing (since *object* has a much more generic meaning in common usage), but it's what *object* means in this case. The combination of Paintbrush and a bit-mapped image can be an object, for instance, and it is an object that can be *contained* within the OLE specification.

Objects don't necessarily have to be what you'd normally think of in terms of a written document. Given sound-recording

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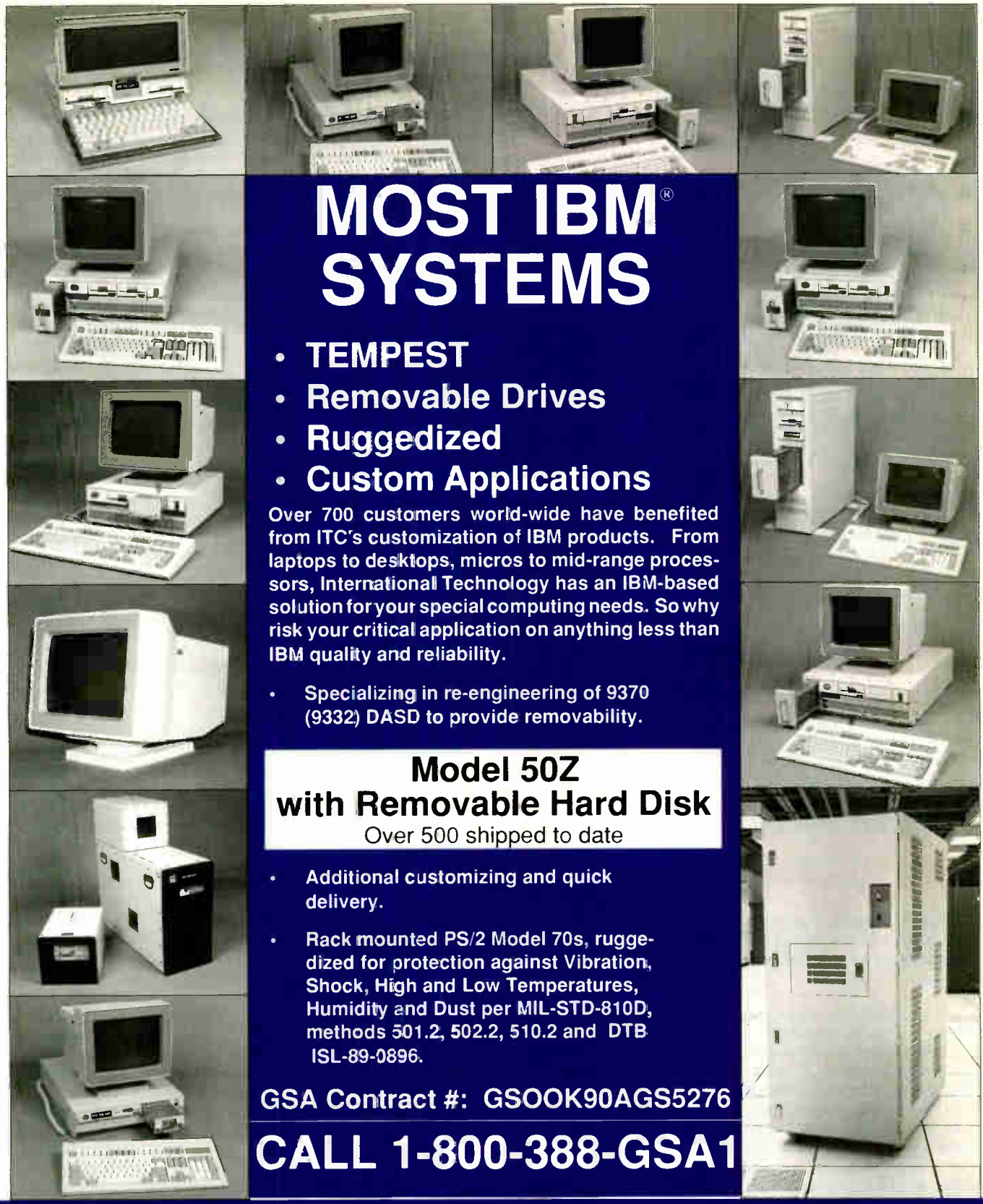

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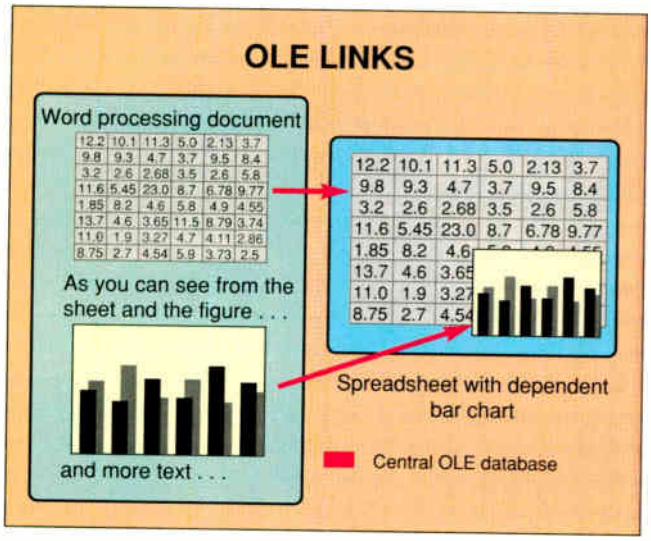

Figure 3: *With OLE links, the format of the linked documents is automatically applied because there is a central database and a set of "reader" programs for OLE-compliant applications. Here, a word processor document contains links to a spreadsheet and its embedded graph.*

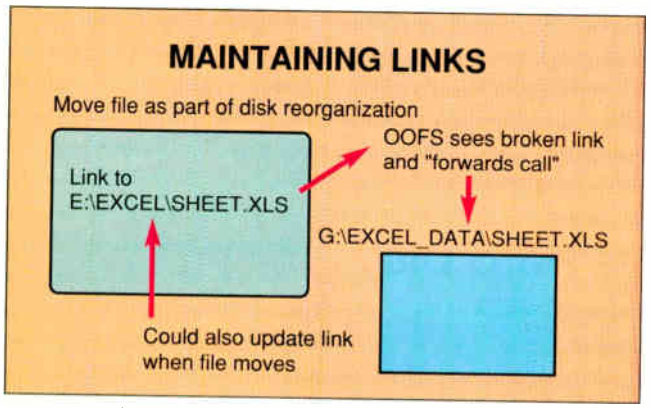

Figure 4: *The object-oriented file system will resolve the problem of broken links described in figure 2. Any file that is moved leaves a forwarding address.*

and playback capabilities, voice, music, and sounds can be objects. Given an animation player, animations can be objects. Given a way to record and play back handwriting, handwritten notes can be objects. Given a videotape or CD-ROM controller, video segments can be objects.

Back to the image object. All of Paintbrush is not carried around inside a Word document. The "object" contained in this case can either be an embedded object (in which case the data is actually inside the Word document) along with a flag that says what program knows how to edit the data, or it can be a linked object, in which case what is inside the Word document is the name of the linked document along with the flag for the program to use to edit the data.

Back to the subject of an "object-oriented file system." What this term seems to promise—and no more than promise, as Microsoft is loath to tell more—is a file system that can track objects and is oriented to, and knows about, the sorts of compound documents and linkages I've been talking about.

You can hope, at least, that the object-oriented file system would be able to remember that your spreadsheet is linked to your word processing document. You can also hope that, when you mail your document electronically across a network to a colleague, the file system recognizes and automatically ships all the linked documents along with the container document, or it maintains the linkages across the network. You can also hope that, when you have a major housecleaning and reorganize your hard disk, the file system will know that the spreadsheet previously in E:\EXCEL\SHEET.XLS is now at G:\EXCEL_DATA\SHEET.XLS. Think of the file system as a telephone exchange; you want the file system to do the equivalent of forwarding your calls when you change offices (see figure 4).

Old New Wave

Unlike OLE, HP's New Wave is well beyond the planning and development stage. It has been running on HP Vectras (and other similar machines) for several years now. It is also about to ship on HP-UX workstations.

New Wave is implemented as a layer on top of Windows. The New Wave Office window is a "root" object that owns all New Wave tools and objects. Tools are resources (e.g., printers), represented on the desktop as three-dimensional icons. Objects are data (e.g., files) of specific types (e.g., applications), which may in turn contain other objects.

People familiar with the Macintosh or the old Xerox Star will find New Wave easy to work with—much more so than Windows itself. You throw things away by dragging them to the trashcan (later, you can root through the trashcan or empty it). You put files in folders by dragging them to the folder icon. You put folders in the file cabinet by dragging them to the cabinet icon. You print a file by dragging it to the printer icon. You open a folder, file, or any object by double-clicking on its icon.

New Wave also has helpful *agents*, which are scripts for automating activities. (The agent icon wears FBI-ish sunglasses, a little pun.) New Wave also has *bridges*, its own version of the .PIF file that contains the information on how to run both DOS and Windows applications. (Bridges are much more complex and important than .PIF files.) And New Wave has *object containment links* (described below).

While OLE requires you to choose between embedding and linking at each step of producing a compound document, New Wave links between parent and child objects with a more integrated strategy: object containment links. These are internal links to external files, the information maintained in a database. As long as you use New Wave (rather than DOS or Windows) to work with New Wave documents, your links are unbreakable, even when you send documents across a network.

New Wave's intelligent database, the Object Management Facility (OMF), maintains linkages using a second *name space*, a second file-system directory that maintains its own list of New Wave–style filenames and the DOS paths to them. (You can convert documents to and from DOS files.) In the far future (with Windows 4.0 and DOS 6.0), Microsoft file systems will maintain linkages in a single name space. Microsoft is not likely to ship such an object-oriented file system before 1992, and in any case, it will require the Installable File System capability scheduled for inclusion in DOS 6.0.

New Wave is reliable with the current DOS file system, and it is fully hierarchical. New Wave objects can be moved into folders, and folders can be moved into the file cabinet. Objects can be contained in other objects, and they can be shared. You can use a single TIFF image in multiple New Wave Write documents and also have the image available from the New Wave Office desktop as an icon.

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If there is a problem with New Wave, it is that relatively few applications are available that fully support it. Why is this the case? For one thing, New Wave was not very practical for end users before Windows 3.0 was introduced. For another, New Wave development has been difficult: Most developers had difficulty getting their applications working as stand-alone applications under Windows, a few hardy souls implemented DDE and Clipboard transfers, and only the bravest went on to support New Wave. Developing a program that is part of a larger system is very different from developing a program that is a "thing unto itself," alone in its own universe.

HP is currently working hard to make New Wave support easier for developers to implement. The company is enhancing New Wave's bridge capability to stay ahead of OLE, but it is hedging its investment by redesigning the New Wave developer's kit so that applications supporting OLE will need very few changes to also support New Wave.

OLE Implementation

As it is currently designed for Windows and Presentation Manager, OLE manages compound documents using the Clipboard and DDE. Copy commands offer multiple formats to the Clipboard in order of their fidelity (the most preferable ones first). Applications that want to use the Clipboard should specify a format as well as content. An application wanting to paste from the Clipboard should take the first object with an appropriate format. (You wouldn't, for instance, paste a picture where text was expected.) Link is one of the possible formats on the Clipboard; it is offered only if the copying application can act as a DDE server.

Along with standard, descriptive formats like Rich Text File and BIFF, applications can use native formats for private data, and OwnerLink formats for embedded objects. Native and OwnerLink data can be handled by object-specific libraries; the "viewer DLL" concept helps to make OLE more object-oriented and extensible than ordinary DDE.

Suppose you are writing an OLE-compliant application that supports compound documents. You have in the middle of your private data format a "foreign" format—the embedded object. Somehow you have to connect this unknown format with a server that knows about this object.

The information on what server handles what formats goes in a central registration database. In the beta-test version of OLE, the registration database is just a few lines in WIN.INI. The final implementation, however, will have a real database to handle registrations, presumably to efficiently look up the hundreds—or thousands—of OLE servers that will become available.

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Clients and Servers

An application that wants to receive or contain data from another application is called a *client* or a *container*. An application that can provide the data or edit an embedded object format is called a *server*. This terminology isn't much changed from that of DDE clients and DDE servers. But a few things have been added to make DDE work better; one of these is protocols.

For instance, the standard OLE protocol is called `StdFileEditing`. If a client has an embedded object that the user has double-clicked, the container sees that `MyApp` is the server for this object. Then the container checks that `MyApp` can support `StdFileEditing` with an OLE library call:

```
if(EcdCreateFromClip("StdFileEditing",
  pStruct,&lpObj,
  option,cfFormat)==ECD_OK) {
 <actually do the editing>
  }
```

As you can see from the above code, OLE library calls begin with the prefix `Ecd` and return a status defined with the prefix ECD_. ECD stands for Extensible Compound Document, which was one of the many early names for OLE.

The OLE interface makes heavy use of a table of function pointers, called a `vtbl`, and a pointer to this table, called a `vptr`. The return codes from all the OLE functions are an enumerated type (ECDSTATUS) with values ECD_OK, ECD_ERROR_MEMORY, and so on. A general object structure, `struct _ECDOBJECT`, is provided for internal use by the libraries; client applications work with a long pointer to the object rather than the object itself.

Client applications provide a callback function so that servers can notify them of events that need action: for instance, notification that the object has changed and must be redrawn. Clients also provide streams that the library can use for loading and saving objects. OLE provides three different rendering options: The client can do all the drawing of objects, it can let the library manage the data, or it can let the library manage both the drawing and the data.

The OLE library includes functions for managing the Clipboard, managing links, doing file I/O, creating and manipulating objects, and rendering objects. *Handlers* specific to each object implement the details of many of these functions; the appropriate handler is called by the OLE library through a function table pointer (the `vptr` mentioned above).

Most of the library functionality is embodied in *object methods*. An object method has the same arguments as the corresponding application programming interface function; a handler may override any of the method functions. For instance, the API function

```
ECDSTATUS FAR PASCAL
  EcdDraw(lpObject,hDC,lpBounds,hFormatDC)
```

has a corresponding method:

```
ECDSTATUS (FAR PASCAL *Draw)
  (lpObject,hDC,lpBounds,hFormatDC)
```

whose pointer is kept in a `vtbl`.

An OLE server has only one API: `EcdRegisterServer`. For the most part, a server is a supplier of methods. The client application calls the OLE library with requests, and the OLE library in turn invokes methods supplied by the server.

In the current implementation of OLE, links are done with DDE. Since all the client application does is call the OLE client API, and all the server application does is execute methods called by the OLE server library, the client-server implementation details don't matter. If a better communication method than DDE comes along in the future and the OLE dynamic link libraries change, it shouldn't matter at all to applications using the libraries.

New Wave Implementation

In contrast to OLE's reliance on DDE, New Wave relies on the OMF for managing application-data binding, information links, and object integration. The object hierarchy descends from the New Wave Office desktop through office tools (e.g., a file cabinet), container objects (e.g., a file folder), compound objects (e.g., a compound New Wave Write document), and simple objects (e.g., a piece of text, a chart, or an image).

The OMF keeps track of object relationships through *information links*. Each link has a *parent* (the container, corresponding to an OLE client) and a *child* (the contained object). Information links are managed entirely within the OMF; there is no need for DDE in New Wave, nor is there any need to physically copy or embed data, since the OMF information link is quite robust. An information link is both *dynamic* (like OLE linking) and *persistent* (like OLE embedding).

In addition to simple containment links, OMF supports *views*, which are links combined with additional information that the child will pass to the parent on request or when the data is updated. *Visual views* allow the child's application to display information in the parent's window. *Data views* pass the underlying data from child to parent, after which the parent is responsible for displaying the data.

New Wave applications communicate with other New Wave applications, New Wave system services, Microsoft Windows, and the OMF via *messages*. Normally in Windows, messages are passed only to active programs. OMF enhances the Windows message-passing facility by automatically launching inactive programs when they are the recipient of a message. Effectively, a New Wave program can send a message to any object and be sure that the message will arrive whether or not the object's associated code is currently loaded.

New Wave messages are quite general; individual objects need to supply *methods* to implement any appropriate messages. A New Wave object *supports* each message for which it has a method. Messages are sent among applications via the OMF's interobject message facility; interobject messages are addressed using the sender's reference name for the recipient, the message type, and message parameters. The OMF returns the status to the sender after the message has been delivered and the appropriate action taken.

In addition to the OMF, New Wave has APIs for *agents* (a systemwide task-automation facility) and CBT (computer-based training), as well as for context-sensitive help. Agent Tasks in particular offer a high level of flexibility and automation to the end user.

There is no question that, because of Microsoft's influence on PC users, OLE will achieve acceptance. But HP's New Wave is tried and true and will always offer users at least one more feature than OLE. With HP finally delivering New Wave for Motif, the company is offering its design to the largest growing base of new systems as well. Both OLE and New Wave are winners.

New Wave adds a lot of useful functionality to Windows, at the expense of some extra overhead. OLE will add some of the same features as New Wave, primarily compound documents. But even if OLE is widely implemented, New Wave will offer extra features: object management, agent scripts, and so on. The ideal strategy for developers wishing to play in the new "information at your fingertips" arena is to write applications to fully support both OLE and New Wave. ■

Martin Heller, a contributing editor for BYTE, is a software developer. He is currently writing an advanced Windows programming book. You can reach him on BIX as "mheller."

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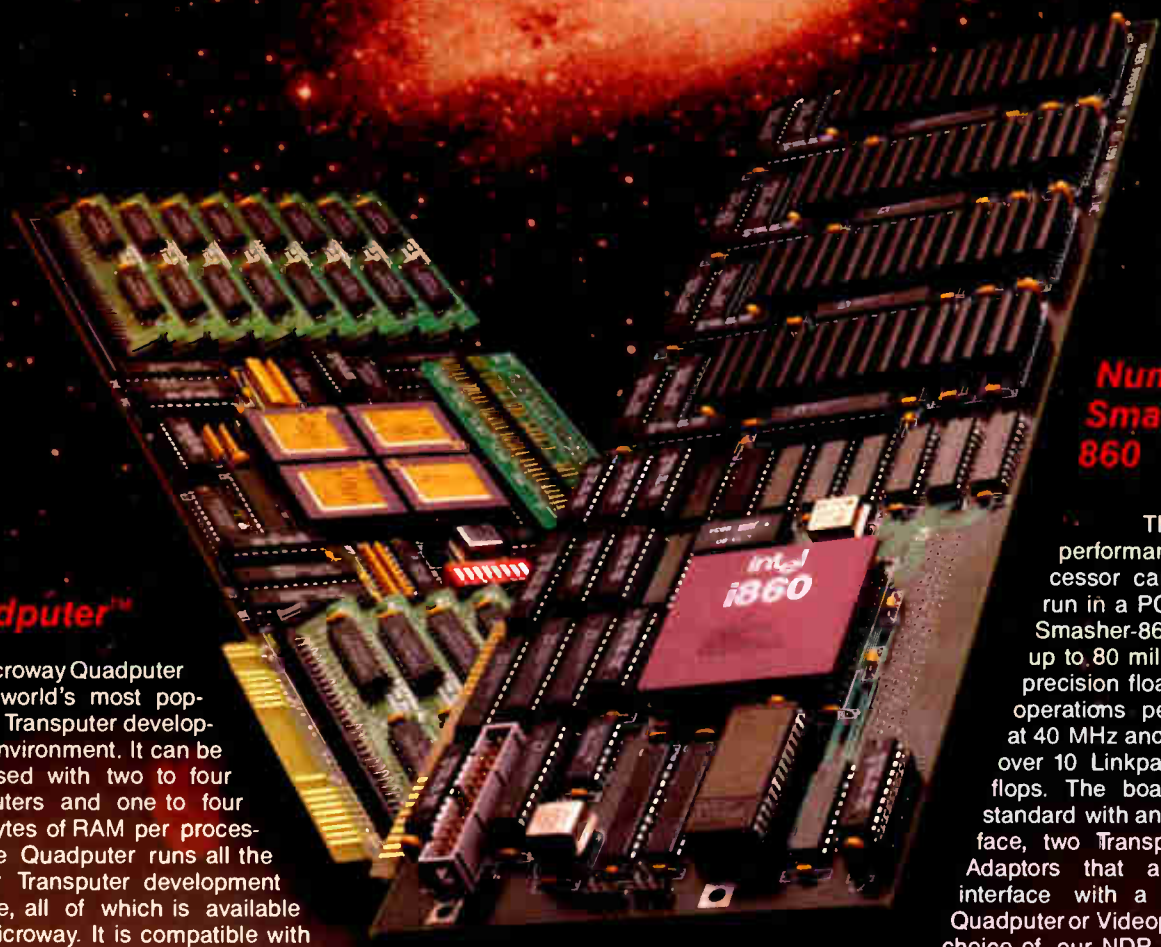

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So far, the new technology is used mostly for making industrial design models (or *prototypes*) out of plastic or investment casting wax (i.e., wax that is melted away to create a mold). Such models are integral to the industrial design process, either for "form, fit, and function" testing or just for aesthetic visualization.

Making a complex model by hand or by numerical-control (NC) milling machines can take weeks and may have to be redone for each stage of the design process. Rapid automated prototyping, however, allows even the most complex prototypes to be made overnight—an advantage so compelling that this process is already being widely used in the automotive, aerospace, and medical fields. Experts agree that anyone in the design field is likely to encounter this technology in the next few years.

That also means that many industrial design organizations will have to update their methods, since 2-D CAD is not adequate for the process of rapid automated prototyping. Even 3-D wireframes are usually not adequate. Generally, you need 3-D surface models, and solid-object models are still better, if only because you don't have to worry about whether the surfaces of the models have gaps in the corners. (Solid-object models contain information about what's *inside* an object, rather than just what appears on the surface of the object.)

From Screen to Reality

There are several approaches to toolless model-making, but generally, the process starts with a workstation CAD design that is output to a file using a special format. This format, called STL (for *stereo-lithography*, a technology used to produce models), is supported by over 40 CAD packages.

Using an approach similar to one that many CAD packages use to draw surfaces of on-screen images, an STL file defines the surface of an object as a set of interfacing triangles. Each triangle is defined with three vertices and a *normal*, which identifies which side faces out and which faces in. The STL file can use any unit of measure as long as there are no zero or negative coordinates.

The file is then fed to the toolless model-making machine, which generally has a powerful microcomputer for its controller. The controller uses special software to "slice" the object described by the STL file into cross sections, or layers. The machine then uses one of several techniques to deposit a material in a container in a precisely controlled manner, building the defined object one layer at a time (see the figure).

If cross sections of an object are taken at random points in the process, they may produce unconnected "islands." Therefore, some techniques will require that you add thin webbing to a design to keep the object

BYTE ACTION SUMMARY

Now you can create small 3-D models from a personal computer, just as you can use a printer to create 2-D images—but the units aren't cheap, and it's best to have a CAD system that uses solid-object modeling.

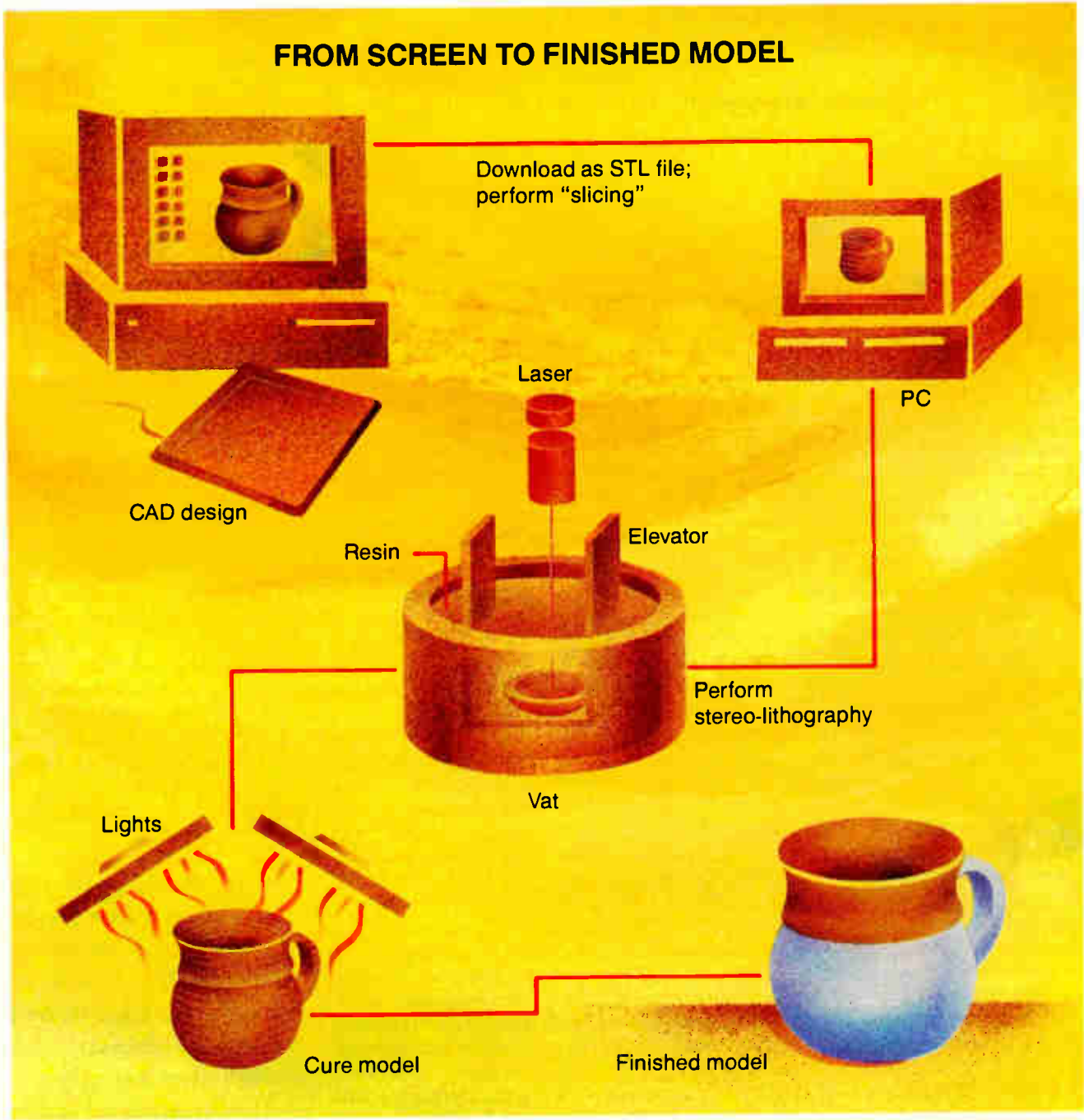
together during construction. You peel off the webbing later in the process.

Aside from the size restriction and the limited range of materials that can (so far) be used, the main limitation of toolless model-making is the tolerances that can be achieved. A model that will be used for a production mold will typically require tolerances of $\frac{1}{1000}$ inch or better. Tolerances claimed for toolless model-making machines, meanwhile, average about $\frac{1}{200}$ inch. Skilled operators, however, have been known to produce small models that could go straight into production.

Stereo-Lithography: Printing in 3-D

The leading technology in the field of rapid automated prototyping is stereo-lithography. This process was pioneered in 1987 by 3D Systems (Valencia, CA)—the company that created the STL file format.

In stereo-lithography, an ultraviolet laser scans the first layer of a sliced object onto the surface of a vat of a special resin. The resin polymerizes (solidifies) when it is hit by the ultraviolet light. The system then lowers the model slightly into the tank and scans the next layer. This process continues, adding layer



Rapid automated prototyping, a technology that is now available on microcomputers and workstations, lets you build prototypes from solid-model CAD drawings—just as you use a printer to create 2-D printouts of screen images.

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(MicroCAD News review)

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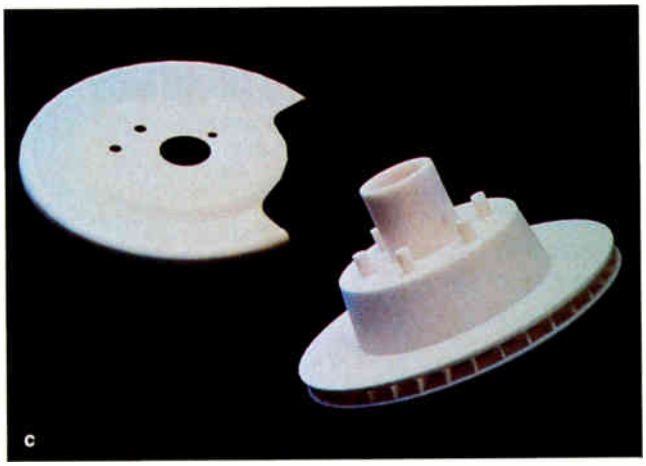

Photo 1: *Selective laser sintering, a process developed by DTM, starts with a surface model CAD design* **(a)**. *A laser then "welds" together particles of wax or plastic* **(b)** *to create a single cross section of the model. The system builds layer upon layer to create a model, which is used to make the finished object—in this case, a gear* **(c)**.

upon layer, until the model is finished. You must add webbing to your design to keep parts from floating away, and the object has to be cured after the modeling is finished. 3D's machines range in price from $95,000 to $385,000 and use 386 computers as system controllers.

Another stereo-lithography machine uses a slightly different technique: Instead of lowering a model into a vat, it raises the resin level. This $195,000 system from Quadrax Laser Technologies (Portsmouth, RI) uses a more powerful visible-light

Prototyping service bureaus still receive design files in every conceivable format, including on the backs of envelopes.

laser that partially cures each layer as it goes along. The system also controls the diameter of the laser beam, making it thinner for drawing a perimeter and thicker for filling an interior. The Quadrax unit is controlled by an i486 CPU and accepts STL input as well as input directly from I-DEAS, a solid-object modeling CAD software system from Structural Dynamics Research Corp. (SDRC) in Cincinnati, Ohio.

Another, more elaborate version of stereo-lithography is available from Cubital (Herzlia, Israel). The company's $490,000 Solider 5600 makes models with the "solid base" curing process. This process exposes each layer of polymer resin to powerful but conventional ultraviolet light through a photomask. The system makes a new mask for each layer using electrostatic toner. The ultraviolet light is powerful enough to cure each layer of polymer immediately. After curing, the system removes the unpolymerized resin and replaces it with molten wax. It cools the new polymer-wax layer and mills it to the correct thickness. Then the next layer of polymer is deposited, and that new layer is treated the same as the one before. When the model is finished, the wax is washed or melted away.

Despite the number of steps in this process, the Cubital machine can deposit 60 to 100 layers per hour, each with an average thickness of 0.15 millimeter. The unit is controlled by a VAXstation 3100 over an Ethernet connection. Cubital accepts STL, SDRC, and other CAD formats but converts them to its proprietary Cubital Facet Language format. Because the wax supports any floating pieces until they are attached, designs do not need webbing.

Sintering and Plotting

An entirely different approach, called *selective laser sintering*, comes from DTM (for *desktop manufacturing*) of Austin, Texas. This technology involves depositing a layer of fine powder (usually investment casting wax or plastic) in a container and heating it nearly to the powder's melting point. A powerful laser then *sinters* the powder—welds the particles together without melting them—to produce a cross section of the desired object. Another layer of powder is then deposited, and the next cross section is produced (see photo 1). This is followed by

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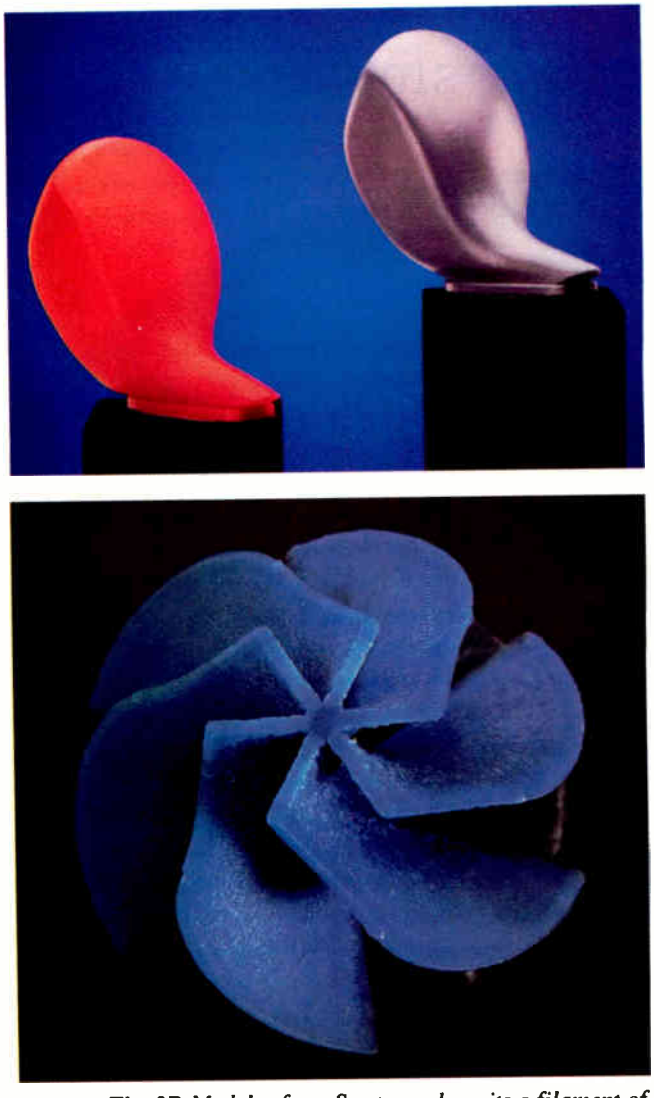

Photo 2: *The 3D Modeler from Stratasys deposits a filament of melted plastic—much as a pen plotter creates a 2-D drawing—of objects as simple as the head of a golf club (top, model on left, finished club on right) or as complex as a turbo fan (bottom).*

more layers until the object is complete.

Since the unused powder supports overhangs, the system needs no webbing. But the major attraction of the process is that it could conceivably be used with metal as well as plastic and wax, allowing you to make working parts on demand. That, however, appears to be several years away.

The DTM unit is controlled by a 386 microcomputer running Unix, and it accepts input in the STL format. DTM hopes to be selling end-user machines next year.

Meanwhile, a start-up company has entered the field—with a technology that has attracted immediate attention because of its comparatively low price and because it does not use exotic chemicals or heat. The 3D Modeler from Stratasys (Minneapolis, MN) is basically a pen plotter that deposits a filament of melted plastic or investment casting wax instead of ink (see photo 2). The device moves at 15 inches per second, building a model of up to 1 cubic foot through successive laminations.

The Stratasys Unix-based slicing software is a subset of the CAM system marketed by CAMAX Systems of Minneapolis and can accept standard NC codes, IGES files, and STL files. Due to the way the unit deposits material, you don't need a surface model; 3-D wire-frame CAD models will suffice. The 3D Modeler does, however, require webbing for unsupported subsections.

Stratasys is offering its 3D Modeler with a base price of $130,000. The unit's software can run on Sun Microsystems, Silicon Graphics, Hewlett-Packard, or IBM RISC System/6000 workstations, or it can be purchased with its own Silicon Graphics Iris workstation for $178,000.

Prototyping the Future

In the days to come, vendors of rapid automated prototyping equipment will be shooting for better tolerances, lower prices, and a larger market. Another likely major development in the field is an enhancement or replacement of the current STL file format. That's because STL is too limited for the things manufacturers would like to do.

"The approximations it uses keeps us from hitting the tolerances we are working toward," says Ray Hill, general manager at Quadrax. Hill notes that curves are often hard to fit with triangles. Also, for the purpose of adding "offsets" to various curves (to compensate for expected shrinkage during curing), it would be nice if the file description could divide the object into its geometric components. "But with STL, a cross section of an object looks like one entity—a cross section of a box is seen as one line instead of four." Quadrax is working on a replacement for STL but hasn't released details.

Others feel that STL, while not perfect, is better than nothing. Kent Nutt of DTM says, "I agree that STL is not adequate, but it's a good first step, and we need an industry standard right now." Nutt noted that most CAD packages that support STL let you set the resolution, allowing you to use more and smaller triangles for complex surfaces. Of course, this takes more disk space and processing time.

Another change that will need to occur is among users, who do as much as three-fourths of all design work with 2-D CAD systems. (Operators of rapid prototyping service bureaus report that they still receive design files in every conceivable format, including on the backs of envelopes.)

Al Cassista, principal engineer at DEC in Maynard, Massachusetts, says, "Rapid prototyping is only a small part of the things possible because of solid-object modeling CAD. Thanks to the volumetric information it gives you, you can do tolerance analysis, play what-if games for manufacturing, or try different materials before making the part."

Cassista admits that DEC was markedly unsuccessful in promoting solid-object modeling until they were able to demonstrate these other types of analyses. Once they did, they saw a migration to solid-object modeling.

Today, you can actually have a 3-D prototype of your CAD creation on the table the day after you design it, while someone without a rapid automated prototyping system may work for months to get their design off paper. That's why, according to Structural Dynamics' Chuck Kuess, "we see a tremendous need among our customers for rapid prototyping, and we have to believe that the customers of other CAD vendors are similar to ours. It's a small field today, but we think it will become big. It will be something you encounter more and more often in the design field." ■

Lamont Wood is a freelance writer specializing in high technology. He can be reached on BIX as "lwood."

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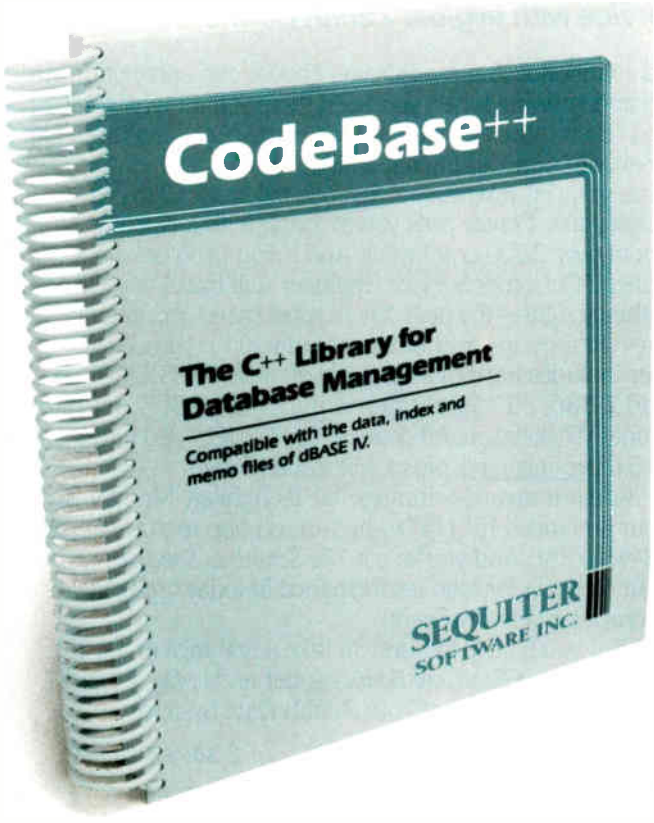

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FEATURE

Data Acquisition: PCs on the Bench

Data acquisition tools have migrated from specialized test equipment to general-purpose personal computers

NICHOLAS BARAN

Measuring and analyzing real-world conditions has always been a major component of research, design, testing, and manufacturing. Whether you are measuring voltage, temperature, pressure, or other physical phenomena, data acquisition is the process of converting sensor or transducer signals into data that can be processed and analyzed on a computer (see figure 1).

While data acquisition can be broadly defined as including sound and image processing, these categories of data acquisition have become separate technologies in their own right and were covered in detail in the In Depth section of the December 1989 BYTE. Here, I'll focus primarily on data acquisition using personal computers and workstations—that is, data acquisition in the laboratory as it applies to physical phenomena other than sound and images.

Before the advent of the personal computer, data acquisition was primarily the domain of expensive and specialized test equipment, as well as minicomputers and mainframes. But the personal computer has changed all that. While early 8-bit personal computers had limited data acquisition capabilities, today's 16-bit and 32-bit machines offer the power and flexibility to handle the great majority of data acquisition tasks. Chart recorders and oscilloscopes are giving way to graphical displays on personal computers connected directly to the physical experiment or environment, displaying the physical data in real time.

The photo shows a real-time measurement system using a Mac IIx running National Instruments' LabView software. The system monitors and controls furnace temperatures aboard a NASA KC-135 aircraft to test near-zero-gravity high-temperature superconductor materials. A video image of the material inside the furnace is displayed, as are the voltage being applied to the furnace, the temperature of the specimen, and the gravity level during the experiment.

Data acquisition boards are available for all types of personal computers and workstations. Dozens of manufacturers make boards for all major bus architectures, including the XT and AT, Micro Channel, NuBus (Macintosh), Multibus, VME, and SBus.

Boards vary greatly in performance and capability; they range from simple 8-bit boards for XTs to 32-bit boards with coprocessors or digital signal processors (DSPs) and digital I/O capabilities. You can obtain data acquisition boards that not only acquire data but also control equipment depending on the data readings. External data acquisition instruments

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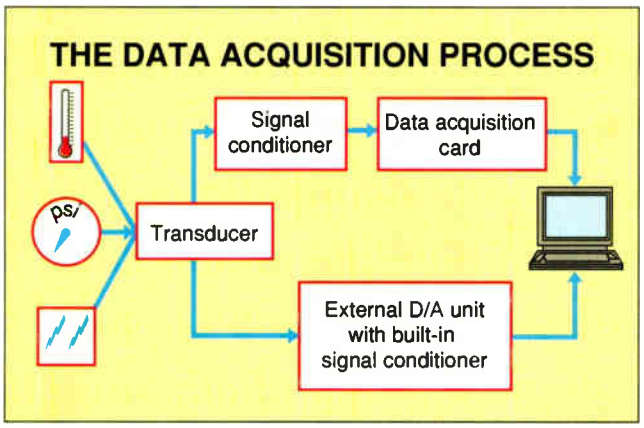
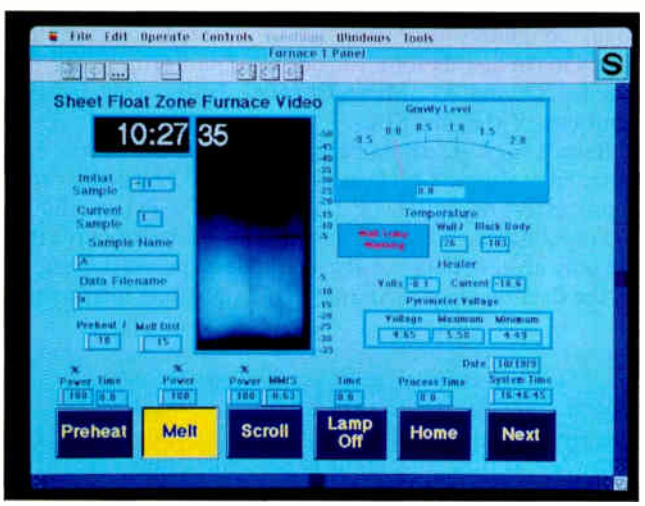


Figure 1: *Data acquisition involves measuring some physical phenomena, such as temperature, pressure, or voltage (left), using sensors or transducers. The captured signals must then be conditioned, either by a separate unit (top) or by one built into a stand-alone data acquisition unit (bottom). The signal is then converted to digital form, and the data is manipulated and displayed on a computer equipped with data acquisition software.*



A Mac IIx running National Instruments' LabView monitors and controls furnace temperatures aboard a NASA KC-135 aircraft used to test near-zero-gravity high-temperature superconductor materials. (Courtesy of National Instruments)

that connect to the personal computer or workstation are also available.

The appropriate data acquisition system depends on the desired type of application. For a simple temperature-measurement application, you can make do with an 8-bit XT board, while for a high-frequency vibration analysis, you need a high-performance 32-bit system.

Some applications require an external data acquisition instrument that connects to the host computer instead of an internal plug-in board. I'll discuss performance requirements and the pros and cons of internal versus external data acquisition systems in more detail later.

There are many methods of transmitting information from a physical system; for example, a simple electromechanical relay can indicate an open or closed circuit. But, regardless of the application, a data acquisition process is composed of four basic components:

- measurement of the physical conditions using sensors or transducers
- conditioning the signal (e.g., amplification, linearization, and buffering)
- A/D conversion of the signal
- interface to the computer (usually includes both hardware and software)

Sensors and Transducers

Although there is a wide variety of sensors on the market, most fall into a few major categories. Probably the oldest and one of the most common types of sensors is the *thermocouple*. A thermocouple is a junction of two dissimilar metals that produces a voltage dependent on temperature.

In a thermocouple, the relationship between output voltage and temperature is nonlinear and is dependent on the cold-junction temperature of the thermocouple. *Cold-junction temperature* is a baseline temperature from which all measurements must be taken. Therefore, thermocouple manufacturers provide specifications for linearizing their output. Many data acquisition systems are set up to automatically perform the linearization for particular thermocouple types. Standard industry thermocouples (e.g., types J, K, and T) are available that operate within various temperature ranges.

Variable resistance sensors include strain gauges, resistance temperature detectors, and voltage, current, or frequency detectors. As their name suggests, variable resistance sensors measure a specific physical quantity (e.g., temperature or pressure) by changing their resistance. For example, you can use strain gauges to measure pressure, force, or displacement—they measure the resistance (or output voltage) as a function of the applied load. The strain gauge is calibrated so that a particular voltage reading corresponds to a particular displacement. Once the displacement is known, other quantities, such as force or pressure, can be calculated.

Signal Conditioning and A/D Conversion

Transducers or sensors generate an electrical signal that usually requires some form of conditioning before it can be processed by the A/D converter and other processing components of the data acquisition hardware. The most frequent type of conditioning involves the amplification of the signal (which is usually accomplished by means of a gain amplifier), so that the voltage of the signal is within the voltage sensitivity range of the ADC.

For example, an ADC may have a sensitivity range of 2.44 millivolts; that would indicate that the ADC can detect a voltage change of 2.44 mV. However, the signal from the transducer may transmit a voltage change of only 0.025 mV. In that case, the programmable gain amplifier in the data acquisition system would be set to 100 to amplify the signal enough for the ADC to detect it.

As I mentioned earlier, conditioning can involve the linearization of the signal as well as isolation, buffering, or attenuation. For example, signals from the transducer could change more rapidly than the ADC can process them. In this case, a sample/hold (S/H) circuit would be employed to buffer the signal and hold it to a constant value until the A/D conversion is complete.

The ADC's job is to take the analog output from the signal conditioner and transform it into binary code that the computer

can process. Signal conditioning is a process that is tightly coupled with the ADC, which is the heart of the data acquisition system. In other words, conditioning components such as the gain amplifier and the S/H circuit are designed to work with a specific ADC.

The ADC's the Key

The ADC specifications largely determine the performance and accuracy of the data acquisition system. These features include the resolution (number of bits), sampling rate (speed), accuracy, input and dynamic range, linearity, and noise rejection capability. Obviously, these factors determine the cost of the ADC. Covering all these factors in detail is beyond the scope of this article, but I'll take a brief look at resolution, sampling rates, and noise rejection.

The resolution is the number of bits (usually 8, 12, or 16) used to represent the analog signal. It determines the voltage sensitivity, also called the least significant bit, or the code width of the ADC.

You can determine the voltage sensitivity by dividing the voltage range by the total binary range (represented by the number of bits). An 8-bit resolution represents a range of 256 (2^8), while a 16-bit converter has a binary range of 65,536. If, for example, a converter's voltage range is 0 to 10 volts, an 8-bit converter would have a sensitivity of 10 divided by 256, or 0.0391 V (39.1 mV). A 12-bit converter would have a sensitivity of 2.44 mV, while a 16-bit converter would have a sensitivity of 0.2 mV.

Coupled with a gain amplifier, the gain factor increases the sensitivity proportionally. For example, a gain of 100 would allow the 12-bit converter to pick up a signal of 0.0244 mV. Clearly, the type of signal that is being processed dictates the required sensitivity. You can handle most data acquisition tasks with either 8-bit or 12-bit converters and appropriate gain amplifiers.

The sampling rate, also called the throughput rate, determines how frequently the ADC can convert signals. The greater the sampling rate, the more accurately an analog signal can be represented. The Nyquist Sampling Theorem states that the sampling rate must be more than twice the rate of the maximum frequency of the signal being acquired. For example, audio signals can have frequencies as high as 20 kHz, requiring a sampling rate of at least 40 kHz. However, most laboratory applications require a sampling rate of under 25 kHz. The sampling rate is usually given for one channel; using multiple channels reduces the sampling rate proportionally. For example, a 20-kHz data acquisition board with two channels yields a sampling rate of 10 kHz per channel.

Noise rejection is another important factor in data acquisition applications. If the noise level in the system approaches the minimum voltage sensitivity of the ADC, the converter cannot distinguish between noise signals and the actual signals that are being acquired. This condition results in errors and is more of a problem for plug-in data acquisition units than for external systems. The proximity of other boards, such as graphics and modem cards, can generate noise interference.

continued

BYTE ACTION SUMMARY

If you need to analyze or experiment with quantitative conditions, personal computer–based data acquisition boards may be for you.

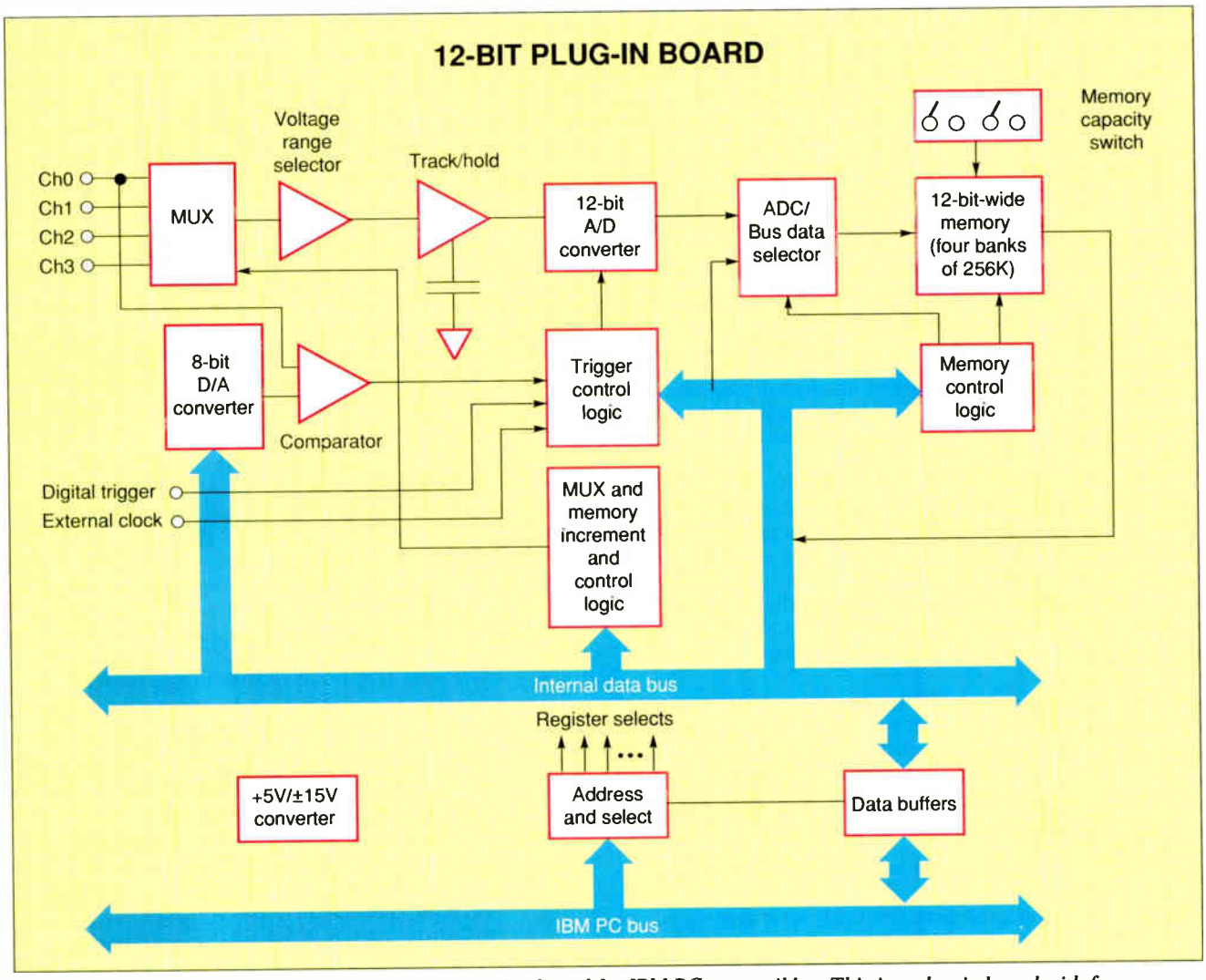


Figure 2: *The block diagram of a 12-bit data acquisition board for IBM PC compatibles. This is a plug-in board with four measurement input channels and a sampling rate of 1 million samples per second. (Courtesy of Keithley Metrabyte)*

Putting It All Together

Acquiring the signal, conditioning it, and converting it from analog to digital are functions common to all data acquisition systems. Beyond these features, data acquisition systems vary considerably.

As you have already seen, the resolution, sampling rate, and number of channels can vary. In addition, some systems include additional circuitry such as counter/timers and digital and analog output functions, as well as on-board DSPs that provide floating-point operations independent of the host computer system. These features add flexibility and power to the data acquisition system.

Personal computer– and workstation-based data acquisition systems can be either internal add-in or plug-in boards. They can also be external front ends—such as those provided by John Fluke Manufacturing (Everett, WA). Among the manufacturers of personal computer–based internal boards are Contec Microelectronics (San Jose, CA) and Data Translation (Marlborough, MA). External front-end data acquisition systems are stand-alone devices connected to the personal computer via the RS-232 serial line. They can also be connected via a special interface called the General Purpose Interface Bus (GPIB) or IEEE 488 bus (a major supplier of this device is IOtech, Cleveland, OH).

The IEEE 488 or GPIB has become the standard interface for data acquisition systems. This parallel interface provides a transfer rate of 1 megabyte per second and can support up to 15 devices simultaneously.

The RS-232 interface is a serial interface with a maximum transfer rate of 19,200 bps, and it can support only one device per port. However, it has the advantage of being built into virtually all personal computers and workstations, while an IEEE 488 board must be purchased separately.

Front-end systems usually have built-in signal conditioning and can support a large number of measurement channels. In addition, they have better isolation and noise rejection characteristics than internal plug-in boards. As a result, they can be used in higher-frequency applications. Another advantage to external devices is that you can access them remotely from the host computer; with plug-in boards, you must locate the host computer in the immediate vicinity of the physical experiment or test.

While not as versatile as external front ends, internal plug-in boards are suitable for many applications. In general, plug-in data acquisition boards cost less than external devices, since they don't require separate power supplies and cabinets and support fewer channels and instrumentation. Figure 2 shows the block diagram of a data acquisition board for IBM PC compatibles with 12-bit resolution, four measurement channels, and 1 million samples per second.

Most internal data acquisition boards require separate signal-conditioning modules. Although some boards have built-in signal-conditioning modules for particular sensors or transducers, most users select separate signal-conditioning modules, depending on the application, to allow greater flexibility.

If you decide to use an internal data acquisition board for a specific application, make sure you carefully weigh the pros and cons, since such boards do have limitations. The physical size of the board's connection interface limits the number of measurement channels. In addition, when you run high-frequency applications, there may be crossover noise from other boards in the system.

Internal plug-in data acquisition boards are ideal for a specific application that is not expected to change over time and for which the internal board produces reliable and accurate results. External devices may be a better choice if you frequently change the measurement application—a situation that requires continual reconfiguration of the transducers and signal-conditioning modules.

The Software

The final component of the data acquisition system is the software. Traditionally, many engineers and scientists have written their own programs, in a high-level language such as BASIC or C, to interface with the test equipment. The IEEE 488 interface supports an ASCII command set, and there are operating-system commands for the RS-232 port that you can use to set up a software interface.

Nevertheless, the trend today is toward commercial software applications that manage the entire data acquisition process. Applications like LabWindows from National Instruments (Austin, TX) or ViewDac from Keithley Metrabyte (Taunton, MA) provide a full graphical interface with "virtual instruments" for simulating actual instrument control panels on the screen.

Most software applications include a development language for designing custom data acquisition interfaces. Commercial software applications generally support a wide variety of data acquisition boards and external devices with either RS-232 or IEEE 488 interfaces.

Data Acquisition: A Growth Market

The growth of the personal computer has mainly focused on personal and office productivity. But data acquisition in the laboratory is a rapidly growing technology that is ideally suited for personal computers and workstations, particularly as they gain processing power and graphics capability.

The combination of live video, sound, and real-time data acquisition offers enormous possibilities in many areas of scientific research and development. While not for everybody, data acquisition is an exciting field that should produce some dazzling applications in the next few years. ■

Nicholas Baran is a contributing editor for BYTE. He is also the editor of Baran's Tech Letter *(Sandpoint, ID), a newsletter covering Next computers. You can contact him on BIX as "nickbaran."*

MANAGING GIGABYTES

Daily, the mountain of data to be processed into useful information grows. Larger and larger, it looms with no end in sight. The more reports we receive, the more we need. The more we read, the more we need to read, and the more we get eyestrain.

Between the almost-paperless office and networking, managing all this computerized data is a monumental task. We must find ways to make sense of it all. I mean, how many gigabytes can *you* read and make sense of in a day?

The Information Age may be here, according to the pundits, but most companies are still trying to handle all that data. Hardware and software aids are appearing at an increasing rate. In "The Data Swamp," Bob Ryan discusses different approaches to managing large amounts of data and turning it into useful information in a business environment.

BYTE columnist and noted science fiction author Jerry Pournelle says that by the year 2000 anyone will be able to get the answer to any question. If that's true—and, knowing Jerry, it probably is—wide-area information servers may contribute many of those answers. Imagine having access to the Library of Congress—on-line! In "Browsing Through Terabytes," Richard Marlon Stein looks at WAISes—what they are and how they work.

But to turn data into useful information, you need a means of judging what is useful. How do you prioritize the various forms of data? What criteria do you use to determine that one piece of data is more or less important than another? In "Prioritizing Information," Rear Adm. Grace Hopper, USN, Ret., expounds on a subject that has interested her for many years: how to assess the value of data.

An MIT research project has taken this assessment a step further in one particular application: E-mail. The Information Lens constructs intelligent filters that can determine what mail you must see right now and what can wait. In "Through a Lens Smartly," Mike Robinson describes this intelligent assistant, which is beginning to show up in products, and the tasks it can handle. You'll be amazed at how "intelligent" this system really is.

Another concern of data management is the security of your data. When you add the complexities of networked systems—and heterogeneous ones at that—to the personal computer environment, the permutations of possible problems grow exponentially. In "From Pyramids to Peers," Tom Toperczer looks at data management applications and the facilities they provide so that you can examine and manipulate data and make it safe in a distributed, networked environment.

No section on managing gigabytes would be complete without talking about physical storage and the media that can hold gigabytes of information. In "Giga-Storage," Richard A. Peters describes primary and secondary storage with capacities in this range. And in a related text box, "Native or Compressed?" Grant Wilcox talks about how data compression can increase storage and how much you should—or should not—rely on it.

The management of huge amounts of data is a subject that spans many topics, some concrete and some more esoteric. The concrete aspects have been dealt with quite successfully, between massive-capacity backup tapes and optical jukeboxes, but the more esoteric aspects are more elusive, in definition and in solution.

Grace Hopper says, "For a couple of decades now, I've been asking people how they value their information. I haven't received any answers, but I have received a really great assortment of blank stares." Well, the time for blank stares is over. If we don't get a handle on what's important in all this data, that mountain will bury us—and our businesses—in trivia.

—Jane Morrill Tazelaar
Senior Editor,
State of the Art

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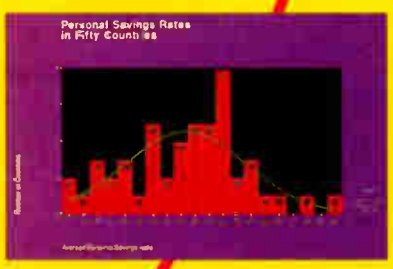

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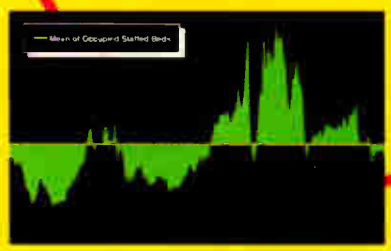

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THE DATA SWAMP

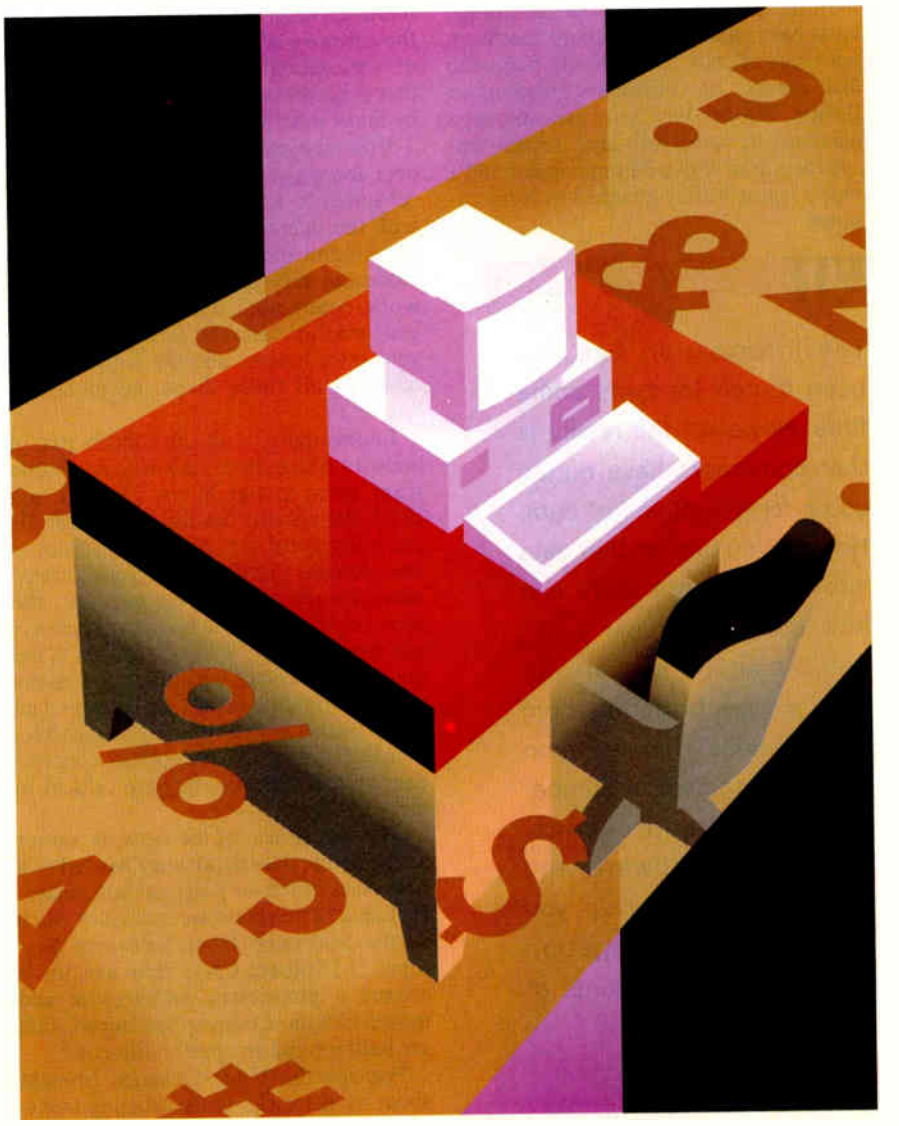
Bill Gates talks about *Information at Your Fingertips*, but what about that slime on your boots?

BOB RYAN

Futurists, commentators, megatrendists, and other darlings of the best-seller lists have been saying for some time that humankind has entered a new age—the Information Age—where the basis of all wealth, power, security, and good manners is access to information. Welcome to the information society, where knowledge is power, the service economy is king, and a good agent can get you a $300,000 advance.

Spend a few days in this brave new world, however, and you come away with a markedly different perspective. Rather than inaugurating the Information Age, computers have just mired us in the data swamp. They give you access to mountains of data, but in many cases they have not made it easier to glean useful information from all that data. Some call this condition information overload, but it is really data overload. Until you can get a handle on all the data available to you, the Information Age will remain little more than a blurb on a dust jacket.

Managing a large amount of data in a business environment—and extracting useful information from it—is a hardware and software function. As with most areas of computing, the hardware is well ahead at this point. Powerful data-handling software is available, but primarily in structured environments, such as DBMSes.



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Storage and Delivery

The hardware side of managing data concerns storage and delivery. Although magnetic storage systems provide faster access and higher data transmission rates than do optical systems, the cost per

megabyte of such storage is much greater. In fact, given the removable nature of optical media, its cost advantage over magnetic media can border on the ridiculous. Even without considering removable cartridges, the advantage is significant.

The latest advances in optical storage concern multidrive systems and multiple-media systems (not to be confused with multimedia). Multidrive systems, known as jukeboxes, let you store incredible amounts of data on-line. For example, the Hitachi OL321 Optical Library Unit stores nearly a half a terabyte (500 gigabytes) on 64 WORM disks and can mount any disk in less than 10 seconds. Multiple-media systems, available from many companies, let you use different types of optical media in the same drive. These are a godsend if you need to access CD-ROM, WORM, and rewritable optical disks.

In the past five years, optical storage costs have enabled applications that were not economically feasible with magnetic disk drives. At Children's Hospital in Boston, Stephen Wertheim uses an image database to store full-color neural images acquired with a 35mm scanner and a video frame buffer attached to a microscope.

BYTE ACTION SUMMARY

The Information Age has been touted for quite some time. However, the reality is that computers have buried us under mountains of data. How do you turn all that data into useful information, and how do you manage it all? Rather than information overload, we are suffering from data overload. Depending on your environment, a number of different approaches, combining hardware and software, exist to help you glean useful information from very large amounts of data.

The images are used in research and in teaching neuroanatomy to second-year Harvard medical students, with different Supercard stacks (Silicon Beach Software, San Diego, CA) providing different interfaces to researchers and students. The images are stored on two Sony rewritable optical disks and accessed via a database running on Mac IIs.

Requiring between 3 and 4 gigabytes of storage, the system would be prohibitively expensive using magnetic media. Thus, optical media not only increases the amount of storage available to you, but also enables new applications.

On the Move

Providing storage is only half the battle. It is also important to move the data from the storage device into memory—where it can be massaged into information—as expeditiously as possible. The limiting factor here is the communications bandwidth between the storage subsystem and the memory of your personal computer or workstation. More and more, you find that mass-storage subsystems are shared by many users in a network.

Communications bandwidth is dependent on many factors. Beyond the storage subsystem's latency, you have to deal with the interconnects between the subsystem and the memory. These can include the server's bus system, the network connectors and media between your machine and the server, the bus in your own system, and the software that controls all these disparate pieces of hardware.

Interestingly, with the sudden rise in network connections, the expected battle royal between the Micro Channel and EISA bus systems has failed to materialize. Given that the network medium is the slowest link between your largest mass-storage devices and memory, the speed of the bus in the end-user system is not very relevant. What *is* relevant is the bus in the server, which handles many requests simultaneously and moves data out to the network as quickly as possible. While 32-bit buses have not had a big impact on the desktop, they are critical in the LAN closet.

The emergence of the network server as the prime data depository has led to a new class of server personal computers. Included in this class are machines, such as the NetFrame from NetFrame Systems (Milpitas, CA), that are built around a proprietary architecture and those, like the Compaq Systempro, that are built around an open architecture.

Perhaps the biggest change brought about by networks is the ongoing transformation of minicomputer and mainframe platforms from the primary computational devices on a network to big, fast servers. As desktop computers become more and more powerful and cost-effective, it is inevitable that they will replace larger systems as your company's primary computational resource. Minicomputers and mainframes will continue to do what they do most effectively: move tremendous amounts of data rapidly.

Given fast servers—whether microcomputer-, minicomputer-, or mainframe-based—the current bottleneck in transmitting large amounts of data is the network. While fast networks, such as the Fiber Distributed Data Interface, have appeared as backbones, most network nodes are still serviced by media that range from AppleTalk's 230,000 bps to Token Ring's 16 megabits per second. As more and more data comes in graphical format, the need for a mechanism to economically bring FDDI-level speed (100 Mbps) to the desktop increases.

In response to this need, a number of companies are working on FDDI implementations over twisted-pair wiring. Currently, the ANSI standard specifies an interface that supports wiring distances up to 2 kilometers, and only optical cabling meets this standard.

However, the vast majority of network nodes are much closer than that. Realizing this, companies such as SynOptics (Santa Clara, CA) and Cabletron Systems (Rochester, NH) are working on delivering FDDI over twisted pair. Without the requirement for optical cabling, FDDI could soon be an economical option for many desktops.

With the enormous volume of storage available with optical and high-capacity magnetic media, and with the platforms and networks available to deliver it, the crunch in managing large amounts of data is not on the hardware side, but in software. After all, only software is capable of helping you transform data into information.

Structured Data Management

You can classify computer data according to the degree it is structured. The most common example of highly structured data is a DBMS, where individual items are assigned to two-dimensional relational tables. Highly unstructured data is best exemplified by the text files you create with a word processor, which may consist of little more than variable-length paragraphs separated by carriage returns.

The management of structured data is as old as computing and is still the prime task of computers at most companies. Database systems, spreadsheets, and accounting packages all work with data whose structure is well defined; each data item is a specific type that determines how the software processes it.

Most companies manage their structured data using a relational DBMS and will continue to do so for the foreseeable future. With networks taking over, the chief database management concern is providing access to the data without compromising its integrity.

In the past few years, client-server database implementation has been ascendant. This model divides the database function into two parts: front-end client software that generates data queries and back-end server software that processes queries and returns the resultant data to the client. The server handles all data management functions, including security, file and record locking, and atomizing transactions.

The advantages of the client-server model are twofold. First, it is much easier to manage the database if all data is stored in one location. Second, the separation of the data engine from the front end lets any type of application access the database, including spreadsheets, business graphics programs, and accounting packages. Any application that generates acceptable queries can access the database.

While wonderful in theory, client-server implementations are less than ideal. A server can only handle queries that conform to its specifications, yet there is no single standard for generating queries. The closest we have to a standard is Structured Query Language.

The problem with SQL is that you rarely find an ANSI standard implementation of the language. Different database vendors extend the language in different ways, making it difficult for those who supply client software to know what version of the language to implement. Thus, you can have situations where a spreadsheet client might support Gupta's server engine but not Sybase's or IBM's DB2.

The problem is not technical, but one of politics and marketing. The best hope is that one of the engines will gain a large enough market share that it becomes the de facto standard.

The second problem that is engendered by the client-server model is technological. By its very nature, a database server will be the busiest node on any network, and it will therefore be the biggest bottleneck in the network.

Faster network cabling will help, as will schemes that give the server more packet buffers and greater access to the network. With token-passing implementations, this latter might mean that the server node will get the token more often. In collision-detection schemes, such as Ethernet, this may mean giving the server node a shorter time-out on average than other nodes.

Eventually, if hundreds or thousands of users need to share your database, it may be necessary to distribute the database over different servers. This introduces myriad consistency problems and negates the virtues of a centralized server, but it may be the only way to make data available to clients without saturating a network segment.

Handling Multimedia Data

Over the past few years, one of the major themes in computing has been the explosion of applications that rely on data that can't be structured the way an address list can. Computers now regularly access pictures, animations, sounds, music, and other types of data that aren't well suited to a tabular structure. As a result, researchers are looking at different ways of handling unstructured data.

Two major concepts of how masses of irregular data should be dealt with have emerged. The first is to provide extensions to the current relational model; the second is to create object-oriented databases by enabling the storage and retrieval of persistent objects.

The object-oriented database is more radical and more reactionary than the extended relational model—radical because it seeks to store data and the methods used to access the data together rather than keeping data and methods segregated, and reactionary because in many ways it harkens back to the CODASYL-network-database model that was supplanted by the relational model in the early 1980s.

At present, the relational model remains unsurpassed for handling the most common types of data you encounter in a business environment. Object-oriented databases, however, seem better suited to handling less traditional data, such as CAD drawings, image files, and other types of data normally associated with multimedia applications.

For the time being, a multimedia database that can handle traditional and nontraditional data with equal facility is not in the cards. Businesses that use multimedia applications require specialized storage systems that cannot be easily

integrated with the company database. This situation will only improve if market pressure for such integration increases markedly.

The Text Dilemma

Ironically, the greatest impediment to realizing the Information Age is how computers handle—or fail to handle—good old text files. Much of the information you need to work effectively can't be reduced to a relational table or encapsulated in a simple object. This information comes to you in the form of memos, E-mail, newspapers, wire-service news copy, journal articles, and so on.

Between E-mail services, on-line databases, and CD-ROM products, you have trillions of bits of relatively free-form data available to you at any time. So, the problem is one not of access but of culling significant bits from all those floating around in the ether.

The problem of getting the information you need—and only the information you need—appears in two primary aspects. The first involves the difficulty of obtaining just the information you need by searching electronic sources. The second involves dealing with all the information that just naturally comes your way in the course of the day. (This second area is discussed in "Through a Lens Smartly" on page 177.) I'll concentrate on the problems of information retrieval from external databases.

Searching for Answers

If you've ever tried to research a topic using an on-line information service, you know the frustration of data overload. You must first decide which databases to search and then construct queries that not only garner the information you need but also weed out extraneous material. Of these two situations, the latter is usually far more serious than the former. A simple search of a news wire can result in thousands of "hits," which is only marginally better than a query that results in no hits at all.

The basic problem is that, unlike the structured data in a relational database, there are no fixed keys for searching through text documents. Effective indexing of unstructured data requires that someone read the document and provide keys that permit it to be retrieved when and only when it fits the search profile. (See "The Dark Side of DIP" in the April BYTE for more information about the process and problems of indexing.)

Currently, due to the great number of information providers and the different indexing schemes and vocabularies used by them, it is extraordinarily difficult for an individual to effectively use more than a few data sources. For example, in researching the topic of indexing for this article, I had to try various combinations of terms, such as *indexing*, *searching*, *retrieval*, *text retrieval*, *text databases*, *information bases*, *on-line information*, *queries*, *on-line queries*, *trends*, *technology*, *artificial intelligence*, *information filters*, *information refineries*, and *agents*, as search keys on a popular on-line database.

The process was only partially successful, because I didn't know the exact vocabulary the indexers used to describe the relevant stories (and the indexers were apparently less than consistent in applying their vocabulary, if they had one at all). I wound up going through a lot of irrelevant material because I wasn't used to the quirks of that particular database.

That's just one database. The problem becomes magnified when the information you need is in several databases. You could spend so much time finding what you need that you have no time to read it!

Solutions to this type of data overload are continually evolving. Some are commercial realities; others are university-based research projects. The best will eventually usher in that oft-proclaimed Information Age.

Golden Retrievers

One way to deal with information retrieval is to have someone else deal with it. Individual Incorporated (Cambridge, MA) is an "information refiner." The company captures data from dozens of on-line news feeds and provides you with information relevant to your needs, using a sophisticated information filter. By continually querying you about the effectiveness of the refined information you receive, Individual can closely tailor a filter to your needs. Once a day, the company sends you the filtered information via E-mail or fax.

NewsEdge/PC from Desktop Data (Waltham, MA) is useful if you require near-real-time information. Attached to an FM receiver, it can run in the background on your personal computer, notifying you of stories matching a keyword profile you've specified. At NetWorld '91 in Boston, Desktop Data showed products that work with LANs and corporate E-mail systems.

Another significant information-retrieval product is Topic Real-Time from Verity (Mountain View, CA). Instead of relying on keywords, Topic Real-Time uses concept-retrieval technology, using multilevel queries, where you assign different weights to different subjects. This approach can be much more effective than Boolean searches, which treat each keyword equally. In addition, Topic Real-Time can refine its results by taking advantage of the structure that some publishers use in delivering information.

A drawback to using these information-retrieval systems is that, although they can greatly increase the relevancy of the information you download, you must still read the information to extract the meaning. Logically, the next step is to automate that process, too.

Cut to the Quick

The System for Conceptual Information Summarization, Organization, and Retrieval is a project at the GE Research and Development Center (Schenectady, NY). Unlike many retrieval products, SCISOR operates in a limited domain—specifically, it culls information concerning mergers and acquisitions from Dow Jones News/Retrieval—and it is able to do more than simply flag interesting stories.

Written in Common Lisp and running on a Sun workstation, SCISOR employs different techniques to retrieve relevant stories and extract information. Among these are many from the AI field, including natural-language processing and knowledge representation, and other more prosaic techniques (e.g., lexical analysis and word searches).

Using these techniques, SCISOR retrieves the stories and extracts information, such as the names of the companies involved in an acquisition and the per-share and total price of their offers. In addition, SCISOR can answer natural-language questions about the information that it collects with natural-language responses.

Information from Data

SCISOR and the other examples above demonstrate ways you can use computers to deal with the very problem computers made possible—data overload. By making it easier to find what you want and, as with SCISOR, by performing some basic analysis of the data for you, products like these can keep you on top of developments critical to your business.

Together, hardware and software developments are making it easier to handle massive amounts of data. We have yet to be extricated from the data swamp, but the wading sure is a lot easier. ■

Bob Ryan is a BYTE technical editor. You can reach him on BIX as "b.ryan."

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BROWSING THROUGH TERABYTES

Wide-area information servers open a new frontier in personal and corporate information services

RICHARD MARLON STEIN

The Library of Congress archives roughly 25 terabytes in its collection. To browse through this volume on your own would be nearly impossible. Wide-area information servers supply the means to achieve this goal by providing the user-interface structure and underlying information-retrieval protocol necessary to automatically collate, collect, and integrate diverse data streams. WAISes can distill the contents of vast archives into neatly manageable and browsable folders.

On-line information services, such as BIX and CompuServe, attest to the need for this kind of technology. Information has acquired a commodity-like status. While not on a par with wheat, pork bellies, or gold futures, the information-service industry fills a vital role. The next phase of information commerce will add WAIS capabilities to existing on-line services, opening a new frontier in personal and corporate information services.

Intentions and Goals

Initiated in early 1989, the WAIS engineering effort is spearheaded by Thinking Machines (Cambridge, MA), the manufacturer of the Connection Machine, a massively parallel supercomputer (see reference 1). The principal goal of the research project is to demonstrate "how current technology can be used to open a market of information services that will allow a user's workstation to act as librarian and information collection agent from a large number of sources." (See reference 2.) WAISes aim to enhance existing information services and provide a utilitarian mechanism for the industry.

continued

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Information servers already provide direct access to many databases and archive structures. You can easily check the local weather, make travel reservations, obtain entertainment schedules, or browse through the latest stock-market quotes on-line. These services are highly interactive, charging users on the basis of minutes spent on-line, and each has a unique user interface.

WAISes alleviate unnecessary user interaction through a predominantly computer-to-computer approach to remote information retrieval. By minimizing human interaction with a remote information server, they handle requests for information expeditiously and inexpensively. WAISes also alleviate unnecessary complexity by moving all user interaction to the local workstation and by having WAIS software handle all transactions with the remote server.

On-line servers are limited in their connectivity. While many services, such as BIX, CompuServe, and AppleLink, incorporate wide-area network structures, sharing information between different services is not a wholly transparent option. This restriction constrains information commerce and hampers the circulation of potentially useful ideas.

WAISes circumvent this barrier with a standard information-exchange protocol that offers unlimited connectivity and retrieval functionality. All servers can apply the WAIS protocol to their archive structures to conduct information retrieval. (Unlimited connectivity also raises concerns of security and privacy. See the text box "The Right to Privacy" on page 160.)

Organized and coherent information of topical importance has value. Individuals and companies should be able to market their information to the widest possible audience. Current on-line services can't easily accomplish this, since their connectivity is restricted.

To direct your information to the best marketplace, you could subscribe to multiple on-line sources and post the same message on all of them. But it would be more efficient to post the data on one server and have the data, or an abstract of it, broadcast to the others. Using the WAIS protocol, WAISes facilitate this server function.

Suppose, for example, you have reviewed the latest set of RISC microprocessor benchmarks, taking note of specific architectural advantages, and you wish to make this information available to others. The benchmark review is kept on your home computer (i.e., the local WAIS), which is equipped with WAIS technology. The nearest remote WAIS, a hub within a network of servers, also has a folder for RISC microprocessors. So you make a posting to the nearest hub server that inserts a pointer to the review on your home computer.

Everyone with a computer running the WAIS user-interface software can present information to a server and receive compensation for whatever portion of it other WAIS subscribers access. The compensation can be monetary, or you can barter your information for someone else's.

Even publishers of books, magazines, newspapers, and music can participate and profit from WAISes. For example, how much money could a newspaper save in circulation costs if you received the morning paper electronically instead of printed on paper? Similarly, how much money could a book publisher save if you purchased a new best-selling novel electronically instead of at a bookstore?

Traditional information delivery is expensive, and costs are rising. The U.S. Postal Service frequently raises its fees to cover increases in the cost of handling and transporting information. Traditional information transport also represents a significant fraction of transport volume and collateral energy consumption. Moving information electronically can result in enormous savings.

Computer networks such as Internet are conduits of information transport. To replace manual transportation methods, the existing electronic infrastructure must accommodate the newly anticipated volume of traffic. Plans for "a national network of data superhighways," which will be installed within the next few years, are under way (see references 3 and 4).

A principal motivation for WAIS technology is to be able to retrieve topical information for research or investigation, not just to deliver consumable items like newspapers or books. Toward this end, WAISes rely on a novel structure for information retrieval, the *dynamic folder*.

To use a WAIS, you formulate a question (see figure 1), find the information servers that provide satisfactory responses, and create a dynamic folder. The purpose of the dynamic folder is to constantly or periodically update its contents with new material on the subject.

Formulating a question is natural to us all. The difficult part is locating the pertinent information to answer it. Manually locating the information can be laborious and tedious. WAISes automate the search-and-retrieval process. To determine which servers hold the information most pertinent to your question, and where you should submit dynamic folders, you may want to consult *server directories*.

Server Directories

WAIS directories are servers that support a directory-services function. They are indexes to other services within the WAIS network and are organized to help you locate information. Like telephone-directory services, WAIS directories list pointers to servers, which are grouped according to content and function.

A *directory-entry header* contains sufficient data to describe the service, such as an English-language description of the server, the parent server (if the server is a subsidiary of a larger one), related servers, contact information (including networks and human-interface points), and cost information.

The local workstation, when equipped with a WAIS, should maintain a directory entry that includes the directory-entry header, a locally determined rank, subscription information (if any), user comments, and the time of last contact. You can use this information to decide whether to contact the server and how to handle the responses.

By using content navigation, you can find the most appropriate server to

BYTE ACTION SUMMARY

The next phase of information commerce will add wide-area information server capabilities to existing on-line services. WAISes provide the user-interface structure and the underlying information-retrieval protocol necessary to automatically collate, collect, and integrate information from various sources. When these are implemented, you should be able to directly access such sources as the Library of Congress and the myriad of newspapers, journals, and books.

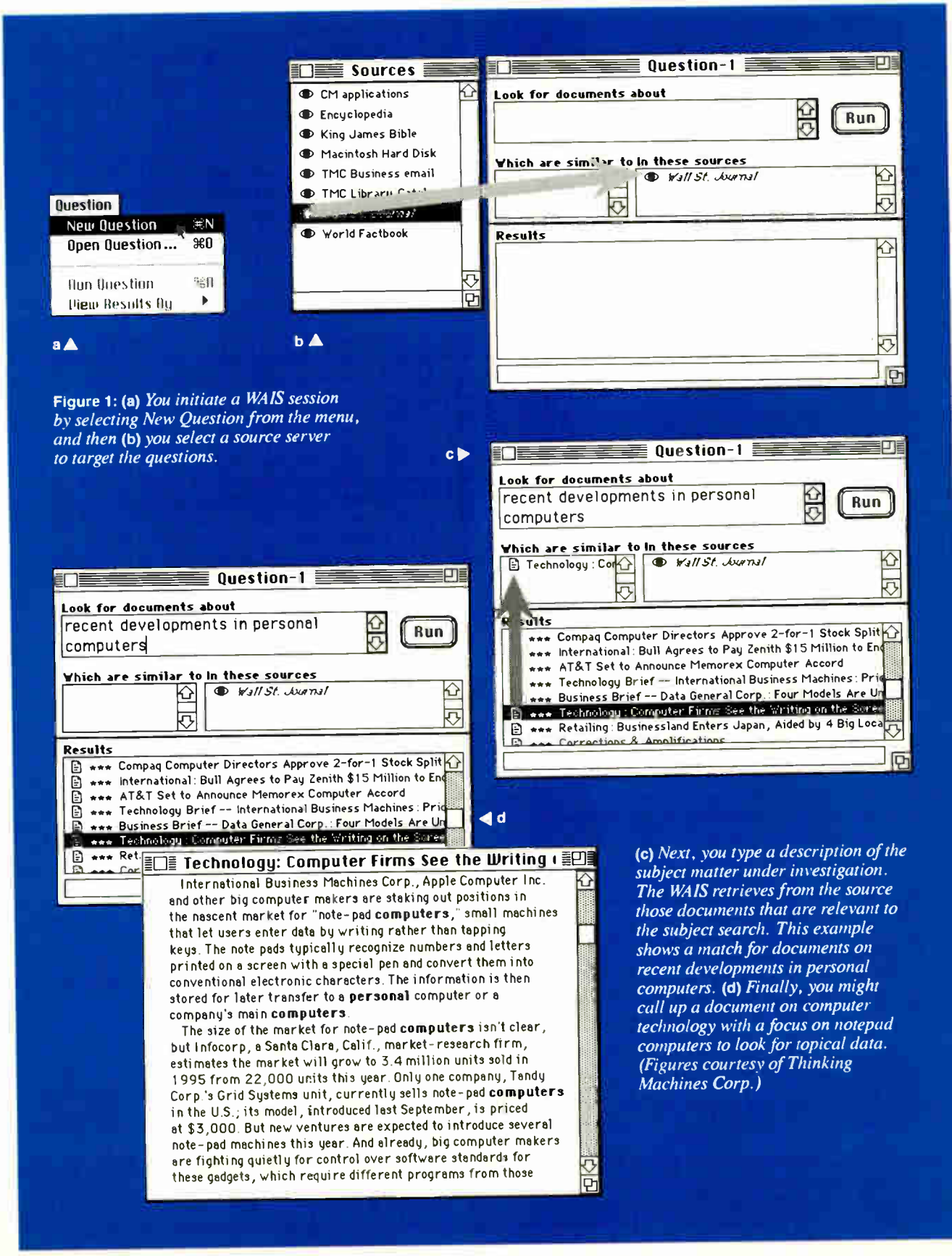

Figure 1: (a) *You initiate a WAIS session by selecting New Question from the menu, and then* **(b)** *you select a source server to target the questions.* **(c)** *Next, you type a description of the subject matter under investigation. The WAIS retrieves from the source those documents that are relevant to the subject search. This example shows a match for documents on recent developments in personal computers.* **(d)** *Finally, you might call up a document on computer technology with a focus on notepad computers to look for topical data. (Figures courtesy of Thinking Machines Corp.)*

The Right to Privacy

WAIStation, a prototype user interface developed by the Thinking Machines wide-area information server project staff, embodies many functional aspects of WAIS technology. Forming and refining queries via relevance feedback, server selection, and dynamic folders are the principal features that this prototype supports. These assets provide a powerful tool set for information retrieval. While WAIStation achieves several desirable technical goals, the security and privacy issues have not yet received serious attention and need refinement.

Security and privacy issues are not specific to WAIStation or WAISes in general, but are endemic, topical concerns of the information-retrieval industry as a whole. WAIS technology seeks to extend connectivity through the WAIS protocol, thus intensifying the urgency of security measures and standards. Greater connectivity promotes information commerce, but it also adds to the risk of compromising the privacy and confidentiality of electronic transactions.

Individuals and corporations that subscribe to WAISes must safeguard proprietary information. The tendency to organize information within a computer for ease of access or to act as a convenient archive creates a security and privacy dilemma. And if the sensitive data is located on a machine with high connectivity, the risk is multiplied.

A WAIStation that holds personal information, such as tax forms, diaries, business transactions, medical records, or bank accounts, must be protected from intrusion by unauthorized individuals. A computer system storing this information "knows" more about you than you can instantly recall. Access to this personal data must be protected, controlled, and limited to authorized individuals.

The WAIS protocol is an application-layer protocol that runs over X.25 communications, modems, or IEEE 802.3 (Ethernet) backbones. Residing beneath this protocol is the WAIStation host computer and operating system. Extracting information from the server depends on access granted through a recognition and authentication system that the host computer operates. Only authorized subscribers can access information from the server.

The WAIS protocol is stateless, so each transaction, whether a query or document-retrieval process, exists in a separate context at the server. Subversion of the WAIS protocol, whether intentional or accidental, might unlock or bypass a server's native file-system protection structure. If it did, the entire archive contents would be available to the intruding party.

The WAIS protocol should be noncorruptible and should detect privileged transactions (i.e., those data streams that possess restricted command sequences). However, to be effective as a noncorruptible application-layer protocol, the underlying computer system must also be unbreachable.

Unfortunately, you cannot always guarantee protection. In 1988, a virus introduced through a known port assaulted computer systems attached to Internet. Subsequent sleuthing discovered that a remote system could activate the debug mode of the Unix mailer, forcing the instigator into a privileged state. The debug mode then permitted the virus to propagate and multiply.

Can a rogue dynamic folder, fashioned after the Internet virus, intentionally access information from strategic servers running WAIS software? How will WAISes safeguard information against illegal intrusion?

The right to privacy is inalienable, and WAIS technology or any enabling system that promotes information commerce must preserve it. A cautionary approach toward implementating WAIS technology is necessary and appropriate. Several legal issues must be addressed to secure both privacy and fair business practice.

handle a query. For example, a question on RISC microprocessor benchmarks would list directory entries for servers as well as pointers to articles on the subject. When you retrieve a document, the directory entry is also provided. Thus, you obtain ranking information for questions of similar content.

Each server, then, contains information of value to certain subscribers. The dynamic folder can continuously poll newspaper servers for new articles as they arrive from the news wires, while it would probably query a dictionary or encyclopedia server only once, since the content changes much less frequently.

Policing the large number of anticipated servers (in the tens of thousands) requires an independent quality-control mechanism. An audit of the server directory would reflect any server that frequently returns erroneous information or does not perform. An independent agency like *Consumer Reports*, the Better Business Bureau, or other watchdog groups could create *rating servers*, which monitor and rate other servers in the directory.

These rating servers resemble movie and TV critics. Consumers acquire confidence in the reports and reviews that certain critics issue because they share similar tastes. Just as moviegoers start to trust a particular reviewer who has agreed with them on past movies, WAIS users will begin to trust the specific rating services that agree with them.

A subscriber base generates income for a server. The rating servers will attract subscribers as well, for they direct trends in the information marketplace. In fact, they may become the first "information speculators" as a by-product of WAIS technology.

Dynamic Folders

A folder, like those found on the Macintosh, provides the WAIS framework for organizing questions. A folder is a repository for documents. A file system, in the Macintosh sense, is full of folders organized in a tree structure that supports an efficient document-location mechanism.

To find a document within a file system, you typically use the `find` command under Unix or Finder on the Mac.

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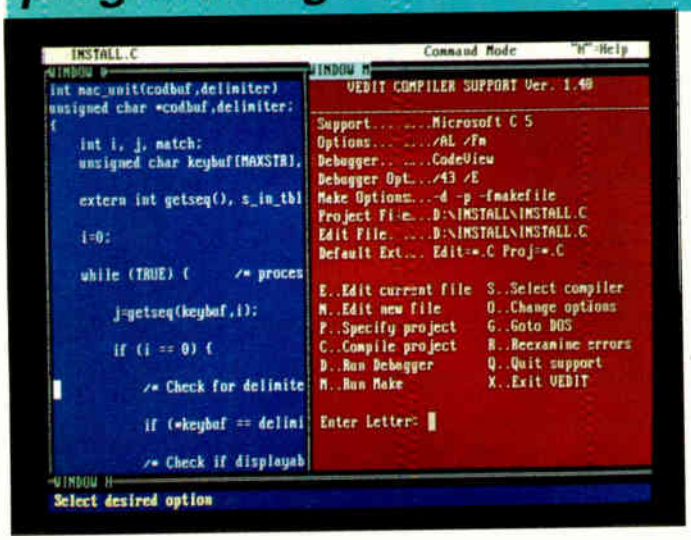

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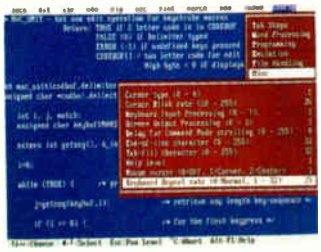

Just about everything about VEDIT is configurable, from the keyboard layout, to the screen colors, to the way control characters, tabs and the end of lines are displayed. Configure VEDIT with easy to use menus.

BENCHMARKS IN 3 MEG FILE

	VEDIT	BRIEF	Sage	QEdit
Simple search	57 sec	1:17 min	28 sec	Cannot
Save and continue	52 sec	3:52 min	1:47 min	Cannot
Load, modify, save, exit	21 sec	49 sec	1:38 min	Cannot
Block-column copy (40x200)	2 sec	30 sec	2 sec	2 sec
Delete one column in file	9:58 min	1:50 hour	1:03 hour	Cannot
60,000 replacements	3:18 min	1:44 hour	1:32 hour	Cannot

* DOS version also supports Concurrent DOS, DESQview, Microsoft Windows, PC-MOS/386 and most networks. Special CRT terminal version runs over serial lines and modems.

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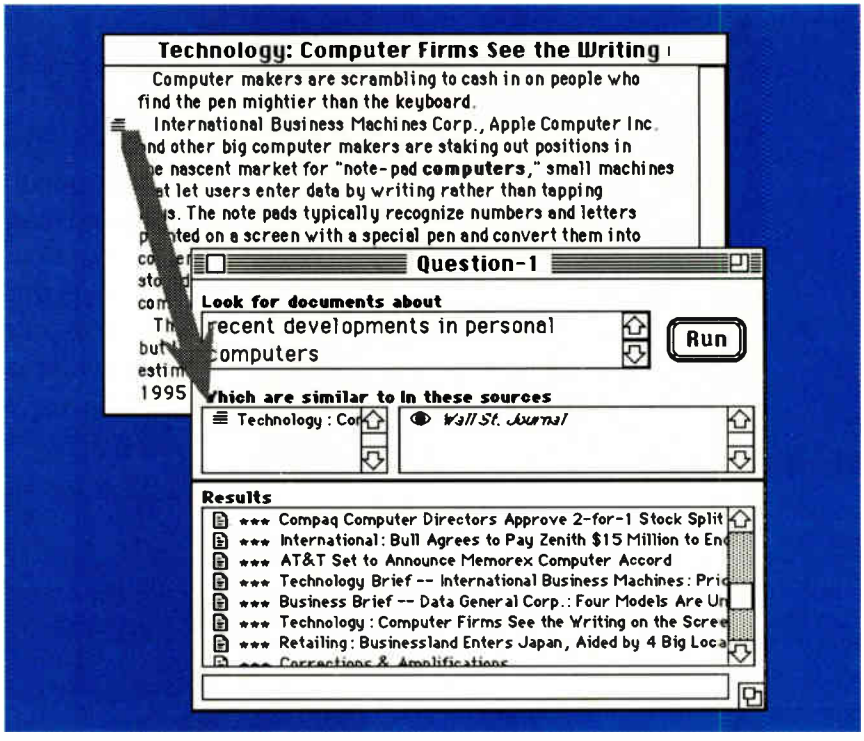

Figure 2: *The* `similar to` *function lets you retrieve more documents on notepad computers using relevance feedback. You then might initiate a search for additional documents with similar content. Selecting text from a section of a retrieved document helps to refine subject-matter searches or locate collateral information. You can also use the selected text to execute a new query. (Courtesy of Thinking Machines Corp.)*

With one of these tools, you can locate the position of a file and gain access to its contents. Path-driven locators search an information base for a document's name, but they do not provide a means to examine its contents.

Retrieving documents pertinent to a specific question requires *content navigation* (i.e., examining the contents of a document, or a representative abstract or index for the document, for its relevance to the question). The similarity between the question and the document's index determines a retrieval score, an indication of the likelihood that the document is pertinent.

WAISes rely on the dynamic folder to encapsulate a question. In its most passive form, it contains a question and a set of servers to target. The WAIS posts the dynamic folder to servers of known quality and functionality, and then query processing begins.

The dynamic folder executes a remote query that sends questions to the remote servers. There the questions find relevant information and return a list of document titles (document pointers) encapsulated within the originating folder to the local WAIS system. The results from the query may initially include a list of documents with fair, good, or high similarities.

Now you can refine your query strategy by perusing the document titles to determine which are the most appropriate documents. WAIS technology, in the form of the WAIStation user interface (see reference 5), assists this process through a content-associativity function known as `similar to`.

The `similar to` function informs the WAIS user interface that a document is "interesting." The server uses this information to find other documents that are similar to the one you have chosen. This search strategy, an embedded component of WAISes, represents a significant improvement over traditional database methods, such as Structured Query Language (SQL) and Boolean search.

This form of query execution is known as *relevance feedback*. It lets you extend the query to incorporate a "more-like-that-one" functionality and lets you retrieve documents that have similar contents. The WAIS user interface is organized around the English language, and English-language-oriented query structures are easier to use than SQL.

The similar to function is like working with a reference librarian. First, you state the topic of your research, which the librarian translates into queries. After you examine the results of the queries, you indicate which results were on the mark; thus, the librarian gains a better understanding of your needs and can improve the search.

With relevance feedback, WAISes can retrieve documents with greater ease and speed. You no longer need to alter a SQL Boolean operator to adjust the query filter; instead, you can ask for "more documents like this one."

Dynamic folders can also possess *vitality*, which gives the folder a continuous charter to execute queries periodically and update its contents with new material. A folder's charter expresses purpose, intent, and the goal that you want the query to accomplish. You can build the folder to periodically poll servers known to receive frequently updated material that matches its charter.

If the search retrieves an interesting document, WAISes let you select a portion of the text and use it as an adjunct to the initial query. Selecting text from a portion of a document that may contain some particularly topical or relevant information and using it to refine the search is an innovative approach for exploring subjects (see figure 2).

WAISes also let you chain questions by taking the results of a previous search, starting a new question with different subject matter, and dragging the previous results into the similar to menu box (see figure 3). Chaining questions can either broaden or narrow a search, depending on the relevance-feedback results.

The recursive capacity of dynamic folders to initiate "sibling" folders demonstrates the WAIS potential to harness and refine subject matter. Query refinement alters the charter of a dynamic folder. Sibling dynamic folders execute directed searches and can have an autonomous authority to broaden the range of server choices.

Controlling the extent of search expansion is a critical issue. For individuals, cost can be an overwhelming concern. WAIS technology does not yet contain an accounting system to govern search criteria. Participating information services will have to engineer this element of the technology themselves.

WAIS Protocol

WAISes promote connectivity and access to remote electronic-information sources through a standard protocol, the WAIS protocol. This protocol is an extension of the National Information Standards Organization (NISO) Z39.50-1988 specification, which defines an interface to remote information-retrieval services and library-protocol applications. The Z39.50 standard is the backbone of the WAIS protocol and the foundation for WAIS applications development.

With relevance feedback, WAISes can retrieve documents with greater ease and speed.

Incorporating the Z39.50 standard into the WAIS protocol frees developers to build articulated user interfaces for WAIS applications. The interface standard isolates the server's text-retrieval method, such as SQL, giving the application a transparent access mode. The particulars of database queries are hidden beneath the interface. A developer only needs to be sure that the server possesses an equivalent functionality to conduct remote information-retrieval transactions from a local WAIS workstation.

Concealing the server's implementation through the WAIS protocol is important in another respect as well. Isolating the implementation implies that you can specify a single, more palatable query language. The WAIS protocol also lets you use an English-language-style query

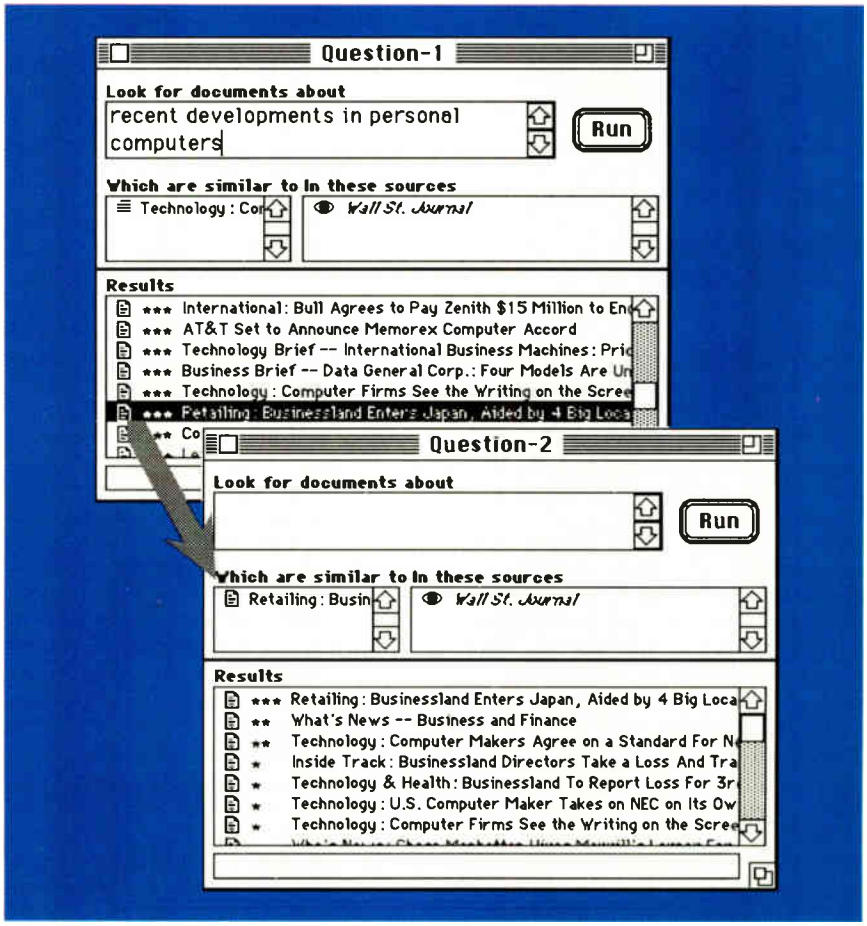

Figure 3: *Chaining questions permits you to use a query on multiple information sources by opening a new question and dragging previous query results into the* similar to *field. You can also apply the* similar to *operation to invoke a new document search, as in this example. (Courtesy of Thinking Machines Corp.)*

lexicon instead of cryptic SQL or fourth-generation languages. When you find a document that is appropriate, the WAIS protocol automatically handles the download process from the server. This is quite different from existing services, where manual file-capture mechanisms require vigilance. With the WAIS protocol, all documents look like they are local to your system.

The WAIS protocol incorporates two important modifications that the NISO Z39.50 standard does not address. First, it permits hypermedia document transport. Most documents today are composed primarily of ASCII text codes and sequences, but the next generation of documents, constructed from hypermedia and multimedia sources, integrates images and fully formatted text. These media forms are rapidly becoming popular and conventional.

While still a research project that is undergoing development and refinement, the WAIS holds immense promise.

Second, the WAIS protocol is stateless for the server. It does not have to keep any information about the client between transactions, because the user's state is kept on the local workstation. Every search or retrieval operation is a separate process. The contexts are decoupled under the statelessness of the protocol. This decoupling lets you make a search, store away the document pointer, and retrieve it later.

Further, you can use a dynamic folder to pass one of these document pointers to someone else who can also retrieve the document. A document pointer is like an International Standard Book Number for the electronic age. (The ISBN is a unique identification assigned to each publication.) Passing a document pointer conforms with copyright law and lets you easily return to the document source instead of making copies.

The WAIS protocol is designed to transport information through modems, X.25 communications, or network backbones. This flexibility provides an enormous framework within which to conduct retrieval transactions. For example, with a portable computer, you could connect with a WAIS hub through a modem and post dynamic folders, directing the query results to be routed to your office system for later examination.

Retrieval Technology

The computing infrastructure needed to implement WAISes varies with a server's functionality. A Library of Congress WAIS, with 25 terabytes of data, could not expeditiously dispatch queries and function if a serial computer were used to process the information. For a problem of this magnitude, massive parallelism is needed. The Connection Machine's Text-Retrieval System is a viable information-retrieval system for gigabyte-size databases.

The DowQuest service from Dow Jones runs on the Connection Machine. The service incorporates approximately 1 gigabyte of original text derived from over 400 sources. The *Wall Street Journal*, the *Washington Post*, *Barron's*, *Fortune*, *Forbes*, and several regional business and technical journals are included, covering the previous eight calendar months. The search time with a 100-word query composed of typed English and relevance feedback (e.g., "more like that one") is less than half a second. The system can provide access to many gigabytes of text and to thousands of users interactively.

The projections for the Connection Machine system indicate that when it is scaled to a 1-terabyte database with 10-word queries, obtaining an answer within 10 seconds or less is highly probable. This performance is accomplished by harnessing the Connection Machine's 65,536 separate processors to execute a parallel index algorithm (see reference 6). These estimates are phenomenal and truly indicative of the computing power manifest in parallel systems. No serial machine can even come close to this level of performance.

The Connection Machine system generates these results by searching the entire contents of an archive, not a representative abstract of a keyword frequency table. Each document within the archive is used to determine a match. This is not typical for systems organized around serial computers, and it is another dramatic demonstration of parallel-computing technology.

The cost of a system like the Connection Machine runs in the millions of dollars. But a Macintosh with a 100-megabyte hard disk drive or a 386-based PC can serve the typical WAIS user.

Immense Promise

The prototype WAIS user interface and protocol are currently being beta-tested at Thinking Machines, Apple Computer, and Dow Jones News/Retrieval. Thinking Machines, the principal developer of the WAIS architecture and software, plans to share the WAIS protocol free of charge and hopes to help user-interface developers build interfaces to WAIS servers.

While still a research project that is undergoing development and refinement, the WAIS holds immense promise. Information commerce, buoyed through the widespread acceptance of computer systems and networks, forces individuals and companies to expedite transactions and simplify activities. These coveted sources of efficiency stand out as prominent allies of competitive advantage. ■

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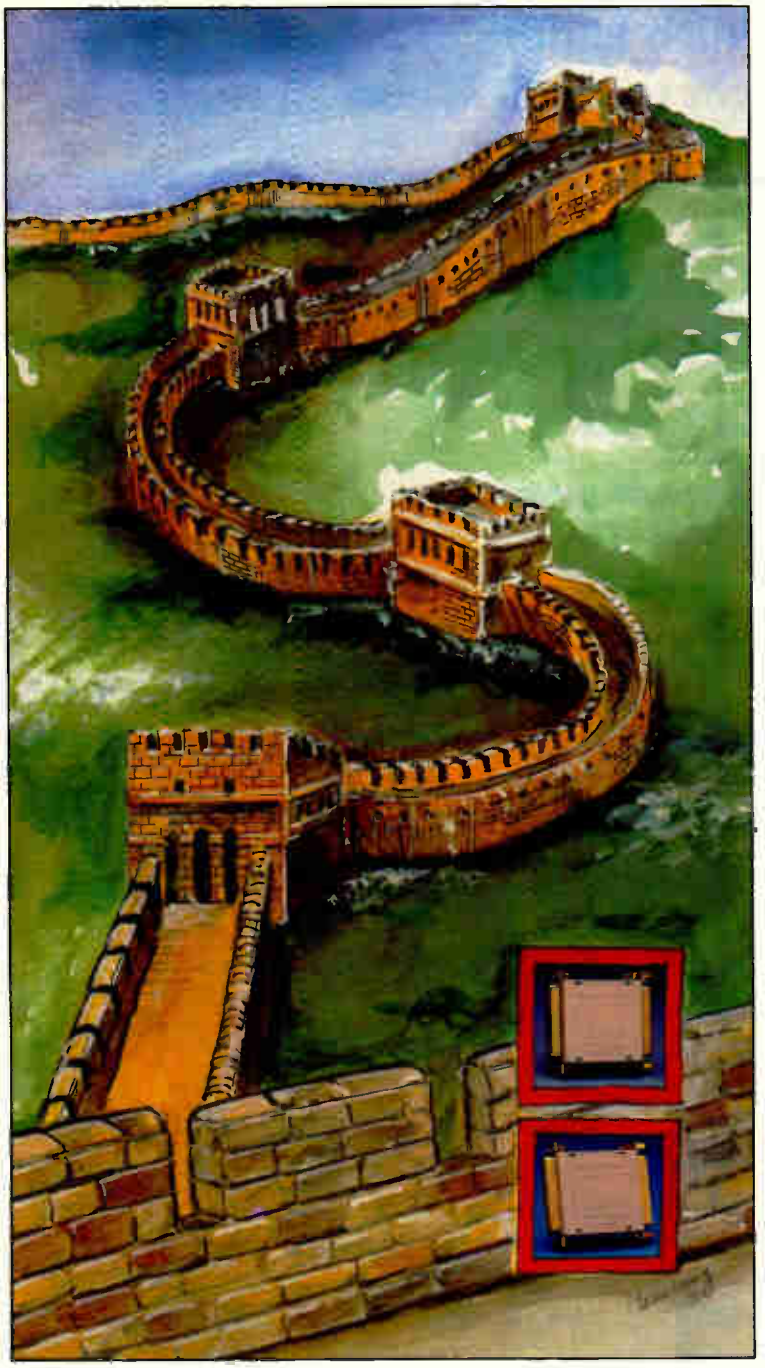

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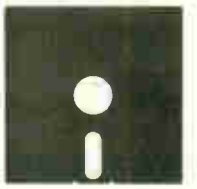

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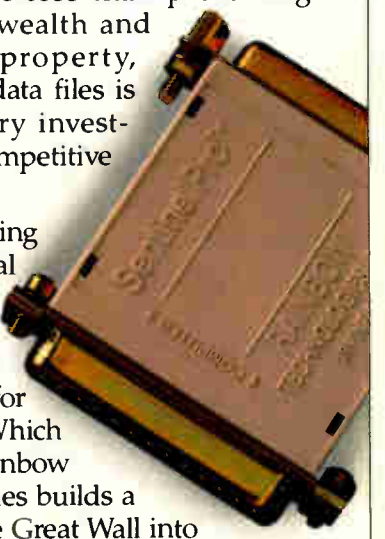

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TM3000/20MB w/4MB	$3498.00	TM3000/60MB w/2MB	N/A
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9MB	$3858.00
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T3200SX/120MB			
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w/11MB	$4,708.00	w/13MB	$4,948.00
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w/5MB	$2,078.00	w/9MB	$2,568.00
T1000XE/20MB w/2MB			$1,378.00
T3200SXC/120MB			
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T5100/100MB w/4MB			$3,488.00
T5200/40MB		w/4MB	$4,568.00
w/6MB	$4,748.00	w/8MB	$4,928.00
w/12MB	$5,358.00	w/14MB	$5,528.00
T5200/100MB		w/4MB	$4,928.00
w/6MB	$5,108.00	w/8MB	$5,288.00
w/12MB	$5,718.00	w/14MB	$5,888.00
T5200/200MB		w/4MB	$5,338.00
w/6MB	$5,518.00	w/8MB	$5,698.00
w/12MB	$6,118.00	w/14MB	$6,298.00
T5200C/200MB		w/4MB	$5,938.00
w/6MB	$6,118.00	w/8MB	$6,298.00
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PRIORITIZING INFORMATION

Rear Adm. Grace Hopper, USN, Ret., speaks out on how we must analyze, evaluate, and use the various kinds of data that we input into computers

Compiled by JANET J. BARRON

Model Ts totally changed the world of transportation. They cost between $300 and $600, and all of a sudden, people could afford to buy and own cars. The whole world changed because of the Model T, and yet, somehow, we totally neglected the underlying concept—*transportation as a whole*. Because we didn't look at transportation as a whole, today roadbeds and railroads are falling apart all over the U.S.

Now we're at the real beginning of a relatively new industry [the computer industry] that will eventually be the largest in this country. And I am very much afraid we'll make the same mistake all over again. I'm afraid we'll continue to go out and buy pieces of hardware with flashing lights and lovely "user-unfriendly" software and totally neglect the underlying subject—the total flow of *information* through any organization, activity, company, and so forth. We should be looking at the information flow and then selecting the equipment to implement that information flow.

Of course, to use our best equipment for handling the most valuable information, the first thing we need to know is which is the most valuable information. For a couple of decades now, I've been asking people how they value their information. I haven't received any answers, but I have received a really great assortment of blank stares. Some people even question that there's a difference in the value of information.

I know of an oil refinery that's operated by computer. Information comes in from marketing and goes to the computer, which opens valves and pushes

ILLUSTRATION RON CHAN © 1991

stuff through pipes and tells inventory how much of the finished product has been made. The computer puts out payroll reports and makes out the checks, as well as generating reports on all the activity that occurs.

Let's suppose that two pieces of data simultaneously enter that flow. One comes from a valve out in the plant and says, "If you don't open me, the plant's going to blow up. You have 45 seconds to act to save 78 lives and a $120 million plant." At the very same instant, from another part of the system, comes the fact that Joe did 2 hours of overtime. Which is the more valuable piece of information? And what are our criteria?

Finding the Value of Data

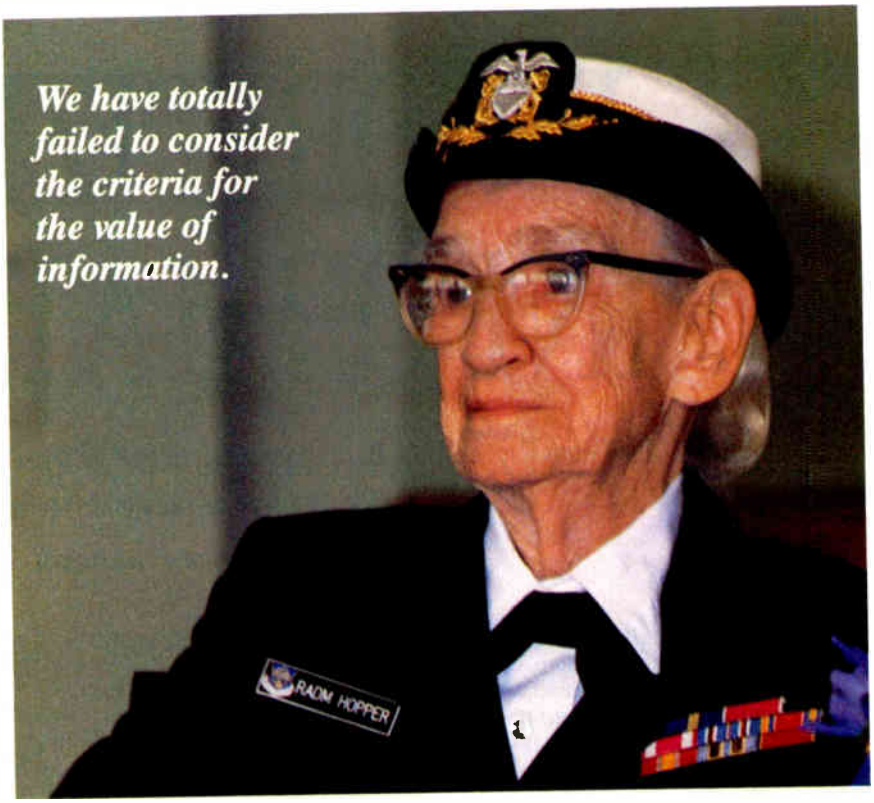
Most large companies insure their databases against damage, inability to access them, and other perils. What happens when the insurance company or the FBI asks, "How much is it worth?" Probably one of the biggest jobs we have ahead of us is to determine that value.

We have totally failed to consider the criteria for the value of information. We haven't even defined our criteria. And yet we must know something about the value of the information and data we are processing.

I think we must create several priorities: the time you have to act on the data and the number of lives and the number of dollars at stake. But there's another one—the importance of that piece of data in making decisions.

BYTE ACTION SUMMARY

The total flow of information through any organization, activity, company, and so forth is what matters. Look first at the information flow, and then select the right equipment to implement that flow. To use the best equipment to handle the most valuable information, you need to know which is the most valuable information. That's the hard part. How do you value your information?



We have completely failed to analyze the raw material that we are processing. We've spent almost half a decade talking about the process, the system, and the training. We've forgotten to look at the data or at the information we are producing. We've also neglected to notice something about information: Information is totally inert; it never does anything. It's something you see on the printed page, or you may see it on a computer screen, or you may hear it over a telephone. Although it never does anything, it still has to be fed through another process.

We have a raw material that is called data. We feed it into a process. In this case, the process consists of hardware, software, communications, and trained people. Hopefully, the output product is information. Equally hopefully, this process is under some form of control and there's a feedback loop from the information to the control to improve the quality of the information.

This process consists of a human being who analyzes, correlates, relates that information and turns it into something we can call knowledge, or intelligence—that we can make decisions on. But since we've added another process, we have to have another means of control and another feedback loop to improve the quality of the knowledge.

Take the example of a manager of a service business. Say he has 150 computers in his company, all providing data to him. He tells you, as his office manager, that he wants to know how much the firm has spent on gasoline for its fleet of vehicles. You can tell him how much it has spent on gasoline, but that's an insufficient answer.

Noting how many months there are left in the fiscal year, you should tell him how many gallons of gasoline the fleet has used so far and how many miles each vehicle travels on average per month. Considering the possibility of an oil shortage, you can also project how much each gallon of gasoline could end up costing and, with some what-if scenarios, give your manager a rundown, in both figures and charts, of several possibilities of what the firm may have to spend on gasoline for the rest of the fiscal year.

We have got to give people better answers—more complete answers. This is where we're going to need the little expert routines—not the great big ones, the little ones—and we're going to need them very badly. One of the biggest jobs for these applications will be to find out what people need to know. What does the manager of a business need to know? We've got a tremendous job ahead of us.

There's something else that is important about this information business. Information has an actual value to a

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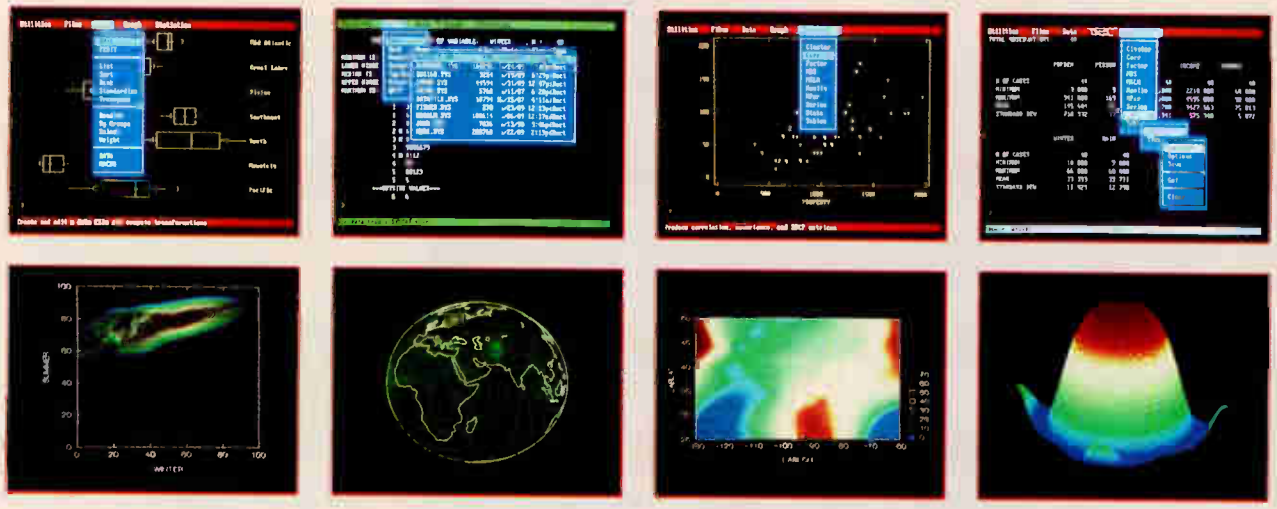

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corporation. Someday, under "Other Assets," there's going to be an entry on the corporate balance sheet—"Information"—with a value on it. I asked the IRS how they plan to depreciate the value of information. They didn't answer me.

A Question of Accuracy

There are some other issues regarding information that we need to address, such as accuracy—correctness of the information that comes from your computer. One year I turned in my budget, and even though it added up right and had beautiful charts in it, it was rejected for inaccuracy. I put it through my computer again, and it came up with the same answers. *Certainly*, it was correct because it came from the computers. We've gone that way for too long.

When one of my supervisors heard about this situation, he decided to find out the possible costs of incorrect information in a data-processing system. He found a section of the privacy law applying to government employees in the military that dealt with this issue.

It states that if there is inaccurate data in a personnel file and, because of it, someone is denied a raise or a promotion or otherwise treated improperly, they have a right to sue the federal government. The fact this law is on the books shows how serious a situation the military considers the possible consequences of inaccurate information. There are few cases an individual is given the right to directly sue the federal government.

This officer decided to analyze the possible costs to the government of inaccurate information in a personnel file. He used a hypothetical case and extrapolated, using statistical probabilities, and estimated the damages in a best-case scenario.

He came up with the fact that in just one possible situation, inaccurate information in a few personnel files could cost an organization in the range of $500,000. Now, this half-million-dollar projection was just for one not-so-bad case of incorrect data unintentionally finding its way into a small percentage of one department's personnel files.

You can use your imagination and multiply that figure by a factor of *n*. Then you can see for yourself how many millions of dollars of damage (not to mention the grief of those who get turned down for jobs, raises in salary, and so forth) that inaccurate computer information can cause. And the issue can't be resolved by going to your boss and asking for hundreds of thousands of dollars to correct the files and save the company

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money. We've got to find out something about, and analyze, the cost of incorrect information, and it's a subject we've totally failed to address.

The Flow of Information

Consider the concept of a river. It starts with little tiny rills, tiny drops of water going downhill. These drops coalesce into a small brook. That process continues on and on until somebody decides to use some of that water. So, they build a little dam and create a small pool. They use the water there. Then it coalesces again and runs on down and finally gets to be quite a good-size brook, and the brook runs into another dam before it enters a lake.

People use the lake water locally before they send it into the lake itself, from which some of the water flows out into a main river, which goes into some part of the state. Everywhere along the way, there are dams and reservoirs, and the water's used, coalesced, and sent in a broader stream on down until it finally reaches the sea.

I think data ought to behave this way. It should be collected locally at a branch office or somewhere and used there. Then it ought to be coalesced and forwarded to a regional office and used there, coalesced, and finally end up at a headquarters. Then there also would be a reverse flow that matches the river flow.

Telephone lines parallel rivers. When headquarters decides that something needs to be done, it sends orders back out to all these parallel branches, out to the branch office. That's a real flow of information, where the data goes both ways, and it's used locally before it's sent on down to headquarters. It's not centralized. There's no sense in sending every detail that concerns the branch office into Washington, D.C.

It makes sense that when the data-processing and MIS departments within a company look only at the computers and the telephone lines that they control, they're not doing their jobs. They're not looking at the information itself, at the value of that information, or at who uses it and why. We have to learn to manage information and its flow. If we don't, it will all end up in turbulence. ■

ACKNOWLEDGMENT

The information in this article is from a speech by and an interview with Grace Hopper.

Janet J. Barron is a BYTE technical editor. She can be contacted on BIX as "neural."

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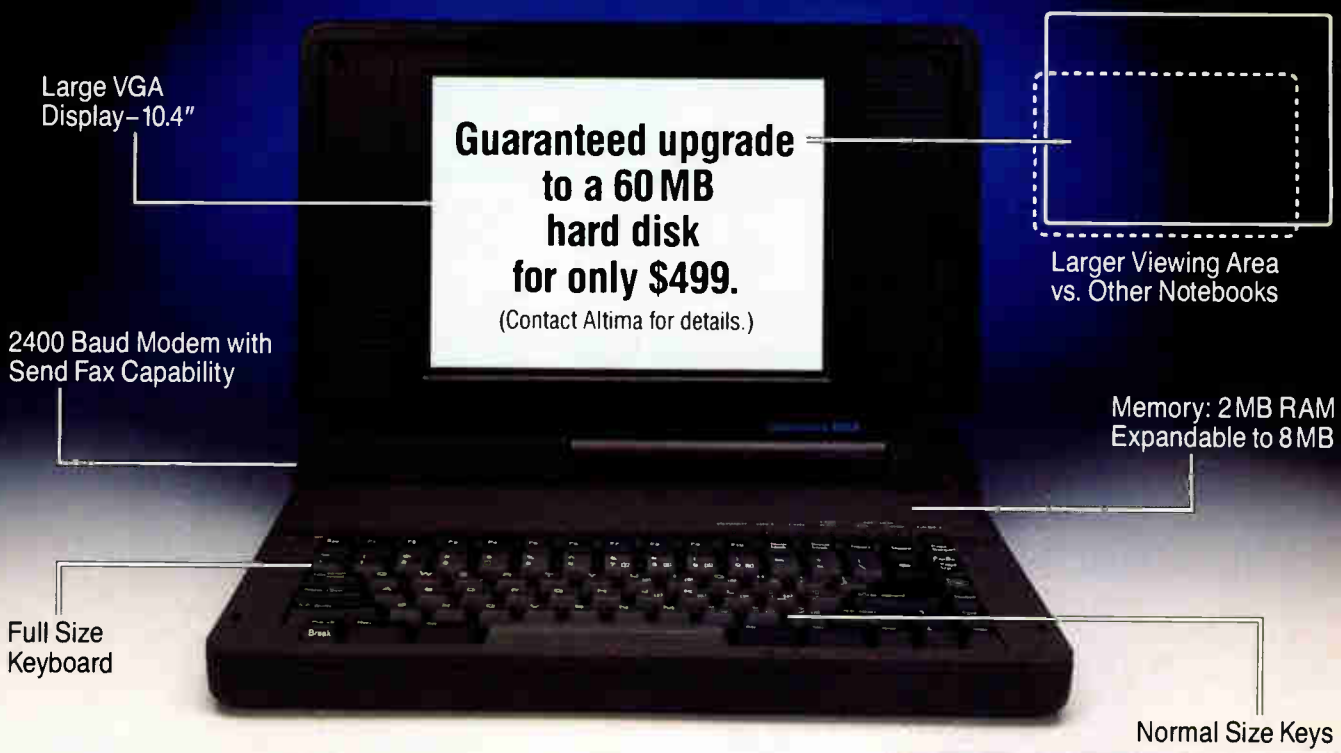

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THROUGH A LENS SMARTLY

MIT's Information Lens project has laid the foundation for intelligent assistants for your E-mail system

Mike Robinson

Information overload is something like the weather, only a bit better: Yes, everyone complains about it, but some people are trying to *do* something about it.

Consider E-mail. Almost every company already has some form of E-mail, and information overload is often as much of a problem with such systems as it is with in-boxes; many users receive anywhere from 30 to 100 messages daily. Handling that amount of mail, especially when you have been away for a day—not to mention several days or a week—is daunting, to say the least.

What's more, the problem will grow worse. The number of electronic mailboxes will soar from 17.4 million in 1990 to 64.7 million in 1995, according to International Data Corp. (Framingham, MA). E-mail systems will increasingly be interconnected, a trend that's already well under way. And beyond the messages themselves lies all that information you may want to find, made available electronically by on-line news, stock quotations, and a host of other services.

ILLUSTRATION RON CHAN © 1991

Enter Information Lens

Information Lens, a research project at MIT's Sloan School of Management, addresses electronic information overload by attacking not just the problem of dealing with the sea of messages many people receive, but also the problem of finding the information people need or want.

Dubbed an *information-sharing system*, Information Lens uses concepts from AI and graphical-user-interface (GUI) design to create a kind of secretary or "intelligent assistant" that can sort incoming messages into meaningful

From Information to Objects

The Information Lens project ended in 1989, when it was, in effect, transformed into the Object Lens project. Called "the second generation" of the Information Lens system, Object Lens builds on the experience Malone and his team had in using and enhancing the Information Lens. It therefore contains a large number of enhancements suggested for the original project.

These changes created a "significant generalization" of the Information Lens, so that the Object Lens can far exceed it in the kinds of knowledge that can be represented and the ways that information can be manipulated. The result is a knowledge-based system for developing cooperative work applications. Another way its developers look at the system is as a user interface that integrates hypertext, object-oriented databases, electronic messaging, and rule-based intelligent agents.

Like the Information Lens, the Object Lens relies on semistructured templates and rule-based processing, as well as a consistent graphical user interface and an inheritance network. But it goes beyond the Information Lens in that you can represent information not only about messages, but also about many other types of information—for example, people, tasks, and products. Such representation is possible because of the Object Lens's object-oriented database.

Objects and Agents

You create objects using semistructured templates and matching editors. These templates and editors are also based on fields and resemble familiar forms. You can group the objects into customizable folders, which are themselves special kinds of objects. (You can also customize the way a summary of the contents of a folder is displayed, as well as how the objects themselves are shown.)

Finally, the Information Lens's concept of rule sets has been extended to one of rule-based intelligent agents. The agents are semiautonomous: You are in control in that you specify what they do to what, and when, and you can always change or delete them. (You can also have them refer an object to you for action.) They are, however, autonomous in the sense that once you have created them, they can act without your doing anything further if you so specify.

The ability to specify "when" is an important addition to the Object Lens. Not only can you have rules trigger, or "fire," when mail arrives, but you can also specify a time or times for them to fire instead.

Coming Attractions

MIT is making the Object Lens technology (for which it has several patents pending) available for a modest fee. In fact, Beyond and DEC have licensed the technology. In addition, Agility Systems is considering signing a licensing agreement.

Beyond has incorporated some elements of the Object Lens system into BeyondMail (see the text box "Going to Market" on page 182), but it is unwilling to discuss them. Some aspects are, in effect, present now; others are included in the system architecture as a basis for enhancements in later versions of the product.

With its emphasis on managing other kinds of information, Agility Systems' WiJit looks more like the Object Lens than like the Information Lens (see the text box "From Rules to Agents" on page 186). Perhaps more important, it borrows from the Object Lens in its use of intelligent agents instead of mere rule sets and in its ability to have the agents act at particular times.

DEC has several research projects based on both the Information Lens and the Object Lens. The projects, conducted by the Advanced Development group of the Business Office Systems Engineering division, are in two main areas—advanced information management and interpersonal computing. More specifically, they deal with such areas as the management of mail, news feeds, and other information, and the use of agents to maintain things like appointment calendars and travel itineraries. And last summer at DECWorld in Boston, DEC showed mail filtering and context-based retrieval of information as part of its "Office of the Future."

categories (or *folders*), prioritize the messages based on importance and urgency, and even go out and find specified kinds of information. In addition, it can automatically respond to certain kinds of messages, and it can suggest actions you may want to take once you have read other kinds of messages.

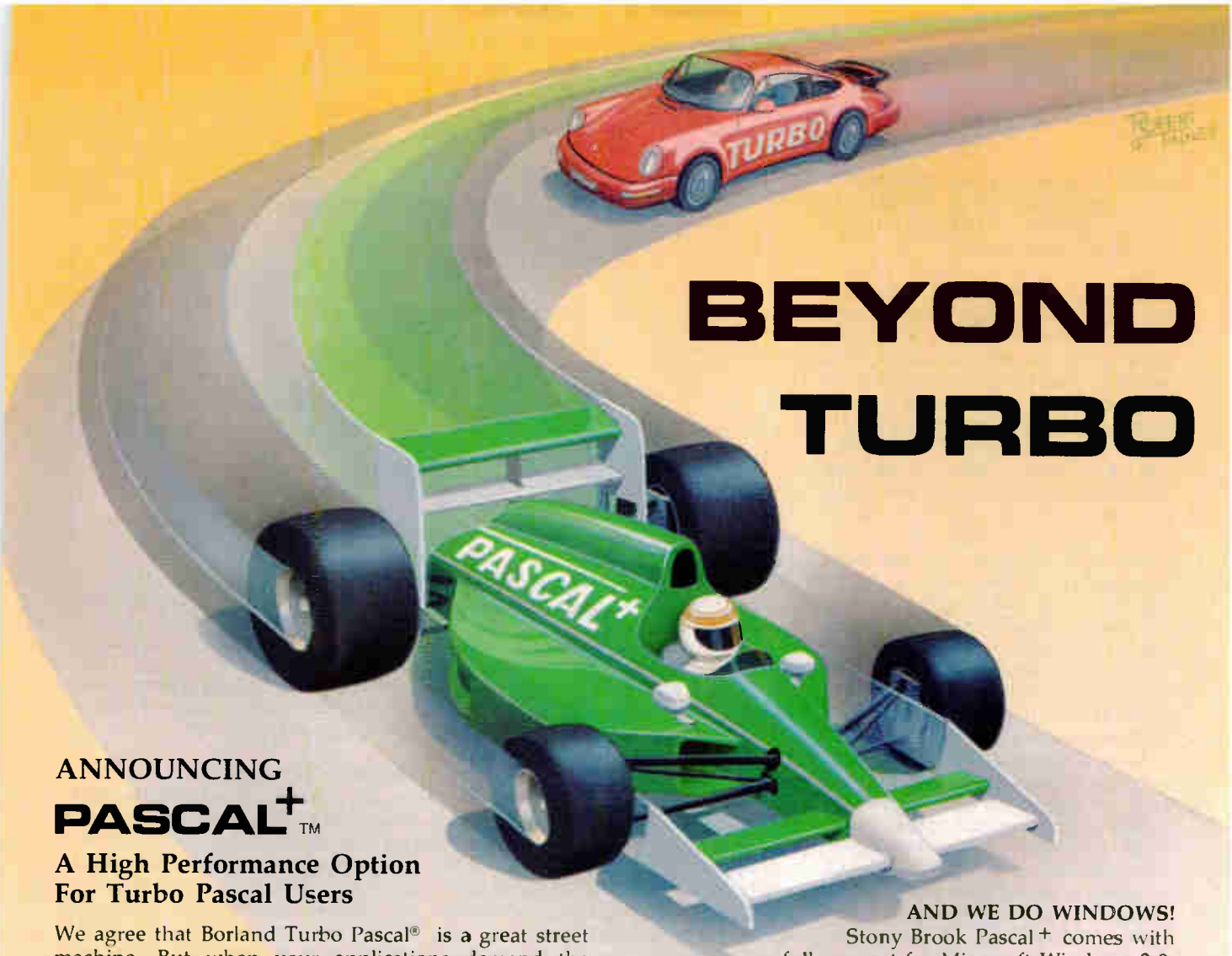
The project, which ran from 1985 through 1989, was conceived and directed by Thomas W. Malone, Patrick J. McGovern Professor of Information Systems at Sloan and director of MIT's Center for Coordination Science. Earlier, Malone had worked at Xerox's Palo Alto Research Center, where people were heavy users of E-mail. There, Malone experienced the flood of electronic messages many years before most people. In fact, he helped develop a prototype mail-sorting system at Xerox PARC to help its E-mail users.

While this development was going on at Xerox PARC, people active in organization theory were predicting that the internal structure of large organizations would evolve into a conglomeration of temporary groups requiring lots of lateral communication (a structure first described by Alvin Toffler in *Future Shock* and known as *ad-hocracy*). One of Malone's interests was trying to figure out what might help serve such a need.

At MIT, Malone worked on the problem of information overload that E-mail users encounter, but general issues of group communication and coordination were always part of his concerns. With his preliminary ideas centered on two fundamental technologies of AI—rule-based processing and frames—he initiated the Information Lens project.

Lens Elements

Malone's ideas coalesced into a system built on five elements: semistructured message templates (*frames*, in AI parlance); sets of rules to process messages (AI's production rules); a consistent set of display-oriented (graphical) editors for composing messages, creating rules,



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and defining new message templates; a frame-inheritance lattice, or network, for message types; and a public mailbox, called the Anyone server.

• *Semistructured message templates*: Semistructured messages are the basis of the Information Lens system. They make possible the powerful processing and highly graphical display-oriented editors that characterize Information Lens. Using specific message types further expands the potential power of any rules and of the editors. Specific message types also help the system present intelligent options for what you might want to do after reading a message.

Electronic messages, like the paper memos they emulate, already exhibit some structure, specifying basic kinds of information, signaled by *To*, *From*, *cc*, *Date*, and *Subject*. Beyond these fields, some types of messages have other fields or provide information that additional fields can easily specify; meeting announcements are an obvious example.

Using templates containing appropriate fields makes it possible to automatically process a much wider range of information than you could otherwise. The fields, or structure, represent enough information that simple rules can provide relatively powerful processing, and sophisticated rules can provide even more power. Without fields, you would need an "intelligent agent" capable of natural-language parsing and free-text understanding.

Semistructured messages offer several other advantages, some realizable even without automatic processing. A simple one is standardization, given that everyone in a group or organization uses the same message types. Another advantage is having essential information, like an action request and its deadline, immediately apparent in its own fields, instead of requiring you to read a message to find out what you have to do and when it has to be done. (On the other hand, semistructured messages still give you the flexibility to say anything you want in the text field, and the fields can be edited as desired.) Message types and their fields reflect the processing that people naturally do with the messages and mail they receive.

• *Rule sets*: Rules consist of a test (IF) imposed on the information in the fields (and, if specified, in the free-text part of a message) and an action (THEN). Grouped into sets, they allow much more powerful processing than simple Boolean queries, enabling you to specify extended reasoning chains about what you want done with your messages and any information available from on-line services.

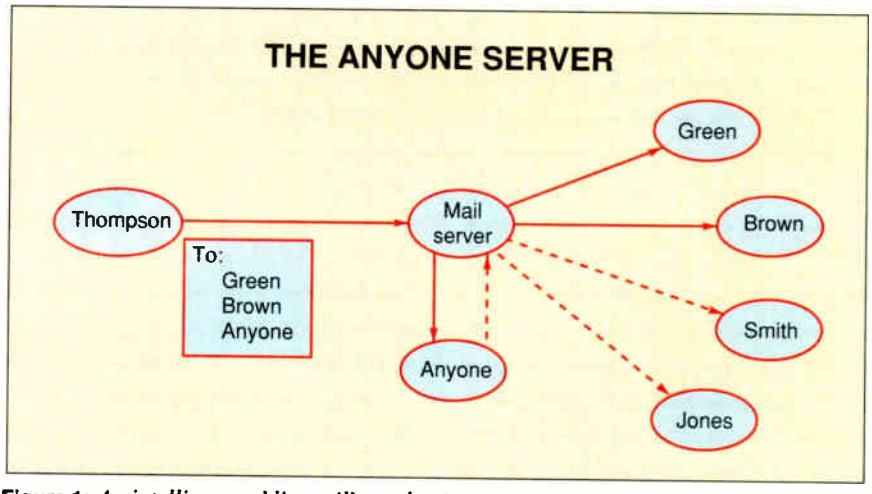

Figure 1: *An intelligent public mailbox, the Anyone server receives messages that include "Anyone" as an addressee and redistributes them according to rules written by individual users.*

• *Display-oriented editors*: Graphical editors—also called direct-manipulation editors—that resemble what is being edited greatly simplify the editing process, making it easy even for novice computer users. Information Lens uses three similar editors: one for composing messages, one for creating rules, and one for defining new message types. All are based on representations of message types, and much of the editing is done using menus of options.

• *Inheritance network*: Organizing the message types in an inheritance network simplifies the definition and use of semistructured messages and of the processing rules as well. With the inheritance network, which is an aspect of object-oriented design, certain types of messages are special kinds, or subsets, of other types of messages and automatically inherit properties and processing rules from the more general message type (i.e., the parent) they are descended from.

• *The Anyone server*: The Anyone server is the only one of the five basic elements specifically designed to let you go out and find messages or information not addressed to you. It is a public mailbox that runs on its own workstation and acts in some ways as a postal substation. You can send a message to Anyone, in addition to the designated addressee or distribution list, indicating that the message may be automatically redistributed to anyone who is interested. On-line services could also be fed into Anyone. The Anyone server then distributes its messages and feeds according to the processing rules for selection that individuals have written (see figure 1).

To Have or Have Not

Taken together, the above elements yield a system that offers a distinct advantage over most other intelligent systems: incremental adoption, both by individuals and by groups. In Malone's phrase, you don't have to "scale a cliff of learning" before receiving any benefit. Instead, you can adopt the Information Lens system in a "series of small steps, each of which requires only a small amount of learning and provides an immediate benefit, and each of which can be taken or not taken," as you prefer.

In other words, you could initially adopt the most basic feature of Information Lens—message types (templates)—

BYTE ACTION SUMMARY

As an MIT-based research project, Information Lens focused on methods that let you handle large amounts of E-mail and other on-line communications. Many of the intelligent-assistant concepts developed for Information Lens are now being applied to commercial products.

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Going to Market

Beyond (Cambridge, MA), a productivity-software developer for personal computer users, is readying a product, BeyondMail, that's based on the Information Lens project from MIT. The company was founded in mid-1988 by Charles Digate, a former senior vice president of analytic products (spreadsheets) at Lotus Development (Cambridge, MA).

Charles Digate

Digate's first employee was Eugene Lee, who received an M.S. in management from MIT's Sloan School of Management, where he took one of Thomas W. Malone's classes. Lee is now director of product planning for Beyond. He is responsible for the overall architecture of Beyond's product line, the detailed definition of the products, and management of the development organization.

Beyond seems to have taken the Information Lens approach—to create a system that helps but doesn't necessarily solve the whole problem—even more to heart than the original developers did. The company has scaled back the reach of Information Lens, discarding not only the Anyone server and the idea of giving people the ability to find information that was not sent directly to them, but also the frame-inheritance network.

Nevertheless, Beyond has added several useful capabilities and features to the Information Lens concept. The most significant of these enhancements is the ability to launch an application from within the program.

BeyondMail uses the three other basic elements of Information Lens—semistructured message templates, processing-rule sets, and display-oriented editors—and a similar capability for incremental adoption.

The product is itself a complete E-mail front end. The company also stresses BeyondMail's role as a personal productivity tool for mailbox management and its function as a potential platform for the development of workgroup applications.

Currently, BeyondMail has three message types: the standard E-mail form, a phone message, and a request form. A meeting-announcement type is nearing completion, and Lee says that a fifth message type will be added by the time BeyondMail ships.

With BeyondMail, you can create multiple rule sets—for instance, a standard set, one for when you are traveling, and one for when you are on vacation—and you can turn the sets on and off as needed. Another added feature is that you can send and share your rules with others.

Also new is the AutoTickle. With this feature, you can have the program automatically "tickle" a message, moving it into a folder when it is time for you to do some particular task—such as return a phone call to someone who has been away.

You can also use rules to create beeps or customized visual alerts to signal you when certain kinds of messages arrive. Finally, you can configure BeyondMail's initial setup, so that it can, for example, start your E-mail session by showing you a list of those messages marked urgent.

BeyondMail was announced on January 28 and demonstrated at NetWorld '91 in February. The initial release, for IBM PCs and compatibles, uses Novell's Message Handling Service standard for LAN messaging. It also works with native MHS products (e.g., Da Vinci eMail), through gateways, with public E-mail systems (e.g., cc:Mail, MCI Mail, and All-in-1), and with systems that conform to the X.400 standard.

BeyondMail runs in character mode under DOS or Windows 3.0 (a native Windows version is in development). The program requires at least a 286 processor and 1 megabyte of RAM. Shipment is slated for the middle of this year. The price is $250 for a single-user copy and $1395 for an eight-user LAN package.

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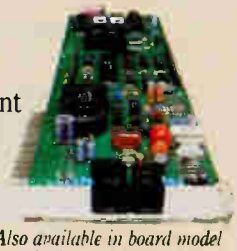

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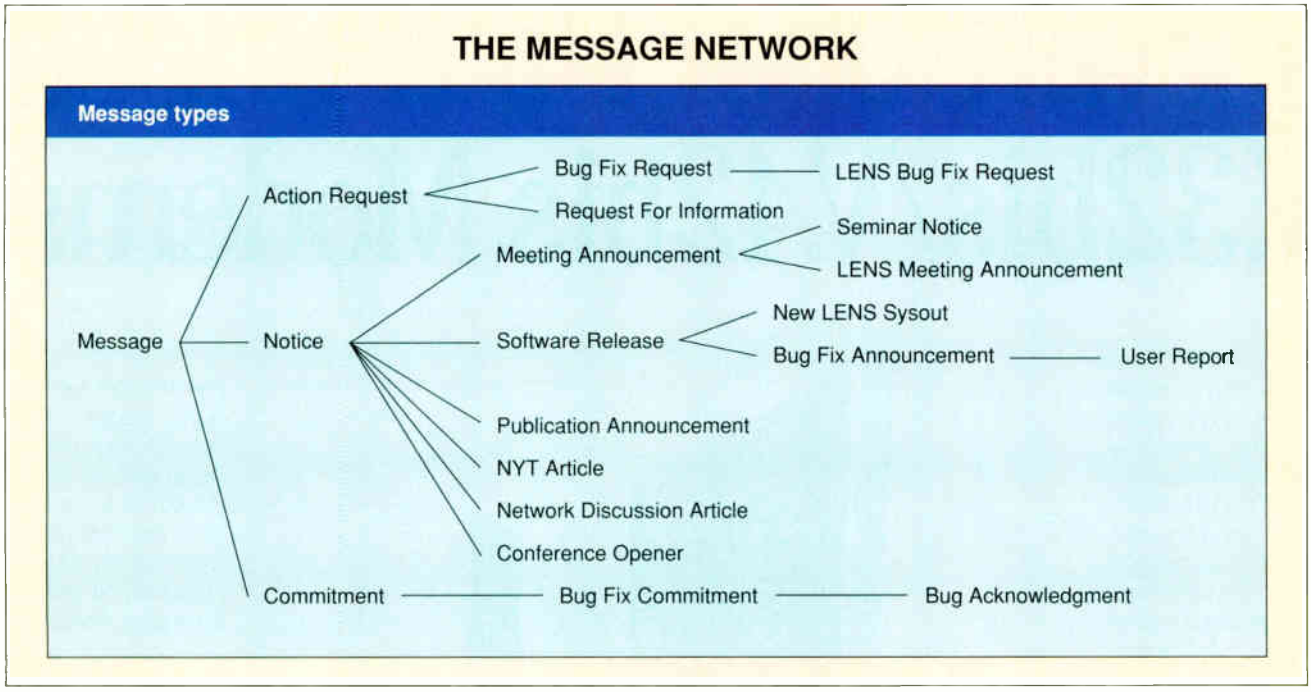

Figure 2: *The message templates are arranged in a network with more general types (to the left) and more specific types (to the right).*

and then proceed to adopt other features at various times. By using just the message type component, you would obtain the benefit of standard, semistructured forms (plus, in some cases, fields with default values filled in).

Adopting simple rules gives you useful automatic processing procedures, and you can go on from there. You gain much of the benefit of rule-based processing even if no one else uses the system, since all E-mail messages contain basic fields on which your rules can work. By gradually adding new rules, you can continually increase the usefulness of the system.

When groups of people who communicate frequently with each other all use the same message types, they gain further benefits from standardization. More important, as they increase the usefulness or power of their rules, they gain the ability to create applications that support a variety of coordination and communication procedures, like task tracking. By creating new message types and applications, groups, too, can continually increase the system's usefulness.

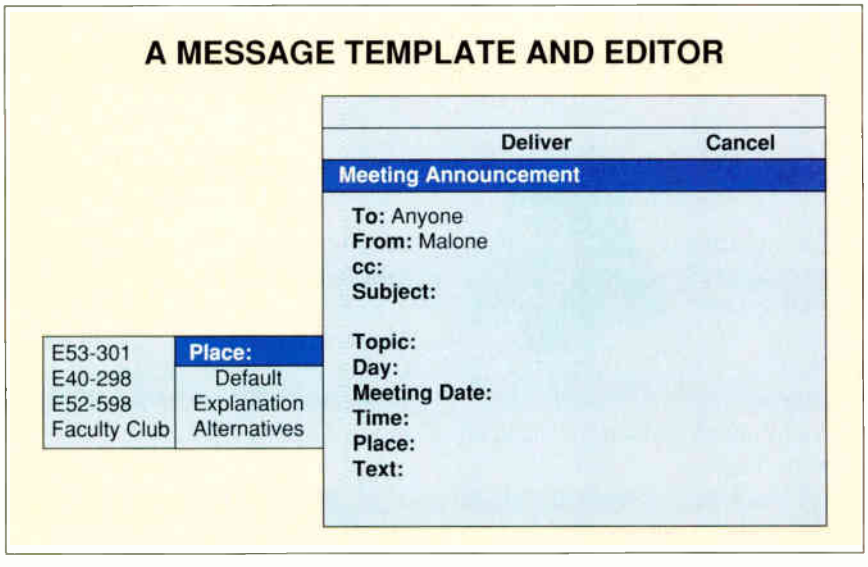

Figure 3: *The message editor uses the appropriate message template and pop-up menus associated with the template fields.*

The Lens in Action

Information Lens was first implemented as a prototype system, mainly through the work of Kenneth R. Grant, who was a research staff member at MIT at the time. The system was under development in various forms throughout the project's lifetime. Written in Interlisp-D using Loops (an object-oriented extension of Lisp) and running on Xerox 1100 series workstations connected by an Ethernet network, Information Lens was built on top of the existing E-mail system. Thus, people could keep using the existing E-mail system and be free to adopt as much or as little of Information Lens as they wanted.

Information Lens has three basic message types—Action Request, Notice, and Commitment—that are distinguished by purpose, as well as a general, all-embracing message type called Message (see figure 2). Below those three basic types, the researchers created a variety of others; some are general enough to be applicable to any organization, such as Meeting Announcement, and some are

specific to the Information Lens project, such as LENS Meeting Announcement. The more general a message type, the more likely it is to be applicable to a variety of organizations.

The template for each message type contains a number of fields. Associated with each field are three properties: a default value, a list of possible alternative values, and an explanation of why that particular field is part of the template. Some templates may have some of their fields' default values already filled in (see figure 3).

To compose a message, you click on the message type you want, as listed in the message network. The template appears on the screen. Clicking on a field brings up the basic editing menu for that field, showing its name and giving you a choice of viewing the default value, the explanation of the field's purpose (if you are not familiar with the template), or the list of alternative values (see figure 3). If you choose a value, it is automatically inserted in the text of the field. You can also directly edit any field at any time.

To find, filter, or sort messages, you call up the rule editor. This editor uses rule templates based on those used for the message types (see figure 4). It includes the fields of the message type that you have chosen, plus other appropriate fields for the IF section, as well as a field for the THEN section. Pop-up menus appear on the left side of the screen to aid you in filling in the fields.

Because of frame inheritance, message types inherit the rules of all the types above them in the message network. However, just as with the fields and field characteristics that a message type inherits, you can delete or change any inherited rule.

Shifting into Automatic

To create a rule, you choose the message type you want it to apply to, select Edit a Local Rule Set, and then select Add. (Local rules are those that apply to individual mailboxes.) To specify the IF part of a rule, you fill in selection specifications for the message fields. The simplest kind is a string.

You can create more complex specifications by combining strings with AND, OR, NOT, and parentheses; in other words, you can use arbitrary Boolean combinations within any field. If you create specifications for more than one field, all the specifications must be met for the action to occur; that is, the specifications in different fields are combined using an AND operation.

To specify an action, you click on THEN and choose from the menu. Typical actions put a message in a specific folder (Move To) or remove it (Delete) (see figure 5). The system includes the ability to create folders. Move To and Delete do not physically expunge a message; in the case of Move To, therefore, subsequent rules can put copies of a moved message into other folders.

Every rule template includes a field labeled Characteristics. You create a rule to set the characteristics of a message; then you can create other rules to test a message for those characteristics. For example, you could create a rule that determines whether a message is from a VIP (e.g., if the message is from President Bush, then it's a VIP message) and then test for that characteristic using other rules.

This mechanism has the obvious advantage of eliminating the need to repeat the specification of who is a VIP in all the rules that test for that characteristic.

continued

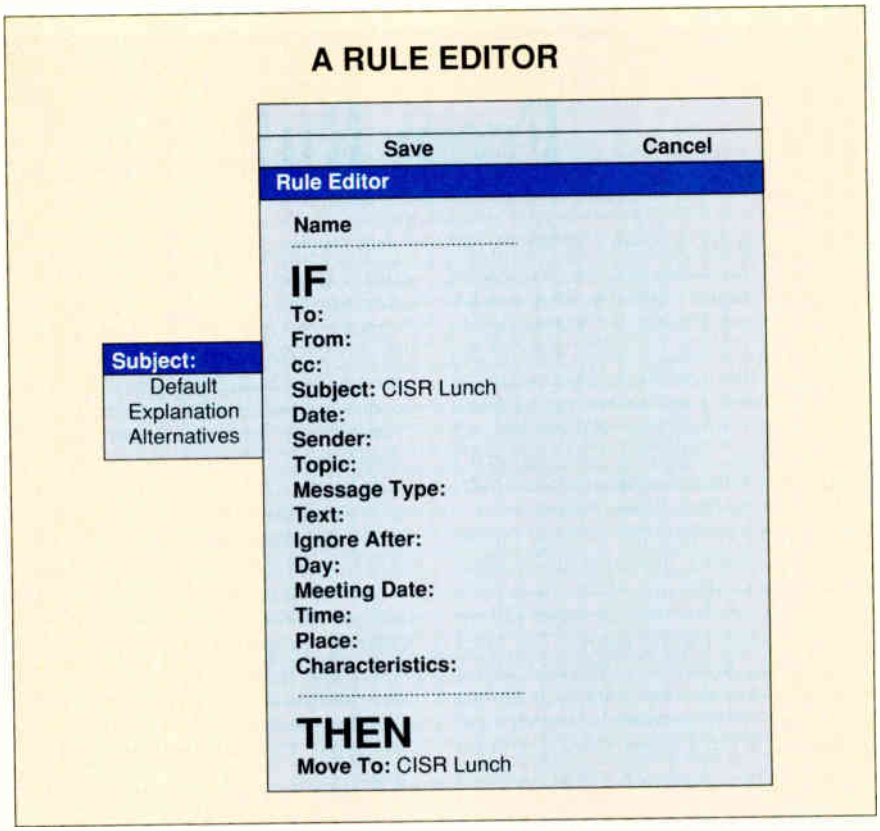

Figure 4: *Rules for processing messages are composed using the same kind of editor and the same templates as those used for composing messages.*

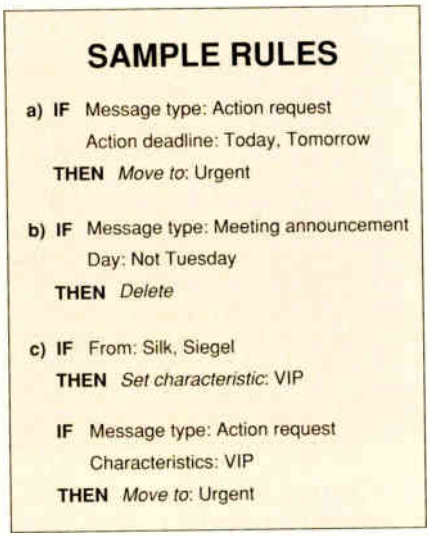

Figure 5: *Examples of simple rules. Move To* **(a)** *and Delete* **(b)** *are two basic actions. The action can be to set a characteristic, and another rule can test for that characteristic* **(c)**.

From Rules to Agents

Agility Systems of Waltham, Massachusetts, was founded in August 1989 by John Landry and Thomas W. Malone to, in Landry's words, "exploit some of the things that had been done with the Information Lens system and to develop other things that Malone had not thought of." It is now readying such a product, which also incorporates an element of the Object Lens system.

Agility retained much of the "information-sharing" nature of the Information Lens—that is, both the basic management of electronic messages and the information-finding aspect. The latter function, however, is directed not at public messages but, rather, at on-line services and a company's internal databases. (In other words, there is no Anyone server.) Thus, the system is aimed at people who don't want to be bothered with the syntax of, say, the CompuServe services or Structured Query Language queries for relational databases. Indeed, when describing Agility's WiJit (for With Information Just in Time) product, Landry puts the use of E-mail to get information out of public and private database systems above the management of internal E-mail.

WiJit in Action

In addition to Information Lens functions and features such as incremental adoption, WiJit adds the Object Lens system's more powerful concept of semiautonomous agents (see the text box "From Information to Objects" on page 178). With agents, you group sets of rules together to take actions for you at a time or times that you specify. Indeed, Landry says that WiJit is "truly agent-based software." As such, he continues, the product makes possible "deferred connectivity," rather than real-time connectivity, to external and internal databases.

Like the Information Lens, WiJit runs on top of an existing mail system. It starts with three of the basic Information Lens elements: message templates, rule-based processing, and graphical editors. While Information Lens enables you to apply rules to just your inbox, WiJit applies them to the contents of a particular folder according to the specified status of the documents or messages—for example, `new`, `opened` (read), or `all`.

More specifically, as with the Information Lens, you group your rules into sets, called *tasks* in WiJit. An agent performs a series of tasks in order. Thus, you could have WiJit dial up the Dow Jones News/Retrieval every day at predetermined times, get specific stock quotes, arrange them in a particular way, and put them into a Stock Quotes folder. You could even have WiJit signal you if a stock rose or fell beyond a specified range. (WiJit includes an interface to DynaComm, a Windows-based communications link.) Through Windows' Dynamic Data Exchange, you could also have the quotes put into a spreadsheet and launch your spreadsheet program.

Similarly, you could create an agent to query your company's sales database every Monday morning at 10:00 for the latest figures on a particular product. (WiJit interfaces with Q+E, a gateway package for Microsoft's SQL Server DBMS.) You could then go on to manipulate that information as well. This capability means that you can leave your machine on and have your agents work at night or when you are out of the office.

In sending messages, you can mix multiple "forms" of communication. That is, you could have a message that goes to people on your local E-mail system, through a gateway to people on other networks, to people elsewhere who are reached through a public mail system, or to people reached by your fax machine or by fax through MCI.

You can create new message types using the editor, rules, or WiJit's scripting language. You can also write script for tasks. (WiJit includes scripts for calling up MCI Mail, AT&T Mail, All-in-One, Profs, and CompuServe and converting their messages or information into WiJit messages. It also lets you write custom scripts.)

Furthermore, you can program the system through messages—what WiJit calls "metamail." That is, you can install a new message template using the Install New Template message and a new agent using the Install Script message.

WiJit runs under Windows 3.0 on PCs with a 286 microprocessor or high-

Furthermore, the characteristics mechanism also lets you construct tests that include any combination of features in any combination of fields (i.e., arbitrary Boolean combinations among fields). In addition, taking an action always sets a characteristic (for instance, MOVED). Thus, subsequent rules can include a condition like "the message has not been moved" (i.e., NOT MOVED).

Similarly, you can create rules to find messages of interest in the Anyone server. Such rules, called *central rules*, are run by the Anyone server. Central rules are the same as local rules, except that your actions are limited to Show and to setting characteristics. Show causes Anyone to pass the selected messages to the central mail server for distribution to your mailbox.

In addition to individual rules, Information Lens lets groups construct more sophisticated rules for dealing with specialized message types. Thus, groups can create applications that automate a variety of communication and coordination procedures, thereby increasing the benefits to be gained from using Information Lens.

Finally, you can edit message types for your own use. You click on the message types you want to change and select Edit Message Template. The message template editor appears for that particular message type, and you then modify any property of any field in the template in much the same way that you would create a message.

New message types are created by the message template administrator. He or she has a more powerful template editor that works similarly but also specifies new message types for the system. Each new message type inherits the fields and properties of its parent unless the admin-

er. There are plans for a version that will run under OS/2 Presentation Manager, to be developed shortly after the DOS Windows release, as well as for a version for the Macintosh sometime later.

Future WiJit

WiJit was scheduled to be formally introduced at the Platforms for Computing Forum on March 16 in Tucson, Arizona. It was supposed to be ready for beta shipment shortly thereafter. The exact product status and timing are uncertain, however, because Landry became executive vice president for R&D at Dun & Bradstreet Software in December 1990. As this article was being prepared, the *Wall Street Journal* reported (February 28, 1991) that WiJit is "likely to be acquired by Dun & Bradstreet's software unit."

According to Landry, D&B is "in an excellent position to use WiJit as a key component of a new system architecture." He also notes that easy access through E-mail makes all the parent company's information more valuable. Therefore, he is "very confident" that D&B will use the WiJit technology. The question, he says, is whether Agility's arrangement with D&B will be exclusive. If so, that puts the schedule for beta testing and general release, as well as pricing, in D&B's hands. If not, others, too, may license the WiJit technology. Agility will probably continue as a company, but it may not sell products to end users.

istrator modifies them. The administrator can add new fields and determine their properties as well.

Future Lens

Information Lens is an extremely powerful, flexible system for coping with the information overload of E-mail and online-service users. It gains much of its power from rule-based processing and the use of semistructured message templates, and much of its ease of use from GUI design concepts. Much of its power also comes from its firm grounding in how people already process information.

In addition to providing the basis of the ongoing Object Lens project at MIT (see the text box "From Information to Objects" on page 178), the concepts embodied in Information Lens are also beginning to appear in commercial products (see the text boxes "Going to Market" on page 182 and "From Rules to Agents" at left). The first of these will appear this year.

Information Lens is capable of doing so much partly because its developers had a seemingly modest goal: They sought to develop a "somewhat intelligent" system, not an intelligent, autonomous one. What they came up with was, as Malone rather modestly puts it, "a system that can give you some help but does not have to solve the whole problem." ■

ACKNOWLEDGMENT

I'd like to thank Professor Thomas W. Malone of the Sloan School of Management at MIT for his extensive cooperation in preparing this article.

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Mike Robinson is a freelance writer and editor in Lexington, Massachusetts, specializing in a variety of electronics technologies. Previously, he served as managing editor at the Technology Research Group (Boston, MA), a strategic consulting and market-research firm focusing on advanced electronics technologies for industry. You can reach him on BIX c/o "editors."

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FROM PYRAMIDS TO PEERS

Data management takes on new importance in today's networked environments

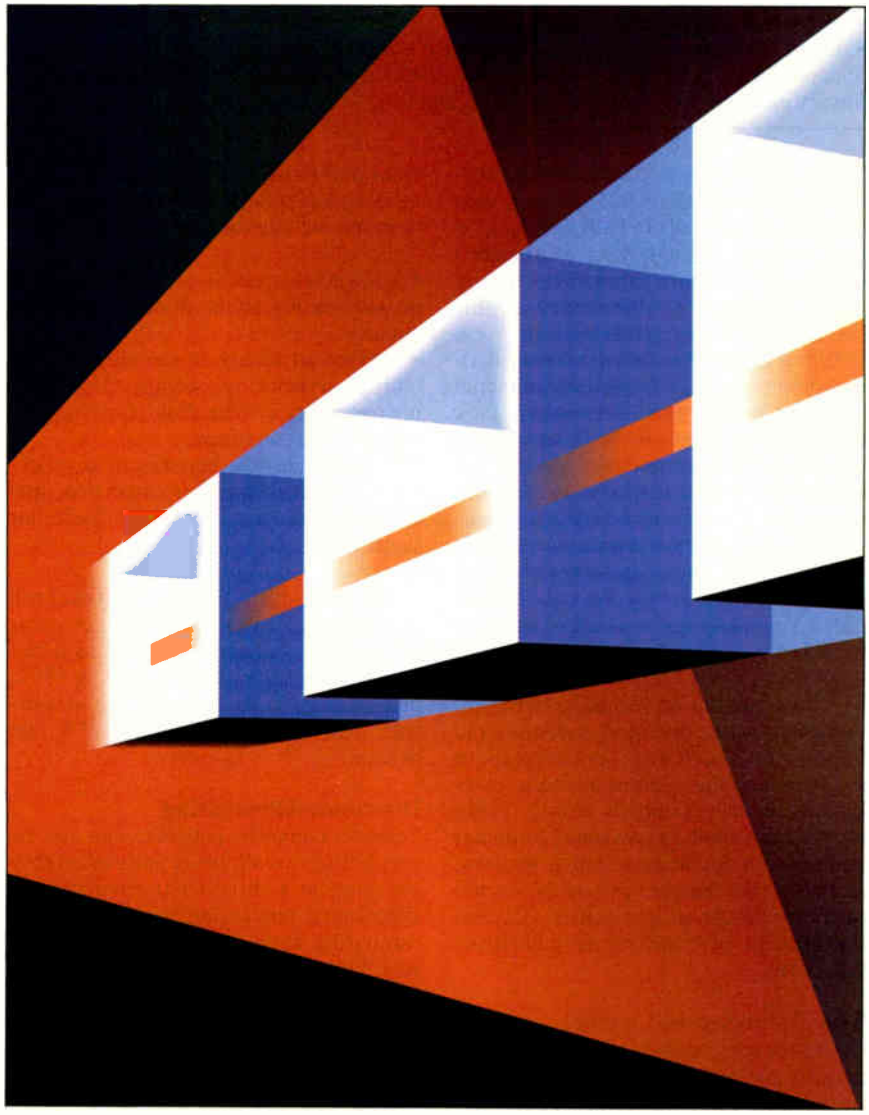
TOM TOPERCZER

How important . manage network data? In 'n Infonetics Research In. .e (San Jose, CA) survey of Fortune 1000 companies found that networked corporations lost nearly $3.5 million annually in employee productivity due to LAN downtime, some of which was directly related to failed storage devices. These same companies reported annual revenue losses in lost data and lower employee productivity averaging more than $660,000. Data management in networked environments can significantly reduce these losses.

Before the personal computer explosion, data management followed a simple procedure in a mainframe environment. A mainframe system typically has a CPU connected to terminals for input, peripherals (e.g., printers and plotters) for output, and storage devices for filing and archiving data and holding applications software. Its storage devices usually take two forms: hard disk drives, or direct-access storage devices (DASDs), for primary on-line storage and for application program and file retrieval; and tape drives for secondary off-line storage and archived-data retrieval.

The classic pyramid-shaped storage hierarchy (see figure 1) is a good model for data management on mainframes. DASD space is allocated on the basis of user privilege, usage, and media cost. The operating system provides centralized systems-resource management in this single-vendor environment.

The advent of the personal computer made managing data easier for the individual—a one-on-one, or single-dimension, task. While personal computers do



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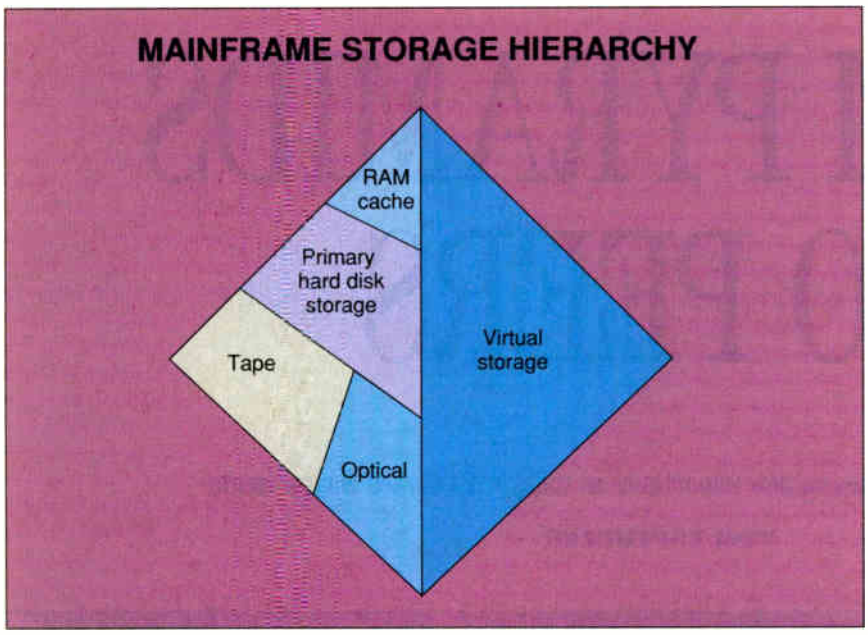

Figure 1: *The classic centralized-mainframe storage hierarchy covers a variety of capabilities: backup; disk space management and grooming; archive and tape library management; and audit trails, accounting, and usage-trend analysis.*

not require the extensive data management software used on mainframes, they do need simple tools to help you back up and navigate through your hard disk's data. The pyramid storage-hierarchy model, although not necessary in this simpler environment, still applies.

When LANs came on the scene, realizing the benefits of combining personal computer power, data management took on another dimension. With more than one person using the data, how do you manage it? Who is responsible for backing up the file server and the hard disk? How do you prevent file servers from running out of space, and when they do, how do you get rid of the old, unused files? Are the shared resources of the network being used to their greatest advantage?

A third dimension was added when diverse hardware, operating systems, and applications software became more available and the need or desire to combine these data resources arose. Trying to shoehorn multiple personal computer and network operating systems, vendors, and network-transport protocols was too much for the classic pyramid model, and the concept of client-server computing was born.

The Client-Server Concept

Client-server computing formalizes the natural distinction in an application between those components that request services and those that provide them. This model's advantages over traditional networking include the following:

- It acknowledges the personal computer or workstation as the desktop device of choice;
- It takes advantage of the unique computing, networking, storage, and printing capabilities of the desktop device and the specialized servers;
- It recognizes the benefits of networking flexibility, modular expansion, and compatibility of resources in dissimilar systems.

According to Forrester Research (Cambridge, MA), client-server computing will continue to emerge as a distinct market through 1992, and by 1993, that market, including associated software and services, will total $2.9 billion in sales.

Distributed Processing

Personal computer networks can also be very efficient computing tools when they are used in a distributed environment. Distributed processing lets you allocate computing tasks in the most efficient way. For example, a specialized task like CAD might be allocated to a system that has a special large-screen monitor.

The ability to distribute the processing makes a network more flexible and efficient than single-host processing. Since networks are composed of many intelligent machines, any of them, regardless of whether they are file servers or workstations, can support the processing.

Since distributed processing allocates system components among processors, the key to its sound implementation is an effective interprocess communications mechanism. The resulting system is more robust than a client-server implementation because client-server architectures do not take full advantage of the network's capabilities.

It's important to realize that distributed computing does not automatically indicate dynamic load balancing. (*Dynamic load balancing* refers to real-time allocation of computing power among the requesting network applications.) Applications can be distributed a priori. For example, you decide which machine to install a server process on, and it stays there. If a task requires data or some other resource that resides only on that machine, the server process may not be able to offload it dynamically.

Distributed Applications

Distributed applications form a special case for the client-server model. In a

BYTE ACTION SUMMARY

The problems of managing data on a single computer are significant enough, but when you add the complexity of a LAN, and a heterogeneous one to boot, the problems can become overwhelming. Proper data management enables you to ensure data integrity, manipulate data, obtain detailed reports on data usage, and completely recover your data after a catastrophic failure—a major money-saver. Data management applications let you view, organize, and secure your data in a fully distributed environment.

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distributed application, a process may be a client for its own native workstation and a server for everyone else. The distinction between client and server depends on who you are within the network. If the process on your machine requests services from another machine, it is a client; if it has services requested of it by other machines, it is a server.

The implications of distributed applications oftentimes relate to their modularity. In the particular case of data management, it is likely that each application will be sold as a separate product. At the moment, backup, server-based backup, librarian, and related products (e.g., virus protection) are sold by separate vendors.

Even as greater numbers of vendors sell more applications, the software will in all probability be packaged and priced separately so that customers can pick and choose exactly what they want. This is particularly true as vendors start to support different operating systems and CPUs. In the future, modular packaging and pricing will become the rule rather than the exception with distributed-applications software.

Data Management

Leading industry analysts define data management as "the administration of data in a system such that it can be stored, backed up, cataloged, retrieved, and protected in the most cost-effective way." Data is the lifeblood of all computing needs, and it is imperative to maintain its integrity.

Proper data management enables you to ensure data integrity, manipulate data, obtain detailed reports on data usage, and completely recover all data after a catastrophic failure.

According to Peripheral Strategies (Santa Barbara, CA), 1.3 million personal computer LANs were in operation worldwide in 1990, and 38 percent of all personal computers installed worldwide were connected to them. Peripheral Strategies predicts that by 1995 LANs will number 2.4 million worldwide, and the percentage of business personal computers attached to them will increase to 89.2 percent.

As LANs support more users and interconnect with other LANs and wide-area networks, new strategies and methods for managing these large, multivendor networks will be needed. Several approaches become more important when managing data in a multivendor environment.

One approach, enterprise networking, is well suited to large multivendor networks. This approach provides a managed backbone that LANs can attach to and receive services from. This allows organizations that span continents to be maintained as one unit.

However, data management is typically left to local network administrators, while a centralized support staff handles backbone maintenance. The local network administrator still has to perform backup and data management duties. This approach forces local sites to handle data management.

Unlike the traditional client-server method, which processes each request for shared information through the file server, the peer-to-peer services approach identifies each of the workstations as an entity in the network and allows communications and resource sharing between entities without the intermediary functions that a file server performs. Thus, each workstation ap-

pears to be a small server of resources.

Another approach you may want to incorporate is directory and naming services, a component of several network data management environments. Similar in concept to the White Pages and Yellow Pages of a telephone book, these services map names to network addresses and provide lookup and cataloging of hardware, users, and system resources. You can search network addresses by name, as in the White Pages, or by service type, as in the Yellow Pages. Directory and naming services are becoming key resources of the network and its management.

The Challenge

Different networks are made up of differing host computers, operating systems, and file systems. A typical networked environment might consist of several PCs on a LAN running Novell's NetWare or Microsoft's LAN Manager, connected to another LAN with several Macintoshes using AppleShare. The LANs may all be Ethernet-based, but the similarities will probably stop there.

As more and more network software vendors enter the market, the more complex data management becomes. Single-source support for all of these multivendor environments is not available. Data management in these environments must provide a seamless, transparent, and logical method of managing data and address each of the following issues:

- *Storage requirements*. As more companies have realized the potential of the networked personal computer as a business machine, the size and complexity of applications and data have grown. Many networks now face increased requirements for both primary on-line and secondary off-line storage. It is not unusual to find networks with 1 gigabyte of primary storage and, in order to provide sufficient backup capacity, several gigabytes of secondary storage.
- *Ease of use*. Data management must also be made easy. Graphical user interfaces have made applications development much easier by providing an intuitive environment. GUIs can be useful tools here as well.
- *Shared resources*. Following the client-server model, data management software should offer shared resources. A data management server must be able to handle requests from multiple clients at the same time. In addition, access to off-line storage devices must be provided in a distributed, multiuser fashion, whether the device is attached to a file server or another workstation in the network.
- *Interoperability*. This is the key to network industry growth. It allows client-server environments from multiple vendors to work together. The focused efforts of the major desktop and network operating-system vendors are necessary to achieve successful interoperability. With effective data management solutions and interoperability, heterogeneous computer systems can offer effective and viable enterprise-networking solutions (see figure 2).

The Solution

A network data management system is an example of an application that can benefit from distributed computing. This architecture separates the various components of the system: peer-to-peer communications, front-end applications, and storage-management services. The front

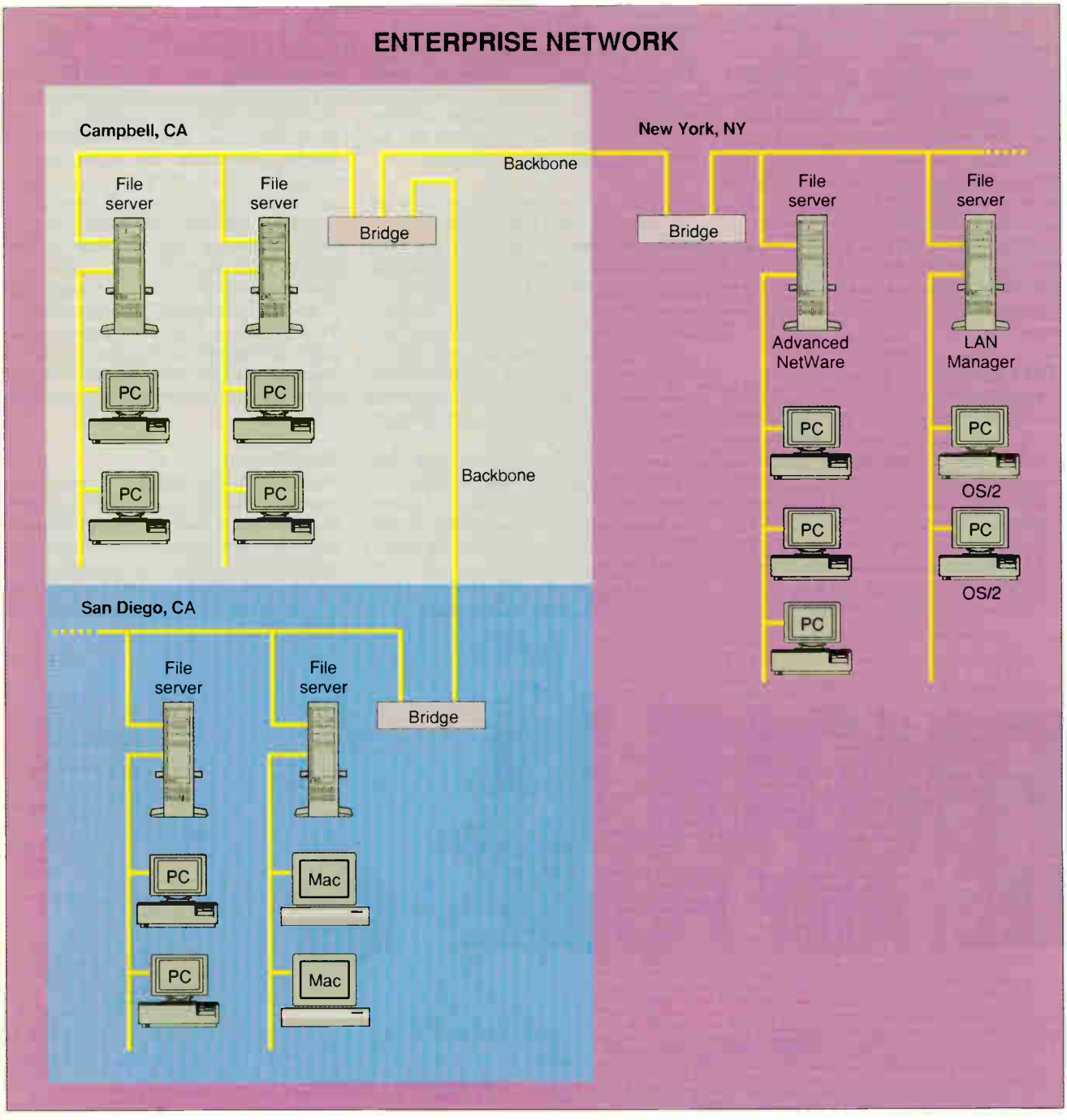

Figure 2: *An enterprise network with centralized backbone communications management and local data management. Interoperability and effective data management can make heterogeneous networks viable.*

end runs on the workstation and becomes a client for data management services. The back-end server centralizes data management processes and services requests from all the clients.

Distributed applications yield several benefits. A well-designed distributed application reduces network traffic by centralizing some processes that all users can share and by allocating other processes to individual workstations. This improves the performance of the network and the application, particularly when using shared resources like tape backup. Modularity in distributed computing is more flexible, making it easier to manage and install additional components.

The following elements help to ensure data integrity on networks. They are particularly effective when designed as distributed applications that can interact with each other throughout the network.

• *Data backup and transfer, and hard disk navigation.* In a distributed environment, this element should provide all network users and administrators with a

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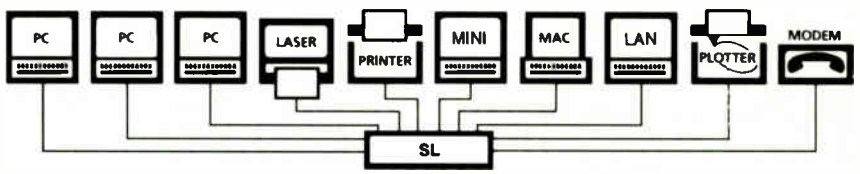

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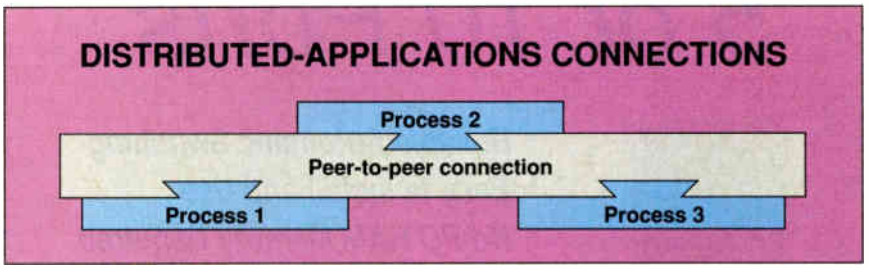


Figure 3: *Distributed applications connect much as Tinkertoys do. Instead of using multicolored sticks, however, they connect via the network and peer-to-peer communications.*

pictorial (icon-based) view of both the file server and all published local hard disks on a network. (When a local workstation makes some or all of its hard disk data available to other network users, that disk is considered to be *published*.) This workstation would also contain the utilities necessary to transfer data anywhere in the network and to back up the data, either to a local tape device or to another tape device in the network.

- *Peer-to-peer*. This element provides communications between all clients in a network. It is a required addition in networks where peer-to-peer facilities do not already exist. Peer-to-peer communications should operate over several network protocols (IPX, NetBIOS, AppleTalk, and TCP/IP) so that file-system navigation and data transfer can take place over heterogeneous networks.
- *Tape/media cataloging and maintenance*. An ongoing problem with traditional network-backup methods is handling tape logistics—which tapes to use, and in what order. This problem becomes more unmanageable as more sites are included in the data management process and the amount of maintained data increases. While tape/media cataloging and maintenance is often a popular topic of industry forums and white papers, few companies have been able to implement satisfactory solutions.
- *File grooming and data migration*. Primary on-line hard disk space is at a premium in most networking environments. It seems users will fill whatever space is available. Creating more hard disk space usually means investing in additional resources. Grooming old, out-of-use hard disk files and migrating the data onto secondary storage media would free up valuable on-line resources.
- *Virus protection*. Viruses can jeopardize data integrity and the operation of the entire system. The fear of lost or corrupted data has fueled a new market for virus protection and detection software.

Note the difference between virus protection and detection. The former implies active search, detection, and eradication of known viruses. The latter refers to the systematic detection of corrupted data and prompt notification of the proper person to correct the problem. Data management applications should warn you if data integrity is compromised.

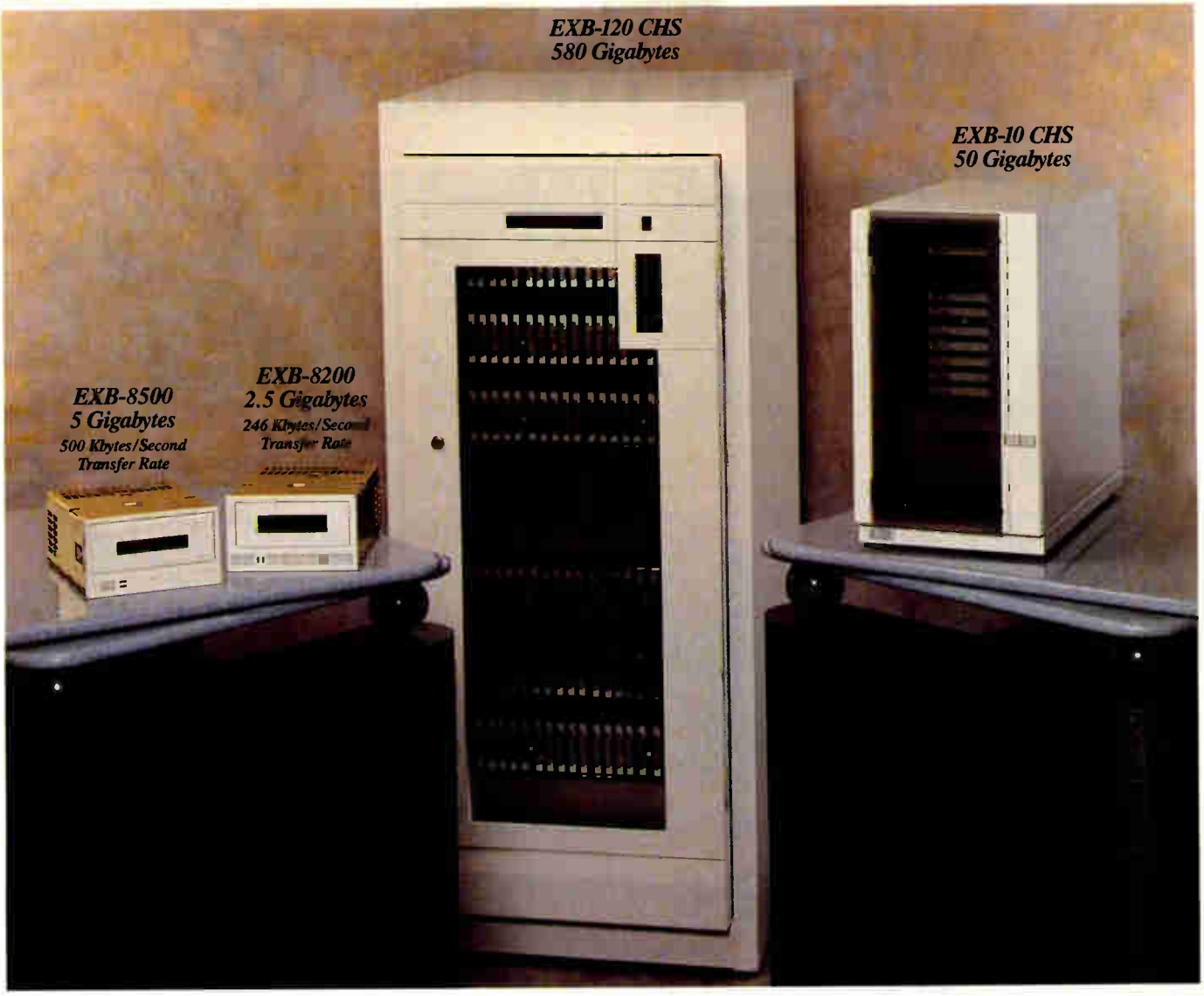
- *Reporting services*. Advanced data analysis is necessary to understand and monitor data usage trends. It provides the information necessary to make intelligent decisions on how to place and optimize network data resources to maximize file-server performance. These services should be uniformly accessible from all client applications. Targeting data-access bottlenecks and resource allocation, you could generate reports on file-server free space, usage, and custom variations.

Green Sticks and Wire

You could compare distributed applications to Tinkertoys that are connected. Perhaps this explains why the term *sockets* caught on so quickly among network systems programmers. Instead of green sticks, distributed-processing applications are held together by network "wire" and peer-to-peer communications (see figure 3).

Distributed computing has taken hold, especially in corporate environments. Data management applications provide the means to view, organize, and secure data in a fully distributed environment. These applications, when properly implemented, will provide the same reliability and confidence in distributed personal computer systems in the future that centralized mainframe storage systems have enjoyed in the past. ■

Tom Toperczer is vice president of marketing for Mountain Network Solutions (Campbell, CA). You can reach him on BIX c/o "editors."



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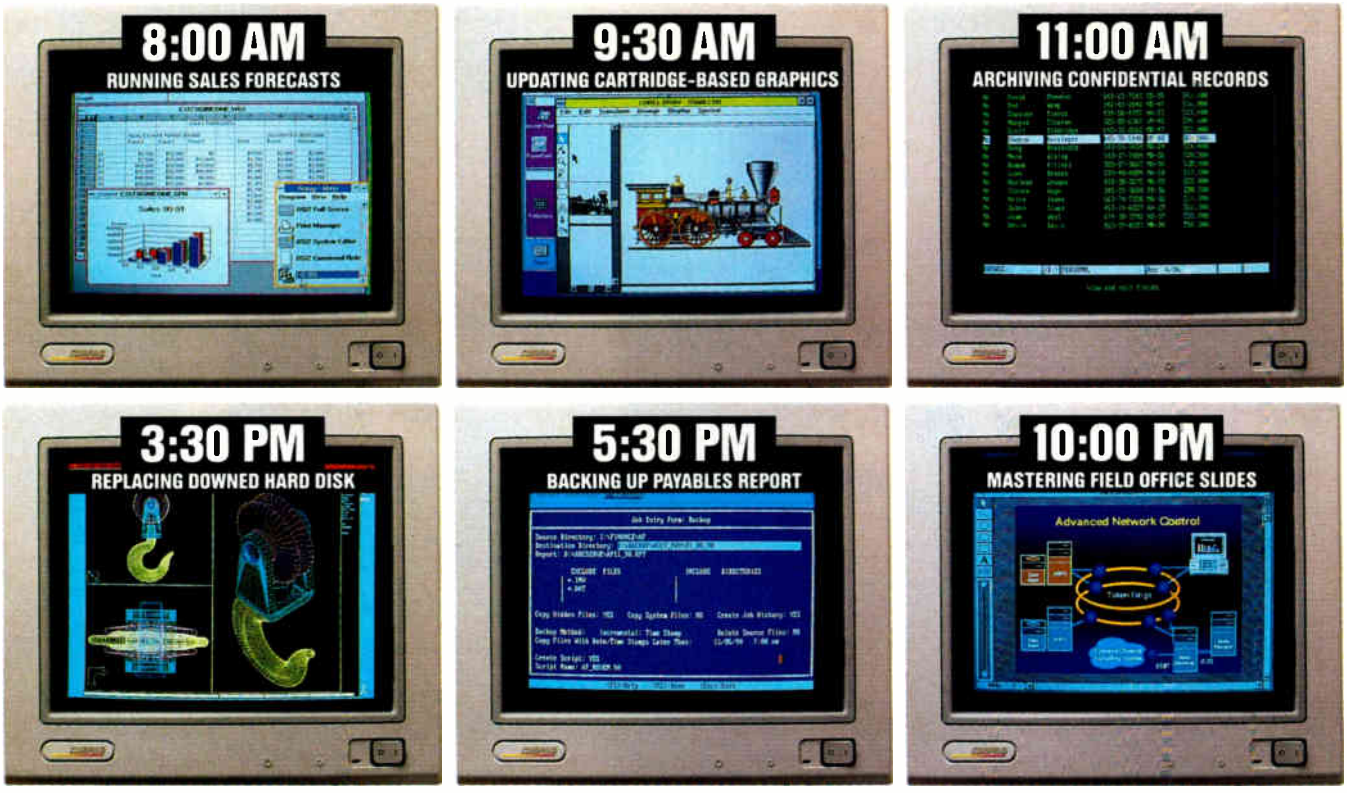

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GIGA-STORAGE

Choosing among mass-storage technologies in a multigigabyte PC environment isn't simple; there are conflicting criteria

RICHARD A. PETERS

Powerful 386- and i486-based PCs are placing new demands on data-storage systems. With the proliferation of gigabyte-plus database applications, the need arises for greater storage capacities and increased operating efficiencies. This is evident in applications such as high-performance CAE and desktop publishing workstations, as well as data-packed LAN file servers.

Many PC applications need 1 gigabyte of storage capacity or more, and mass-storage technology must keep pace with this need. A variety of technologies are available for this new multigigabyte environment, and conflicting considerations are involved in choosing among them.

ILLUSTRATION: RON CHAN © 1991

Primary-Storage Choices

A wide range of mass-storage technologies for high-capacity systems exists on the market today. They compete with and often complement each other (see table 1). Any examination of what to buy begins with knowing if you intend to use the device as the primary- or backup-storage medium.

The hard disk drive is almost omnipresent with personal computer systems today. It is the dominant primary data-storage product and will remain so until the next century.

Hard disk drives supplanted tape drives more than 10 years ago as the preeminent primary-storage medium because the technology could randomly access data. Random access makes it possible to retrieve data anywhere on the disk in milliseconds. Many suppliers provide 1-gigabyte-plus hard disk drives with varying costs, capacities, and

DATA-STORAGE TECHNOLOGIES

Table 1: *The wide range of mass-storage technologies for gigabyte storage on the market today provides a full range of advantages and disadvantages. Weighing the pluses and minuses against your needs is the challenge.*

Technology	Benefits	Negative issues
Hard disk	Random access High capacity	Lack of removability
Rewritable optical	Random access High capacity	High drive cost High media cost Lack of standards
Quarter-inch cartridge	Low cost Compatible among multiple sources High data transfer rate	Low capacity, but increases are evolving quickly
4-mm DAT helical scan	High capacity Low media cost Fast search capability	Lack of compatibility among multiple sources High drive cost Low data transfer rate
8-mm helical scan	High capacity Low media cost	Single-source supplier Low data transfer rate

software-derived performance features.

Hard disk drives are fixed devices with finite storage capacities. The finite capacity makes it important to know how much storage you really need—now and in the future. Since the medium is not removable, the data-processing system needs to provide for backup of the database. Backup data-storage systems must be rewritable and use removable media.

The rewritable optical disk drive is becoming a popular option for primary storage. Rewritable optical drives, currently featuring up to 600-megabyte capacities per removable disk, record data on extremely thin platters that can be removed like floppy disks and moved easily from system to system. The optical disk provides a two-sided medium that you must manually turn over to access the other half of available storage.

Demand for optical-storage technology began with the advent of rewritable optical devices, which you can reliably reuse as often as you wish. In fact, testing by manufacturers has demonstrated that you can perform 1000 read/write cycles per day for 40 years with no degradation of data, disk, or drive mechanism. There are three main OEMs of rewritable optical disk drives—Ricoh (San Jose, CA), Sony Corp. of America (San Jose, CA), and Hitachi America (Tarrytown, NY).

Ideal as primary-storage devices in image-oriented applications in vertical markets, optical drives also have notable drawbacks. The key drawback is their data-access times. The random-access times for optical drives are 5 to 7½ times higher than those for hard disk drives (50 to 150 ms compared with 10 to 20 ms). A primary factor is the weight of the intricate optical drive head. Even though the respective weights can be measured in grams, these heads tend to be 20 to 50 times heavier than hard disk drive heads.

The up-front cost for rewritable optical disk technology is also very high. The average price for a 300-MB rewritable optical disk drive is about $5500, compared with below $3000 for a 300-MB hard disk drive.

Finally, while hard disk drives can give you more than 1 gigabyte of continuous storage, current rewritable opticals give you a maximum of 300 MB per side—you must then manually turn them over to obtain additional storage. This amount of storage may be too small for LANs with more than 10 users.

Rewritable optical disk drives have some utility in backup and archiving applications, but high costs for the drive and medium make the technology cost-effective only when it is justified by other applications.

Another type of optical technology should also be noted. You can only write to WORM (write once, read many times) optical disks once, but you can read them as often as you need to—much like a phonograph record (if anybody still remembers what they are). WORM drives are useful in specialized backup and archival applications, such as the storage of legal and financial documents, because the stored information cannot be altered.

Backup Storage

To protect against catastrophic data loss, you need to keep a backup copy of the data stored on your primary devices. Periodic system backups performed to copy data from the primary device to an off-line medium become increasingly time-consuming and impractical with the growing size of a database.

With today's multigigabyte PC applications, having a backup mass-storage unit is a necessity. You use the backup device to make copies of frequently used data, transfer older data from the primary unit, and retrieve archived data with maximum efficiency. While tape drives are no longer used as primary-storage devices, they remain the most attractive medium for inexpensive, removable, and high-capacity backup storage.

The quarter-inch cartridge is the leading tape-drive technology. It was invented specifically for data-processing applications. QICs now account for more than two-thirds of all tape-drive shipments, and they will continue to be the dominant backup technology well into the mid-1990s. The QIC manufacturing community began introducing products with storage capacities above 1 gigabyte late last year, and 6-gigabyte products are projected by early 1993.

In comparison with competing technologies, QIC drives are low in cost, with retail prices under $2000 for a 1.3-gigabyte system; 1.3-gigabyte cartridges retail for about $35. Data transfer rates for current products reach up to 600,000 bps, allowing backup of 1 gigabyte in under 30 minutes. Any file can be accessed in 40 seconds or less in 1-gigabyte-plus tape devices.

continued

BYTE ACTION SUMMARY

The increasing storage needs of large applications for 386- and i486-based PCs have brought a surge of higher and higher–capacity mass-storage devices. A variety of different disk and tape choices exists, including some more-suited to primary storage and others more appropriate for backup. Making the right choice isn't necessarily easy; it may require balancing your needs against your wallet.

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BUYING-CONSIDERATIONS CHECKLIST

Table 2: *In deciding which technology to purchase for gigabyte storage among the primary-storage media (hard disk or rewritable optical) and the secondary-storage media (QIC, 4-mm DAT helical scan, or 8-mm helical scan), the following are the criteria you should consider.*

Specification-related criteria	Application-related criteria
Random/sequential access	Security:
Capacity	Shock
Speed:	Environment
Transfer rate	Data:
Access time	Shelf life
Compatibility	Transportability
Fault tolerance	Quality
Data integrity	Mixes and matches
	Growth potential
	Costs:
	Drive
	Media

QICs are also enhanced by the clear performance standards that manufacturers in this field have developed. Through the work of a cooperative organization known as Quarter-Inch Cartridge Drives Standards, manufacturers now supply products that are interchangeable between drive and medium regardless of origin. Some key suppliers of these products include Tandberg Data (Westlake Village, CA), Wangtek (Simi Valley, CA), Sankyo Seiki America (Torrance, CA), and Archive (Costa Mesa, CA).

Two new types of high-capacity tape drives, 8-mm helical-scan tape and 4-mm digital audiotape, have made their presence felt in the last few years using a technology known as helical scan. *Helical scan* describes how the tape travels over the read/write heads, which are mounted on a spinning drum aligned diagonally with the recording track. With the drum spinning rapidly and the tape passing over the drum slowly, the head writes data in a diagonal pattern corresponding to the pitch of the head, with a high tape-to-head velocity. Helical-scan drives function the same as videocassette and commercial DAT recorders, and intricate error checking and redundancy must be implemented to produce an acceptable error rate for data-processing applications.

The 8-mm helical-scan tape drives are provided solely by Exabyte (Boulder, CO). These drives provide the highest capacity-to-volume storage ratio of any mass-storage device currently in use (326 MB per cubic inch) for storage capacities of from 2½ to 5 gigabytes. The higher-capacity drives sell for about $3900 at OEM quantities. Medium costs are in the $10 range.

DAT systems use a data-recording standard devised by Hewlett-Packard and Sony, called Digital Data Storage. DDS is currently licensed by 17 different companies.

DAT storage devices use the same tapes that DAT recorders use for entertainment purposes. The needs of the audio world dictate that DAT provide long recording times (2 hours) with relatively slow transfer rates (180,000 bps). The audio recording industry has lobbied successfully to protect its intellectual property rights against unauthorized copying by DAT devices. These restrictions have reduced the availability of consumer DAT drives.

Optimizing your PC data-storage capabilities is a multistep process. Plan for growth.

The capacity of the DAT cassette is about 2 gigabytes. Medium costs could be as low as $7 each, but some experts say a special cassette may be more desirable. The cost of such a medium may be $15 each. Drive costs at the OEM level are under $1000.

DAT offers a fast-search capability that allows access to a file in an average time of about 15 seconds. Comparable time for a QIC is about 30 seconds.

New Storage Trends

Recent technological breakthroughs in rewritable optical disk drives and high-capacity tape drives have at least one common thread: They all provide unlimited storage because they use high-capacity media that you can quickly insert and withdraw from the drive.

This trend toward removability is further supported by jukeboxes, or autochangers. These devices have recently become available for all three major storage technologies, although optical devices seem to be leading the way. A jukebox typically contains two drives and a mechanical arm used to select and load one of many disks stored within it. A newly announced optical jukebox contains 32 optical disks for a total storage capacity of 17.9 gigabytes.

Another development unfolding, particularly for very large storage applications, is the mixed-media mass-storage systems. These systems use a combination of hard disks, optical disks, and tape-to-store files. Where the data is stored depends on how frequently it is used—a particular file will automatically migrate from on-line hard disk storage to slower optical and tape systems as the frequency of its use decreases. Such mixed-media systems allow you to take advantage of all technologies, using each to its maximum potential.

Buying Considerations

There are several criteria you should consider when you plan to purchase a mass-storage medium (see table 2). The issues relate to the specifications of the products and to the particulars of your individual applications.

Several specifications are fundamental to choosing appropriate primary and backup storage, beginning with how a mass-storage device obtains data—randomly or sequentially. A random-access device stores data randomly and retrieves it using an identifying address. A sequential-access device stores data in a prescribed ascending or descending sequence and retrieves it by searching for it from the beginning to the end of the file.

Random access is typical of hard disk and optical disk drives, and sequential access is typical of tape drives. Random access is a more direct and faster method of accessing data, but you must weigh that against the increased cost, the size of

Native or Compressed?

Grant Wilcox

The compress-or-not-compress issue has existed for years, but the advent of data-compression chips, performing what is termed *lossless* compression, has made it popular again.

Data compression maintains data integrity and compresses the data in real time—transparently. It removes redundancy from a closed set of information symbols (i.e., a data block) without any loss of information. In simple terms, it records more data in a smaller space. *Compression ratio* is the length of compressed output relative to the length of uncompressed input. The key is that data stored in a compressed form must be reliably retrievable. (For more detailed information on data compression, see "Getting Your Byte's Worth," November 1990 BYTE, and "Putting the Squeeze on Graphics," December 1990 BYTE.)

Benefits can be derived from implementing data compression at the peripheral level. You can theoretically increase the peripheral's capacity by the factor of the compression ratio and can increase the peripheral's internal continuous-transfer rate because it's recording less data. For example, a 2-to-1 compression factor could double the peripheral's sustained data rate.

However, Mike Casey from InfoCorp (Cupertino, CA) pointed out, "If data compression is implemented at the system level, no benefit will be obtained by incorporated data compression in an intelligent disk or tape drive." Also, if data interchange is a requirement, all systems involved not only need compression but must use the same hardware/firmware implementation of it, or they will find their data unreadable.

Remember, not all data lends itself to compression. First, the benefits will vary because the amount of data redundancy varies widely among types of data; this variation changes the compression ratio. Second, you will benefit from compression only if the host system can support the higher continuous-transfer rates. Third, the benefits will be negated if the compression process cannot keep up with system needs. Fourth, compressed data may actually expand when compressed again. With compression, there are no hard and fast rules.

Compression is not the complete answer to the need for increased capacity and data rate. The decision to adopt data compression must be carefully thought out because of its associated risks. If you are interested in unattended backup, it's wise to rely on native capacity instead of compressed capacity. With native capacity, you know that the data will fit on a particular medium and that it will take a certain length of time to back up.

Many standards and implementations of data compression exist, such as Hewlett-Packard's, STAC's, IBM's, and a number of other proprietary algorithms. You could almost say it's *algorithm du jour*. Given the rapid advances in computer throughput, it is extremely important that the compression algorithm be able to handle the higher data rates of future systems. Some cannot.

In addition, different companies, using the same compression algorithm, may offer unique implementations of it. Furthermore, multiple compression algorithms on top of multiple formats (e.g., digital audiotape's DDS and Data/DAT) create more confusion. You can only roll the dice and hope your selected product, format, algorithm, and vendor are around in the coming years.

Whole sections of the computer industry, mainly at the high end, are attracted to 8-mm tape's large data-storage capabilities and low cost, but they've held back because of transfer rate. In these cases, adding data compression will satisfy their needs until 8-mm products with further native-performance increases are introduced.

When looking to the future, technologies that can be extended without compression are ultimately much better than those that can only be extended with compression. You can always improve the native performance by adding compression to it. Exabyte (Boulder, CO) currently has plans to extend the 8-mm tape's transfer rate to 1 megabyte per second and the cartridge capacity up to 10 gigabytes using current native technology.

Be aware that some backup peripherals are being advertised with large capacities and high transfer rates—improvements made by using data compression. Because so many variables affect data compression, you may not be able to achieve these large advertised performance capabilities as promised.

Data compression is an added benefit, but it's not the total answer. Native capacity and transfer rate are also important.

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your database, and the intended use of the device (as a primary- or secondary-storage unit). Sequential access is slower and less convenient, but it is much less expensive.

How much storage capacity is enough to meet your needs in a cost-effective manner? Having too much is no better than having too little because you will be saddled with expensive, underutilized storage equipment.

To estimate your data-capacity requirements, consider the following example. Assume you have 20 users on a LAN. Allocate 40 MB for system and common-application files and 20 MB per user. Assume one 200-MB common database. Under this formula, the drive size required is 640 MB. However, the growth factor is also important, and you should factor in roughly twice a user's current needs for growth. The recommended drive size, then, exceeds 1 gigabyte.

Speed is another key performance consideration. Speed specifications include the product's access time, measuring how fast it can locate data, and its transfer rate, measuring how fast it can move data from one place to another.

continued

BACKUP-TAPE TECHNOLOGIES

Table 3: *The various secondary-storage (tape) technologies available provide a full spectrum of capabilities, from a capacity of 5 gigabytes for 8-mm helical scan to a data transfer rate of 600,000 bps for QIC.*

Technology	Capacity	Transfer rate (bytes/sec.)	Form factor	Avg. access (sec.)	Backup time for 300 MB
QIC	250 MB	90,000	5¼" HH	40	60 min.
	525 MB	200,000	5¼" HH	30	25 min.
	1.00 GB	300,000	5¼" HH	30	20 min.
	1.35 GB	600,000	5¼" HH	36	10 min.
4-mm DAT helical scan	2.00 GB	180,000	3½"	20	30 min.
8-mm helical scan	2.50 GB	246,000	5¼" FH	484	21 min.
	5.00 GB	500,000	5¼" FH	90	12 min.

HH = half height
FH = full height

Sometimes it's difficult to know how fast is fast enough. You must weigh the importance of speed against your other needs. A few milliseconds' worth of speed could come with an unacceptable price tag.

It is also worth noting that the data-rate capability of a storage device is often not the limiting factor on a system's ability to move data to and from the device. Average data transfer rates above 300,000 bps for peripheral devices are unusual on today's PC systems, so a tape drive's data transfer rate of only 200,000 bps is often the optimum solution.

Compatibility of the mass-storage device with the LAN operating systems and topologies in which it must operate is also important. Widely used LAN operating systems include Novell's NetWare 286/386 and Microsoft's MS-NET for IBM PC-compatible LAN environments, and AppleTalk/AppleShare and A/UX from Apple and TOPS from Sun Microsystems for the Macintosh world.

Topology refers to the physical layout of the components of a LAN—a bus topology connects all devices in one line; a ring topology connects each workstation to two other workstations in a circle. The topology that you employ can affect how the storage device will perform. With ring topologies, for example, the more PCs that are present, the slower the LAN, which can slow down data access and transfer times.

You will also want to examine fault-tolerance features: Do you want or need duplicate systems for continuous storage operation in the event that one should fail? What data-integrity features does the product provide to prevent the accidental erasing or contamination of your data?

Further Factors

There are a number of other issues that you need to take into account before choosing a 1-gigabyte-plus mass-storage device.

Data security is the first of these issues. What happens if the drive or the medium is dropped? The ability of the device to withstand shock is very important. Is the device rugged and impervious to the environment? Some mass-storage units are sensitive to magnetic fields and x-rays. You also need to find out the unit's operational range in terms of temperature and humidity.

You should consider the projected longevity (shelf life) of the storage medium and drive, and how long you intend to store the data on the device. The demand for WORM optical drives continues in spite of the arrival of rewritable optical ones because WORM technology provides permanent storage that can't be overwritten.

The transportability of the medium and drive can be a key factor. Data-storage applications used in banks, insurance companies, government agencies, corporate records departments, and multiple-site companies all require easily transportable storage equipment, sometimes above all other considerations.

Product quality is fundamental. This is basically a question of looking at the steps the manufacturer has taken to ensure reliable performance. These steps include user troubleshooting and fault-isolation diagnostic routines, the warranty of the mass-storage unit, the availability of information from the manufacturer or supplier, and postsale support.

Another critical issue is how well the device mixes and matches with other mass-storage devices that may already be in place in the computer system. Are the devices compatible with each other, and do their collective data capacities equal what you need?

The growth potential of the respective technologies is also worth looking at in terms of selecting a solution that you will be able to live and grow with in the long term. QIC's relatively low data densities and large available tape area make upward migration to larger capacities an ongoing evolutionary process.

The very high data densities of DAT permit using a small cassette with a small available recording area, making upward migration more difficult. The 8-mm helical scan also has higher data density than QIC and a larger available record area than DAT.

Current QIC densities are about 0.6 MB per square inch, while 4-mm DAT is about 3.8 MB per square inch on a medium area of less than 25 percent of QIC. QIC has more room to grow. Table 3 summarizes the current comparative situation for backup-tape technologies.

Hard disk technology appears to achieve higher data capacities almost monthly, while rewritable optical disk capacities are moving at a slower pace.

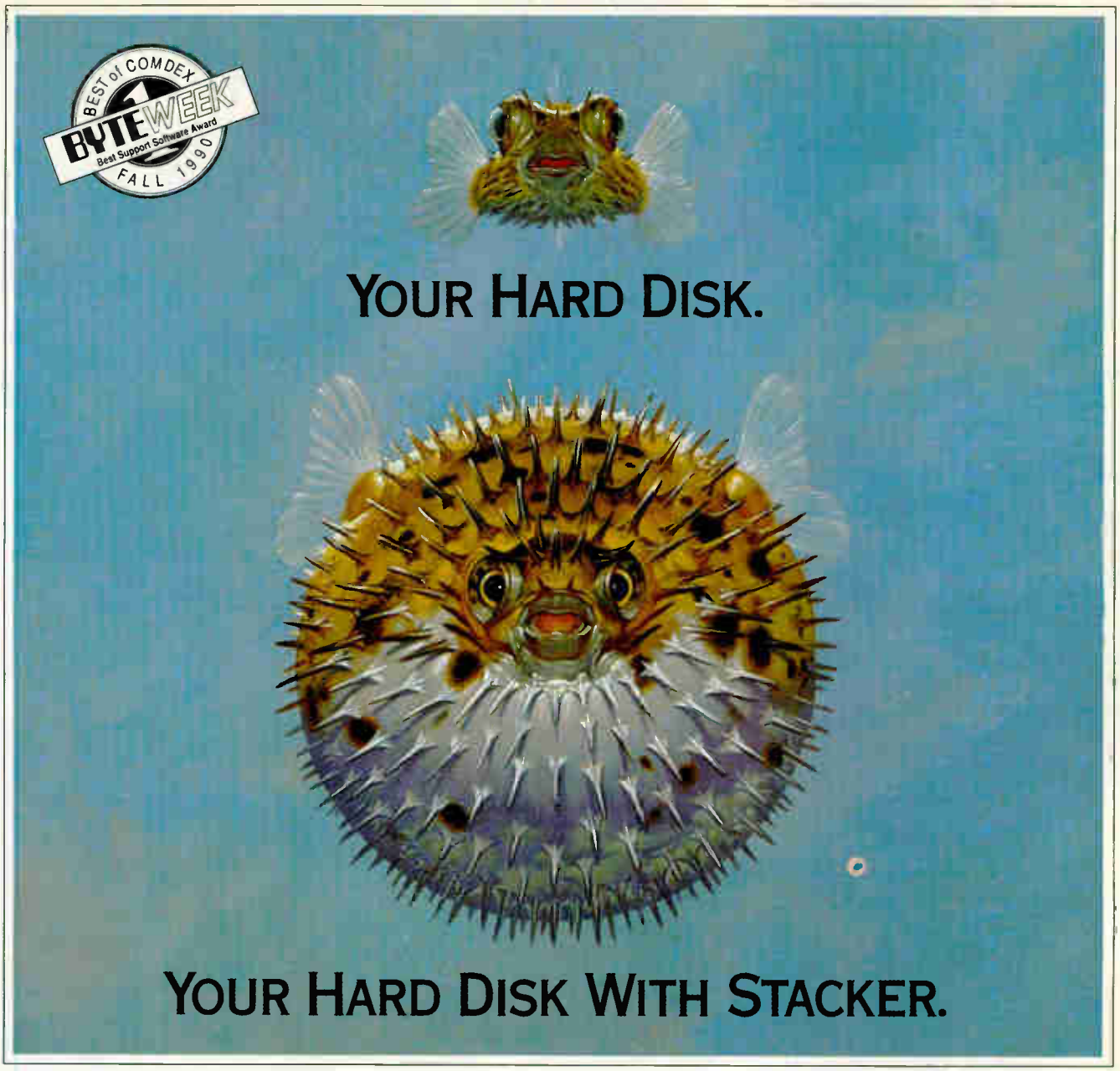
Last but not least, there are the costs of the storage device and medium. The cost of a mass-storage subsystem varies greatly, depending on the technology and manufacturer. However, cost increases with capacity. As important as cost is, it comes into perspective when you think about the possibility of losing your data due to a choice made on the basis of cost alone.

Narrowed Choices and Trade-Offs

When you draw up your list of requirements—How much capacity do you need? How much speed? What kinds of compatibility?—the choices of mass-storage systems narrow. There will be inevitable trade-offs involving price, functionality, and performance. A lower-cost unit will not display lightning-quick throughput speed; you may not be able to easily move a very high capacity system; or you may not be able to afford the most reliable system.

Optimizing your PC data-storage capabilities is a multistep process that involves many different considerations—taking particular care to plan for growth. Nothing is cost-effective if it does not provide what you need. ■

Richard A. Peters is vice president of marketing at Tandberg Data, Inc. (Westlake Village, CA). You can reach him on BIX c/o "editors."



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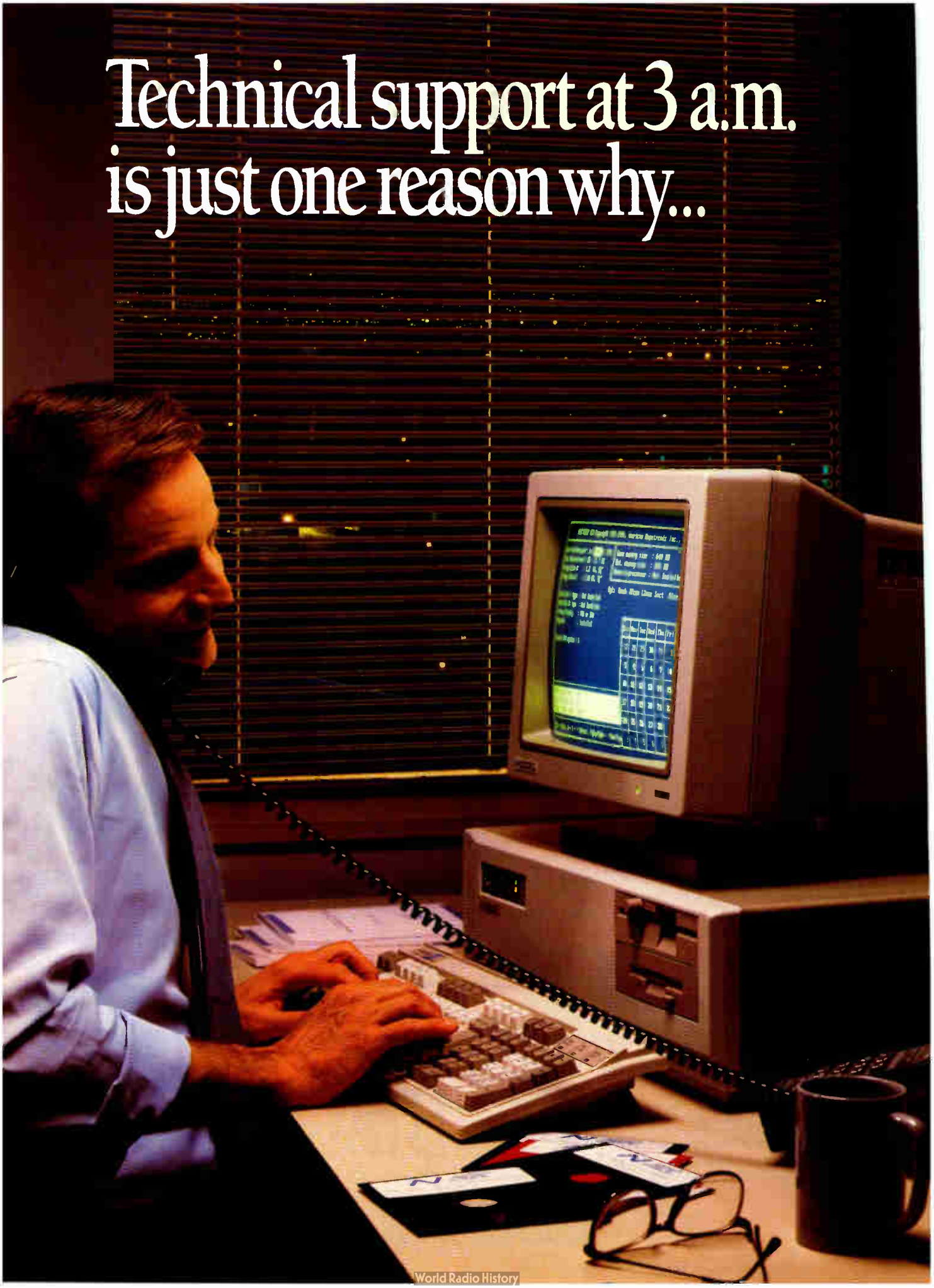

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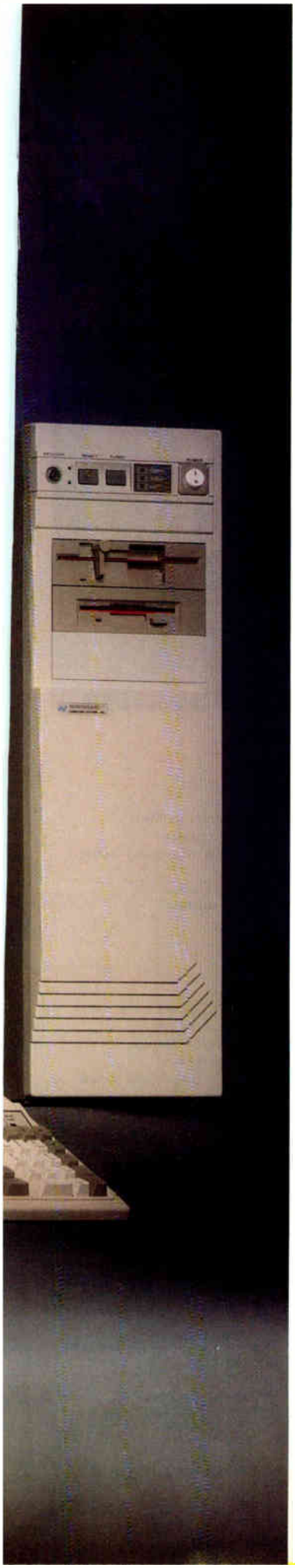

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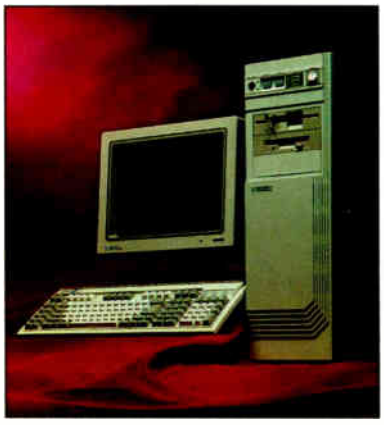

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For *real* mass storage, be prepared to drop a couple of hundred thousand dimes in the jukebox. Jukeboxes (also called auto-changers) provide unprecedented on-line storage for PC, workstation, and LAN users. They range in capacity from a few tens of gigabytes to over a terabyte, and they are available in CD-ROM, WORM (write once, read many times), rewritable optical, and tape-based configurations. Listed below are some manufacturers of jukebox mass-storage systems.

Advanced Graphics Applications, Inc.
90 Fifth Ave.
New York, NY 10011
(212) 337-4200
Circle 1060 on Inquiry Card.

Alphatronix, Inc.
2300 Englert Dr., Suite C
Research Triangle Park, NC 27709
(919) 544-0001
fax: (919) 544-4079
Circle 1061 on Inquiry Card.

Aquidneck Systems International, Inc.
650 Ten Rod Rd.
North Kingstown, RI 02852
(401) 295-2691
fax: (401) 295-1851
Circle 1255 on Inquiry Card.

AT&T
100 Southgate Pkwy.
Morristown, NJ 07960
(800) 247-1212
(201) 898-8000
Circle 1062 on Inquiry Card.

Bell & Howell Document Management Products Co.
6800 McCormick Rd.
Chicago, IL 60645
(708) 675-7600
fax: (708) 675-9271
Circle 1063 on Inquiry Card.

Control Data Corp.
P.O. Box 0
Minneapolis, MN 55440
(612) 853-8100
fax: (612) 853-5300
Circle 1064 on Inquiry Card.

Cygnet Systems, Inc.
2560 Junctions Ave.
San Jose, CA 95134
(408) 954-1800
fax: (408) 954-9391
Circle 1065 on Inquiry Card.

Delta Microsystems, Inc.
5039 Preston Ave.
Livermore, CA 94550
(415) 449-6881
fax: (415) 449-6885
Circle 1066 on Inquiry Card.

Digital Equipment Corp.
146 Main St.
Maynard, MA 01754
(508) 493-5111
fax: (508) 493-8780
Circle 1067 on Inquiry Card.

Dilog Corp.
1555 South Sinclair St.
Anaheim, CA 92806
(714) 937-5700
fax: (714) 978-2420
Circle 1068 on Inquiry Card.

Epoch Systems
8 Technology Dr.
Westborough, MA 01581
(508) 836-4300
fax: (508) 836-3802
Circle 1069 on Inquiry Card.

Exabyte Corp.
1685 38th St.
Boulder, CO 80301
(303) 442-4333
fax: (303) 442-4269
Circle 1070 on Inquiry Card.

FileNet Corp.
3565 Harbor Blvd.
Costa Mesa, CA 92626
(714) 966-3400
fax: (714) 966-3490
Circle 1071 on Inquiry Card.

Hewlett-Packard Co., Inc.
Disk Storage Systems Division
11413 Chindin Blvd.
Boise, ID 83714
(208) 323-3290
fax: (208) 323-3991
Circle 1072 on Inquiry Card.

Hitachi America, Ltd.
Computer Division
Peripherals & Systems Marketing, MS:500
Hitachi Plaza
2000 Sierra Point Pkwy.
Brisbane, CA 94005
(800) 283-4080, ext. 877
(415) 589-8300
Circle 1073 on Inquiry Card.

Laser Magnetic Storage International Co.
4425 Arrows West Dr.
Colorado Springs, CO 80907
(800) 777-5674
(719) 593-7900
Circle 1256 on Inquiry Card.

Literal Corp.
2180 Executive Cir.
Colorado Springs, CO 80906
(719) 579-0460
fax: (719) 579-0450
Circle 1074 on Inquiry Card.

Memorex Telex Corp.
6422 East 41st St.
Tulsa, OK 74135
(800) 950-3465
(918) 627-1111
fax: (918) 628-2768
Circle 1257 on Inquiry Card.

Micro Design International, Inc.
6985 University Blvd.
Winter Park, FL 32792
(800) 228-0891
(407) 677-8333
fax: (407) 677-8365
Circle 1258 on Inquiry Card.

Micro Technology, Inc.
5065 East Hunter St.
Anaheim, CA 92807
(714) 970-0300
fax: (714) 970-5743
Circle 1259 on Inquiry Card.

Optimem
297 North Bernard Ave.
Mountain View, CA 94043
(415) 961-1800
fax: (415) 961-8913
Circle 1260 on Inquiry Card.

Pinnacle Micro, Inc.
15265 Alton Pkwy.
Irvine, CA 92718
(800) 553-7070
(714) 727-3300
fax: (714) 727-1913
Circle 1261 on Inquiry Card.

Pioneer Communications
600 East Crescent Ave.
Upper Saddle River, NJ 07458
(201) 327-6400
fax: (201) 327-9379
Circle 1262 on Inquiry Card.

Reflection Systems, Inc.
P.O. Box 611608
San Jose, CA 95161
(408) 432-0943
fax: (408) 432-0843
Circle 1263 on Inquiry Card.

Ricoh Corp.
Sales Office
3567 Parkway Lane, Suite 150
Norcross, GA 30092
(404) 446-3533
fax: (404) 447-4102
Circle 1264 on Inquiry Card.

Sony Corp. of America
Peripheral Systems Co.
Sony Dr.
Park Ridge, NJ 07656
(201) 930-1000
fax: (201) 573-8608
Circle 1265 on Inquiry Card.

Storage Dimensions, Inc.
2145 Hamilton Ave.
San Jose, CA 95125
(408) 879-0300
fax: (408) 879-3397
Circle 1266 on Inquiry Card.

Storage Technology Corp.
2270 South 88th St.
Louisville, CO 80028
(303) 673-5151
fax: (303) 673-5019
Circle 1267 on Inquiry Card.

Summus Computer Systems
17171 Park Row, Suite 300
Houston, TX 77084
(713) 492-6611
fax: (713) 492-0092
Circle 1268 on Inquiry Card.

Trimarchi, Inc.
P.O. Box 560
State College, PA 16804
(814) 353-9120
Circle 1269 on Inquiry Card.

Wang Laboratories, Inc.
One Industrial Ave.
Lowell, MA 01851
(508) 459-5000
Circle 1270 on Inquiry Card.

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PC Magazine says "Editors' Choice!" When reviewing 486/25 systems, they said "Only one machine stands out ... you could pay less for a 486 system, but not get the bonuses that are offered with the Elegance."†† In the February 12, 1991 issue, *PC Magazine* declared Elegance 486/33 Editors' Choice, saying the system was "a sure winner in its class."

Elegance 486/25i, Sept. 11, 1990
Elegance 486/33i, Feb. 12, 1991

Computer Shopper readers agree! Elegance 486/25i breezed past the competition and captured a 1990 "Best Buy" award. This makes three years in a row, a Northgate Elegance system was voted tops by *Computer Shopper* readers.

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- 300 watt power supply
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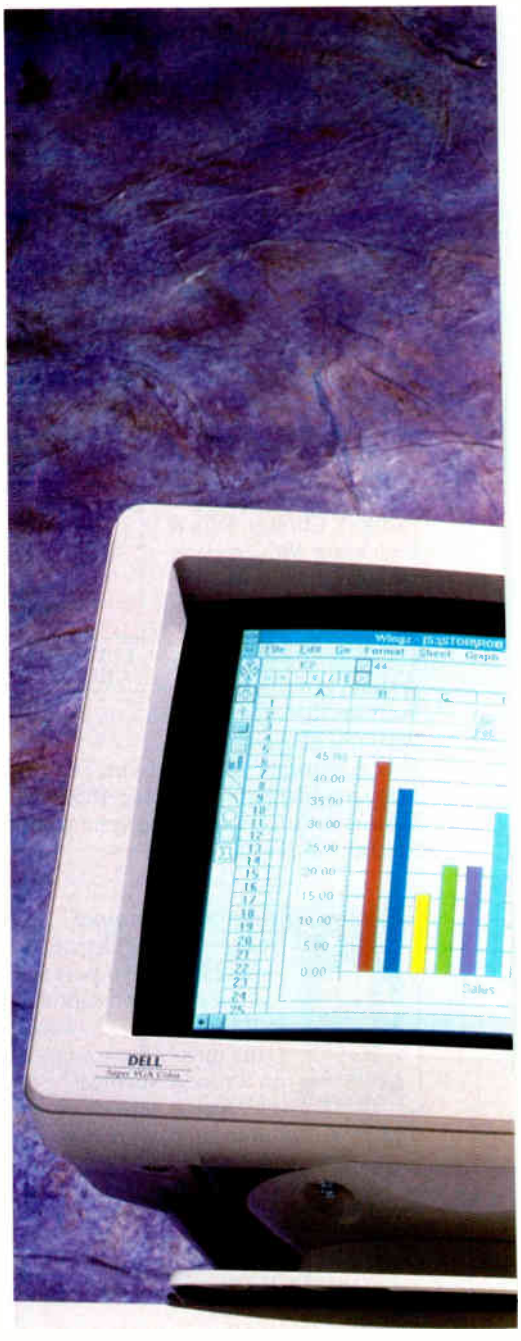
†*InfoWorld*, July 30, 1990 †† *PC Magazine*, September 11, 1990

486 EISA: BORN TO BLAZE



The new systems are fast, but a few problems make us wonder if EISA has really arrived

STEVE APIKI AND
STANFORD DIEHL

When it comes to heroes, we like the underdog, but when it comes to our workstations, we want nothing less than pure, unadulterated *power*. We want our disks to scream and our video to sparkle. We want to do whatever the job requires without running into frustrating hardware constraints. We want to sense the power rumbling beneath our fingertips.

This month the BYTE Lab looks at the up-and-coming standard in high-end systems: the powerful combination of Intel's 33-MHz i486 and the 32-bit EISA bus. These new machines beg for more than casual applications. System vendors pitch them as file servers, multiuser Unix hosts, and high-performance workstations (see the text box "EISA and i486: Workstation Class?" on page 220).

We didn't optimize these systems for any one application, however. Instead, we asked vendors for a general-purpose configuration that included 4 megabytes of system RAM, a VGA or better graphics subsystem and monitor, a 300-MB hard disk drive, and a 150-MB tape backup unit. Surprisingly, vendors didn't always supply EISA components with their systems (see the features summary table on pages 218 and 219).

The lure of buying the latest and greatest technology can be irresistible, but if you don't look beyond the glitz, you're likely to make a bad decision. You'll end up with more power than you need or, worse, with an expensive, immature product. When we began testing these machines, we had our usual object in mind: to pick the best of the bunch. But after getting our hands dirty, we started to question whether the EISA market has really arrived.

The Promise of EISA

The i486 processor, with its built-in FPU and 8K-byte cache, is fantastically fast, but the 16-bit ISA bus and its slow attendant peripherals drag down the performance of i486 systems. The i486 promises improvements over the 386 (see the text box "i486—Evolution, Not Revolution" on page 228), and EISA promises

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BYTE ACTION SUMMARY

- 33-MHZ 486 EISA SYSTEMS
- WHAT YOU'LL LIKE
  These high-end systems deliver unprecedented speed. EISA technology promises still greater performance when EISA peripherals become more widely available.
- WHAT YOU'LL DISLIKE
  EISA systems still experience the configuration and reliability problems associated with developing technology.
- WHAT WE RECOMMEND
  Currently, the best mix of price, performance, and ease of operation are in the midrange systems. Machines from Dell, Zeos, and Acma stand out. If you don't need a system right way, consider holding off on buying until EISA peripherals become more plentiful and more stable. In another six months, vendors should have ironed out many of the wrinkles with current add-in boards, and many new boards should be available.

peripherals that can supply data as fast as the processor can handle it. EISA's 32-bit bus is twice as wide as the ISA bus, making it capable of delivering twice the data. EISA can also handle multiple bus masters, which may dramatically improve the throughput of I/O-bound tasks. Finally, EISA's software-based board configuration should make board installations easier. (For an in-depth look at EISA, see "Inside EISA," November 1989 BYTE.)

EISA's greater bandwidth makes it ideal for networks and multiuser environments, which require fast access to system peripherals. However, EISA peripherals have been slow in coming. Most EISA devices introduced to date have been disk drive controllers (included in most of our test machines) and network interface cards. Other EISA peripherals, such as video controllers, aren't readily available.

Software-based configuration means that you use a vendor-supplied EISA setup disk to add peripherals or to modify the configuration of any of the boards. You can set the parameters of each EISA device from the EISA setup utility, choosing IRQ numbers, ROM addresses, and other settings

33-MHZ 486 EISA SYSTEMS: FEATURES SUMMARY

Price and performance varied widely among these systems, but most manufacturers assembled systems from a common pool of components. Machines with similar disk drive controllers and amounts of disk drive cache often turned in similar benchmark results (N/A = not applicable).

System	List price[1]	Size (inches) (W x H x D)	Maximum on-board memory	Off-chip cache			ROM BIOS	EISA/ISA slots	Hard disk drive	Capacity (MB)	Avg. seek time (ms)
				Size	Min./max.	Type					
Standard Systems:											
Acma 486/33	$7790	7.5 x 25.5 x 17	64 MB	256 KB	64/256 KB	Direct-mapped/ posted writes	Award	6/2	Maxtor XT-8380E	360	14.5
ALR PowerPro VM	$13,477[5]	7.25 x 24 x 18.5	49 MB	64 KB	64 KB[3]	Direct-mapped/ write through	Phoenix	8/2	Seagate ST2383E	320	16.0
American Mitac 4280G	$13,185	8.7 x 23.6 x 19.7	64 MB	128 KB	64/256 KB	Direct-mapped/ write back	Phoenix	6/2	Maxtor XT-8380S	360	14.5
AT&T StarServer S	$17,679	7.75 x 25.5 x 31.4	64 MB	128 KB	128 KB	Direct-mapped/ write back	Phoenix	10/0	Seagate ST4376N	376	17.5
Blue Star 486/33E	$7249	17.25 x 7 x 16.25	64 MB	256 KB	0/256 KB	Direct-mapped/ write through	AIR/Phoenix	8/0	Seagate Wren 6 HH	330	16.0
CCS 486-33c	$14,247	11 x 26 x 17.5	32 MB	128 KB	128 KB	Direct-mapped/ write through	Mylex	8/0	Fujitsu M 2249S	318	18.0
Compaq Deskpro 486/33L	$21,835	19.2 x 6.5 x 17.7	100 MB	128 KB	128 KB	Direct-mapped/ write through	Compaq	7/0	Seagate ST2383E	320	16.0
Dell 433TE	$10,958	7.6 x 24 x 22.4	64 MB	128 KB	128 KB	Direct-mapped/ write through	Phoenix	8/0	Micropolis 1664-7	345	14.0
Dyna Micro Work Master 486	$9999	7.75 x 16 x 16	64 MB	256 KB	0/256 KB	Direct-mapped/ write through	AIR/Phoenix	8/0	Seagate ST2383E	320	16.0
Lucky 486/33E	$7250	21.25 x 6.25 x 16.5	64 MB	64 KB	64/256 KB	Direct-mapped/ write back	Phoenix	8/0	Maxtor XT-8380E	360	14.5
Micro Express ME 486	$7672	11 x 26 x 17.5	64 MB	256 KB	256 KB	4-way associative/ write through	Mylex	6/1	Micropolis 1558	340	16.0
Misys EISA/33MHz	$8960	25.5 x 9.3 x 18.5	96 MB	256 KB	64/256 KB	Direct-mapped/ write back	AMI	7/1	Maxtor XT-4380E	340	16.0
PC Craft 2304/33D	$9082	21.25 x 6.25 x 16.5	64 MB	64 KB	64/256 KB	Direct-mapped/ posted writes	Award	6/2	Maxtor XT-4380E	340	16.0
SAI 486/33	$7495	21.25 x 6.25 x 16.5	64 MB	256 KB	0/256 KB	Direct-mapped/ write through	AIR/Phoenix	8/0	Maxtor XT-4380E	340	16.0
Tandon DT 486/33	$9956[8]	21.25 x 6.25 x 16.5	64 MB	64 KB	64 KB	Direct-mapped/ posted writes	Tandon	6/2	Seagate ST2382N	320	16.0
Tangent 486/33	$8999	7.5 x 25.5 x17	32 MB	128 KB	128 KB	Direct-mapped/ write back	Mylex	8/0	Maxtor LXT-340SY	340	15.0
Touche 5550T	$6117	11 x 26 x 17.5	96 MB	128 KB	64/256 KB	Direct-mapped/ write back	AMI	7/1	Maxtor XT-8380E	360	14.5
Zeos 486-33C	$9190	21.25 x 6.25 x 16.5	32 MB	128 KB	128 KB	Direct-mapped/ write back	Mylex	8/0	Seagate ST4376N	376	17.5
Portable System:											
Bitwise 433E/VP	$12,495[9]	16 x 10.5 x 8.5	32 MB	None	N/A	N/A	AIR/Phoenix	6/0	Maxtor LXT-200S	200	14.5

[1] Price includes 4 MB of system memory, VGA or Super VGA graphics with monitor, hard disk drive of about 300 MB, 150-MB tape backup unit, parallel port, and 101-key Enhanced keyboard.
[2] Minimum supported configuration.
[3] Other models are available with additional cache.
[4] Pixels x pixels x colors.
[5] System tested and priced with 5 MB; 4-MB configuration not available.
[6] System also has additional IDE interface.
[7] System also includes VGA built into motherboard.
[8] Price does not include tape backup system (not available from vendor).
[9] Portable system without external monitor and with 200-MB hard disk drive.
[10] Resolutions above standard VGA require external monitor.

that usually require DIP switches or jumper blocks.

Unfortunately, EISA subsystems and supporting software are still quite new, and most aren't totally wrinkle-free. A few systems presented inaccurate EISA configuration information; with others, reconfiguring an option produced some odd side effects. For example, LapLink couldn't find the parallel port on the Blue Star system's motherboard even though the EISA configuration software showed the port as enabled. We fixed the problem by disabling and then reenabling the port through software. On every system, running the configuration utility was unbearably time-consuming, making the prospect of opening the system and fiddling with DIP switches more appealing.

Common Threads

Given the newness of EISA technology, it's not surprising that many of these systems share many of the same components. Three EISA motherboards and two EISA disk drive controllers form the core hardware for many of these machines. None offers an EISA video controller, but many include fast 16-bit Super VGA controllers. Since similar components mean similar features, we'll discuss some of the more popular components here.

The most popular motherboard among our test systems was Advanced Integration Research's 486EL, which uses Intel's EISA chip set. It supports an i486 at 25 or 33 MHz, with up to a 256K-byte static RAM (SRAM) cache and a socket for a Weitek WTL4167 math coprocessor. The motherboard's 16 single in-line memory module sockets accept up to 64 MB of on-board memory when loaded with 4-MB SIMMs. The AIR board has

33-MHZ 486 EISA SYSTEMS: FEATURES SUMMARY

Interface	Disk drive controller	Disk drive controller cache[2]	Floppy disk drive	Disk drive bays	Serial ports	Other ports	Video controller[3]	Video RAM	Maximum resolution[4]	Power supply (W)	Distribution channel	Warranty (years)	On-site service
ESDI	UltraStor 22C	512 KB	1.2 MB/ 1.44 MB	6	9-pin, 25-pin	Game	Orchid ProDesigner II	1 MB	1024 x 768 x 256	230	Mail order	1	1 year
ESDI	Western Digital WD-1009V-SE1[6]	64 KB	1.2 MB	6	9-pin, 25-pin	None	ALR/Paradise	256 KB	800 x 600 x 16	300	Dealer, reseller	1	Option
SCSI	Mylex DCE-376	1 MB	1.2 MB	5	2 9-pin	Mouse	Mitac	512 KB	1024 x 768 x 16	300	Distributor, reseller	1	1 year
SCSI	DPT	128 KB	1.2 MB/ 1.44 MB	8	2 9-pin	Mouse, 2nd parallel	AT&T VDC 600	256 KB	800 x 600 x 16	300	Dealer, reseller	1	1 year
ESDI	UltraStor 22C	512 KB	1.2 MB/ 1.44 MB	6	9-pin, 25-pin	Mouse	Diamond Computer SpeedStar VGA	1 MB	1024 x 768 x 256	230	Dealer, reseller	1	Option
SCSI	Mylex DCE-376	1 MB	1.2 MB/ 1.44 MB	10	2 9-pin	2nd parallel	Diamond Computer SpeedStar VGA	1 MB	1024 x 768 x 256	375	Dealer, reseller	1	No
ESDI	Compaq[6]	None	1.2 MB/ 1.44 MB	7	2 9-pin	Mouse	Compaq AG-1024[7]	1 MB	1024 x 768 x 256	300	Dealer	1	No
ESDI	UltraStor 12F[6]	32 KB	1.44 MB	11	2 9-pin	Mouse	Dell	512 KB	1024 x 768 x 16	300	Mail order, retail	1	1 year
ESDI	UltraStor 22C	512 KB	1.2 MB/ 1.44 MB	5	2 25-pin	None	Orchid ProDesigner II	1 MB	1024 x 768 x 256	230	Dealer, reseller	1	Option
ESDI	UltraStor 22C	512 KB	1.2 MB	5	9-pin	None	STB Systems PowerGraph VGA	1 MB	1024 x 768 x 256	220	Mail order, retail	1	Option
ESDI	UltraStor 22C	512 KB	1.2 MB/ 1.44 MB	10	9-pin, 25-pin	None	Micro Express Extended VGA	1 MB	1024 x 768 x 256	300	Mail order	2	No
ESDI	UltraStor 22C	512 KB	1.2 MB/ 1.44 MB	6	9-pin, 25-pin	Tape	Definicon HiRes 1024	1 MB	1024 x 768 x 256	250	Mail order	3	Yes
ESDI	UltraStor 22C	512 KB	1.2 MB	5	9-pin, 25-pin	Game, mouse	ATI VGA1024	256 KB	800 x 600 x 16	220	Reseller, OEM	1	1 year
ESDI	Data Technology	4 MB	1.2 MB	5	2 25-pin	Game	Diamond Computer SpeedStar VGA	1 MB	1024 x 768 x 256	120	Mail order	1	Option
SCSI	Mylex[6] DCE-376	4 MB	1.2 MB	5	9-pin, 25-pin	None	Orchid ProDesigner II	1 MB	1024 x 768 x 256	230	Mail order	1	1 year
SCSI	Mylex DCE-376	4 MB	1.2 MB	6	9-pin, 25-pin	None	Orchid ProDesigner II	512 KB	1024 x 768 x 16	270	Mail order	1	1 year
ESDI	UltraStor 22C	512 KB	1.2 MB/ 1.44 MB	10	2 9-pin	2nd parallel	Orchid ProDesigner II	1 MB	1024 x 768 x 256	450	Mail order	1	Option
SCSI	Mylex DCE-376	2 MB	1.2 MB/ 1.44 MB	5	9-pin, 25-pin	Game	Diamond Computer SpeedStar VGA	1 MB	1024 x 768 x 256	450	Mail order	1	Option
SCSI	Mylex DCE-376	4 MB	1.2 MB/ 1.44 MB	3	2 25-pin	None	Ahead Systems VGA Wizard	512 KB	1024 x 768 x 16[10]	200	Mail order	1	No

eight EISA slots, six of which support EISA bus-master devices. Systems that are equipped with the AIR motherboard tended to fare worse than other systems on our CPU benchmarks.

Mylex's MAE486 motherboard also supports the i486 at 25 or 33 MHz and includes a Weitek coprocessor socket. Its external processor cache can hold up to 128K bytes of SRAM, and its eight SIMM sockets hold up to 32 MB of system RAM. All eight EISA slots on the MAE486 can handle bus-master devices.

The American Megatrends, Inc., Enterprise motherboard holds up to 96 MB of memory: 32 MB in the board's eight SIMM sockets and 64 MB on a proprietary 32-bit expansion board. AMI offers a 64K- or 256K-byte external processor cache and includes a Weitek socket, seven EISA bus expansion slots, and an 8-bit slot. The proprietary memory board occupies one of the motherboard's EISA slots.

Regardless of motherboard, all but one of the systems supported video BIOS and system BIOS shadowing. The sole exception was Dell's 433TE, which shadows video BIOS only. We found that, for most applications, video BIOS shadowing improves performance more significantly than system BIOS shadowing.

Since even the fastest hard disk drives can't supply data fast enough to take advantage of the EISA bus, all EISA hard disk drive controllers use a cache. Eight machines used UltraStor's Ultra 22C caching ESDI controller; six went with Mylex's DCE-376 caching SCSI controller. Most vendors used Seagate or Maxtor hard disk drives with average seek times in the 14- to 17-millisecond range.

We asked system vendors that supplied caching disk drive controllers to include the minimum amount of cache RAM

EISA and i486: Workstation Class?

Hardly a month passes that we don't see the introduction of a new system or system component that promises to further blur the distinction between PCs, workstations, and minicomputers. The i486 microprocessor and industry support for the 32-bit EISA bus are two significant developments pushing PCs across the fuzzy line onto workstation turf. But despite these advances, the currently available i486 systems don't quite measure up to the RISC-based Unix workstations.

The 33-MHz i486 is a top-notch microprocessor. Innovative caching schemes have further enhanced the i486 PC so that, in terms of raw integer performance measures like Dhrystones, it almost holds its own with a 25-MHz SPARC processor and gives the powerful 20-MHz MIPS R3000 chip set a run for its money (see the table below). Even without a Weitek WTL4167 FPU, the i486 is more than a match for the 25-MHz SPARC in floating-point operations, although it pales beside faster SPARCs and other RISC processors. RISC-based workstations now sell in the $10,000 to $20,000 range and thus directly compete with high-end i486 machines.

The critical issues that separate the workstations from PCs have less to do with raw performance and more to do with compatibility and ease of integration. SPARC-based workstations currently enjoy two significant advantages over i486 PCs: cleaner hardware and more Unix software.

Expansion boards designed for Sun's SBus work right out of the box; many EISA devices that we've seen don't. Most problems revolve around resource conflicts that manufacturers will likely fix with firmware revisions. But for the moment, SPARC workstations have more stable and easier-to-maintain peripherals.

But the biggest hurdle that 486 PCs must overcome to compete with SPARC workstations is the lack of portability between PC implementations of Unix. Currently, PC Unix software developers must choose sides and decide which variation of Unix to support. Hardware companies have to develop drivers for multiple versions of Unix. Both are severely hampered by the lack of binary compatibility from system to system. SPARC developers, because of cross-SPARC binary compatibility, have only a single architecture to target. It's not surprising, therefore, that the range of Unix applications for SPARC workstations is broader than that for i486 PCs.

The operating-system problems and the subsequent software gap show signs of closing, however. The latest version of Unix, System V release 4, promises a much deeper level of binary compatibility across versions of Unix supplied by different vendors. Release 4, which you should see by the end of this year, may finally boost high-end PCs into the workstation arena.

COMPARATIVE UNIX BENCHMARK INDEXES BY PROCESSOR TYPE

BYTE Unix benchmark indexes for machines that use i486, SPARC, and MIPS CPUs. The i486 holds an edge over the SPARC in floating-point operations but lags in raw integer performance (Dhrystones).

	Dhrystone	Floating-point
33-MHz i486	1.3	2.6
25-MHz SPARC	1.5	2.2
20-MHz MIPS R3000	1.7	6.2

offered in a standard system configuration. Each system that used the UltraStor card included a 512K-byte cache; vendors that included the Mylex DCE-376 maintain minimum configurations ranging from 1 to 4 MB. The Ultra 22C accepts up to 3 MB of cache RAM by way of an add-in card. The DCE-376 holds 16 MB of cache RAM.

Both the Ultra 22C and the DCE-376 are EISA bus-master controllers, and both are outstanding performers. The boards with more cache memory proved faster; the cache configuration you specify to the system vendor will be the most important factor in determining the overall performance of your disk subsystem.

These boards are both in a state of early release, and drivers and firmware are evolving quite rapidly. We encountered several EISA configuration problems with the boards in our test machines. More significant, bus-master activity conflicts with memory managers such as 386Max or QEMM386 unless both bus-master card and memory manager adhere to the Virtual DMA Services (VDS) specification. Vendors had just begun to release drivers that implement VDS as we began testing; we conducted our evaluations using these early drivers.

With no EISA video controller boards available, vendors are relying on fast 16-bit Super VGA boards, such as Orchid's ProDesigner II and Diamond Computer Systems' SpeedStar VGA. With 1 MB of video RAM (VRAM), both boards can display graphics at a resolution of 1024 by 768 pixels in 256 colors. Both cards are based on the Tseng Labs VGA chip.

EISA Roundup

We tested eighteen 33-MHz i486 EISA systems in both desktop and tower configurations. We also tested what may be the first i486 EISA portable computer (see the text box "Bitwise 433E/VP Portable" on page 230). Some of the i486 systems we tested are high-end models sold exclusively through resellers and dealers. Others are assembled from common off-the-shelf components and are available directly from the manufacturer. Performance differs widely within their ranks, but every one of these systems is an outstanding performer relative to the last generation of 386 and 486 systems.

We rated the machines on their performance, price, and difficulty of setup and configuration. To measure the system

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performance, we used BYTE's low-level benchmarks, DOS application benchmarks, and Unix system benchmarks (see the figures on pages 224 and 225). The low-level tests isolate specific performance areas, such as CPU and memory or the graphics subsystem. The DOS application benchmarks give a comprehensive overview of system performance under DOS for seven different categories: word processing, desktop publishing, database, compilers, CAD, scientific/engineeering, and spreadsheet. Both the low-level and the application-level results are indexed against an IBM AT. The Unix tests measure system speed when running a complex, multitasking, protected-mode environment. Descriptions of the eighteen individual machines follow.

Acma 486/33

Photo 1: *One of the least expensive systems in this review, the Acma 486/33 offers an outstanding mix of performance, reliable operation, and affordability.*

Acma Computers offers a moderately priced tower system that includes both the fast Ultra 22C caching EISA disk drive controller with a 512K-byte cache and a 256K-byte external processor cache. Our test system, equipped with two floppy disk drives, a 360-MB hard disk drive, a 1-MB ProDesigner II Super VGA card, and a color monitor, sells for $7790 (see photo 1).

The system's large external cache boosted CPU performance in the low-level benchmarks. Average video and hard disk drive scores on the low-level tests translated into average scores on the application benchmarks. Increasing the cache size on the hard disk drive controller would substantially increase the application benchmark results.

The Acma 486/33 was one of a few systems that ran without problems right out of the box. The system's Award BIOS features a detailed ISA setup routine in ROM that handles video and BIOS shadowing.

The Acma 486/33 offers solid construction and good performance for what you'll pay. Several systems are less expensive, but none of these was as well constructed or ran as reliably.

ALR PowerPro VM

Many of the systems covered here represent the most powerful model from a company. Advanced Logic Research is one of a few companies that sell several variations of 33-MHz i486 systems. The PowerPro VM, which we tested, is the low-end model in ALR's premier PowerPro line.

ALR designed the PowerPro to compete with Compaq's Systempro. It features a modular design that can support multiple i486 processor modules and an external processor cache of up to 1 MB. The PowerPro VM that we tested included one processor with a 64K-byte external SRAM cache and 5 MB of system RAM, an ALR/Paradise VGA board with 256 MB of RAM, an ISA-bus ESDI hard disk drive and controller, and a color VGA monitor for $13,477.

The processor card plugs into a proprietary slot on the motherboard, as does the system cache. CPU performance was outstanding, but ALR's choice of a noncaching ISA-bus controller instead of a caching EISA-bus controller resulted in a consistent, if mediocre, performance. ALR's higher-end models have an EISA SCSI bus-master disk drive controller. You'll pay a premium price for the PowerPro, which gives you the added flexibility of adding a second CPU and cache. That's important if you want to use this system as a multiprocessor Unix host or as a network server on a Vines network. Otherwise, other systems may better suit your needs.

American Mitac 4280G

In a collection of systems notable for the number of cookie-cutter clones, American Mitac's 4280G stands out with several design innovations. The motherboard holds a 128K-byte processor cache but no system memory; for this you need a Mitac add-in card that plugs into a proprietary memory slot. A single 16-bit multifunction board integrates VGA with 512K bytes of RAM, a floppy disk drive controller, and I/O port circuitry. Our test configuration also included a color monitor and a 1-MB Mylex SCSI EISA-bus caching hard disk drive controller for $13,185.

The large tower case has convenience features such as a lockable cover for the floppy disk drives and the power, a system lock, and reset switches. One full-height drive bay works like a sliding drive drawer.

Despite a weak raw CPU showing and a smaller disk cache than some other systems, the Mitac system's application benchmark scores placed it close to the top. We would expect it to match the fastest systems if equipped with a larger disk cache.

AT&T StarServer S

Beneath the imposing AT&T logo and the extra-large tower case of the StarServer S lies a fast, well-designed 486/33 system board. This system, equipped with a 128K-byte CPU cache, turned in some of the best CPU test results we've seen. Unfortunately, the relatively underdeveloped 128K-byte disk cache and its slow video performance dragged the StarServer S down to nearly the bottom of the list on our application tests.

The StarServer S configuration we tested sells for $17,679. The system included an AT&T VDC600 VGA card with 256K bytes of VRAM. The StarServer S is about as tall and as wide as an average PC tower system, but twice as deep. AT&T puts the extra room to good use by packing in eight half-height drive bays and 10 EISA expansion slots—more than any other system.

As an AT&T box, the StarServer S will likely see action in a Unix environment. However, its BYTE Unix benchmark results were poor. We compile the Unix benchmark suite on each system, so the performance results represent the efficiency of the operating system and development environment as well as the underlying hardware. Our default PC Unix system is SCO Unix, which includes an outstanding optimizing compiler. The relatively slow C compiler in AT&T Unix penalized the StarServer S on Unix tests. The results demonstrate the performance you can expect if you plan to develop Unix software on the StarServer S.

continued

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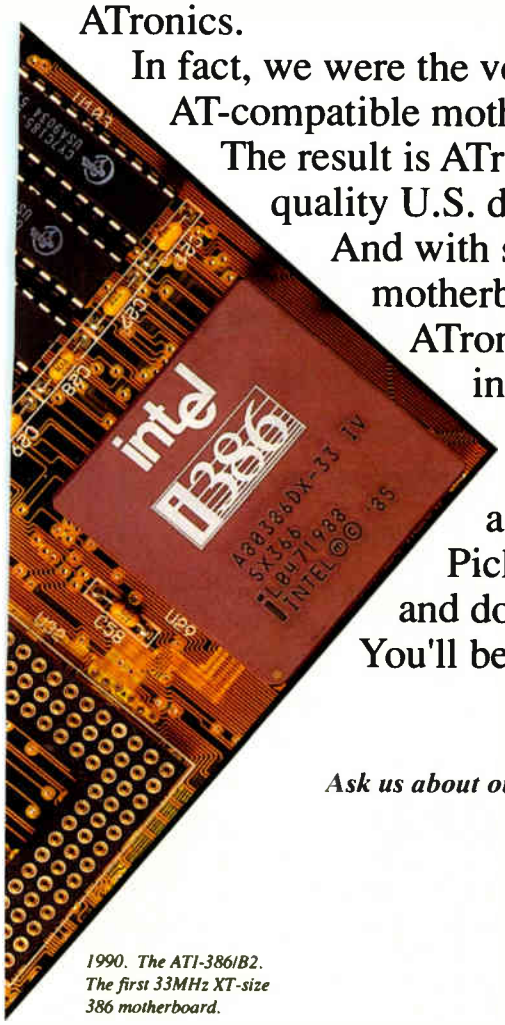

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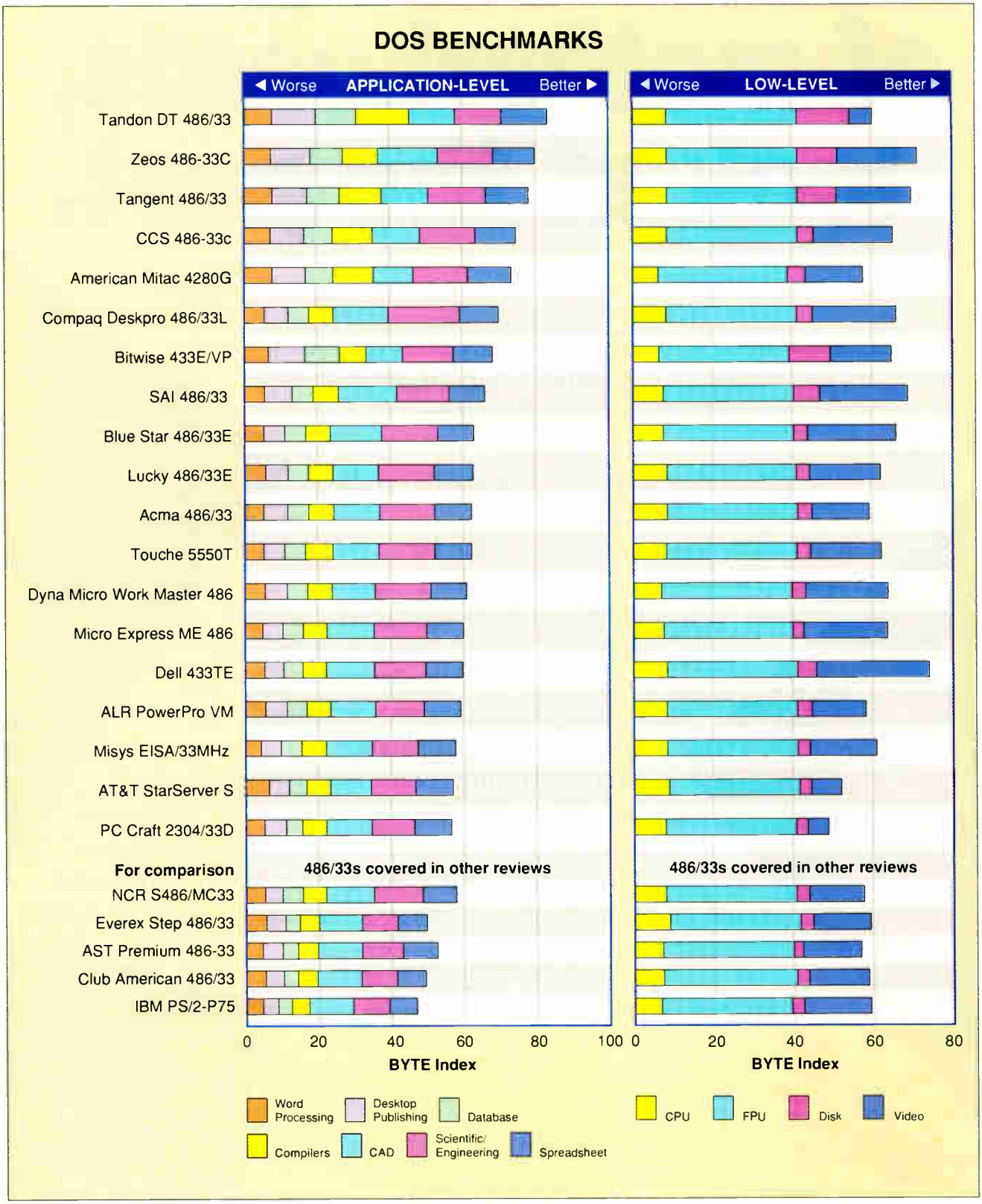
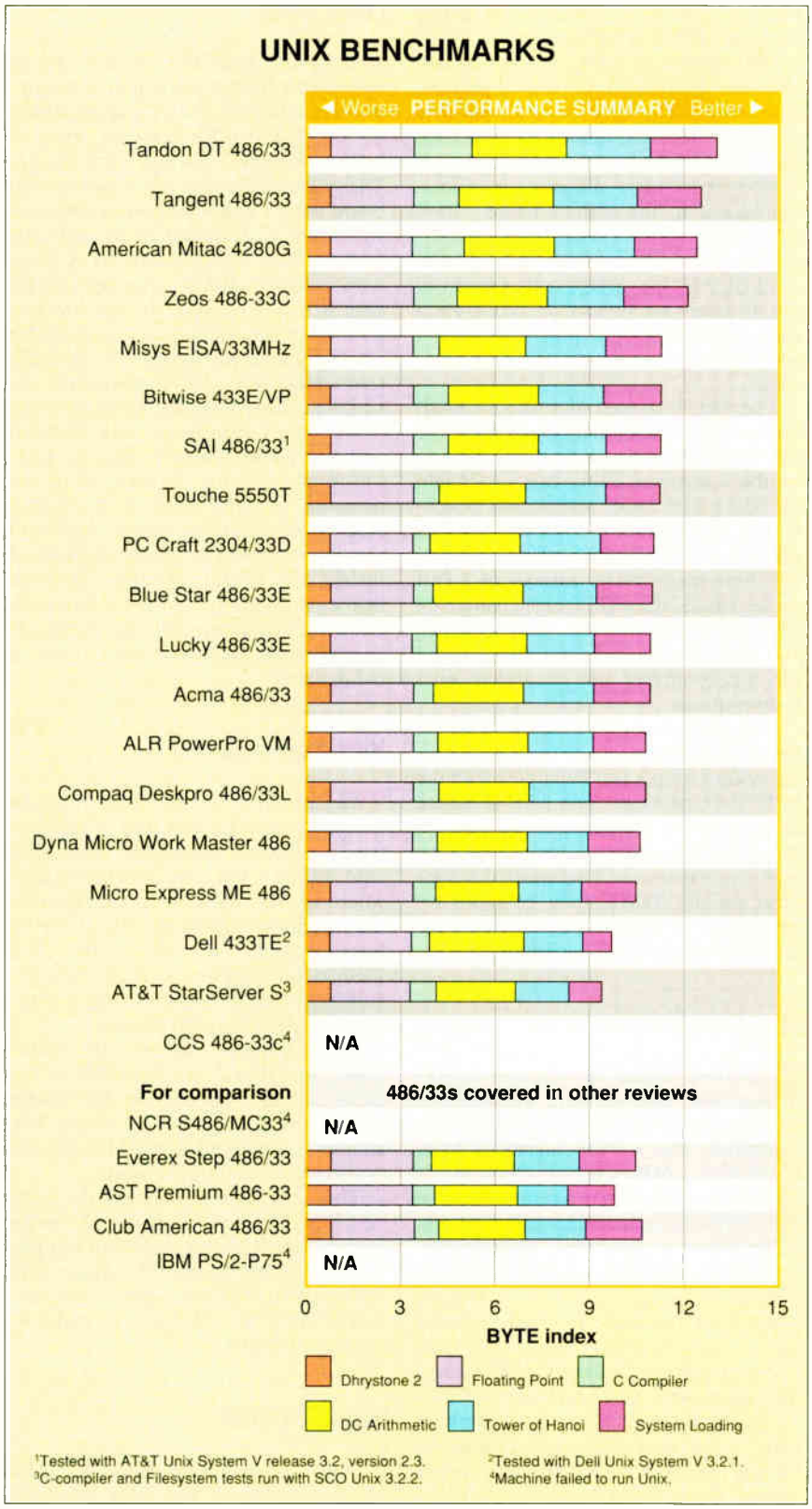


The BYTE DOS benchmark test results, ranked by cumulative application index score, show the Tandon DT 486/33 in the top spot. This results from its large disk cache and hides a relatively poor showing in the low-level video tests. For each index score, an 8-MHz IBM AT = 1.



The Unix benchmarks, ranked by cumulative index scores. We tested each system using SCO Unix System V version 3.2.0. For all results, an Everex Step 386/33 running SCO Xenix 2.3.1 = 1.

Blue Star 486/33E

The Blue Star desktop 486/33E uses an AIR motherboard with a 256K-byte cache, coupled with an Ultra 22C disk drive controller with a 512K-byte cache, and a 1-MB SpeedStar VGA board. Its overall performance was slightly better than average.

Our test system had problems remembering its EISA configuration information; it sometimes booted with the parallel port on the motherboard mysteriously disabled. A session with the EISA configuration utility cleared up the problem, but its intermittent nature made it especially frustrating.

At $7249, the mail-order Blue Star 486/33E is a bargain. However, the support we got when trying to solve configuration conflicts with the Ultra 22C controller was disappointing; the company representative simply passed along UltraStor's phone number. It's unlikely that the level of support will improve as long as EISA systems and peripherals remain in the realm of new technology.

Custom Computer Systems 486-33c

The Custom Computer Systems (CCS) 486-33c puts a Mylex motherboard with a 128K-byte CPU cache in a tower case. Our test system included a Mylex 1-MB caching EISA-bus controller and a 1-MB SpeedStar VGA board for $14,247. The tower case lacks a reset switch, positions the power inconveniently at the rear of the unit, and doesn't offer easy access to the expansion slots.

The CCS machine posted excellent benchmark scores, no doubt boosted by the Mylex caching SCSI controller (the five best performers had this controller installed). The system also posted strong numbers on the CPU and video indexes.

Despite repeated efforts, we could not get Unix properly installed. A Mylex engineer said that timing problems required a BIOS upgrade, but even a new motherboard didn't fix the problem. The Zeos system has a similar configuration (the Mylex motherboard and DCE-376 controller) but ran without a hitch. The problem made us wonder if these systems are heading out the door too soon.

Compaq Deskpro 486/33L

The Deskpro 486/33L exhibits all the qualities for which Compaq machines are known: good performance, quality construction, reliable operation—and

a big price. The Deskpro 486/33L, at $21,835, is by far the most expensive system we reviewed.

Paying top dollar doesn't always bring top quality, but with the Deskpro 486/33L the two go hand in hand. This desktop system includes Compaq's fast ISA ESDI controller, a system board with a 128K-byte processor cache, and Compaq's high-speed, high-resolution AG-1024 video controller, which uses Texas Instruments' 34010 graphics coprocessor. The combination earned the Deskpro 486/33L second place on the low-level video tests. It placed sixth on the application benchmarks, despite not having a caching disk drive controller. The Deskpro 486/33L ran flawlessly and was one of the easiest systems to set up and configure.

The Deskpro is one of the heaviest machines we tested—the locking case includes a lot of heavy steel, with a power supply that runs from the front to the rear of the case. You can access the drive bays from the front or back of the machine.

If price were no object, we'd recommend this system in a heartbeat. But even after considering dealer discounts, the Deskpro 486/33L's stellar price puts it out of the range of all but the most dedicated Compaq shops.

Dell 433TE

Photo 2: *The Dell 433TE, with its well-designed tower, scored well on BYTE's low-level benchmarks and earned high marks for expandability and reliability.*

Although Dell's 433TE garnered only average numbers on most of our benchmarks, this was one of our favorite systems. The 433TE's flawless operation, solid construction, and ample room for expansion make it an excellent choice for its moderate $10,958 price.

Dell earns high marks for its attention to detail. The system came well packed, with good documentation, and was easy to set up. Once you unlock the case, one full side of the tower case snaps off without removing a single screw, allowing access to the system board, drive bays, and expansion slots (see photo 2).

The case accommodates up to 11 half-height drives, the most generous of any of the systems we reviewed. All system memory mounts on a plug-in card that accepts Dell's proprietary memory modules.

The 433TE earned high scores on all the low-level benchmarks and took the top spot in the video tests. Unfortunately, these numbers didn't carry over into the Unix and DOS application benchmarks. The UltraStor Ultra 12F ISA-bus ESDI controller, which offers a small 32K-byte track buffer instead of a full cache, caused the 433TE to lag behind on some DOS applications. Like Compaq and ALR, Dell opted for a more proven ISA-bus controller and sacrificed some system speed.

Dell sells its own variation of Unix; the development package for this operating system simply can't compete with the SCO Unix package. The 433TE lagged along with the StarServer S on many of our Unix benchmark tests. As with AT&T's system, Unix software development on the 433TE may be more restricted by the available development environment than by the hardware.

Dyna Micro Work Master 486

The Work Master 486 features an AT-size AIR motherboard, a 256K-byte CPU cache, an Ultra 22C ESDI EISA controller, and a ProDesigner II VGA board with 1 MB of RAM. Dyna Micro sells the combination in a minitower case for $9999 through dealers and resellers.

The Work Master turned in a middle-of-the-road performance that closely tracked that of the Blue Star system, which uses the same motherboard and disk drive controller. Except for some minor initial configuration difficulties, the system ran without problems. Dyna's minitower case is more like a desktop than a tower unit in expansion capacity; the box has room for just five half-height drives. The case also requires you to remove the motherboard to install disk drives. At 16 inches high, however, the case is a good compromise between compactness and expandability.

Lucky 486/33E

Lucky Computer sells its 486/33E system via direct mail and through a small number of Lucky Computer stores. Its low $7250 price helps to offset the Lucky 486/33E's average performance. The system includes a Micronics motherboard with a 64K-byte processor cache, an Ultra 22C EISA disk drive controller, and a 16-bit PowerGraph VGA board with 1 MB of RAM. The best performance numbers came in the low-level CPU tests; the system trailed the top finishers by a small margin in the video tests. High-level DOS application and Unix benchmark numbers were average.

We didn't experience any problems with the Lucky 486/33E once we had it set up and running, but we did have to open up the unit initially to reattach some loose disk drive cables. And while the system uses brand-name components inside, the overall fit-and-finish was below par. This system is for those who know their way around the inside of a computer and for whom price is the deciding factor.

Micro Express ME 486

The ME 486, a mail-order machine, comes in at the low end of the spectrum at $7672. Using the same tower case as the CCS and Touche systems, Micro Express did a better job laying out the internal components. The drive bay housing does block one of the 32-bit EISA slots, however, so it can't accept a full-length card. The unit ships with a half-length I/O card in this slot.

Micro Express uses an AIR motherboard, an Ultra 22C EISA caching disk drive controller, and a 340-MB Maxtor ESDI hard disk drive. The Super VGA adapter, configured with 1 MB of RAM, carried a Micro Express label.

The unit scored well on the video benchmarks, but sub-par disk performance kept it in the middle of the pack overall. As configured, the system came with only a 512K-byte disk cache, so a heftier cache would probably make it a stellar performer.

Misys EISA/33MHz

Misys has assembled its EISA/33MHz system around the AMI Enterprise motherboard and packaged it in a sturdy tower case. The case has front-mounted turbo, reset, and power switches. The system accepts up to 32 MB of RAM on

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i486—Evolution, Not Revolution

The introduction of the 386 microprocessor in 1986 revolutionized the industry by opening a whole new bag of tricks for DOS-based systems: true multiprocessing, 32-bit operation, access to *4 gigabytes* of memory, and significantly enhanced performance.

The 386 is a tough act to follow. Given the advances of the 386 over the 286, the i486, the latest generation in Intel's bread-and-butter processor line, looks more like an upgrade than a brand-new chip. And with Intel's new marketing strategy, the differences will be even less noteworthy. The company will sell less expensive versions of the chip with the on-board cache or the FPU module disabled.

The most important feature of the i486 is its binary compatibility with the 386DX and SX, 286, 8086, and 8088 processors. Programs written for these earlier processors should run without modification on the i486. Technically, the i486 instruction set is a superset of the 386's with a few added instructions. Still, the new chip is object-code compatible with the 386. In fact, to most software programs the features of the i486 are identical to those of the 386.

The i486 does sport some notable enhancements. For the most part, Intel has simply put some important support functions under one umbrella. An evaluation of performance quickly reveals, however, that the i486 is greater than the sum of its parts. Integration clearly has performance advantages.

Typically, 386-based systems include a discrete memory cache along with the Intel 82385 cache controller. The i486 has an on-board 8K-byte internal four-way set-associative cache and controller. Each memory address has a tag assigned to it. When the i486 requests data from memory, it compares the address to each tag simultaneously. If it finds a match (a cache hit), it fetches the data from the fast static RAM. On memory writes, the i486 cache updates both cache memory and main memory (write-through).

Integrated caching hasn't deterred vendors from adding their own external CPU cache designs. An external cache increases the hit rate, but as its size increases, the law of diminishing returns takes hold. A 64K-byte external cache should account for most cache hits. Larger caches only marginally enhance the speed of memory access. We found only small differences in CPU performance between a system with a 64K-byte cache and a similar model with a 256K-byte cache.

The i486 also incorporates a math coprocessor that's object-code compatible with the 80387. If you have many math-intensive applications, the i486 is enticing, since you won't have to buy a separate math chip. Remember, though, that your applications must recognize and enable floating-point functions.

Perhaps the biggest change the i486 has wrought lies in how the rest of the system unit has had to change with the times. These new systems typically include larger and faster hard disk drives, caching disk drive controllers, high-resolution video components, and high-performance EISA expansion buses. These i486-based systems require a complex mix of new components that far surpasses what most souped-up 386 systems offer. Clearly, this new breed is targeted for high-end applications.

the motherboard and another 64 MB on a proprietary 32-bit AMI memory board.

Misys includes the Ultra 22C EISA disk drive controller with a 512K-byte cache. The 340-MB Maxtor hard disk drive boasts an excellent 16-ms access time. The graphics subsystem includes a Super VGA monitor and a Definicon HiRes 1024 Super VGA adapter. The video board ships with with 1 MB of VRAM. The unit sells for $8960.

Relatively poor disk performance kept the Misys in the bottom tier in the application benchmark tests. This was mainly due to the relatively small disk cache. An upgrade to the cache should resolve any performance deficiency. We were impressed with the system's rugged construction. It gave us no major headaches and worked flawlessly right out of the box. Misys backs the system with a 3-year warranty—the longest in the group. And if you're worried about the stability of the vendor, the warranty is underwritten by an insurance company.

PC Craft 2304/33D

PC Craft designed its system around the same third-party motherboard included in the Acma 486/33, although it opted for a smaller, 64K-byte processor cache. Our test system carried a list price of $9082, which put it squarely in the middle of the price spectrum. Processing power was quite respectable, and the Ultra 22C caching ESDI EISA disk drive controller contributed to the system's average disk drive performance; unfortunately, we ran into several annoying flaws while working with the machine. In the end, these problems tempered our enthusiasm for this system.

The bulk of the problems were minor and had to do with poor configuration at the factory. Our system had 4 MB of RAM, but the motherboard was configured for 2 MB. The unit arrived with the disk drive cables completely disconnected from the controller card. Our 1-MB ATI VGA1024 video card came configured for 8-bit operation. (Setting it for 16-bit mode gave better performance and didn't cause any conflicts.) And PC Craft mounted the parallel port so close to the bottom of the system case that it was impossible to plug in a standard printer cable. Eventually we worked around all these problems, but tracking them down was an annoyance that should have been unnecessary. Users making such a major purchase expect to receive a system that is carefully constructed and properly configured.

More critically, the PC Craft system posted below-average benchmark scores. Slow video performance kept the 2304/33D at the bottom on our DOS application benchmarks. With video BIOS shadowing active, we detected no increase in speed on our BIOS-call-intensive video benchmarks. As it turned out, shadowing is always on. PC Craft disabled the setup toggle due to problems with the system's Award BIOS, which it says should be fixed in the next release.

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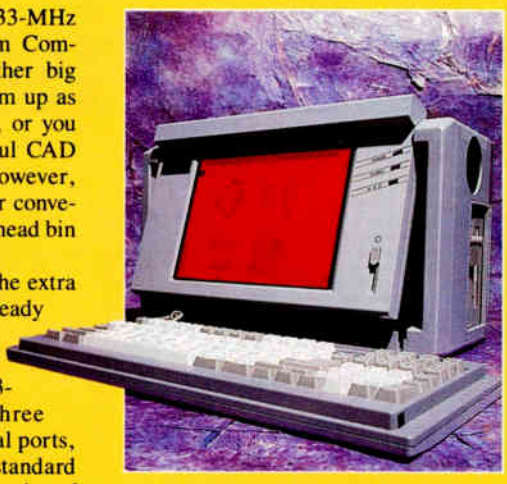
Bitwise 433E/VP Portable

You can do a lot with the 33-MHz 486 EISA systems from Compaq, ALR, and the other big names. You can set them up as network or workgroup servers, or you can configure them as powerful CAD workstations. You cannot, however, carry one over your shoulder or conveniently stash it away in the overhead bin on an airplane.

The Bitwise 433E/VP adds the extra feature of portability to the already impressive performance features of 486-based EISA systems. The 433E/VP packs a 33-MHz i486, six EISA slots, three half-height drive bays, two serial ports, and one parallel port into a standard "lunchbox" case that's about the size of a Compaq Portable III. At a hefty 22 pounds, this isn't the kind of machine you want to haul around on every trip. But for the processing power it contains, the 433E/VP's weight is more than reasonable.

Bitwise Designs is one of the first vendors to release a 486/33 EISA portable—the system competes with IBM's PS/2 Model P75 (see "The Fastest Portable: IBM's P75 Road Warrior," April BYTE). The 433E/VP is faster and cheaper than IBM's Micro Channel portable, but the PS/2 Model P75 is much more ruggedly designed.

Our test unit, which included a Mylex caching SCSI disk drive controller with 4 megabytes of RAM and a 200-MB hard disk drive, turned in DOS and Unix benchmark results worthy of any of the 486 desktops (see the figures). There is a performance penalty to pay for reduced size, however. The Bitwise portable is built around a baby version of the AIR motherboard found in several desktops, and it has no external processor cache. The result is weak performance on CPU benchmarks, relative to the other 486/33s.



Bitwise's luggable 433E/VP packs 486/33 EISA performance into a 22-pound package.

The case construction is good, but the two flimsy folding brackets that hold the orange gas-plasma display tend to stick if you aren't careful when folding and unfolding the screen. The display itself has good contrast and is quite readable. Since the system includes a Super VGA card, you can set up a high-resolution graphics system by jacking in an external analog monitor. We noticed, however, that this FCC Class A portable causes significant interference on some external monitors.

Our test system sells for $12,495, making it somewhat more costly than the bulk of the systems reviewed. But add a tape drive and a high-resolution monitor, and it's a notable alternative to most desktop models, although with slightly lower CPU performance.

The 433E/VP works best as a desktop machine that you can take with you on occasion. All peripherals plug into standard ports, so you can add an external keyboard and monitor, and there are enough slots to add a network adapter.

Software developers and CAD users who take work home or travel with their systems will also find the Bitwise system attractive. While the 433E/VP can handle network chores or be used to process large databases, portability presents a security problem you may not want to risk. But if you need a 486 EISA system and are willing to sacrifice a bit of processing power for portability, the 433E/VP is a good choice.

SAI 486/33

SAI Systems Laboratories' $7495 486/33 desktop system is one of a group of systems vying for bargain status. Our test unit included an AIR motherboard with a 256K-byte CPU cache, a SpeedStar VGA board with 1 MB of VRAM, and Data Technology's caching ESDI EISA bus-mastering disk drive controller with a 4-MB cache. By going with the Data Technology controller, SAI bucks the UltraStor ESDI disk drive controller trend set by other vendors. Data Technology's board performed well, but because it caches disk reads only, it didn't quite match the numbers posted by the Zeos, Tangent, and Tandon systems using Mylex controllers. If you require extremely high data reliability, however, Data Technology's no-write cache is arguably a safer design.

The 486/33 appears to be assembled well, and its overall performance is better than average. Its sole problem was an intermittent keyboard failure.

Tandon DT 486/33

The top spot on our application benchmark performance index belongs to Tandon's DT 486/33, which edged out other systems with large disk caches. Tandon's entry included a 64K-byte processor cache, a Mylex caching disk drive controller with a 4-MB cache, and a ProDesigner II VGA board with 1 MB of RAM for $9956. This price doesn't include a tape backup unit, as do the other systems we tested.

The Tandon motherboard has an Intelligent Drive Electronics interface but no RAM sockets; Tandon put system memory on a card that fits into a proprietary 32-bit slot. The case design makes for easy access to the internal components.

Tandon's enhanced BIOS and DOS include several useful utilities. For example, the BIOS lets you choose whether you want to boot from a disk or from the hard disk partition of your choice when the system starts up. If you intend to run more than one operating system, this is a

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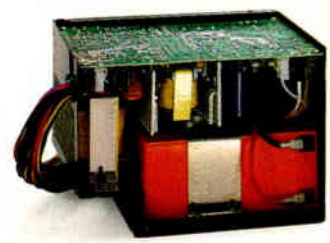

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handy feature. Tandon's DOS also includes disk-partition managing utilities that are better and more comprehensive than the usual FDISK.

Video performance was disappointing despite the inclusion of the ProDesigner II. The DT 486/33's video system fared poorly on text-mode applications, primarily because video BIOS shadowing had little effect.

Tangent 486/33

Tangent's system included a Mylex disk drive controller with a 4-MB cache. Its 128K-byte external processor cache and ProDesigner II VGA board with 512K bytes of RAM propelled it nearly to the top on most of our benchmarks. These top-of-the-line components come mounted on a Mylex EISA motherboard and in a generic tower case, for $8999.

The system had just a few minor problems. The floppy disk drive cables weren't connected when the system arrived, and the system experienced an unrecoverable disk error while it was running Unix. The disk error occurred only once. These problems aside, we found the unit fast and sturdy. Like some of the other midrange systems we've seen, the Tangent 486/33 offers a good mix of speed and consistency.

Touche 5550T

At $6117 for our standard test configuration, the Touche 5550T offers strong features at an attractive price. The system uses the Ultra 22C disk drive controller and the Maxtor XT-8380E ESDI hard disk drive with a fast 14.5-ms average seek time. The system also uses the ProDesigner II video adapter with 1 MB of VRAM. The Touche's 450-watt power supply was one of the largest we tested.

The system uses AMI's Enterprise motherboard with a 128K-byte processor cache. The internal layout doesn't seem well thought out, however. The drive bay housing partially blocks two of the seven EISA slots in the system, so they can't accept full-length boards. The case design also prevents you from placing a screwdriver squarely into the expansion slot screws.

Despite its relatively small (512K-byte) disk cache, the Touche performed well, posting consistent numbers across the board. At this price, the Touche deserves a close look.

Zeos 486-33C

Photo 3: *Zeos's desktop 486-33C blends high performance and excellent reliability.*

Most of the machines we tested offer either performance or reliability. Zeos's 486-33C desktop machine was one of the few that offered both. The system finished close to the top on both our DOS application and Unix tests, and it ran without a single snag for the several weeks that we used it (see photo 3).

Our test system used a Mylex motherboard with a 2-MB Mylex caching hard disk drive controller and a SpeedStar VGA board with 1 MB of VRAM. Like Touche, Zeos powers its system with a rugged 450-W power supply.

Zeos's price/performance ratio is good. The 486-33C's price of $9190 sits at the midpoint. Together with the reliability we've seen and the company's generally good reputation for support, the 486-33C looks like an excellent choice.

Thinking It Over

EISA technology has been around for well over a year, but EISA expansion-board manufacturers are still working out the kinks. EISA peripherals have yet to reach the point where you can confidently buy off the shelf and expect to assemble a system without difficulty.

The problems we experienced make us leery of buying one of these complex

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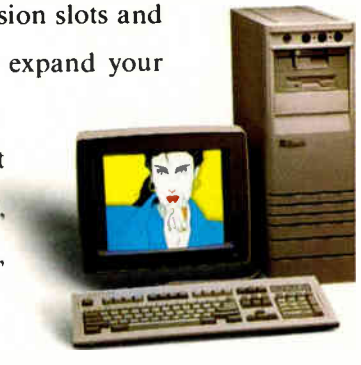

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machines from the ultralow-cost mail-order clone vendors. Unless the added performance is crucial and you're on a strict budget, consider paying a little more for added support and stability.

On the other hand, the conservative approach of the very high-end system vendors generally means that you'll be paying top dollar without reaping the performance advantages of EISA components. The ALR multiprocessing system offers extra power, but you'll want more than this bottom-line configuration to fully exploit the EISA bus and deliver the speed you expect.

A few systems between the two extremes blend reliability, good performance, and affordability. The three most outstanding were systems built by Zeos, Dell, and Acma.

Zeos's 486-33C scored very well on our benchmarks; its price is moderate, and the manufacturer has a good reputation for service.

Dell's 433TE, while not quite as fast, is reliable and ruggedly constructed. The company builds the 433TE from the ground up, giving it better control of the interaction between components than is the case with systems that are assembled from third-party subsystems.

Finally, Acma's 486/33 offers speed and reliability at an outstanding price.

Our best advice is simply to wait for the technology to develop further. Six months from now, reliable, full EISA 486s should be available. For now, however, buying into EISA means accepting the risks as well as the benefits of pioneering new technology. ■

Steve Apiki and Stanford Diehl are testing editors for the BYTE Lab. You can reach them on BIX as "apiki" and "sdiehl," respectively.

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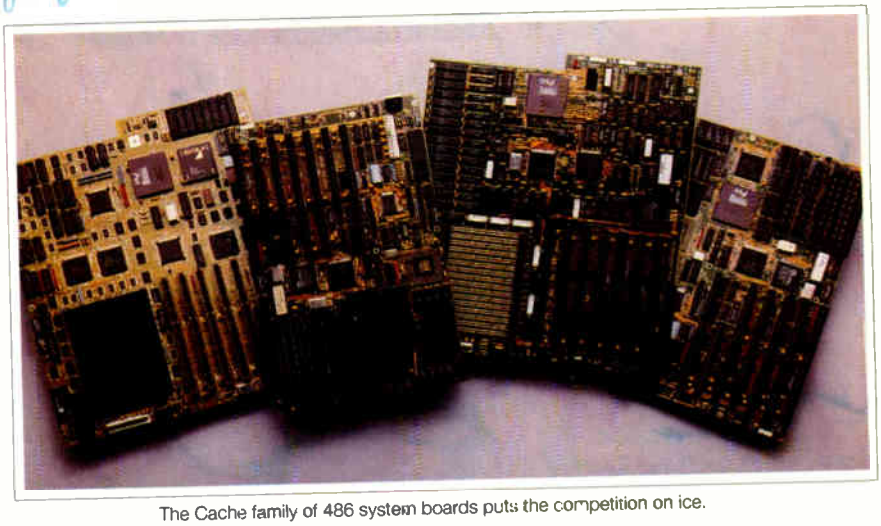

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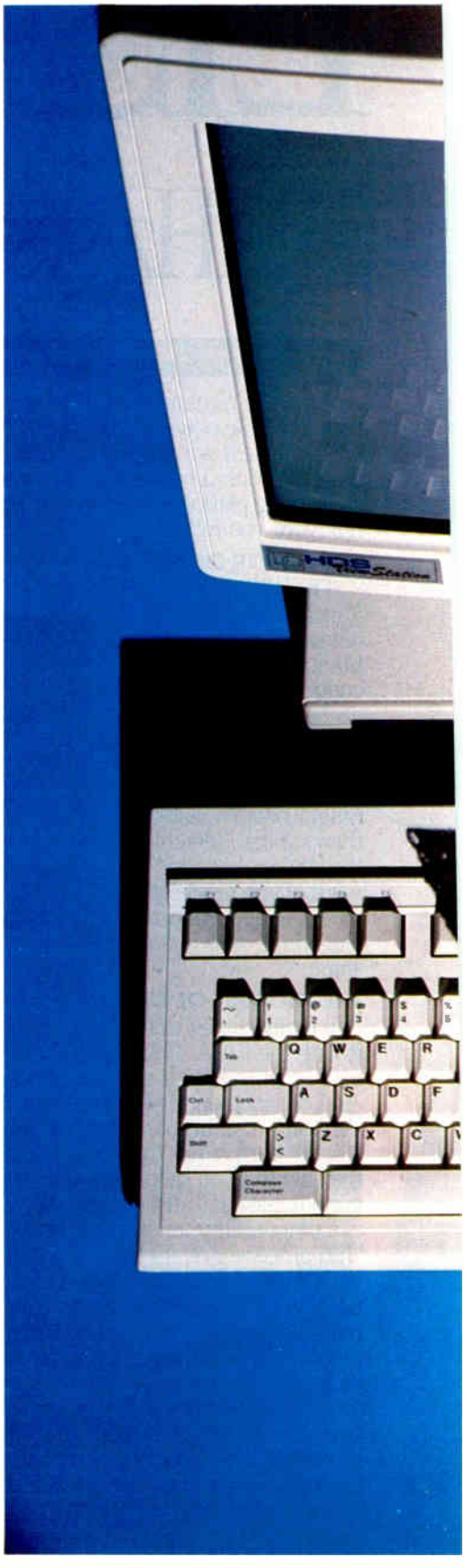

Even though workstation costs are coming down, they're still by no means cheap: A fully configured color workstation for less than $9000 is a rare find. But the power of Unix and the visual impact and ease of use of the X Window System may not be too expensive to put on every desk in the office—that is, if you consider using X terminals.

Even though they've been available for some time, there is still confusion about what an X terminal is and what it does. Simply stated, X terminals are to graphics workstations what serial "dumb" terminals are to text-based multiuser systems. Both allow you to run applications without having to sit in front of the host system. But while a serial terminal's internal software is mostly limited to displaying text (at a particular position and with certain attributes), an X terminal runs MIT's X Window System graphical windowing software.

Thus, instead of merely displaying one text application that occupies the entire screen, an X terminal can display several applications, textual and graphical, simultaneously. What's more, each application can be running on a different host; and since the connection is via 10-megabit-per-second Ethernet, display performance is often fast enough to rival (or beat) the workstation's original display.

The thing that distinguishes an X terminal from a diskless workstation is that the applications load and run on a remote host. Display output, along with mouse and keyboard input requests, is routed through the network from the host to the terminal. X Window software can't tell the difference.

In theory, any X Window software that your workstation can run will operate identically at an X terminal. And, with few exceptions, that's just how it works. The exceptions come when applications developers depart from the standard for reasons of their own, or when the underlying software itself is flawed. Any "properly behaved" X application, written using quality X Window libraries, operates every bit as well on an X terminal as on the host's display.

The Common Threads

Up to a point, every X terminal I looked at was much like the others. They all run the same software—MIT's X Window System 11 release 4 (X11.4)—and provide a similar range of services to users. The X Window standard is broad and specific, leaving (thankfully) little room for the kind of innovation that breaks things. What differentiates X terminals from one another are issues not related to their basic capabilities, so I focused my testing on application and host compatibility, configuration interface, ease of connection, and performance.

It might surprise you that performance was the *last* thing that I concerned myself with when evaluating these terminals. Great, deep political debates are raging over whether X Window performance can reliably be gauged at all, but my reason for not worrying about it is much simpler: Once a terminal goes past the "fast enough" mark, it matters little if one scrolls text 10 percent faster than another. The point is to obtain a cost-effective terminal that hooks up easily and runs everything it's asked to run.

This review was not intended to include every X terminal ever made. I selected five high-resolution color units that are representative of what you'll find on the market. The units were supplied

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BYTE ACTION SUMMARY

- **X TERMINALS**
- **WHAT YOU'LL LIKE**
  These X terminals provide an excellent way to put graphics power on every desk while keeping costs down.
- **WHAT YOU'LL DISLIKE**
  Some terminals' setup and host connection software made the task more difficult than it needed to be. Some X applications still make unreasonable assumptions about hardware and servers, affecting the ability of certain terminals to run a small class of applications.
- **WHAT WE RECOMMEND**
  For overall value, the HDS ViewStation for $5199 provides a large viewing area, high resolution, and excellent software on tape. Its standard 2-MB memory may cramp a demanding user, but it is expandable. For a smaller terminal, the 17-inch NCR X-Station had a slight edge over the NCD NCD17c in cost-effectiveness and quality software.
- **WHAT YOU'LL PAY**
  HDS ViewStation: $5199
  NCD NCD17c: $5050
  NCR X-Station: $4800
  Tektronix XP29: $7495
  Visual Technology XDS: $7555

by Human Designed Systems (HDS), Network Computing Devices (NCD), NCR, Tektronix, and Visual Technology. All provide a minimum display of 1024 by 768 pixels in 256 colors on a 17-inch or larger screen.

I connected the terminals to BYTE's Unix Lab network via thin-wire Ethernet cable. I ran X applications from the following hosts: a Sun IPC running Open Windows 2.0, an Altos System 5000 running Altos Unix (with The Santa Cruz Operation's Open Desktop), a Multimicro 386/33 running Interactive Unix 2.2 and X Window 1.2, an IBM RISC System 6000 running AIX, and an Arche 486/33 running Intel System V release 4.

The suite of applications that I ran included FrameMaker 2.1x, IslandWrite, IslandPaint, and IslandDraw 2.3 for Open Look, Uniplex Windows, Looking

Glass, X.desktop, Motif and Open Look window managers (and the Open Look file manager), and a small group of public domain custom programs. I also used the standard X Window assortment of terminal emulator, clock, calculator, and other programs.

They've Got Connections

You might think, with all this rampant connectivity, that an X terminal would be a plug-and-play device. Well, not quite. I'd hardly call it an ordeal, but configuring an X terminal for your environment is anything but automatic.

The terminals came with X11.4, configuration utilities, and `telnet` network terminal emulation programs in ROM. Generally, all that was needed to make the first connection was to load the terminal's TCP/IP address into configuration RAM, reboot, and use `telnet` to connect to the host to run the `xterm` terminal program. Each X terminal comes with a tiny selection of X Window fonts in memory, just enough to get basic applications (e.g., terminal emulator windows) running. To do any real work, you must create a way for the terminal to access the 200-plus fonts that come standard with X11.4.

On a workstation, an X server can load fonts off the hard disk as needed. Lacking local disks, X terminals fetch fonts in a rather clever way. A cartridge tape is provided that contains font bit maps. You load the tape onto a workstation's hard disk and then configure the terminal with the network address and directory name in which the fonts are stored. Because some applications (e.g., Looking Glass) require special fonts, some tapes also include tools for converting fonts from their original format to one the X terminal can use.

Configured fonts are downloaded into the X terminal's RAM from the font host as needed. In addition to fonts, color tables, ASCII configuration files, and even server binary images can be stored on and loaded from remote hosts. The server image download capability is a nice touch; some of these terminals' server software can be upgraded with a tape rather than firmware.

All the tested terminals include some form of point-and-click configuration utility; some are graphical, while others are mostly text based. How they work is covered in the individual discussions that follow. The monitors, keyboards, and mice are not discussed below because all but the Visual Technology X Display Station's monitor, which had an adjustment problem, were of excellent quality.

HDS ViewStation

The HDS ViewStation came with a 19-inch color display, 2 megabytes of memory, and a 1280- by 1024-pixel resolution. Like most of the other terminals, it is a "monitor base" style, a slim case on which the monitor can stand. This takes up the least desk space and places the power switches and indicator lights within easy reach.

HDS's configuration program has a plain, even primitive, interface; it is really a text application with mouse sensitivity. It has its good points, like the informative header displays showing the terminal's Ethernet address, but it has some drawbacks, too. The most serious problem with the configuration manager is its tendency to have immovable pop-up windows that obscure important information in underlying windows. It's possible to get so deep in pop-up windows that you lose track of what you're modifying. Descriptive window titles would avoid confusion.

The HDS ViewStation mostly breezed through the tests.

When you make a change to the configuration, a set of prompts appears at the bottom of the main window telling you what steps you need to take to commit those changes. "Apply Changes" or "Save Settings in NVRAM" (nonvolatile RAM) will light up, depending on the changes you make, and these instructions are a little bit ambiguous. "Apply Changes" should really read "Apply Changes to Current Session Only."

The HDS ViewStation mostly breezed through the tests, performing well with the mix of Open Look and Motif applications. This is partly thanks to the excellent assortment of fonts and conversion utilities provided by the company. HDS's was the only tape that included a program to convert fonts from one binary type to another. I used this program while testing the other terminals to get programs such as Looking Glass to work; Looking Glass provided its fonts only in a binary form compatible with Interactive's X Window System.

The ViewStation did, however, exhibit compatibility problems with IslandWrite and X.desktop 2.0. In the first case, fonts were jumbled beyond recognition. This isn't necessarily the ViewStation's fault; IslandWrite uses Sun's scalable font mechanism, which may make assumptions about byte order when font bit maps are uploaded to the X server. And X.desktop's large, imaginative cursor bit maps would only display in part (the upper-left part, to be exact). This problem has reportedly been fixed; existing HDS customers can download a new server image from HDS's BBS.

The configuration manager, along with the `telnet` terminal emulator, benefits from being an X application. When you connect to your primary host and fire up a window manager, the configuration manager is *re-parented*: Its window takes on the same border and window manager characteristics that any host-run application would. Thus, the configuration manager and terminal emulator are always an icon click away, even after the first X session is started.

The ViewStation's best attribute is the tape of software included with it. I had no trouble getting fussy applications like Looking Glass to run. The ViewStation fared only a little worse than the other terminals in performance and compatibility. Large windows could be seen redrawing from top to bottom after being moved, and text scrolled visibly more slowly than with other terminals. Still, performance was well within reasonable boundaries, and the minor speed difference had little or no impact on the tested applications.

NCD NCD17c

NCD provided its NCD17c terminal with a 17-inch display (1024 by 768 pixels in 256 colors), 4 MB of memory, and both PROM-based and downloadable servers.

NCD's configuration manager has a much better interface than HDS's, but neither it nor the `telnet` terminal emulation program is an X application. They both take over the terminal to the exclusion of X applications. A display request from a host is held up until the configuration manager and `telnet` programs are exited. The latest version of NCD's downloadable server software does offer a "local client" implementation of `telnet` for terminals with sufficient memory, but you still have to hang up X Window to run the configuration program.

The optional ROM in the NCD17c contained a default version of the X11.4

server, *without* the local client support. To access the local clients (which include serial communications and DEC network terminal server access; a Motif-look-alike window manager was also provided in prerelease form as a local client), you need to load a binary image from the optional tape onto a selected Unix host. That host must be equipped with the programs `bootpd` and `tftpd`. NCD supplies the source code for these programs on the tape—a boon, since the chosen server was a Sun IPC that lacked these two utilities. Once equipped, the X server executable is loaded into the terminal from the network host instead of from ROM.

Incidentally, all five terminals required that at least `tftpd` be present and running on the host. Even if you don't use it to download the X server software to the terminal, you need it to support later font downloads. Most terminals also support Network File System connections for fonts, but `tftp` was easier to manage and incurred less overhead.

Compared to the HDS ViewStation, the NCD17c was fast. This was partly due to the lower resolution, but the difference in speed was very noticeable. Moved windows snapped instantly into their new positions, and scrolling text and graphics, such as Looking Glass's scrolling icons in the file view window, were appreciably faster. Something like this won't necessarily make you more productive, but it does seem to make the environment a little easier to live with.

Overall, the NCD17c performed well, running every application without complaint and responding quickly to host requests.

NCR X-Station

The NCR X-Station was configured with a 17-inch, 1024- by 768-pixel, 256-color display. The unit had 6 MB of memory and an X Window server in PROM. The font tape installed easily, but I was displeased that it clobbered the crucial color table file during installation. The NCR unit had a monitor-base case style, but it had a problem: the push-button power switch, once pushed, couldn't be popped out again.

The X-Station had, by far, the best setup software. The graphical interface was clear and responsive, and it was tuned to reducing unnecessary keystrokes and mouse movements. For example, once configured, the X-Station could connect to selected hosts through a simple icon click (the icons were named for the hosts). The host-resident configuration file can specify a different connect command for each host. This was the easiest connection mechanism offered by any of the terminals' software.

I also liked the X-Station's ability to have a large virtual screen. Even though its resolution is 1024 by 768 pixels, the configuration file lets you fix the terminal to "pretend" it has a 1024- by 1024-pixel screen. The display scrolls rapidly when the mouse is advanced off the top or bottom of the screen.

The setup software is done in multiple, modeless windows (all windows are active at once; positioning the mouse determines which one is "listening"). They are true X applications and are always available, even during an active session. Oddly, the setup windows were reparentable by the Motif window manager, but not by Open Look's. The latter was not incompatible; it just didn't seem to notice the setup windows.

Running Open Look did bring out a rather unusual flaw in NCR's implementation. Open Look uses hot dog–shaped

outlines to highlight menu selections. The X-Station drew these shapes painfully slowly—slowly enough to have a serious impact on application usage. I ran other tests that drew ellipses and circles, and the X-Station kept up well. Open Look menus turned out to be the only performance problem.

Like the ViewStation, the X-Station couldn't run properly with IslandWrite. The symptoms were identical—apparently, another byte-ordering mismatch. The X-Station passed all other application tests and turned in a solid performance.

Tektronix XP29

Tektronix provided an XP29 terminal with a 19-inch display (1280 by 1024 pixels in 256 colors). The memory was strangely split between graphics and I/O memory: An extra 4 MB of graphics memory was installed, but 3.5 MB was used for I/O memory.

The Tektronix unit was the only one that needed to have its case opened. The XP29's logic is housed in a small tower case. This arrangement takes up unnecessary desk space, and the construction of the case feels shabby. The unit didn't operate when it arrived—the cards had shaken loose. Removing the top of the case revealed that the cards were not—and can't be—fastened to their connectors. The case top has a few niches that keep the cards straight, but I found the boards scattered inside the case when the unit arrived.

The logic unit was not matched to the monitor it was sent with. When I reassembled and booted it, the display spun around in a syncless frenzy. It was explained to me that I needed to wait until some swimming dots appeared that "looked something like a prompt" and that I then type `monset` followed by a monitor setting number. The manual lists three different 1280- by 1024-pixel monitor settings. I found the right number after a couple of tries, but I came away feeling that the whole ordeal was a waste of time.

The XP29 has an attractive and quite usable configuration interface. Again, the internal setup and `telnet` programs turned out to be X applications. I was also impressed with the quality of the host tape installation program. After you load a short portion of the tape by hand (the manual provides the commands for several types of workstations), a friendly installation script takes over, loading the rest of the tape and configuring the workstation to support the terminal. Following installation, I got the XP29 connected quickly.

Once over all the initial hurdles, the XP29 held its own. I encountered no compatibility problems in the application tests. I'm not sure how much the extra memory helped, but the XP29's performance was superb. The only compatibility problem I encountered was with the Open Look fonts that Tektronix provided. They seem to differ from the style of the standard Open Look fonts. I could have lived with that, but some common fonts were so much larger than their standard counterparts that applications grew too large for their default windows.

Visual Technology XDS

Visual Technology rounded out this monitor group with its 21-inch, 1280- by 1024-pixel, 256-color X Display Station (XDS). It came configured with 6 MB of memory and a PROM-resident server.

The XDS's setup software was the most primitive of all those that I tested, presenting the user with a text-based

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interface that understood mouse-clicks but didn't display a cursor to highlight the current position. The configuration and `telnet` sessions were like those of the NCD17c: X clients were not allowed to connect until setup and `telnet` were dismissed. The XDS did have the only `telnet` program to provide emulation of an `xterm` terminal emulator window. The `telnet` window can be suspended with Alt-SYSRQ; this resumes the operation of the X server.

The terminal performed well, passing all the applications tests, with one glitch: When I ran the Open Look window manager, certain cursor shapes appeared scrambled. Under Motif, the Motif cursor shapes (which appear when resizing windows and so on) looked fine, but the root window's cursor was scrambled.

The XDS was the only terminal I reviewed that came with an optical mouse. The supplied mouse pad was flexible, however, and I didn't have any objection to using Visual Technology's pad instead of one of my own.

The 21-inch display was badly in need of adjustment, displaying annoying ghosts around the edges of black characters against a white background. The display didn't seem to have any external adjustments to compensate for this.

Which Brand X Terminal?

It's difficult to choose an overall winner from this group. With rare exceptions, the terminals all did what I asked of them. I was a little put off by IslandWrite's failure on the HDS ViewStation and the NCR X-Station, but that is only one application. These terminals also exhibited minor performance problems that I didn't see in the others. But at $5199 (with a 19-inch display and 2 MB of memory), the HDS ViewStation turned out to be the best value among the 1280- by 1024-pixel terminals I tested, and an excellent value in general. It has the most complete host font/server tape, and it's more than $2000 less than the Tektronix and Visual Technology units. The ViewStation had less memory than these other terminals, but the difference in cost was far more than the price of memory.

The Visual Technology XDS delivered fair value for the money at $7555 for 6 MB of memory and a 21-inch monitor. The loser in the large-screen, high-resolution category would have to be the Tektronix XP29. The quality of construction was unimpressive, and the blind monitor configuration struck me as something that the factory should suffer through, not the user. Its $7495 price tag seemed high, although it did include expanded graphics and user memory.

For the 1024- by 768-pixel terminals, I liked both the NCD NCD17c and the NCR X-Station about equally, but I have to give the nod to NCR for its aggressive pricing, great setup/configuration/`telnet` software, and 1024- by 1024-pixel logical screen size. The NCD17c was blazingly fast, and at $5050 with 4 MB of memory, it's still a good buy. Nevertheless, I judged the NCR X-Station to be the better of the two smaller terminals in terms of cost and features. At around $5000, neither of these terminals should have any trouble competing against diskless workstations and PCs. ■

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COMPANY INFORMATION

Human Designed Systems, Inc.
(ViewStation)
421 Feheley Dr.
King of Prussia, PA 19406
(215) 277-8300
fax: (215) 275-5739
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NCR Corp.
(X-Station)
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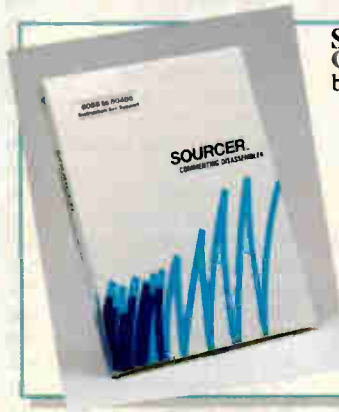

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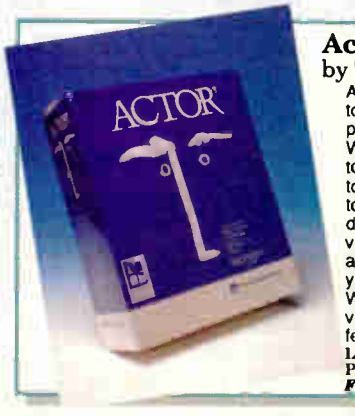

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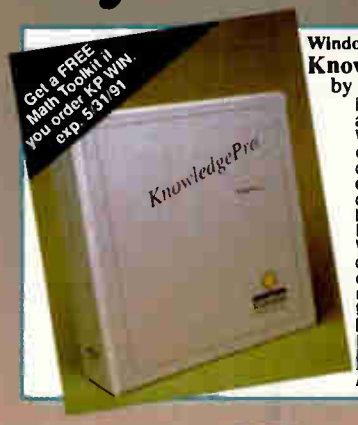

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HARDWARE

"Smart" UPSes Alert LANs to Power Problems

RICK GREHAN

The Smart-UPS 900, IPS/A.I. 800, and UniPower PS8.0 (clockwise, from left) monitor and display power conditions for network managers in addition to providing traditional UPS protection.

Uninterruptible power supplies (UPSes) are heavy metallic boxes that sit under your desk, hum distantly, and remain forgotten unless utility power goes off suddenly. Right? Not anymore.

A new generation of network-based UPSes can continually apprise you of such important conditions as battery level, current input load, power quality, and impending malfunctions. So rather than a box that passively sits around waiting for power problems, your UPS becomes an active device that can help you head off potential damage.

To test that, I selected three UPSes that, to varying degrees, provide this kind of intelligence: American Power Conversion's (APC) Smart-UPS 900 (900 volt-amperes), Elgar's IPS/A.I. 800 (800 VA), and Tripp Lite/Unison's UniPower PS8.0 (800 VA). I chose 800- and 900-VA sizes because they are appropriate for a network the size of the BYTE Lab's. The Minuteman series of UPSes from Para Systems also offers intelligent network features.

Common attributes of these units include software that can inform network users about a power failure and instruct them to log off. Also, the software can automatically shut down the network server after a designated log-off period. Each unit accommodates a variety of network operating systems. For evaluation, I chose the NetWare 386 configuration.

Smart-UPS 900

APC's PowerDoctor software lets you monitor the Smart-UPS 900 in real time. As screen 1 shows, PowerDoctor displays bar graphs that indicate the current battery voltage, line voltage, and UPS load. Other statistics include line frequency, the internal temperature of the UPS, and whether the UPS is supplying utility power or running off the internal battery.

PowerDoctor consists of two modules: a foreground monitoring program and a background logging program. The background logging program runs as a TSR program: You can program it to regularly sample the status of the Smart-UPS and record the results in a log file. You can easily move log-file results into spreadsheet programs, such as Lotus 1-2-3 or Microsoft Excel.

APC's PowerChute software runs on the network server and brings PowerDoctor's logging and display capabilities to the network operating system. It monitors the status of the Smart-UPS and signals workstations of a shutdown. Network managers select the shutdown time; when shutdown time expires, PowerChute gives one last warning to network users and "downs" the network.

The front plate of the Smart-UPS 900 has plenty of LEDs to provide status information. This includes two vertical-bar-graph LEDs and a load-indicator bar graph that displays the current load as a percentage of the UPS's capacity. The bar graphs provide a range of data, including battery charge and utility-power voltage levels (in steps of 6 volts starting at 98 V). Another LED tells you if the system is connected to acceptable utility power, and an "on battery" light shows when the Smart-UPS is running on battery power. (With the "replace battery" light, the Smart-UPS tells you when its battery can no longer hold a charge. Normally, this will occur once every two to three years, according to the company.)

When the Smart-UPS detects that utility voltage has fallen to brownout levels of between 90 V and 103 V, it can raise incoming power by up to 12 percent with SmartBoost, an internal step-up transformer. If the Smart-UPS 900 senses a brownout, it first switches to the battery and then monitors the line for 4 seconds to ensure that voltage levels aren't worsening. If the line is stable, the UPS enables the SmartBoost feature and takes the battery off-line so extended brownouts don't consume battery power.

In the unit's back is a nine-pin female connector, which is the computer interface port. In standard mode, the port's pins send and respond to simple voltage transitions. In "smart mode," the port acts as a true RS-232 port (which is how I tested it). Adjacent to the serial connector is a set of four DIP switches that let you set internal parameters. For example, you can move the top of the acceptable voltage range higher and desensitize the system to battery switchover in case your line voltage makes frequent excursions into the "marginally safe" zone, which would ordinarily trigger the unit.

UniPower PS8.0

Unlike the other UPS systems in this review, the UniPower is not meant to sit on the floor, hidden under a desk. Its small footprint makes it ideal for placement

Screen 1: *PowerDoctor software, available with the Smart-UPS 900, displays bar graphs that indicate the current battery voltage, line voltage, and UPS load.*

between the CPU case and the monitor. This means you won't have to get down on your hands and knees to access it. Also, the unit's designers recessed a light in the front panel, so if power goes out, this backup light can illuminate your keyboard while you type in a shutdown sequence.

The UniPower also provides a "remote-on" feature using two RJ-11C telephone jacks that let you connect the UPS to a telephone and a modem. You flip a toggle switch to enable the remote-on feature. Whenever the UniPower detects the ring signal of an incoming phone call, it turns on automatically, thus applying power to your computer system. Your AUTOEXEC.BAT file launches any application that you want to run remotely. When you've finished and you disconnect, the UniPower waits 2 minutes for your applications software to terminate and then shuts itself off and waits for the next ring. (APC's documentation describes a similar remote-on accessory for the Smart-UPS 900, but I didn't receive this accessory in time for testing.)

The UniPower's front panel looks absolutely Spartan compared to the other units. An AC status light and audible alarm signal power conditions with various colors and flashing lights. The alarm sings in pulses of various durations depending on the problem, so you can tell what's happening to your UPS even if you can't see the front-panel lights. The other front-panel LED indicates battery charge levels.

Tripp Lite/Unison sells Ocean Isle's Network Monitor to run with the UniPower. This software runs as a NetWare loadable module (NLM) under Novell's NetWare 386 (there is also a value-added-process version of Network Monitor for NetWare 286). It keeps an eye on the serial-port signals running from the UniPower, and, in case of a power failure, it signals workstations of the upcoming shutdown. After a supervisor-selectable delay to allow users to log off, Network Monitor sends a last broadcast

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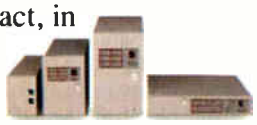

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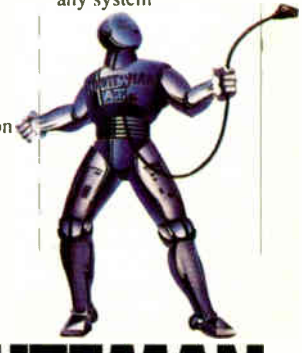

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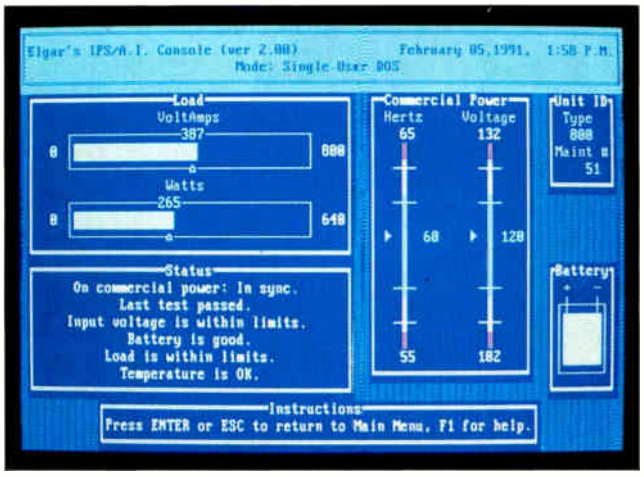

Screen 2: *LanSafe A.I.+ control software for Elgar's IPS/A.I. shows instantaneous values for incoming voltage and line frequency, outgoing power and equivalent volt-amperes, battery level, and other parameters.*

BYTE ACTION SUMMARY

- **LAN-BASED UPSES**
- **WHAT THEY DO**
  Combined with "smart" software, they inform network users about a power failure, broadcast log-off messages, and automatically shut down the network server. By continually monitoring battery levels and power quality, they can help you head off potential damage caused by faulty power conditions.
- **WHAT WE RECOMMEND**
  Our highest marks go to the Smart-UPS 900 because of its long holdup time, its power-monitoring software, and the SmartBoost feature, which helps the UPS survive extended brownouts.
- **WHAT YOU'LL PAY**
  Smart-UPS 900: $999; PowerChute software (available for Novell's NetWare 286 and 386, IBM LAN Server, SCO Xenix 286 and 386, SCO Unix System V/386, AT&T Unix, Interactive Unix, LAN Manager, 3+Open, and AppleShare): $99; PowerDoctor software: $99
  IPS/A.I. 800: $899; LanSafe A.I. 386+ software for Novell NetWare 386 (as tested): $135; LanSafe A.I. 286+ for NetWare 286: $99
  UniPower PS8.0: $999; NetWork Monitor for Novell NetWare 286 and 386: $99.95

message of impending shutdown. About a minute later, it downs the server.

IPS/A.I. 800

Elgar's IPS/A.I. 800 uses LanSafe A.I. control software to view the status of the UPS and provide a software control panel to adjust internal parameters and run system tests. With the optional software, the unit continuously updates status display (see screen 2) to show instantaneous values for incoming voltage and line frequency, outgoing power and equivalent volt-amperes, battery level, and other parameters. If you have a significant number of power problems that you'd like documented, you can program the software (a portion of which runs as a TSR) to periodically write line-status information to a log file. Since part of the software runs as a TSR, even when you're in another application a pop-up window can alert you to a problem.

LanSafe A.I.+ is a network version of the IPS/A.I.'s control software. I tested it under NetWare 386. To run LanSafe, you create a user named LanSafe with supervisor and console rights. You then install an NLM that's loaded when the server boots up. Once it's installed, the NLM acts like a user and will respond to English-language messages. The lexicon is limited but more than sufficient for this purpose. For example, if you enter

Send "What is the power status" to LanSafe

you'll get a quick response of

"Commercial power and batteries are OK."

Under normal circumstances, this command interface is active for only 10 minutes after the network boots up. After that, you have to send a "Set User Command Interface On" message to LanSafe. When you're done talking to this artificial user, you send a "Set User Command Interface Off" message. This keeps LanSafe from responding sporadically to broadcast messages.

Other network workstations with an attached IPS/A.I. UPS and running LanSafe become "power nodes." That is, you can execute LanSafe's console program and view the status screen of another user's UPS. (The screen is identical to the single-user version of IPS/A.I. software.) You can even issue self-tests across the network so a network administrator can monitor the entire network without leaving his or her office.

As with the other network packages tested, LanSafe continuously monitors the condition of the UPS. If a power outage occurs, LanSafe warns all network users of the condition. After a sufficient delay, LanSafe downs the network.

The front panel of the UPS contains five LEDs that illuminate various colors and flash sequences. This variety is not simply meant to impress. A single glance at the LEDs tells you about the condition of a host of line conditions. The trick, of course, is to remember the language of the LEDs: I found it necessary to keep the IPS/A.I.'s 15-page manual handy for that reason.

The UPS uses a 15-pin female connector for communication with a host system. The function of this connector can be set by DIP switches to either standard or smart mode.

Holdup Times

My evaluation focused on the software that ships with each of these units. But power reliability remains the most important job of a UPS. To test this, I recorded holdup times—the period between the interruption of utility power and when the UPS shuts off its outputs. I charged each UPS overnight and connected them one at a time to a load workstation. I installed a variable transformer between the UPS and the utility power and ran the input voltage down to 0.

Shutdown time varies depending on the size of the load. My load workstation was a 10-MHz AT clone with a 5¼-inch floppy disk drive, a hard disk drive, a Western Digital network adapter, and a VGA card connected to a Tatung monitor. This amounted to a power draw of about 120 watts (the VA rating was about 240).

Based on these tests, the Smart-UPS 900 performed the best, with a holdup

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time of 62 minutes, followed by the IPS/A.I. 800 at 40 minutes and the UniPower PS8.0 at 31 minutes.

Close Contest

Compared to the other two units, the UniPower PS8.0 suffers from fewer AC outlets: four, as opposed to six on the others. This could be remedied with a bus strip, but that might tempt users to overextend the capacity of the UPS. The UniPower is also the least intelligent of the three. Given that the UniPower is in the same price class as the others, I don't recommend it unless you need its remote-on feature.

The race between the Smart-UPS 900 and the IPS/A.I. 800 is almost a dead heat. Although the Smart-UPS performed noticeably better than the IPS in the holdup tests, both manufacturers say the UPSes can sustain equivalent battery loads for approximately the same amount of time. Ultimately, I would choose the Smart-UPS based on its SmartBoost feature. Given the vagaries of utility power in many parts of the country, this feature could help the Smart-UPS survive extended brownouts that would send the IPS/A.I. onto battery power. ■

Rick Grehan is the technical director of the BYTE Lab. You can reach him on BIX as "rick_g."

COMPANY INFORMATION

American Power Conversion
(Smart-UPS 900)
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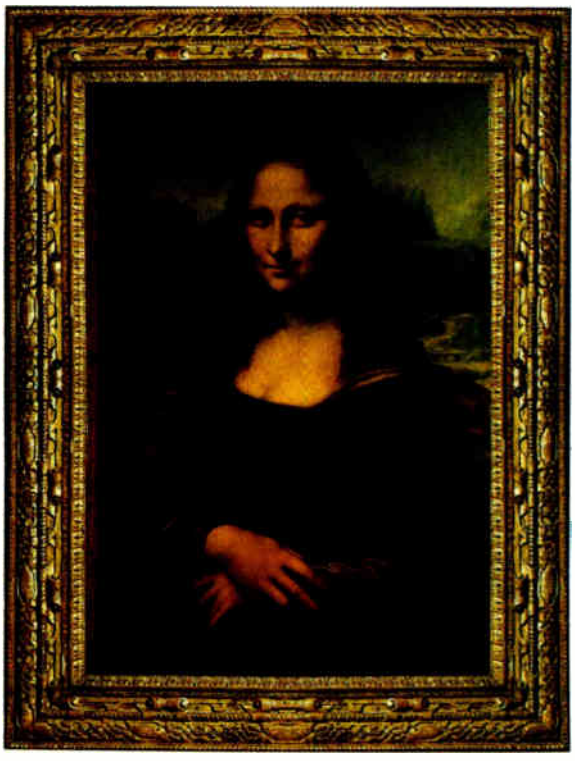

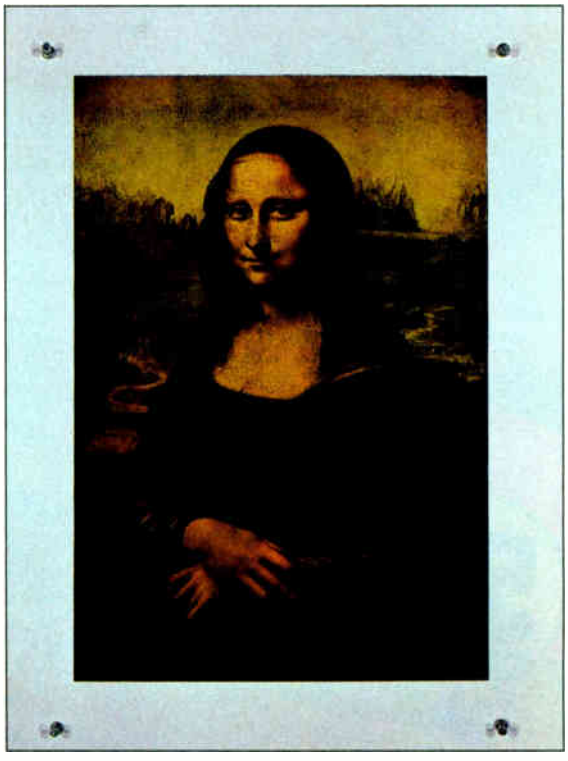

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BRETT GLASS

Many PC users rely on an expanded-memory manager (EMM) to deal with DOS's 640K-byte memory barrier, but users who run Windows in enhanced mode on 386-based systems have a particularly strong incentive. The TSR programs and device drivers that they load into the lower 640K bytes of DOS memory reduce the amount of space available in *every* DOS window.

EMMs help by loading device drivers, network shells, TSRs, and parts of DOS into the high memory area between 640K bytes and 1 megabyte—freeing between 64K and 128K bytes of conventional RAM. They also support the Extended Memory Specification (XMS), the Expanded Memory Specification (EMS), and the Virtual Control Program Interface (VCPI). Two other features—the ability to backfill conventional RAM if your system has less than 640K bytes, and to sort memory by speed—won't work if you're running Windows in enhanced mode.

The combination of Windows and a third-party EMM is by no means bulletproof. I tested two industry leaders—QEMM-386 and 386Max—to see just how well these products work in general, and in the Windows environment in particular. I also installed BlueMax, the Qualitas version of 386Max with special features for IBM's PS/2 computers. All the products support Microsoft's VxD driver standard, which allows EMMs to launch Windows in enhanced mode.

I tested Quarterdeck's QEMM-386 5.12 and Qualitas' 386Max 5.1 and BlueMax 5.1 for PS/2s. For each product, I compared features and compatibility with Windows 3.00a. I also compared how much high RAM each made available for loading programs above conventional memory (see the table).

My test-bed included an Everex Step 386/33 system with 4 MB of RAM, and a Northgate Elegance 386/33 system running MS-DOS 3.3 with 1 MB of fast 32-bit RAM on the motherboard and a 3-MB AST RAMvantage memory card in the backplane. I also tested BlueMax and QEMM-386 on an IBM Micro Channel PS/2 Model 55 SX running PC-DOS 4.0, with 2 MB of RAM.

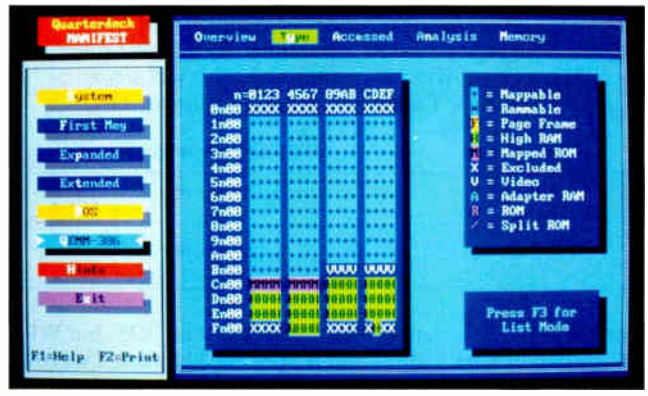

Photo 1: *Manifest graphically illustrates how your system uses memory and lets you tune QEMM for maximum efficiency. This screen shows how my test system has allocated the lower 1 MB of system memory.*

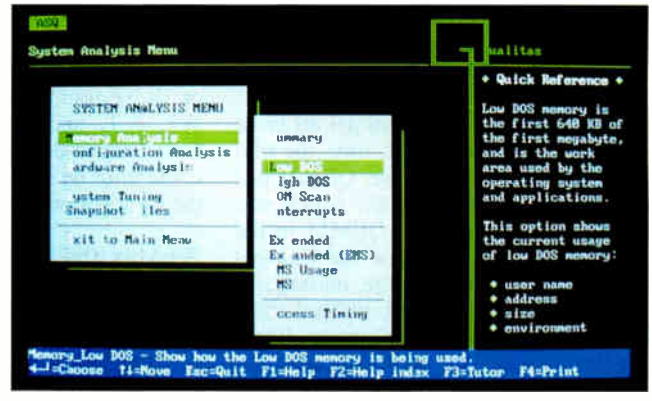

Photo 2: *Qualitas's ASQ, a companion utility for 386Max, includes an excellent on-line tutorial on memory management. Like Manifest, it displays system information graphically, but it doesn't offer as much detail.*

All systems included a color VGA monitor. I installed a Microsoft Serial Mouse and Windows 3.00a on all machines. I ran CHKDSK from the main DOS prompt and from within Windows, running in both standard and enhanced mode, to determine available memory. I also ran several DOS and Windows applications to test system stability.

QEMM-386

Version 5.12 of QEMM-386 has several improvements over earlier versions, including a better VxD driver, support for standard mode and foreign-language versions of Windows, and the ability to use the "Close Window" command on a VCPI application running in a DOS window. Also included is VIDRAM, a utility that lets you use EGA and VGA high memory space to increase DOS memory by up to 96K bytes when running text-mode programs. Finally, Quarterdeck bundles Manifest, a system analyzer (see photo 1).

Both QEMM and 386Max write to the distribution disk during installation. Both can damage your disks by doing so, but QEMM is more likely to because it writes to a low-density disk from what is most likely a high-density drive. Install from a copy to be safe.

The installation program then showed a summary of the default options and asked me if I wanted to change them. I did and entered a series of dialogues that gave me a chance to make the changes. Alas, the options shown on the summary screen don't quite match the ones that you see if you decide to change them later. For instance, the option "Fill all high memory with RAM?" later becomes "Do you want to load resident pro-

AVAILABLE HIGH RAM UNDER 386MAX AND QEMM-386

A 386 memory manager makes more high memory available so you can move more device drivers and TSR programs above the 640K-byte space. I ran each program's optimizer to see how much high RAM it made available on the Northgate and IBM PS/2 Model 55 SX test machines. 386Max freed less high memory initially because it excluded part of the monochrome display area. When I forced 386Max to include this area, the number increased to 112K bytes, but about 64K bytes of memory was lost in each DOS window. BlueMax excelled on the PS/2 due to its BIOS compression capability. Note that I allocated a 64K-byte EMS page frame during testing. If you don't run programs that require EMS outside of Windows, all three EMMs will yield another 64K bytes of space for loading TSRs high. (N/A = not applicable.)

	Northgate	IBM PS/2 Model 55 SX
QEMM-386	112K bytes	96K bytes
386Max	88K bytes	N/A
BlueMax	N/A	152K bytes

grams above the video memory?"

The remainder of the installation went smoothly. I ran QEMM's Optimize utility, which configures your system to load TSRs and device drivers high. The utility worked without a hitch but didn't offer me the option of excluding drivers that I know misbehave when loaded high.

I then rebooted, only to get an error message and a beep each time the machine started up. The cause: QEMM had not removed HIMEM.SYS, which was trying to load on top of QEMM in the CONFIG.SYS file. I took the line out manually to eliminate the message. I then ran Manifest, which offered more suggestions for tuning the system. It told me that I could save additional memory by adding the line STACKS 0,0 to my CONFIG.SYS file. Optimize, when tuning my system, didn't point out this potential optimization.

Optimize is generous with high RAM space—a trait that may motivate you to reconfigure things later. On the PS/2 (with 2 MB of RAM, 1092K bytes available to DOS), I could not open a DOS window in enhanced mode due to insufficient memory. Manifest revealed that QEMM had mapped extended memory into as much of the upper address space as it could, even where it hadn't loaded any programs. I solved the problem by reconfiguring QEMM to return some of this space to the pool of available RAM.

On the Everex Step 386/33, I detected another waste of RAM. The Everex BIOS ROM copies itself into high memory to improve speed. But Optimize, in an attempt to speed up the system, did this a second time, thus wasting precious space. (It didn't notice that there was no speedup obtained by doing this.)

Once QEMM was installed, all the machines ran fine under DOS, but Windows didn't work until I tinkered with the options manually and consulted special information not in the standard documentation. The Windows 3.0 supplement to the manual contains a few tips, but the truly necessary advice comes in the form of three technical notes—designated W3, WT, and WR—that are available from Quarterdeck or from the Desqview conference on BIX. Once I finally chose the right options, Windows ran well.

386Max and BlueMax

386Max works with any 386-based AT clone; BlueMax adds special features for IBM's PS/2s. Qualitas claims that both have significant advantages over QEMM when handling TSRs in Windows and on IBM PS/2s. They do, however, have one distinct disadvantage: Both support Windows only in enhanced mode. (I'll refer to both as *386Max*, except where features are specific to BlueMax.)

The installation process is easier than with QEMM, and it's Windows-aware. It noticed Windows on my disk and offered to support it. Queries included information on how my answers would affect Windows. The installation program removed HIMEM.SYS and swapped in 386MAX.SYS automatically. The Maximize optimization program lets you load TSRs and device drivers low if you know that they won't work when loaded high. I didn't need to read any technical notes—or even look at the manual—to get an installation that worked the first time.

QEMM has one feature that 386Max lacks. It always allocates extended and expanded memory from a common pool, so you needn't decide in advance how much to devote to each. 386Max must know in advance how much to give to each, and you can't change your mind without rebooting. There's one exception: When you start Windows in enhanced mode, 386Max can pull a switch and make as much memory as possible into XMS RAM. Windows then provides EMS emulation for DOS windows.

continued

BYTE ACTION SUMMARY

- **EXPANDED MEMORY MANAGERS**
- **WHAT YOU'LL LIKE**
  Both programs let you load TSR programs and device drivers in high memory above the 640K-byte DOS partition. 386Max and BlueMax are easier to get working with Windows; QEMM lets you run Windows in standard mode under DOS or Desqview.
- **WHAT YOU'LL DISLIKE**
  If the optimization programs don't work, you won't find any easy answers. Be prepared to do a lot of experimenting.
- **SYSTEM REQUIREMENTS**
  386 or 486 computer
- **WHAT WE RECOMMEND**
  Go with QEMM-386 if you run Windows in standard mode or want to use Desqview. Otherwise, both 386Max and BlueMax do a better job of getting you up and running the first time. BlueMax frees up far more memory on PS/2 systems.
- **WHAT YOU'LL PAY**
  QEMM-386 5.12: $99.95;
  386Max 5.1: $130;
  BlueMax 5.1: $155
- **FOR MORE INFORMATION**

Qualitas, Inc.
7101 Wisconsin Ave., Suite 1386
Bethesda, MD 20814
(301) 907-6700
fax: (301) 718-6060

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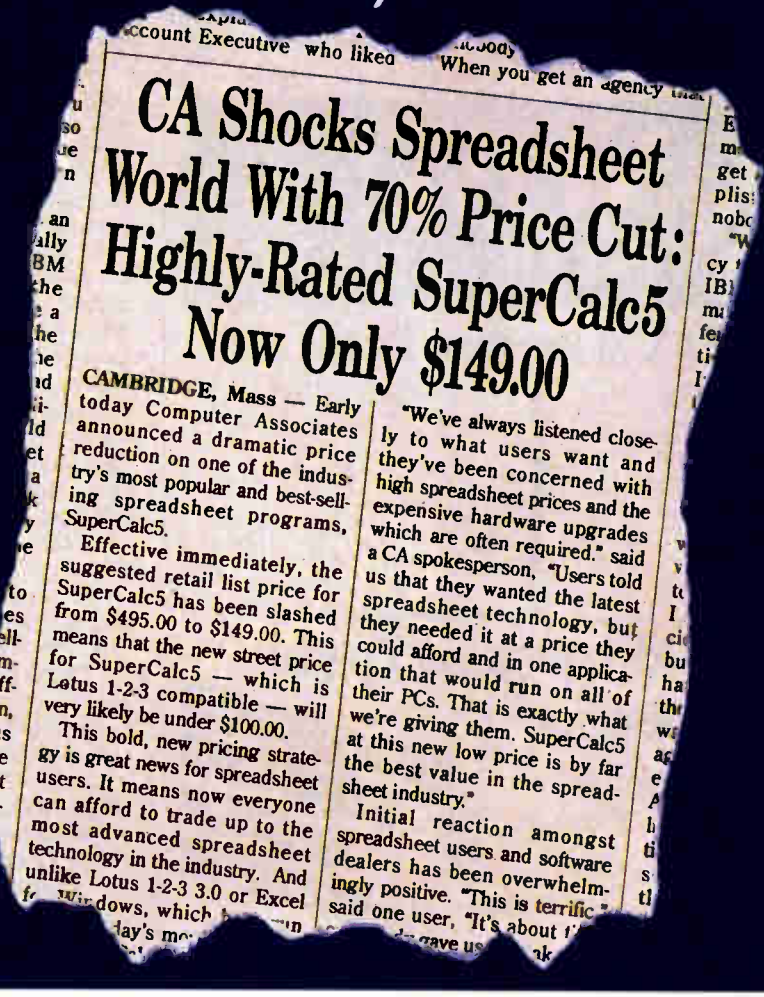

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386Max freed up approximately the same amount of conventional memory as QEMM did under DOS, and BlueMax did something better. It rearranged the mapping of PS/2 peripherals to provide the greatest possible amount of contiguous high RAM. Its BIOS compression feature reclaimed the space that was used by IBM's ABIOS (advanced BIOS), power-on self test, and ROM BASIC—parts of the ROM seldom (if ever) used under DOS. BlueMax made almost 64K bytes more memory available for loading programs high on the PS/2 than did QEMM.

The TSR instancing feature makes life easier for heavy Windows users. If you load a TSR before Windows and then bring it up simultaneously in multiple DOS windows, your actions in one window may confuse the instance of the TSR running in the next, potentially scrambling data. Qualitas' instancing feature gives each invocation of the TSR its own copy of the data, preventing conflicts.

The 386UTIL memory-snooping utility isn't as good as Manifest. Qualitas also offers a more advanced, Manifest-like utility, called ASQ (see photo 2), for free. It's better, but still not quite as good as Manifest. It's not bundled with 386Max, so you'll have to download it from CompuServe or ask Qualitas to send it to you.

On Your Own

You're more likely to need help with QEMM than with 386Max or BlueMax. But if either package fails to work, the installation process becomes a trial-and-error exercise. The technical-support departments of both companies are overburdened; expect busy signals and long waits on hold. Neither company has a toll-free help line. When I called Quarterdeck, the line was continuously busy. When I finally got through, I waited for more than 15 minutes to speak with a representative. Qualitas' voice-mail system gave me the option of holding, talking to a receptionist, or leaving a voice-mail message; I spent less time on hold, and a support technician called back quickly after I left a message.

QEMM-386 and 386Max both do the basics well. In terms of the amount of memory provided at the DOS prompt, my test results showed a dead heat except in a DOS window in enhanced mode on the PS/2. In this case, QEMM came out ahead by about 30K bytes. On the other hand, BlueMax did better at providing high RAM on the same machine.

Either 386Max or BlueMax is a good choice if you're looking for a simple installation process that's likely to work the first time. You'll also want 386Max if you intend to pop up multiple copies of a TSR in several virtual DOS windows.

Choose QEMM-386 if you want to use Desqview as your DOS multitasker. It's the only choice if you want to run Windows in standard mode or if you want to backfill your DOS RAM to 640K bytes. And it's better if you run a mix of programs outside Windows that demand both XMS and EMS memory. QEMM requires more experimentation, but Manifest is a great help when you're fine-tuning. Its VIDRAM utility, which reallocates up to 96K bytes from the EGA and VGA high memory area to conventional memory, is excellent if you're

Brett Glass, a frequent contributor to BYTE, is a programmer, hardware designer, author, and consultant in Palo Alto, California. You can reach him on BIX as "glass."

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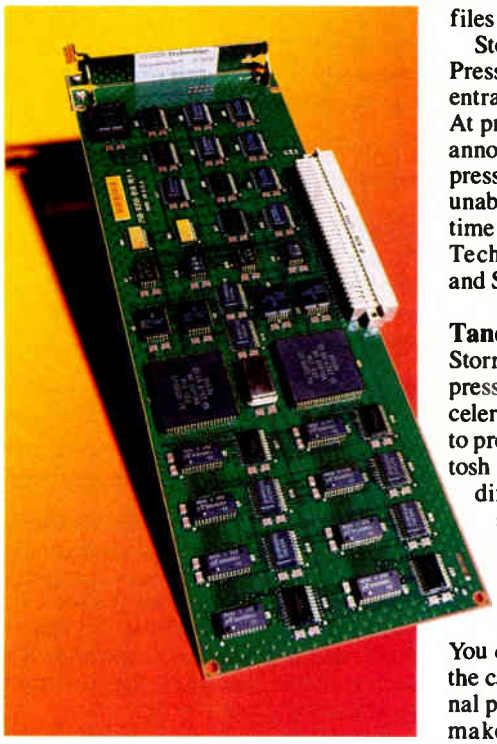
HARDWARE AND SOFTWARE

When Less Is More: Making Mac Images Manageable

STEVEN J. VAUGHAN-NICHOLS



Storm's PicturePress accelerator card and software compress Macintosh-based image files using three types of compression schemes.

Pity the poor Macintosh-based multimedia producer. Most of us have trouble fitting all our programs and data files on a hard disk drive. Multimedia fans have fits squeezing just a handful of files into the same drive. A single 24-bit color image can occupy more than a megabyte of storage.

Fortunately, the oversize file problem is becoming manageable, whether you produce multimedia presentations, four-color magazines, or desktop published brochures. Image-compression software and hardware now hitting the market let you shrink graphics files to maximize storage space. They also save on communications costs if you transmit massive files over a network or telephone line.

Storm Technology, with its PicturePress hardware and software, is an early entrant into the image-compression field. At press time, several other vendors had announced software and hardware compression products for the Mac but were unable to send commercial versions in time for testing. They include Micron Technology, Radius, Sigma Designs, and SuperMac Technology.

Tandem Hardware and Software

Storm Technology's PicturePress compression software and PicturePress Accelerator, a NuBus card, work in tandem to provide image compression for Macintosh users. The pair implement three different flavors of image compression: JPEG, JPEG++, and lossless (see the text box "An Image-Compression Glossary" on page 264).

The card itself doesn't include compression routines in ROM. You can upload PicturePress software to the card and its twin 60-MHz digital signal processors. This innovative approach makes adding improvements simple. Only the program needs to be upgraded, not the card. This more than makes up for the slightly poorer performance of the general-purpose DSPs versus customized data-compression chips with embedded code.

PicturePress software works without the board, but do yourself a favor—use the two together. In my tests on a Mac IIci running with a 25-MHz 68030, I compressed 1-MB images in 51 to 58 seconds with PicturePress software alone. Once I had armed the Macintosh with the PicturePress Accelerator, the compression times dropped to 5 to 8 seconds. The performance benefits far outweigh the additional costs for all but the most penny-pinching offices.

Another PicturePress advantage is that Storm Technology allows users to make copies of the decompression utility. You need only send the program with your images, and the recipient can expand them. Third-party JPEG systems, however, probably would not work with Storm Technology processed images, because the JPEG standard is still in the final stages of evolution. A welcome addition would be an exportable version of PicturePress for MS-DOS machines.

PicturePress runs on any properly equipped Mac II or SE/30. The program requires System 6.0.4 or higher and 32-Bit QuickDraw installed and running. Its hardware demands are minimal: You'll need at least 1 MB of RAM (2 MB are recommended) and 2 MB of free disk space.

Performance varies not only by file size but also by the content of the image being shrunk. A picture of an empty field with a blue sky shrinks faster and into a smaller file than that of a busy city street, for example; in other words, the greater the data redundancy, the higher the possible compression. I compressed a score of 24-bit color PICT files, ranging in size from 750K bytes to 1.5 MB, and found that the amount of detail was the most significant performance factor.

continued

BYTE ACTION SUMMARY

- **WHAT PICTUREPRESS DOES**
  The image-compression software and hardware let you shrink graphics in rates of from about 2-to-1 to 40-to-1.
- **WHAT YOU'LL LIKE**
  Reducing formerly massive files to manageable sizes to maximize storage space and save on communications costs.
- **WHAT YOU'LL DISLIKE**
  PicturePress doesn't directly support compression of TIFF and graphics formats other than PICT.
- **WHAT YOU'LL PAY**
  PicturePress Accelerator (includes software): $999; PicturePress software: $199
- **FOR MORE INFORMATION**
  Storm Technology, Inc.
  220 California Ave., Suite 101
  Palo Alto, CA 94306
  (415) 322-0506
  fax: (415) 322-2439

Circle 978 on Inquiry Card.

An Image-Compression Glossary

The following dictionary highlights some image-compression technologies to help you thread your way through the maze of new names and acronyms.

Fractal Compression A developing and as yet unproven technology based on principles of fractal geometry. It promises high-resolution and impressive compression ratios.

Huffman Encoding A popular lossless-compression algorithm that replaces frequently occurring data strings with shorter codes. Some implementations include tables that predetermine what codes will be generated for a particular string. Other versions of the algorithm build the code table from the data stream during processing.

JPEG (for Joint Photographic Experts Group) An ISO and CCITT committee and a still-image-compression standard being developed by the committee. As of press time, the JPEG standard has not been approved. It uses a one-pass, threefold process to squeeze down images.

JPEG++ Storm Technology's proprietary extension of the JPEG algorithm. It lets users determine the degree of compression that the foreground and background of an image receive; for example, in a portrait, you could compress the face in the foreground only slightly, while you could compress it in the background to a much higher degree.

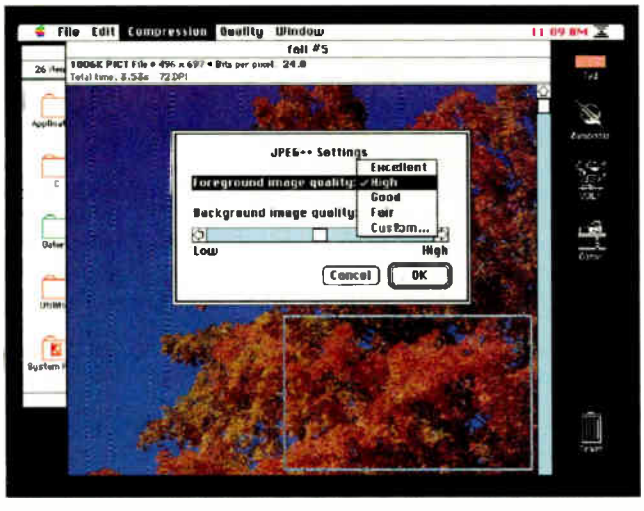
Lossless Image- and data-compression applications and algorithms, such as Huffman Encoding, that reduce a picture's size without losing any data.

Lossy Methods of image compression, such as JPEG, that reduce the size of an image by disregarding some pictorial information.

LZW (for Lempel-Ziv-Welch) A lossless data-compression algorithm.

MPEG (for Moving Pictures Experts Group) Like JPEG, both a group and an algorithm. The algorithm, for compressing moving images, is being developed and is not yet available for use.

Px64 A compression technique used in real-time videoconferencing.



Using Storm's extension to JPEG, you can compress foreground and background image areas at different rates. The outline box above has selected the lower right corner for high compression.

Compression at Work

PicturePress is a cinch to set up and install. I was ready for business in 5 minutes. Using PicturePress is almost as easy. You choose from five preset compression ratios. These ratios range from a 2-to-1 lossless reduction to a 40-to-1 lossy reduction. Even pictures that are shrunk to the lowest setting would be usable in either newspapers or desktop publishing. Images compressed at the 8-to-1 or 15-to-1 settings could be used in four-color slick publications or multimedia applications. You can also adjust the degree of compression to your heart's content by using the customization features. This way, you can squash pictures up to 200 times smaller than their original size. However, extreme compression is more useful as a special-effect toy than for any practical purpose. And be careful: Other than restoring from backups, there's no way of restoring an image to its original condition if it has been compressed into oblivion.

JPEG++, Storm Technology's expanded version of the JPEG standard, lets you divide pictures into foreground and background areas and compress them at different rates (see the screen). This feature was easy to use in PicturePress, and it worked as advertised. It's such a simple procedure that I suspect most users will use it by default.

PicturePress is so easy to install and use, you almost don't need a manual. If you do have questions, the complete, easy-to-read documentation will answer them.

Big-League Compression

The one problem I found with PicturePress is that it can only compress PICT format files. Although the company includes instructions for using third-party applications to transform TIFF images to PICT, I would have liked direct support of TIFF and other graphics formats.

PicturePress Accelerator is big-league technology. Image compression has never been easier or more efficient on the Macintosh. Anyone who works with still images on that platform should give this product serious consideration. ■

Steven J. Vaughan-Nichols is a technical writer and consultant based in Lanham, MD. He can be contacted on BIX as "sjvn."

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APPLICATION

High-Quality Image Editing Develops on the PC

GREG LOVERIA

Personal computers are becoming more important than ever for today's graphics-intensive applications. Unfortunately, scanning or capturing video images doesn't always yield quality results because of flat tones or uninteresting compositions. To achieve images that merit notice for desktop publishing, slide presentations, or publications, you may need the help of image-enhancement software.

Two new packages, Picture Publisher Plus and Desktop Artist, let graphics professionals use their PCs to retouch and enhance bit-mapped images with impressive results.

By emphasizing printed-image quality, Micrografx markets Picture Publisher Plus 2.5 for desktop publishers (see photo 1). The $695 package operates under Windows 3.0 and offers continuous-tone manipulation of both gray-scale and 24-bit color RGB TIFFs. A version for the Macintosh is also available.

Desktop Computing's Desktop Artist 1.0 ($495) requires a Texas Instruments Graphics Architecture (TIGA) display adapter, and while image editing is its main function (see photo 2), the software caters to graphic artists by offering them draw and paint functions without loading images first. This allows the software to double as a stand-alone paint program for freehand creation of drawings. Desktop Artist supports gray-scale and 24-bit color RGB TIFFs, plus PCX, TARGA, and GIF formats, which also makes it a useful file format–conversion tool.

Both packages directly support monochrome or color printers, including PostScript output devices. Both will also generate CMYK (cyan, magenta, yellow, black) color-separated printouts or Encapsulated PostScript (EPS) CMYK color-separation files.

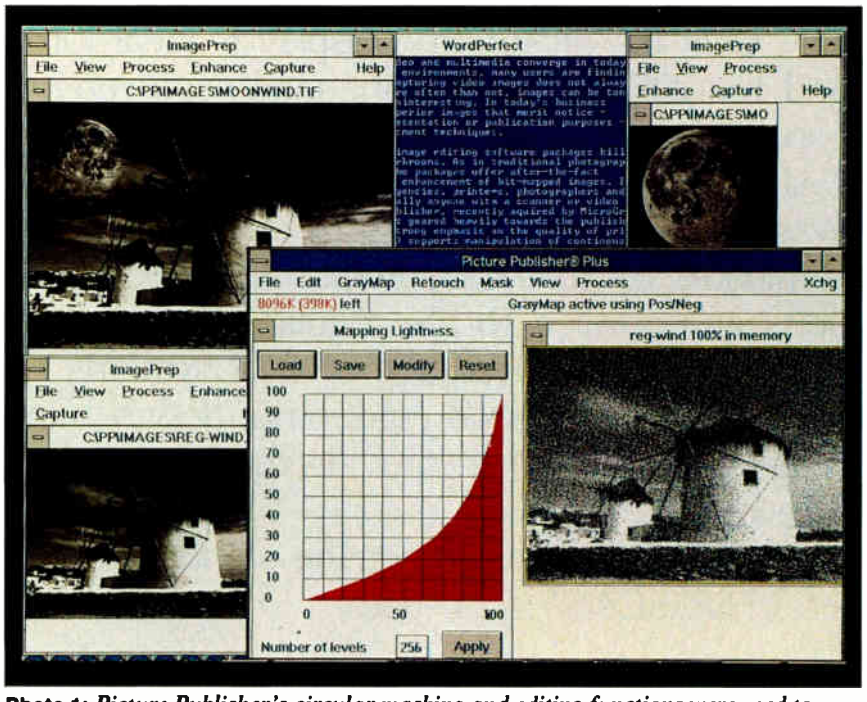

Photo 1: *Picture Publisher's circular masking and editing functions were used to create, clip, store, and paste a mask of the moon into the windmill picture. After pasting, the moon was resized and then flipped vertically. ToneMap highlights and shadows were adjusted using the GrayMap functions to give detail to the moon shadow tones. With the Retouch functions, additional clouds were airbrushed in and the moon's edges were smoothed. The Picture Publisher window shows the software's ramp-curve functions and original dithered windmill image. (Image-file-to-slide conversions courtesy of Image Center)*

Image-Editing Tools

Each package lets you burn in (overexpose specific image zones), dodge (underexpose zones), and correct overall contrast and brightness. You can repair cracks in an old photograph using clipping, pasting, and blending tools. By overlaying images, you can create montages and surrealistic compositions. Both products offer file editing of true 24-bit images (16.7 million colors), but they support only 8-bit (256-color) display output. Depending on your system, this is either a bane or a boon. If you now use a 24-bit display, as I do, backpedaling to 256-color image editing is cumbersome. However, users of standard VGA displays won't have to invest the extra dollars to process and edit 24-bit images. According to both manufacturers, 24-bit true-color display support should be available by the time you read this.

Picture Publisher requires 3 megabytes of free hard disk space; Desktop Artist uses 2 MB. Although Picture Publisher's system specifications recommend an IBM AT or XT, you shouldn't consider anything less than a fast 286 system for either program. I tested both on Zeos International's 486/25 EISA tower system under DOS 4.01, with 8 MB of memory and a Relisys RE1520 16-inch multiscanning monitor. I used Diamond Computer Systems' SpeedStar Plus, a 1-MB Super VGA card, to test Picture Publisher. I ran Desktop Artist with the Hercules Graphics Station Card and Texas Instruments' 34010 TIGA adapter. Both programs and all adapters are capable of 8-bit, 640- by 480-pixel through 1024- by 768-pixel display resolutions.

To test PostScript printing, I used a Pacific Data Products PacificPage PE font cartridge with a Hewlett-Packard LaserJet IIP. I tested color output with Shinko's CHC-445 and QMS's ColorScript 100-30i printers. CMYK color separations, printouts, and EPS CMYK color separations from both packages were superb.

Picture Publisher

Picture Publisher was developed and originally sold by Astral Development,

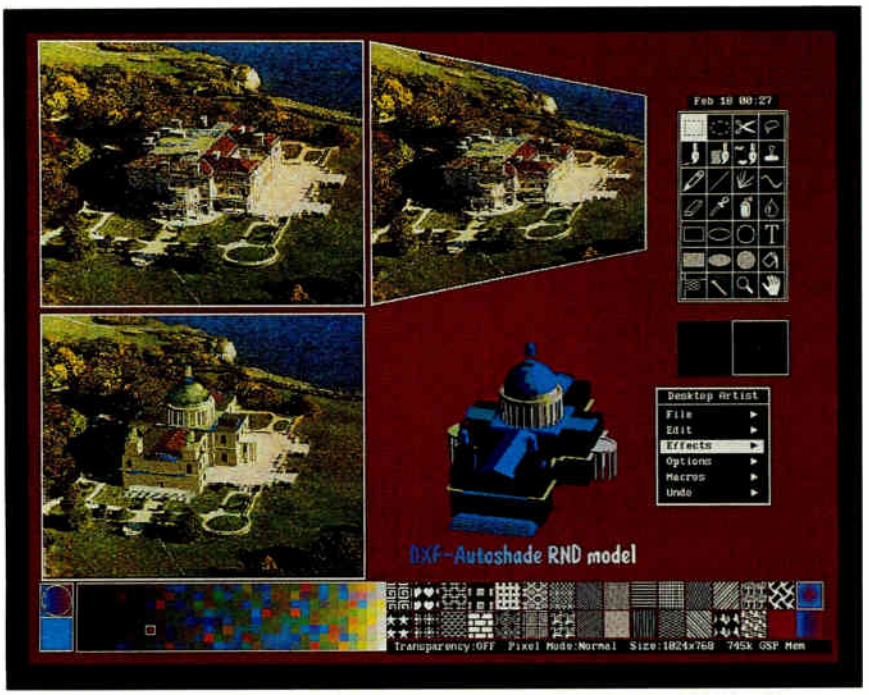

Photo 2: *Above is the Desktop Artist screen in its TIGA display/editing environment. The right menu boxes and bottom color bar detail editing icons. The images, starting from the top left and moving clockwise, show the original site image imported as a PCX file over a two-color gradient-fill background; the same image after being "warped" with Desktop Artist's perspective command; an Autodesk AutoShade render/model imported and labeled using a color-gradated Dom Casual font; and, finally, the AutoShade render pasted and positioned over a duplicate of the original site image. (File-to-slide conversions courtesy of Image Center)*

which merged with Micrografx earlier this year. In the Microsoft Windows 3.0 environment, Picture Publisher loads standard and TIFF 5.0 files, which it displays as dithered, low-resolution reference images in preview windows. To conserve disk space, you can save and open TIFFs using Lempel-Ziv-Walsh 2-to-1 file compression. Pull-down menus let you globally adjust brightness, contrast, and gray-mapping levels. In Windows mode, the program applies these adjustments to the overall image.

Picture Publisher also provides graphs that summarize overall brightness, contrast, or gray-mapping levels. The graphs allowed me to gauge these image variables precisely and save my changes to disk as reference for later jobs. The package also includes hand-held calibration strips and display, printer, and scanner reference/calibration files. Device calibration allows you to gauge imaging variables against a known reference standard, ensuring that you can duplicate results when editing, scanning, or printing different images.

To edit images, you invoke Micrografx's Picture Window by clicking in the Xchg (exchange) area. The program shells from Windows to a 320- by 200-pixel, 256-color VGA display environment (see photo 3). However, the SpeedStar Plus card also supports 256-color display at 1024- by 768-pixel resolution using Tseng Labs' chip set. So I selected an appropriate Picture Window display driver from several I found in the Windows interface screen. I'm always leery of third-party device drivers, but Micrografx's driver worked perfectly.

At 1024 by 768 pixels by 8 bits, you choose the direct image-editing functions of Edit, GrayMap, Retouch, Mask, and View from sidebar icons. The Mask function selectively segregates specific

BYTE ACTION SUMMARY

- **IMAGE-EDITING SOFTWARE**
- **WHAT YOU'LL LIKE**
  You can use your PC to retouch, enhance, and correct exposures of bit-mapped images. Also, you can repair cracks in an old photograph and create montages.
- **HOW THEY DIFFER**
  Picture Publisher Plus operates under Windows 3.0 and offers continuous-tone manipulation of both gray-scale and 24-bit color RGB TIFFs. Desktop Artist requires a TIGA display adapter and provides draw and paint functions. Desktop Artist supports PCX, TARGA, and GIF formats, which also makes it a useful file format–conversion tool.
- **WHAT WE RECOMMEND**
  Choose Desktop Artist and its conversion-utility tool if you work with TIGA images. If you're VGA-based, Picture Publisher, with its impressive documentation, is a winner.
- **WHAT YOU'LL PAY**
  Picture Publisher Plus: $695;
  Desktop Artist: $495
- **FOR MORE INFORMATION**

Desktop Artist 1.0
Desktop Computing, Inc.
4600 Bohannon Dr., Suite 220
Menlo Park, CA 94025
(415) 323-5535
fax: (415) 323-4434

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Picture Publisher Plus 2.5
Micrografx, Inc.
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Richardson, TX 75081
(800) 733-3729
(214) 234-1769
fax: (214) 234-2410

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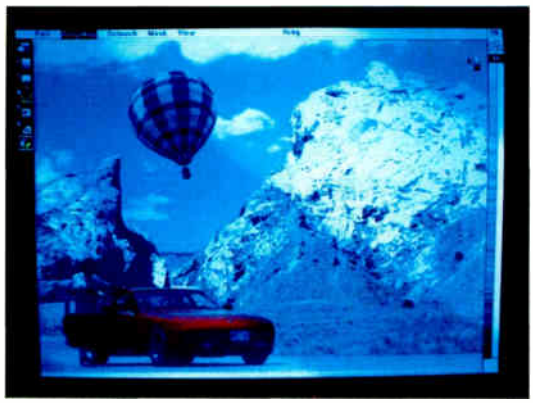

Photo 3: *This screen shows Picture Publisher's editing window. The author scanned in the auto, mountain, and balloon images and then edited them as 24-bit RGB/TIFF files. He darkened the light-blue sky by moving quarter-tone and contour-graph icons. The balloon image was then pasted from the clipboard, and its edges were blended and smoothed using the Retouch tools.*

object zones within an image by rubber-band clicking around image boundaries. After creating masks, you store them in multiple clipboard areas. You can then resize, flip, stretch, and paste masks into other images.

Using GrayMap functions, I was able to visually adjust the individual mask's ToneMap or the whole image ToneMap instantaneously. A ToneMap is the range of image highlight levels (whites), quarter tones, mid-tones, three-quarter tones (intermediate gray levels), and shadows (blacks). You adjust the ToneMap by sliding handles on a ramp-curve overlay graph or by placing quarter-tone icon markers within the image directly. At this display resolution, the additional quarter-tone pop-up icon markers are tiny but usable. Quarter tones are the gray-level values between ToneMap levels (e.g., shadows and mid-tones).

When you're editing RGB color TIFF images, Picture Publisher Plus adds hue, saturation, and lightness manipulation to the ToneMap ramp-curve graph for RGB color adjustments. I also used the ToneMap adjustments to create both color and monochrome posterizations, negatives, and black-and-white line-art images.

The View and Retouch functions were fun to work with and innovative. In View mode, you can enlarge images in increments of 100 percent to 600 percent. By using a rubber-banding box, even 1-pixel "zoom-ins" are easy. Retouch mode permits freehand painting of a protective red filter (Micrografx refers to it as *rubiconing*), which shields areas from retouching "slips." You can select retouch colors or grays directly from the image for painting or combine them with a blending/smoothing tool to soften or sharpen edges. You also can globally apply these functions to rubiconed areas only.

Picture Publisher's scanner, printer, and capture/display board drivers support a wide variety of manufacturers. The few I tested worked flawlessly. I used Willow Peripherals' Publishers' VGA card to capture images directly off videotape and a Microtek MSF-300Z scanner to import 24-bit color and monochrome TIFF images. I preferred Picture Publisher's scanner interface drivers over Microtek's stand-alone software (ImageStar) because it was easier to use. Picture Publisher offers photo prescan, which made it easy to drag resizing/cropping bars around the prescanned image area for the final 24-bit scanning process.

Desktop Artist lets you generate and size text over an image.

Desktop Artist

My first attempts at using Desktop Artist with the Hercules Graphics Station TIGA adapter were futile—the software repeatedly locked up after 5 minutes of use. When I installed a Texas Instruments TMS-34010 TIGA adapter and TI's TIGA drivers, the program worked fine at all display resolutions.

Initially, this looked like just a paint program, but I uncovered many unique features as I worked with the package. The program's main screen layout has a user-movable menu, an icon-brush toolbox, and a palette/pattern status bar. The icon toolbox sports Bézier-curve tools as well as standard paint tools, similar to the Windows 3.0 Paint program. Unlike Picture Publisher, Desktop Artist lets you generate and size text over images, ranging from pleasant-looking Dom Casual to Helvetica fonts.

The real eye-opener in this program is the "gadget box," which opens and surrounds an image. Its buttons invoke standard flip/rotate acrobatics for images and text. However, when you pull on any gadget-box corner, you stretch or warp the image and its perspective in the pull direction. You also use the gadget box to crop and paste clip images. Once you've pasted them, you can set transparency levels to allow bottom images and artwork to bleed through the top image, similar to sandwiching 35mm slides. In addition, Desktop Artist offers many of the same image-editing characteristics as Picture Publisher.

Best of Both Worlds

Although both packages share some image-editing features, each is unique in its own right. I would like to see Desktop Artist take a cue from Picture Publisher with a non-TIGA, VGA version; I'm positive TIGA-less users would like access to the unique features this program offers. On the other hand, some direct paint functions implemented in Picture Publisher would be an asset for that product. In the end, your choice will hinge on whether you generate your final images exclusively for print as TIFFs or for presentation purposes as GIFS or TGA files.

For my own needs, most of my 16- and 24-bit images are born from three-dimensional animation packages using TARGA display adapters. Some are converted to 8-bit gray-scale TIFFs for inclusion in Ventura Publisher or PageMaker desktop publishing layouts. Desktop Artist performed excellently as a conversion-utility tool in this capacity.

However, if you are VGA-based, Picture Publisher's documentation helps it win hands down with the most thorough explanation of gray-scale/color image editing and print processing around. Finally, according to Micrografx, upcoming releases of Picture Publisher will support direct importation and conversion of other image file formats in the near future.

Whichever package you choose, the next time your images require attention-getting, eye-popping perfection, don't settle for stock images. Unleash your imagination and create them yourself. ■

Greg Loveria is a computer graphics and desktop publishing consultant, animator, and technical writer. You can reach him on BIX c/o "editors."

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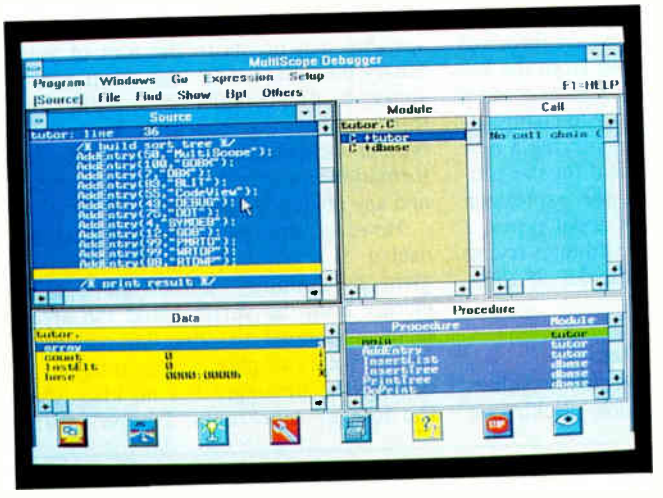
The MultiScope Debuggers Make Debugging Easier

STEVEN KEARNS



The MultiScope Debuggers for DOS handle windows and support a mouse in either graphical (through Windows 3.0, shown) or text modes.

My program has a bug! Awesome!" No, these aren't the rantings of a demented programmer; it might be your reaction after mastering the MultiScope Debuggers. This tool for serious developers is packed with features that make debugging easier and almost fun.

MultiScope offers three different debugging packages, each with numerous configurations specialized for different uses. This is one of their main strengths. I reviewed the Debuggers for DOS version, which lets you debug DOS programs while the debugger uses either a character mode or Windows 3.0 interface. You can also debug a program remotely, through a serial line or network. The Debuggers for Windows and DOS version (not available at the time of this review) will let you debug Windows applications and use a second debugging monitor. There is also an OS/2 version.

In addition, each package includes postmortem debuggers. These are perfect for field-testing your program. You can compile your program so that when it crashes at a user's site, the program automatically takes a snapshot of the software and CPU state. The field testers can return this snapshot to the programmer, who can use the postmortem debugger to figure out what went wrong.

Speaking Your Language

Most PC language development systems come with a capable debugger that is customized for the particular language and compiler. In contrast to this, the MultiScope Debuggers work with any language/compiler that can generate the standard CodeView debugging information: These include the Microsoft family of languages, Zortech C, and others.

Although C++ is not explicitly supported, I used the debugger with some success with Zortech C++. However, because C++ mangles variable and function names, several features become too difficult to use. As a result, I would not recommend the debugger for C++ programs until MultiScope explicitly provides support for it.

Keeping an Eye on Your Code

The MultiScope Debuggers provide a standard set of functions. These include stepping through a program one statement at a time; setting breakpoints on any statement of the program, enabling the programmer to run the program and regain control when the breakpoint is reached; examining the value of program variables and data structures while the program is running; and examining the *call stack*, which lists the functions that

BYTE ACTION SUMMARY

MULTISCOPE DEBUGGERS FOR DOS

WHAT IT DOES
Works with compilers that generate CodeView-compatible debugging information. Provides programmers with a highly versatile, multilanguage, windowed debugging environment for DOS programs. It supports both DOS text and Windows 3.0 interfaces.

WHAT YOU'LL LIKE
Postmortem debugging, network remote debugging, ease of use from both the keyboard and mouse, detachable "remote control," and the excellent use of 386/i486-specific features.

WHAT YOU'LL DISLIKE
The version reviewed suffered from some glitches in the user interface.

SYSTEM REQUIREMENTS
IBM PC or compatible computer with 640K bytes of RAM (386 or i486 and 2 MB required for advanced debugging modes), hard disk drive with 3 MB of free space, and DOS 3.3 or higher (Windows 3.0 or higher is optional).

WHAT WE RECOMMEND
As a replacement for the likes of CodeView, the MultiScope Debuggers is an excellent choice. In terms of features and configurations, it matches the best available. However, the user interface needs refinement.

WHAT YOU'LL PAY
$179

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MultiScope, Inc.
1235 Pear Ave., Suite 111
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were called to get to the current point, where they were called from, and the arguments they were called with. This last function is most useful when the program stops prematurely: Examining the call stack can often indicate the source of the problem.

The package has several advanced features, including the ability to set *read/write watchpoints*. A watchpoint on a memory location stops execution when any part of the program reads or writes to the location. This is crucial for locating parts of your program that write where they shouldn't. Accessing this feature is easy: Click on the variable you want to watch in the Data window and select Set Watchpoint. Best of all, the debugger uses the advanced features of the 386 processor to implement watchpoints with essentially no loss of execution speed. On a lesser processor, a program with a watchpoint may execute 10 times slower than normal, or worse.

Unfortunately, the MultiScope Debuggers allow you to set only five watchpoints. Also, when I tried to watch a whole structure, I was stuck, because the debugger prevented me from editing the Size field of the Set Watchpoint dialog box. This type of user-interface snag cropped up in several situations.

Conditional breakpoints are another advanced feature. They are ignored unless a programmer-defined condition is met. Furthermore, when a conditional breakpoint is triggered, you can direct the debugger to take actions (e.g., logging a message or evaluating an expression) instead of stopping.

I found the conditional breakpoint interface particularly frustrating. If you accidentally input an erroneous condition into the dialog box, you are forced to reenter all the information from the beginning. Similarly, after you have set a breakpoint, there is no way to change it, short of deleting it and reentering a new one. Furthermore, the field for the condition is too small, and the expression evaluator is overly strict about types. I once spent 5 (frustrating) minutes trying to enter a breakpoint thanks to these problems.

Zooming In on Your Data

The Data window displays current values for a set of variables. Double-clicking on a pointer variable displays the values in the structure it points to. There are some unfortunate limitations to the Data window, though. You cannot specify exactly which variables you care to display. You show either all the locals or all the globals in a module. If you double-click on a pointer, you see what it points to, but you lose the display of the other local variables.

One of the niftiest features of the MultiScope Debuggers is the ability to automatically draw a picture of a data structure. For example, you can select the variable that points to the root of your binary tree, and the debugger will draw a snazzy picture complete with arrows and three-dimensional boxes. It knows the type of each variable, and it uses this information to recursively draw the object and any objects it points to.

However, this feature is more fun than useful. If a variable is an index into an array, for example, I'd like a debugger to picture both the variable and the array element pointed to. But the debugger would simply display it as an integer; of course, the debugger has no idea what the integer represents. I hope future

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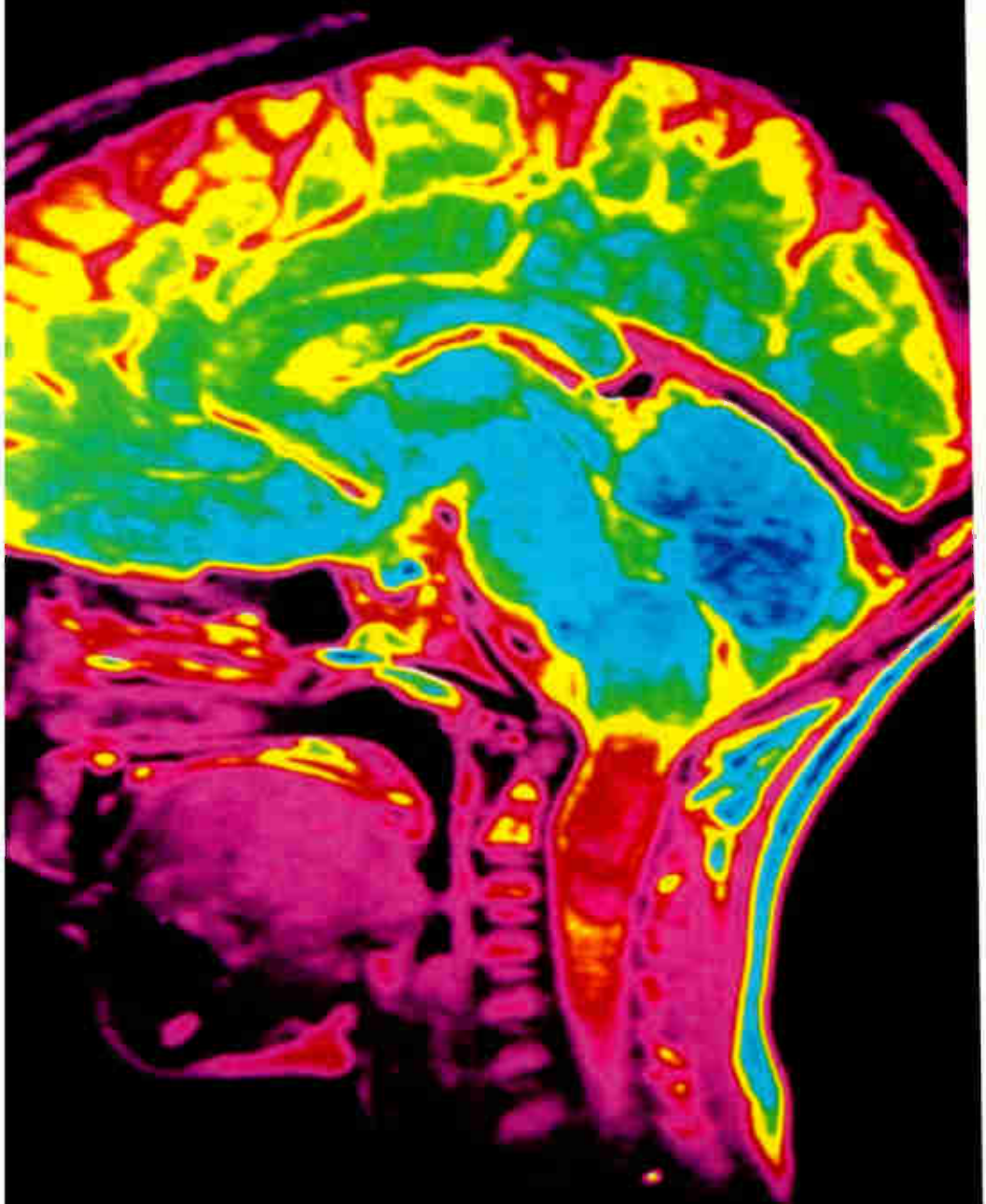

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debuggers will offer a simple way for programmers to create customized graphical displays for their program data.

Some debuggers let you capture and replay a set of debugging actions. This can be useful when it is time-consuming to set up your program to display a bug. The MultiScope Debuggers can display and save all your debugging actions but don't offer any way to replay them.

Just Another Pretty Face?

Aside from the glitches of not allowing you to edit Size fields and forcing you to sometimes reenter information in a dialog box, the user interface is well designed. You can use either the character mode or Windows user interfaces; both work similarly. The most common operations, such as single-stepping, are compressed into single keystrokes. Operation is convenient with both mouse and keyboard. The menus are thoughtfully laid out. It is easy to switch between your program's output and the debugger's display. I especially appreciated that I could choose a font size and color for each window.

I was also impressed with the Remote Control, a small (text or graphical) window that pops up on the application screen. With it, you can perform simple debugging operations (e.g., run, stop, and single-step) with mouse-clicks on icons that mimic VCR control buttons. This is a nice touch, particularly for applications that take up most of the screen when they run.

Finally, a caution. I first used the MultiScope Debuggers to track down an actual bug. I spent several mostly enjoyable hours experimenting with it, using its myriad features in a fruitless attempt to pinpoint the bug. I finally gave up: I had to *think* about the bug. Within 2 minutes, the cause of the bug was clear, and a quick check with the debugger verified the problem. The moral: All the windows, colors, keys, watchpoints, and fancy features of a debugger are no substitute for thinking.

As a replacement for the likes of CodeView, the MultiScope Debuggers are an excellent choice. In terms of features and configurations, they match the best debuggers available. However, the user interface needs refinement. I am looking forward to the next version. ■

Steven Kearns is the president of Software Truth, which is developing a next-generation programming environment. He earned a Ph.D. in computer science from Columbia University. He can be reached on BIX c/o "editors."

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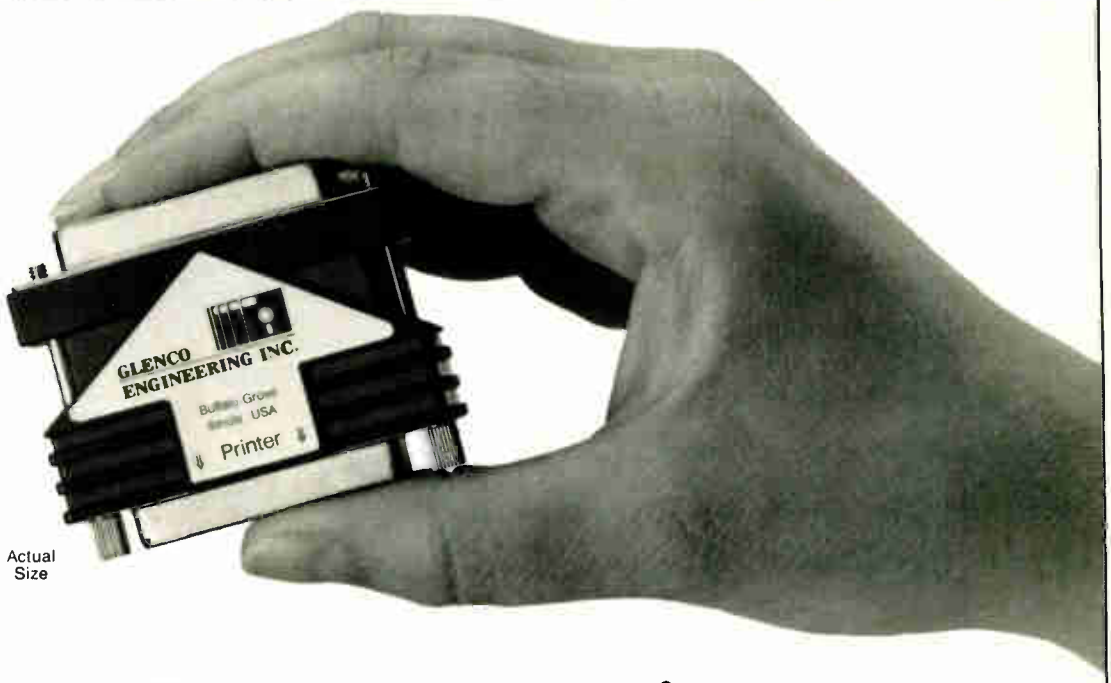

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Extend Your Printer's Reach Without a LAN

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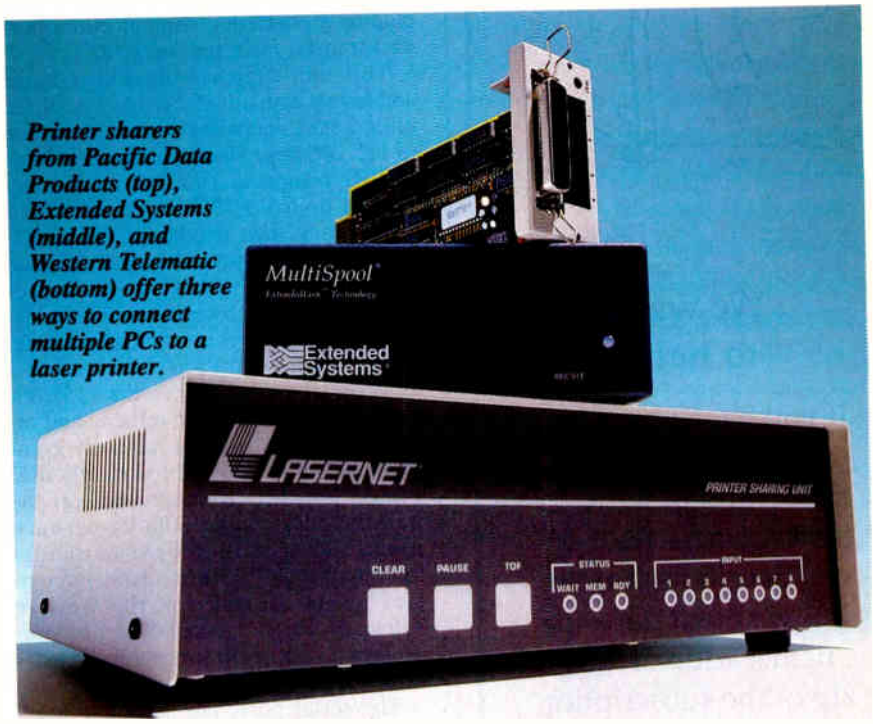

Printer sharers from Pacific Data Products (top), Extended Systems (middle), and Western Telematic (bottom) offer three ways to connect multiple PCs to a laser printer.

Even with laser-printer prices dipping under $2000, good business sense argues against putting a printer on every desktop, especially since many people use printers sporadically throughout the day. A more efficient solution is for many users to share the same printer. This is the rationale behind the new printer-sharing devices hitting the market.

I reviewed three new sharing devices that don't require a LAN to provide multiple access to printers: Pacific Connect from Pacific Data Products, the Lasernet PSU-82SP from Western Telematic, and MultiSpool 2289A from Extended Systems. The latter two units are standalone boxes with serial and parallel interfaces, while Pacific Connect is a card that plugs directly into the Optional I/O slot of a Hewlett-Packard LaserJet II, IID, III, or IIID printer.

Job Queuing

Pacific Connect works with PCs and Macintoshes connected only to LaserJet printers. The other two units can attach to any printer with parallel or serial ports and can work with PCs and Macs, although Mac users can't take advantage of some utility software that ships with the Lasernet and MultiSpool. All three can store incoming data in an internal memory buffer before sending it to the attached printer. If one or more additional ports receive data at the same time, the device sets aside buffer memory for each new job. The jobs proceed to the printer in the order in which they are received.

To determine when one job ends and the next job begins, the devices use a preselected time-out period. When they stop receiving data into the active job port for the duration of the time-out period, the job is considered closed, and the next job in line then flows to the printer. The time-out lets you send multiple-page documents with brief time gaps in between, without other jobs sneaking in. In certain graphics or CAD applications, the computer may need to perform substantial processing between portions of the printer output. The time-out can ensure that a print job from another user does not get sent to the printer between portions of a graphics image.

I tested all three devices with simultaneous serial- and parallel-input connections and with several print jobs being submitted concurrently from different computers. Each of the units performed flawlessly in these tests, with no print jobs inadvertently corrupted. In some cases, I needed to adjust the time-out period to accommodate a lengthy delay between portions of a graphics image.

As expected, the parallel data transfer was substantially faster than the serial data transfer, and it is preferred when feasible, especially when you regularly transfer graphics images. In shared-printer environments, however, it is common for many or most PCs to be too far from the printer for parallel operation, so fast serial communications are important. Extended Systems' MultiSpool, with its serial and parallel adapters, provides a unique solution for using parallel ports over long distances.

Pacific Connect

Easy to use and install, Pacific Connect is the simplest of the three devices. At $399 for the 256K-byte version (user-upgradable to 1.25 megabytes) and $499 for the 1.25-MB version that I reviewed, it is also the least expensive. However, it only works with HP LaserJet printers. In addition, the card provides only five computer connections—four serial and one parallel.

The device offers four RJ-11 phone jacks for the RS-232 serial inputs and a single 36-pin Centronics connector for the parallel input. It ships with four RJ-11 cables and four RJ-11-to-DB-25S adapters, making computer-to-serial port connections straightforward, especially for IBM PC compatibles with the standard 25-pin serial-port connector. Systems that have the IBM 9-pin serial-interface connector will need a 9-pin-to-25-pin adapter (readily available from many suppliers). Non-IBM-compatibles having a female DB-25 connector will need a male adapter.

You can individually select the data transfer rate and time-out (in 10-second increments) for each Pacific Connect port. (Only the time-out can be set for the parallel port.) The company includes a PACSET utility to easily configure the communication and time-out parameters

from a PC. And because Pacific Connect has its own nonvolatile memory, it retains the setup values for all ports even when you shut down the power—a nice feature. Pressing the device's recessed test button generates a status printout, including all current communications port data transfer rates and time-outs.

This unit supports the widest range and fastest data transfer rates of the three units tested, including serial rates of up to 115,200 bps. Since the standard DOS MODE command (for PCs) will only support up to 19,200 bps, Pacific Connect comes with another utility, PACMODE, that permits you to specify a rate of up to 115,200 bps. This fast transfer rate has become proven in the PC industry with such programs as LapLink and Procomm. I tested Pacific Connect in a LaserJet III and found that the 115,200-bps transfer rate worked reliably and reduced transfer time substantially compared to the 19,200 bps I normally use. Pacific Connect cut 30 seconds off the transfer of a simple 300-dot-per-inch image, and it could easily reduce transfer time by minutes for a moderately complex image. In contrast, the Western Telematic and Extended Systems units support a maximum serial data transfer rate of 19,200 bps.

The serial ports normally use hardware (Data Terminal Ready) handshaking between the Pacific Connect unit and the attached PCs. Serial port 1, however, can optionally be configured to use software handshaking (XON/XOFF) for systems that may require this (e.g., certain minicomputer or mainframe systems). You can run the device with Macintoshes that have a LaserJet driver, but you must use a PC to configure transfer rates and time-outs.

Lasernet

The Lasernet supports eight connected computers (four serial and four parallel) and two printers (one serial and one parallel). You can purchase the Lasernet in four memory sizes: 256K bytes ($595), 512K bytes ($695), 1 MB ($795), and 2 MB ($995). I evaluated the 1-MB unit. This product doesn't include any cables, but it does use all standard printer input connectors (DB-25s for the serial ports and 36-pin Centronics connectors for the parallel ports). The two printer output connectors are also DB-25 types (one male and one female), matching the IBM PC standard interface pin-outs.

The full-size, standard connectors (instead of the "RJ" telephone jack connectors), coupled with the unit's internal power supply, account for the relatively

BYTE ACTION SUMMARY

- **WHAT PRINTER SHARERS DO**
  These devices efficiently let many users share one printer without a LAN.
- **WHAT YOU'LL LIKE**
  Easy installation, reliability, and the chance to maximize your printer resources.
- **WHAT YOU'LL DISLIKE**
  Not all of these devices work with all printers; some printer sharers operate at less than optimum transfer rates; and the cost of some fully configured units matches the price of personal laser printers.
- **WHAT WE RECOMMEND**
  For LaserJet users who can accept a five-user limitation, Pacific Connect clearly offers the most for the money.
  In the higher-cost, stand-alone arena, MultiSpool is the winner because of its flexibility and its ability to operate at long distances even with parallel ports.
- **WHAT YOU'LL PAY**
  Pacific Connect: $499 (1.25-MB unit); Lasernet PSU-82SP: $795 (1-MB unit); MultiSpool 2289A: $995 (as tested, 1-MB unit)
- **FOR MORE INFORMATION**

Extended Systems, Inc.
6123 North Meeker Ave.
Boise, ID 83704
(208) 322-7575
fax: (208) 377-1906

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Pacific Data Products
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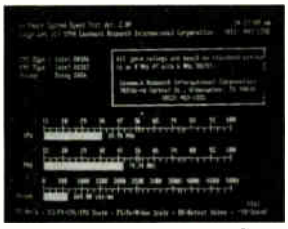

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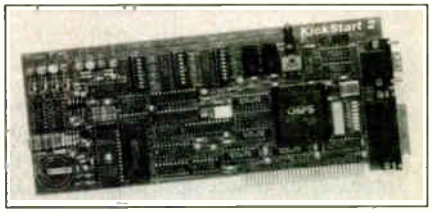

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large size of the Lasernet. A DIP switch at the rear of the unit lets you configure several default values. You can reset the values after power-up using one of the PC utilities included with the unit. You can set the serial-printer-output-port default to either 9600 or 19,200 bps and the serial-input ports for either 9600 or 19,200 bps (although not individually). You can also select one of four printer output modes: serial only (all output goes to the serial printer port), parallel only (all output goes to the parallel printer port), share mode (data passes to the first available printer port), and direct mode (data travels to the "default" printer port unless otherwise instructed by an embedded command to the Lasernet).

The Lasernet only supports 1-, 5-, 20-, or 90-second time-outs. The gap between 20 and 90 is large enough to be an irritation. For example, my CAD program needs a time-out of nearly 40 seconds. The additional 50 seconds wastes a lot of time in a device largely designed to save time.

The Lasernet's maximum 19,200-bps input transfer rate, while the fastest most printers can accommodate, does not offer that extra performance boost that's so notable with Pacific Connect. Ironically, like Pacific Connect, the Lasernet includes a new WMODE utility to replace DOS's MODE command, allowing data transfer rates of up to 115,200 bps to be specified. However, the Lasernet will not support anything beyond 19,200 bps.

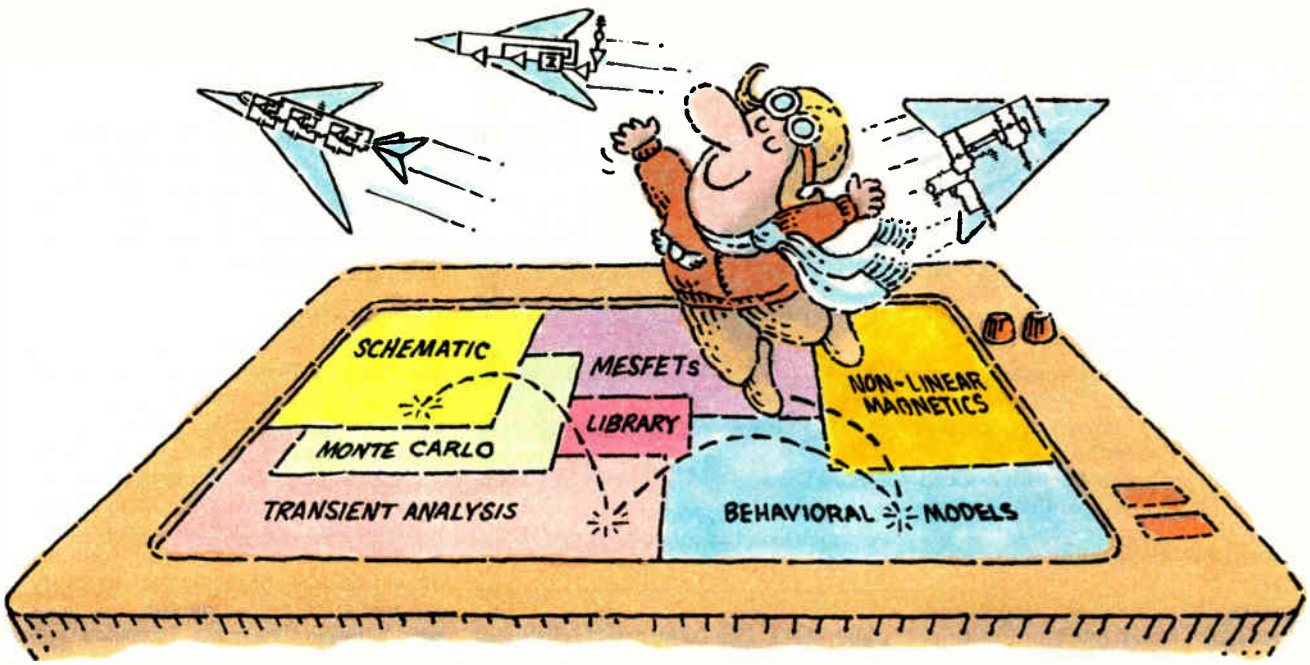
While hardware handshaking is the normal mode for the serial ports, a DIP-switch setting will let you configure the ports for XON/XOFF handshaking. Unfortunately, all the ports must use the same handshaking scheme. The Lasernet accepts certain embedded commands (from the print data stream) for altering the time-out, selecting the output printer, printing multiple copies, and other operations.

Western Telematic includes a disk with several utilities to support the unit. The Lasernet utility can change the default parameters (primarily the communications parameters), but it incorrectly identified my default port setting as 9600 bps when I had set it to 19,200 bps. It did make requested changes properly, but parameter changes are only valid until you shut off the power; the default DIP-switch settings then become active again.

MultiSpool

The stand-alone MultiSpool 2289A from Extended Systems includes a 1-MB buffer memory. Like the Lasernet, it can support a serial printer and a parallel printer (using PC standard DB-25 connectors), as well as a maximum of eight computers. Also, MultiSpool uses DIP switches to determine the power-up default operating parameters; it is limited to 19,200-bps serial operation; and it comes with no cables. It does, however, have many distinguishing features, including its small size. It is roughly one-third the size of the Lasernet, due in part to its external transformer.

But MultiSpool's most notable features relate to its computer connection schemes. Extended Systems sells varying-length cables with an RJ-45 connector on each end, ranging from 25 feet to 100 feet in length, with special orders accepted for lengths of up to 500 feet. The standard 50-foot cables I used cost $25. One end of the cable simply plugs into one of the mating RJ-45 connectors at the



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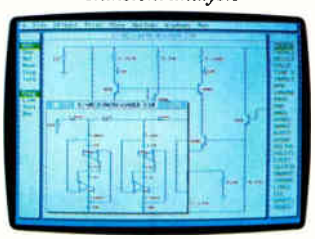

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rear of the MultiSpool. The other cable end attaches to your computer using either a serial or a parallel adapter. To connect to a standard 25-pin PC serial port, you use an ESI-7000PC adapter ($20), and to connect to an AT's 9-pin serial port, you use an ESI-7000AT adapter ($20). If you wish to connect to your computer's parallel port, you must buy an ESI-7000TX transmitter interface ($60) to take advantage of the company's proprietary ExtendedLink technology. The ExtendedLink adapter converts the parallel port to a high-speed serial link (at 23,000 bps) that is transparent to your computer's operation and allows reliable communications to up to 500 feet.

For RS-232 serial communications, you can individually configure each input port with DIP switches to operate at 9600 or 19,200 bps, and each port automatically handles both hardware and XON/XOFF handshaking. The unit defaults to a 20-second time-out period, but you can change this by sending commands to the unit via the PC's printer port. These changes, however, are only in effect as long as power remains applied. Like the Lasernet, MultiSpool also supports other commands to select the output printer and lets you print multiple copies.

MultiSpool's adapters allow any combination of serial and parallel connections among its input channels.

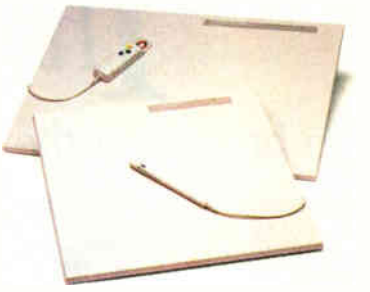
You must purchase the required RJ-45 cables and adapters with MultiSpool to form a useful printer-sharing device. With these adapters, the device becomes a flexible system that allows any combination of serial- and parallel-port connections, and it supports long-distance data transfers at high speeds (see the photo). At $995, this device is not inexpensive, especially when you add the special cables and adapters. But it provides exceptional flexibility.

Flexibility Pays

These three printer-sharing devices are reliable, and they work as advertised. For LaserJet users who can accept a five-user limitation, Pacific Connect clearly offers the most bang for the buck. In the higher-cost, stand-alone arena, the Lasernet provides basic no-frills operation with standard interface connectors, but it offers little to help it stand out from the crowd. Because of its greater flexibility and the ability to operate long distances even with parallel ports, Extended Systems' MultiSpool 2289A is the clear winner. ■

Roger C. Alford is president of Programmable Designs, a Michigan-based consulting firm, and author of the Programmable Logic Designer's Guide *(Howard W. Sams, 1989). You can reach him on BIX c/o "editors."*

THE FIRST.



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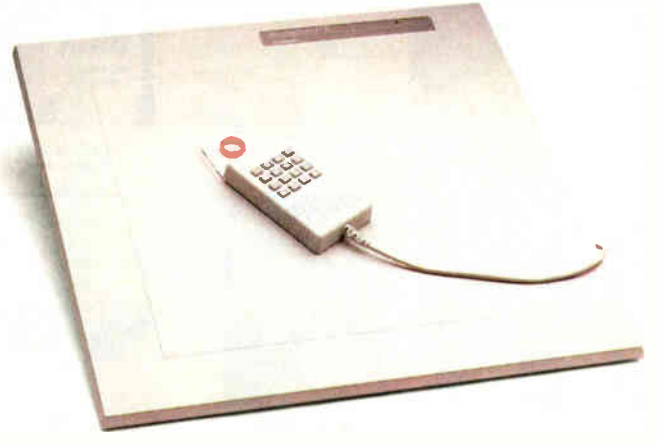

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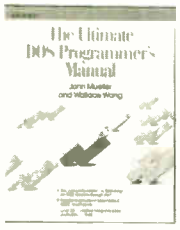

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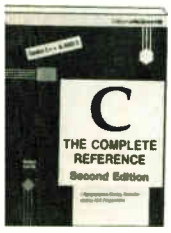

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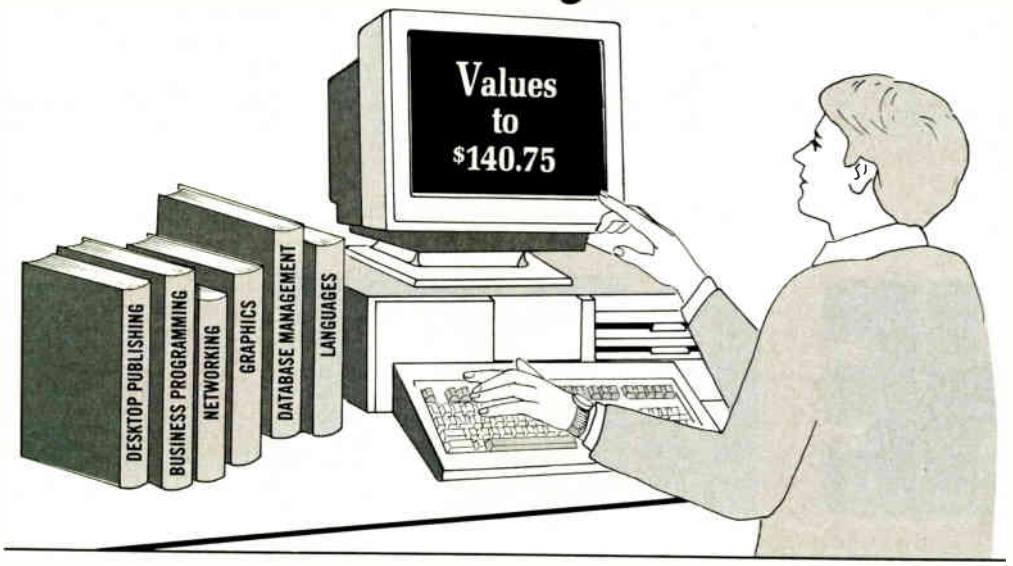

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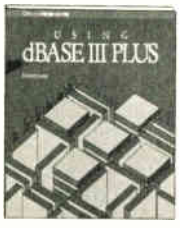

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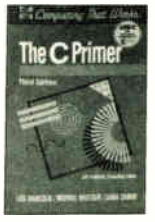

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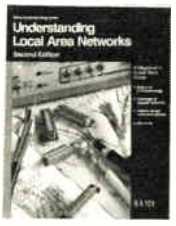

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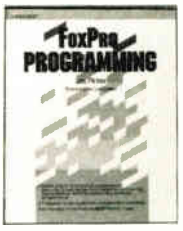

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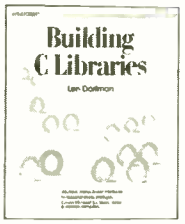

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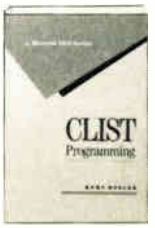

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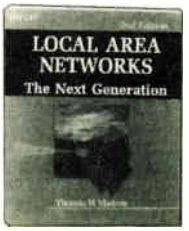

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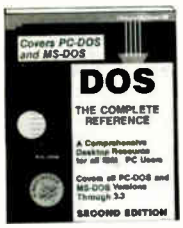

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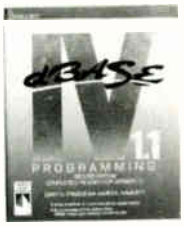

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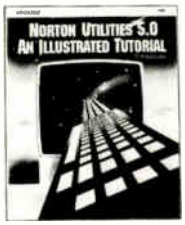

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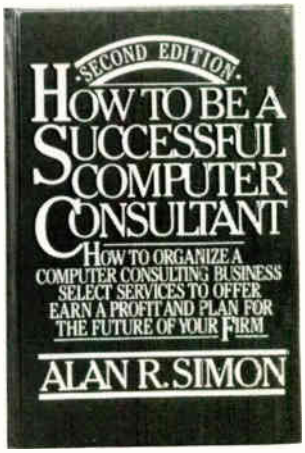

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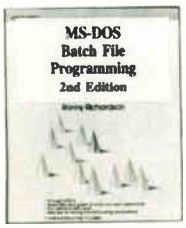

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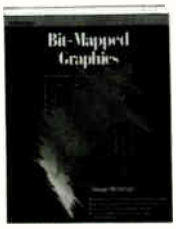

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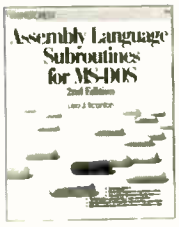

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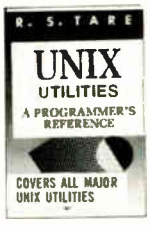

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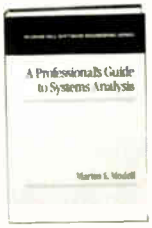

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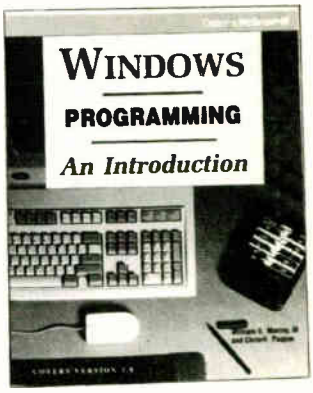

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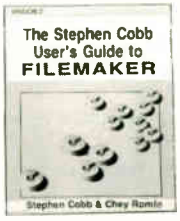

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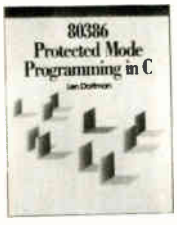

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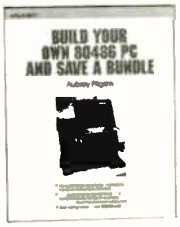

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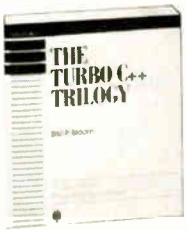

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HARDWARE

Color Printing, Diconix Style: Vibrant but Slow

ALAN JOCH

Kodak's Diconix Color 4 ink-jet printer offers paper-handling versatility and rich colors for business presentations.

BYTE ACTION SUMMARY

- **DICONIX COLOR 4 PRINTER**
- **WHAT YOU'LL LIKE**
  Attention-getting and affordable color for your overhead presentations, business documents, and schematic diagrams.
- **WHAT YOU'LL DISLIKE**
  Slow print speed and imperfect color reproduction.
- **WHAT WE RECOMMEND**
  The Diconix Color 4 is an easy-to-use printer that produces quality output. But with its faster speed and lower price, the Hewlett-Packard PaintJet remains our first choice.
- **WHAT YOU'LL PAY**
  PC version, as tested: $1495; Macintosh version: $1595
- **FOR MORE INFORMATION**
  Eastman Kodak Co.
  Printer Products Division
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  Rochester, NY 14653
  (800) 344-0006
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In the battle for the eyes and minds of harried business people, desktop presentations rely on color as an essential tool. Ink-jet printers remain one of the most economical means of producing color transparencies and handouts, and Hewlett-Packard's PaintJet has carved out an appealing $1400 price point in that market.

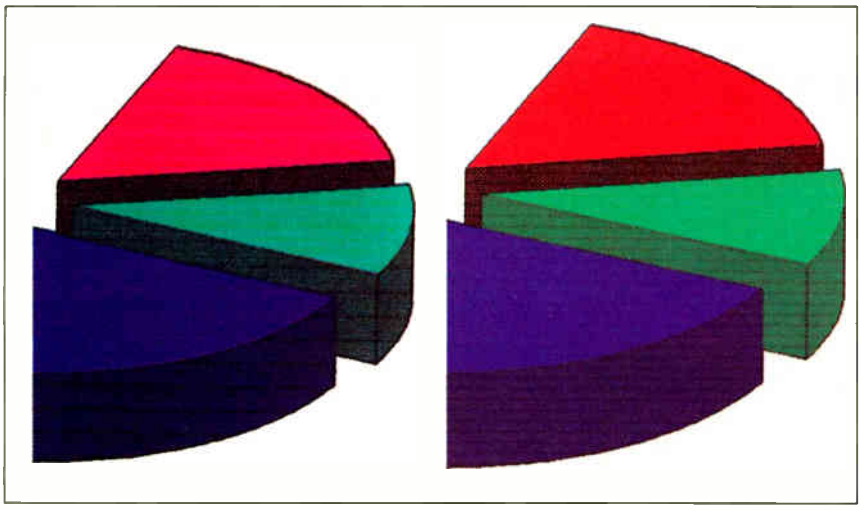
Now Kodak has entered the competition for those who covet color with the Diconix Color 4, a desktop addition to the successful line of portable Diconix printers. At $1495, the Color 4 is $100 more expensive than its main rival, but Kodak has imbued the new printer with standard features that make it more versatile than the PaintJet, including a 50-page paper bin to augment the built-in tractor feeder. Unfortunately, the Color 4 can be excruciatingly slow.

Nevertheless, this is a well-designed printer. Its sleek, rounded-wedge shape lends a modern and unobtrusive profile to the desktop. The Color 4's silence while printing is a pleasant surprise: The advancing paper platen is the only sound you'll hear. The LED interface and the menuing system let you quickly select among resolutions, fonts, and media. In addition to Color 4–specific drivers, the Kodak printer emulates the PaintJet.

Easy setup is another plus. Color ink-jets conjure up installation nightmares thanks to ink cartridges that require priming and cleaning. The Color 4's cartridges need very little fussing. However, to prime them the first time, you must insert a straightened paper clip through a small hole in the cartridge and compress an ink bladder so that some drops squeeze through the nozzle. I pictured a disaster, and magenta-stained hands, as I gingerly poked at the bladders and wondered how much stress they could take. In the end, I suffered no mishaps, even when I punched the bladder harder than necessary for priming. The inks are not water-based and are permanent when dry. They refused to smear even when I repeatedly marked an image with an underliner or rubbed it with a moistened finger.

The Color 4 relies on four ink cartridges: yellow, cyan, magenta, and black. The PaintJet uses one black and one color cartridge. Thus, the Color 4 can save you some money if one color dominates your work. Replacements cost $14 for black and $20 each for the three colors. Kodak rates each cartridge at a maximum of 500 pages.

After installing the ink cartridges and



The Diconix Color 4 produced bold but slightly off-register colors in the pie chart on the left. The Hewlett-Packard PaintJet printer (right) produced the same chart a minute faster.

a cleaning blotter, I merely connected the 8-bit Centronics cable and inserted the ROM card that holds a Microsoft Windows driver and other system information. (Kodak markets a version for the Macintosh with an RS-232 seven-eighths serial interface and cable for $1595.)

The standard 50-page paper bin means you can easily feed cut sheets and transparencies through the Color 4. By contrast, the PaintJet comes only with a tractor feed, so if you're printing cut sheets, you must manually insert them a page at a time. The Color 4 handled both types of paper without jams. Similarly, transparencies fed through the paper bin and printed without incident. The printer produced fine results on 20-pound copier paper, although colors looked even crisper when printed on specially coated inkjet paper.

Using the front-panel menu, you can select three fonts: Prestige, in 10 and 12 characters per inch, and 18-cpi Gothic. You can print each in draft, near-letter-quality, and quality resolutions (96 by 96, 96 by 192, and 192 by 192 dots per inch, respectively).

Performance Tests

To test the Color 4's speed and quality, I printed a series of color graphics and text files. I first generated a color graphics file produced with CorelDraw 2.0 and converted to a 42K-byte PCX file. Using Excel 3.0, I produced a color bar chart and a color pie chart, both of which included text and numerals. DesignView 2.0 enabled me to print a schematic

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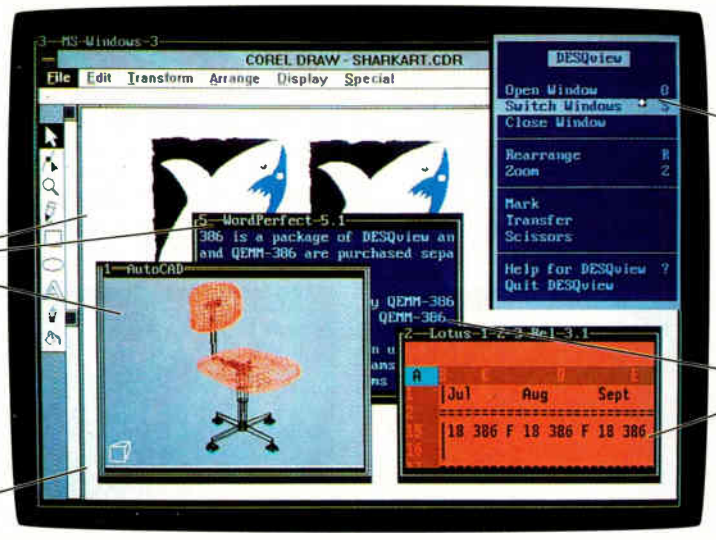

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DESQview 2.3 gives 8088, 8086 and 286 PCs with additional memory most of the same capabilities with surprisingly little performance trade-off.

Whatever programs you use—DOS, extended DOS or Windows—and whatever hardware you have, whether 8088 or i486 or something in between, DESQview is still the best way to get the most out of the hardware and software you own today.

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drawing and specifications for a crane arm, a job designers might typically use a lower-resolution plotter for instead. Finally, I printed some text-only files from XyWrite III Plus, primarily to test for speed. I produced the same output on the PaintJet. In both cases, the tests used coated ink-jet paper, ink-jet transparency media, and 20-pound copier paper. None of the Color 4 tests uncovered any problems emulating the PaintJet.

The most obvious performance difference between these printers is speed. In quality mode, the Color 4 plods along, slowly applying ink in each bidirectional pass of the ink cartridges. The print head then stops, waits for the paper to advance a line, and makes another pass. The PaintJet prints at a steadier pace without a series of starts and stops.

My time tests gave numbers to my frustration. For example, the Color 4 needed an average of 2 minutes, 40 seconds to print the CorelDraw file; the PaintJet zipped out the same image in an average of 1 minute, 30 seconds. Similarly, the Color 4 produced the Excel charts in 2 minutes, 26 seconds and 2 minutes, 28 seconds, respectively. The same charts with the PaintJet: 1 minute, 31 seconds and 1 minute, 27 seconds. Although most people probably wouldn't buy either model to print straight text, the XyWrite tests show that the occasional quality-resolution business memo could be a painful experience with the Color 4. Single text pages averaged 2 minutes, 46 seconds compared to just 50 seconds by the PaintJet.

To its credit, the Color 4 produced chart colors that were richer and more vibrant than the PaintJet's (see the figure). The color richness was especially impressive when I displayed transparencies of the Excel charts with an overhead projector. Under the glare of the projection lamp, the PaintJet charts appeared to be washed out, with weak colors. By contrast, the Color 4 charts and text looked bolder and more eye-catching.

However, a couple of minor flaws lead me to dock points from the Color 4. On the transparency material, some distracting bands in the solid-fill areas detracted from the overall look. In some cases, the register was off slightly, so a faint edge of color appeared beyond black border lines in the Excel pie chart. And in the CorelDraw image, a custom red came out with too much purple and looked less like the original than the PaintJet's output did. If color accuracy is of prime importance to you, these problems may be serious, but for those who use the Color 4 for presentations and who value vibrancy over accuracy, these may be minor flaws.

Color Champ

As a newcomer to an established market, the Color 4 has a tough job cracking through the competition. With this printer, Kodak has made a fine effort to design a more versatile, easier-to-use alternative to the PaintJet.

In the end, however, as much as I like the Color 4's interface and print quality, I still prefer the PaintJet. It's faster and its color reproduction is truer, and although the difference is small, the PaintJet costs less. Unless Kodak offers some more compelling reasons to switch from the market leader, the PaintJet remains my first choice. ■

Alan Joch is a technical editor with the BYTE Lab. He can be reached on BIX as "ajoch."

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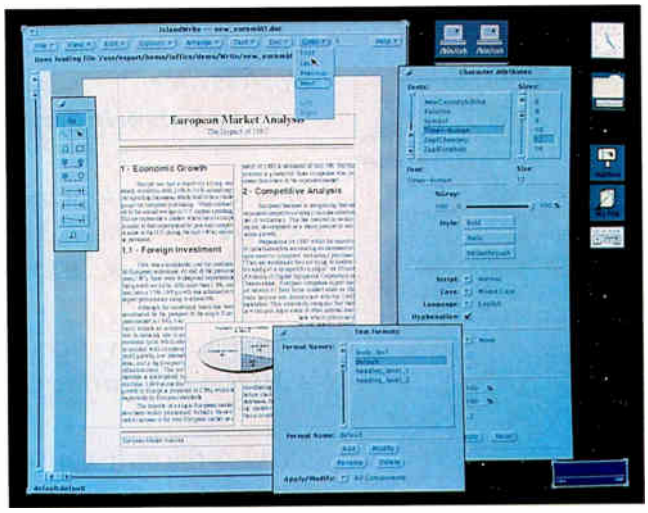
IslandWrite, IslandDraw, and IslandPaint Offer an Isle of Productivity

PC users have it made. The PC has been a general market force for so long that software has stratified nicely into the low end, midrange, and high end of price and capability. Unix workstations, by comparison, are just coming into their own as general-purpose systems. The majority of software in that market is still priced high, with features targeting the most demanding users. While this feature-rich environment is part of what makes Unix attractive, it can also be frightening for those who aren't power users. Falling workstation prices have resulted in the placement of Unix systems on desks that were once the exclusive domain of PCs and Macs. Unfortunately, software has been slow to keep pace; most prices are still high, and most workstation software is still best suited for power users.

IslandWrite, IslandDraw, and IslandPaint, an integrated desktop publishing and graphics package from Island Graphics, is the epitome of the perfect fit. The philosophy behind this bundled trio of applications is this: Users of workstations often need to generate documents and graphics, even though the generation of such material is not their main job. Why spend hours learning an intricate document preparation system when all you need is a proposal or a letter? Furthermore, why pay for capability that you probably won't ever use?



IslandWrite's Open Look interface is typical of the group: attractive and functional.

I worked with version 2.3 of IslandWrite, IslandDraw, and IslandPaint on two SPARC-based systems: a Sun IPC and an Opus PM5000. Both are SPARC-1 machines with roughly identical performance. I used the Open Look version of the software, which ran in color under Open Windows 2.0 and SunOS 4.1.

IslandWrite

Thanks to their Open Look appearance, all three Island applications look sharp and share a common feel (see the photo). From my point of view, though, IslandWrite is the star of the bundle. Any user who feels squeamish about workstations will be immediately calmed by IslandWrite's friendly manner.

If its function had to be identified, IslandWrite would come out somewhere between a WYSIWYG word processor and a desktop publisher. Like a word processor, IslandWrite is easy to learn and use and is built for speed: a first-time user can create and print a memo or fax document in about 5 minutes without using templates. Like a high-end desktop publisher, IslandWrite can do indexes and tables of contents, handle multiple master pages, and perform layout wonders like flowing text around irregularly shaped graphics. By taking a little while longer to run through the 38-page tutorial, most users are ready for practically anything.

I am amazed that IslandWrite's designers have managed to build a simple document-preparation program without sacrificing functionality. When I first approached IslandWrite, I expected it to be full of holes because of its price and target audience. The more I worked with it and learned about it, however, the more I realized it isn't kid's stuff. In over a month of tests, I found only a few nitpicking things that IslandWrite can't do. It is just good software.

Even with its simplicity, I can only begin to describe IslandWrite's myriad features here. IslandWrite's basic layout building block is the *container*. These are objects, as are most document elements throughout the Island series. As objects, containers have attributes and data associated with them. A container can hold text or graphics and can be any shape, although a rectangle is the most common one. Text flows according to connections between containers; for example, an ar-

BYTE ACTION SUMMARY

- **ISLAND PRODUCTIVITY SERIES 2.3**
- **WHAT YOU'LL LIKE**
  The Island Productivity Series—IslandWrite, IslandDraw, and IslandPaint—is an excellent value at $995. It has the power to produce all but the most demanding publishing projects.
- **WHAT YOU'LL DISLIKE**
  Some bugs in the interface; importing and exporting graphics isn't easy.
- **WHAT YOU'LL PAY**
  $995 (single-user, node-locked license; other plans available)
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  San Rafael, CA 94903
  (800) 255-4499
  fax: (415) 472-0335
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ticle on page 1 can automatically flow to page 3 if that's your layout preference. Page layouts can be stored as *formats*, IslandWrite's master pages mechanism. A number of these pages can be stored and tagged according to left- or right-side placement. As you enter text, you can add new pages to a document automatically, or you can add them manually by selecting the desired format page.

From a user-interaction standpoint, IslandWrite is nicely done. Open Look's pushpin facility is used liberally; you can tack your most-used menus and dialog boxes onto the root window to create a sort of control panel. Aside from the interactive aspects, IslandWrite also has a markup language. Unfortunately, this language isn't documented; the only way to learn about it is to put together sample documents, request that they be saved as marked-up ASCII, and study them. Even though this is unacceptable to me, I was able to produce a sed script that used IslandWrite's markup facility to create attractive, three-column proofs of BYTE articles. But Island Graphics should have made markup language information more accessible.

IslandWrite's few other deficiencies are related to its environment. It uses Sun's scalable font mechanism, which produces hard-to-read text at small point sizes. The default page size and font are unacceptably small and squinty for interactive work. But the scalable fonts and zoom mechanism allow IslandWrite to run on workstations with limited display sizes. The downside of its scalable fonts, aside from their poor quality at low point sizes, is their inability to run on certain X Window System servers. When I used IslandWrite to test the X terminals in this month's group review (see page 238), I found one terminal that failed to display IslandWrite's fonts properly. Some other minor problems were related to Open Look/Open Windows: the barely visible text cursor in some dialog boxes and the occasionally unintuitive behavior (e.g., the Return key failing to activate a dialog box's OK or other main button). Although these problems will probably be solved in future releases of Open Windows and IslandWrite, they do not impede the user very much now.

IslandDraw and IslandPaint

The other two packages in the bundle are hardly incidental, but neither impressed me as much as IslandWrite did. IslandDraw creates polygon-based drawings, graphs, and charts. Basic drawing tools, including Bézier curves, can be combined to create drawings of simple to

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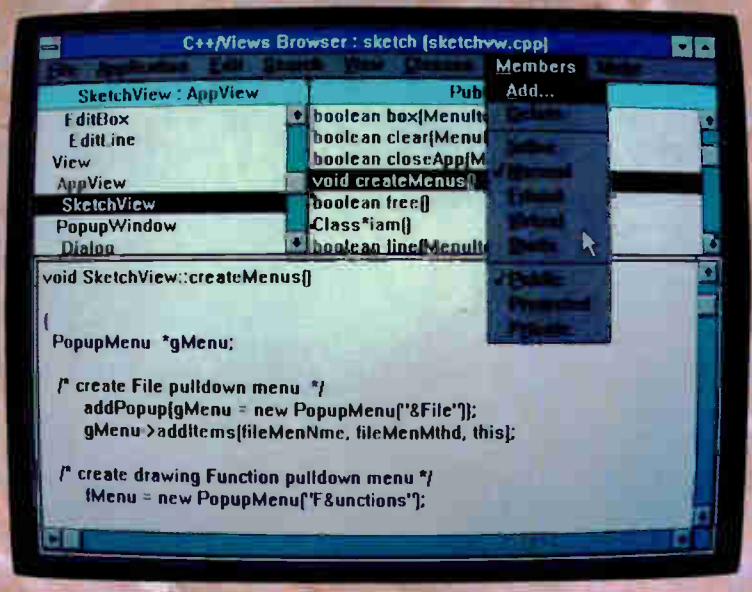

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moderate complexity. IslandDraw treats each polygon and text string as an object with a user-definable stacking order and set of attributes. Its precision and power are sufficient for charts, graphs, and presentation artwork, but it isn't CAD—it won't put CAD software makers out of business. The manual's tutorial works up a floor plan, which is a bit misleading, because IslandDraw is not a CAD package. Still, IslandDraw can pull it off. It excels at combining spline-based and polygonal graphics with shading and scalable text to produce knockout report and presentation graphics. If I had a set of transparencies to produce, IslandDraw would be my tool of choice.

In the hands of those who have little or no artistic talent, as in my case, IslandDraw is a boon. It keeps your lines straight and makes sure your boxes meet at the corners. If you can draw, IslandPaint gives you the raw materials to create freehand illustrations of surprising quality. IslandPaint contains the typical paint-package mix of brush, pattern, and polygon tools. If you need to import graphics, IslandPaint will read PostScript, Group 3 fax, MacPaint, Sun raster, X11 bit-map, and X11 window dump formats.

A Matched Set

The strength of these three publishing tools lies in working as a team. Drawings from IslandPaint and IslandDraw can be loaded into an IslandWrite container, cropped, and scaled. The programs all output PostScript (no other printer support is provided) and can, therefore, be integrated into existing Macintosh networks. PostScript-format file-saving capability permits other applications that read Encapsulated PostScript to use Island-produced graphics and finished pages. My tests proved that this works, but with a catch: Saving an Island drawing or page as an EPS file creates valid EPS code, but it includes a strange binary header that must be stripped before it can be used in another application.

I had trouble in general with the EPS import/export capability. IslandDraw refused to load EPS files that printed perfectly and displayed on the Open Windows `pageview` PostScript previewer. I notified Island Graphics of the problem, but apparently the company hadn't encountered it before. The problem may have been due to an error on my part, although we could not identify it; the import, export, and convert capabilities of the Island programs were the hardest for me to understand.

Still, I consider IslandWrite, IslandDraw, and IslandPaint to be an incredible package value at $995. I breezed through the tutorials and quickly cranked out documents that impressed even the Unix nonbelievers on BYTE's staff. It isn't completely perfect, but everything is perfectly usable. The Island applications stand as excellent examples of the versatility of the Open Look user interface with its pushpins for menus and dialog boxes and its drag-and-drop interface. The combination of this interface and the trio of integrated publishing tools that make up the Island Productivity Series is enough to make even Mac users a little envious. ■

—Tom Yager

Reviewer's Notebook provides new information—including version updates, new test data, long-term usage reports, and reader feedback—on products and product categories that have been previously reviewed in BYTE.

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PACKET DRIVERS

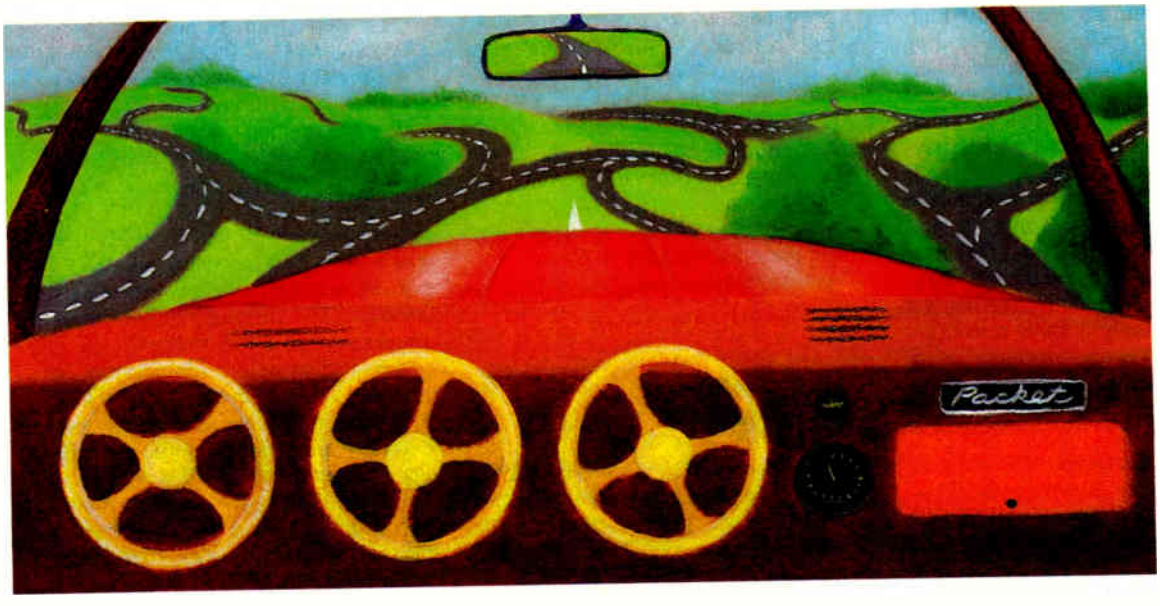


ILLUSTRATION: PAUL COZZOLINO © 1991

Device-independent protocol multiplexing in the public domain

If you follow networking, you've heard a lot about the Network Driver Interface Specification and the Open DataLink Interface (see "Mix-and-Match Network Adapters," August 1990 BYTE). When network software uses protocols that conform to NDIS or ODI, those protocols can ride on top of any network adapter for which a corresponding NDIS or ODI driver exists. Conversely, adapter makers do not need to write and maintain separate drivers for each network product. Multiple protocols, moreover, can share the services of an adapter. All in all, these specifications yield tremendous benefits.

You may not have heard much about an alternative grass-roots effort that predates NDIS and ODI: the packet driver specification. This specification was originally written in 1986 to enable FTP Software's PC/TCP to coexist with a proprietary LAN system. It was enhanced and then released to the general public. Volunteers write drivers for various cards and contribute the drivers to users through Clarkson University and FTP Software.

The "Clarkson collection," which consists of drivers and documentation, is available from several sources. It includes a variety of standard Ethernet drivers (e.g., for 3Com, Novell, InterLan, Tiara, and Western Digital). It also includes more exotic packet drivers: one for serial-line internet protocol and two piggybacking drivers that send IP packets by way of IPX and NetBIOS, respectively. To find out where to get copies of the drivers and the specification, see the text box "How to Get Packet Drivers" on page 298. For a list of adapter cards with existing packet drivers, and for network software products that support the packet driver, see table 1.

All network software products can potentially use packet drivers, but you've got to rewrite the protocol stack driver interface so it can talk to the packet driver interface. FTP Software's PC/TCP, of course, speaks packet driver, as do many of the other TCP implementations for DOS (e.g., Wollongong Group's WIN/TCP, Phil Karn's KA9Q TCP/IP, and Sun Microsystems' PC-NFS). NetWare users have relied on a packet-driver-compliant IPX shell that was developed at Brigham Young University. Thanks to that effort, users at BYU and around the world have been running TCP/IP and NetWare concurrently on DOS workstations since 1988, although Novell's own ODI-based solution has appeared only recently.

Version 2 of the BYU shell is freely available, but the newly developed version 3 is not. That's because Atlantix (formerly CocoNet) has licensed it for use with its Axcess server—an SMB/NetBIOS implementation for Unix. Atlantix's use of packet drivers and the BYU shell demonstrate the generality of the packet driver specification. Although they were invented to simplify FTP Software's adapter support chores and were

subsequently used to enable TCP/IP-NetWare coexistence, packet drivers can be used in all sorts of applications. With Axcess, for example, DOS workstations can simultaneously converse with NetWare servers (using the BYU shell) and Unix-, DOS-, or OS/2-based SMB/NetBIOS servers (using Atlantix's packet-driver-compliant NetBIOS).

Note that packet drivers are distinctly DOS creatures. Theoretically, you can pile on protocol after protocol, but in practice, you'll run up against the real-mode 640K-byte ceiling. High-loading memory managers can offer some relief, and Windows and other DOS-extended applications running in extended memory can use the services that packet drivers provide, but the existing drivers (and, currently, most of the protocols that ride on top of them) operate only in real mode. You may find, therefore, that once you have loaded TCP/IP and NetWare, there is little elbow room remaining. Of course, that's simply a DOS restriction that network software products using packet drivers, NDIS, and ODI share equally.

Using the Specification

With a packet driver, as with an NDIS or ODI driver, protocol stacks gain device independence and the ability to coexist with other protocol stacks. Tailoring a protocol stack to use the packet driver interface is straightforward. Protocol stacks have always had to support lots of network cards, so they typically already have a well-defined software interface for calling drivers. Supporting the packet driver is then simply a matter of mapping that interface to the packet driver interface. According to BYU's Kelly McDonald, it was easy to convert one of the sample hardware-coupled IPX drivers included with Novell's adapter driver kit into a hardware-independent IPX packet driver.

It's trickier to write board-level drivers that present a packet driver interface if only because writing *any* device driver is a tricky undertaking. The breadth of the Clarkson collection is a testimony not only of the ingenuity and dedication shown by the volunteers who contributed to it, but also of the scope of the problem that the packet driver specification solves. Moreover, not all packet drivers represent the effort of volunteers, because it is largely in the interest of board vendors to write packet drivers, too. Packet driver support has to mean, among other things, that even new versions of the vendors' adapters will work with existing applications.

The packet driver doesn't allow two instances of the same protocol stack to access the driver at the same time. You can't, for example, use a public domain TCP and a commercial one on the same system at the same time.

The packet driver also doesn't make software independent of the network media. The protocol stack still has to be customized for Ethernet or Token Ring or whatever the specific type of medium is, because different media require different packet-header formats, translation techniques, and network station addresses. TCP/IP uses 32-bit logical addresses that are unique in the TCP/IP Internet, and these addresses must be mapped to the host's hardware address. Other protocol stacks use different representations of network addresses.

The algorithm for mapping the address varies depending on the network media. While a packet driver could build the hardware-level headers for the application (although it doesn't), it wouldn't be realistic to expect it to translate addresses. That approach would limit its flexibility, as different protocol stacks may use different addressing schemes and translation algorithms.

Novell's ODI differs from the packet driver in that it builds hardware headers for its client protocol stacks. However,

BYTE ACTION SUMMARY

Network interoperability often hinges on the ability to run several protocols at once. Although new driver specifications from Microsoft, 3Com, and Novell now support protocol multiplexing, freely available packet drivers that achieve the same effect have been around for several years.

How to Get Packet Drivers

The Clarkson collection of packet drivers is available through anonymous FTP, archive server, the Clarkson Heath User's Group BBS, BIX (protocols conference), and surface mail. DRIVERS.ARC is executable only; DRIVERSS.ARC contains source code. The FTP location is:

sun.soe.clarkson.edu:
/pub.ka9q/drivers.arc

or

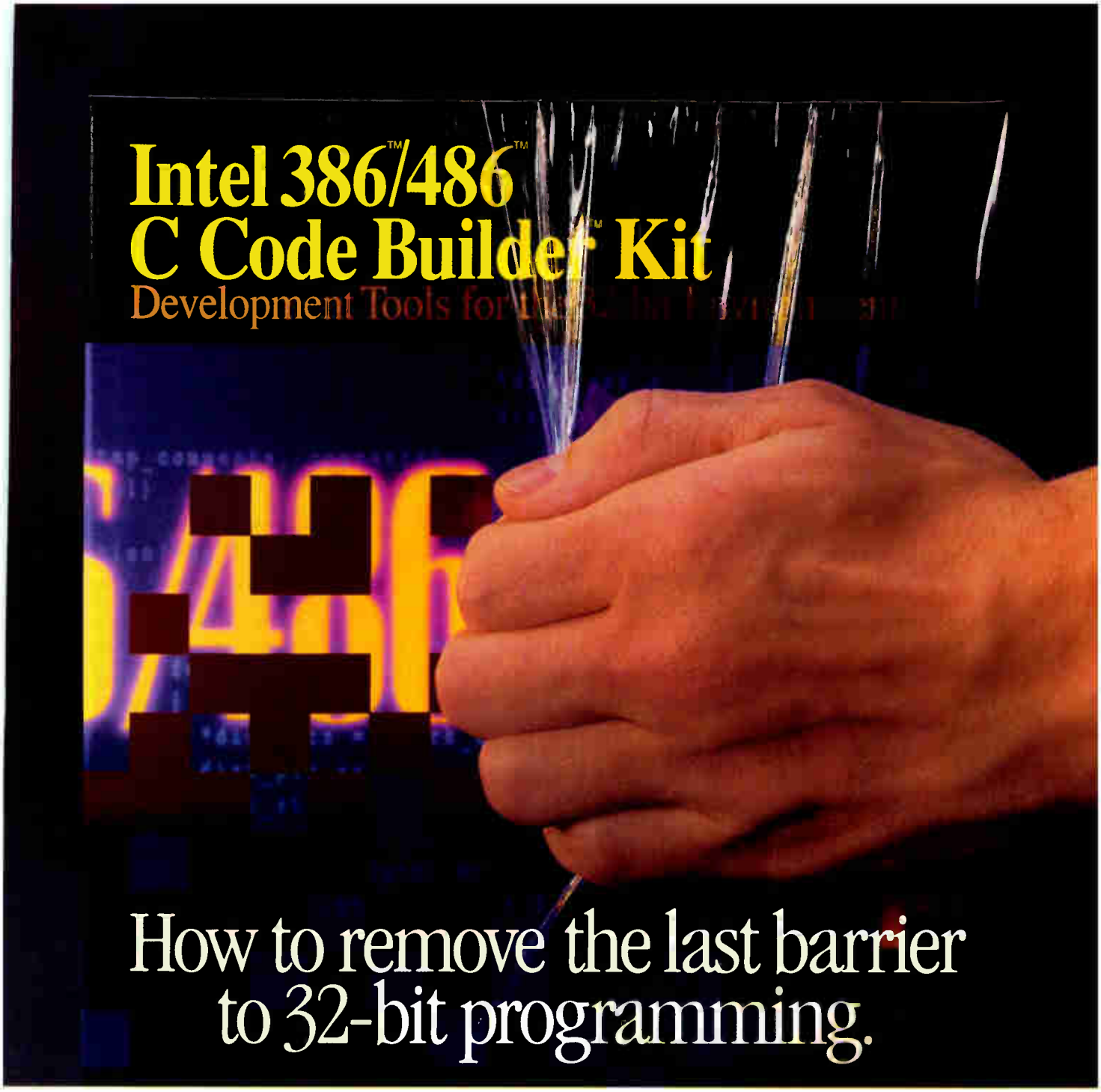
grape.ecs.clarkson.edu:
/e/tcpip/drivers.arc

To retrieve drivers from the archive server, send mail to archive-server-@sun.soe.clarkson with *help* as the body of the message. This sends a help message with further instructions.

The BBS is up 24 hours a day at (315) 268-6667 at 1200/2400 bps with 8N1 format. The drivers are DRIVERS.ARC in file area 24.

For surface mail, send a check for US$20 or a purchase order (which will be billed for US$22) to Russell Nelson, 11 Grant St., Potsdam, NY 13676. The drivers are available on 5¼- or 3½-inch disks. New York residents must add 7 percent sales tax; overseas orders must include US$3 for shipping and make checks payable in U.S. dollars.

The packet driver specification is available via anonymous FTP from FTP Software in vax.ftp.com:/pub/packet-d.ascii. (Other interesting files, including a packet-driver-to-NDIS converter, are in the directory vax.ftp.com:/pub/packet.driver.) If you don't have anonymous FTP capability, call FTP's sales department at (617) 246-0900.



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PACKET-DRIVER-SUPPORTED HARDWARE AND SOFTWARE

Table 1: *Adapter cards with existing packet drivers are listed below. Many free and commercial network software products support the packet driver.*

Adapters with packet drivers:

3Com's 3C501, 3C503, 3C505, 3C507, and 3C523
Any SMC-mode ARCnet card
Telesystems SLW's radio modem
Any AT&T Ethernet or StarLAN card
D-Link Systems' DE-600 Pocket LAN Adapter
Simulated driver over NetWare's IPX
BICC Data Networks' ISOLAN
Apple Computer's LocalTalk PC Card
Sun/TOPS (Sitka) FlashCard
Simulated driver over NetBIOS
NCR's ET-105B
Novell's NE1000, NE2000, and clones
Racal-InterLan's NI5010, NI5210, NI6510, and NI9210
SLIP, using the PC's 8250 serial chip
Ungermann-Bass's NIC and NICps/2
All Western Digital's models

Freely available software that supports the packet driver:

NCSA Telnet
Clarkson NCSA Telnet
Phil Karn's KA9Q TCP/IP (freely copyable only for radio amateurs and educational institutions)
Harvard PC-IP
BYU's IPX packet driver
PCROUTE
Joe Doupnik's version of MIT's NETWATCH
SOS NFS Server
PC-NFS drivers (requires Sun's PC-NFS)

Commercial software that supports the packet driver:

Atlantix's Axcess
FTP Software's PC/TCP
Sun Microsystems' PC-NFS
Wollongong Group's WIN/TCP
Gateway Communications' packet driver
D-Link Systems' D-Link Ethernet card packet driver
Beame & Whiteside Software's BWNFS and Telnet packages
Wiscware's MS-DOS/IP
Cabletron Systems' Ethernet card packet driver

ODI doesn't do address translation, so applications that use it still must retain some media-specific knowledge.

How Packet Drivers Work

The packet driver interface revolves around a software interrupt that network applications call to perform a variety of functions: getting information about the network interface, transmitting packets, and registering to receive packets, for example. You load a packet driver first and then one or more protocol stacks that use it. Here's a sample AUTOEXEC.BAT fragment that illustrates the process:

```
wd8003e 0x72 5 0x240 0xd000
ethdrv
ipx
```

The first line loads the Clarkson University packet driver for the Western Digital WD8003E Ethernet card; the second line loads the FTP Software PC/TCP kernel; and the third line loads the BYU packet driver NetWare shell. All establish themselves as TSR programs.

The packet driver presents a software interface to the network adapter in much the same way as DOS presents a software interface to a hard disk. Disks have several common operations: read a sector, write a sector, and get the disk's characteristics. Similarly, the packet driver provides for the common network adapter operations.

What Networks Look Like to Software

The basic unit of data on a network is a packet, conceptually not unlike a disk sector. You can write a sector to a disk regardless of what's in the sector—a file, a part of a directory, whatever. You can also write a packet to an Ethernet regardless of what's in the packet; it's up to the receiver to figure it out.

To help the receiver, most networks have a way of providing a packet-type indication. On DEC-Intel-Xerox Ethernet, each packet has a 16-bit Type field; on IEEE Ethernet, each carries a Service Access Provider (SAP) field. TCP/IP always uses DIX formats on Ethernet.

Each computer on a network has a network address; address lengths vary depending on network type. Some networks support broadcast packet transmission, wherein a packet goes to all computers on the network. Some support multicast, which is a restricted broadcast to a subset of nodes. (Typically, the subset has its own special network address.) And some support *promiscuous mode*, in which the device is programmed to receive all packets regardless of their destination. This mode is used primarily by network monitors and analyzers.

Multicast reception tends to work in one of two ways. One approach is that you can often program the network interface with a set of multicast addresses that it should listen for. That way, the software doesn't need to verify the addresses. The disadvantage of this approach is that hardware usually has small, fixed tables that allow only a certain number of multicast addresses to be listened for.

The other approach is that the interface can pass all multicast packets up to the software driver and have it screen out the addresses. This is rather like receiving broadcast packets, except that the extra overhead of screening out the undesired packets is incurred only by hosts using multicast and not by every host on the network.

Some software also needs to be able to set the address of its network interface. Most network (and all Ethernet) interfaces come with a globally unique

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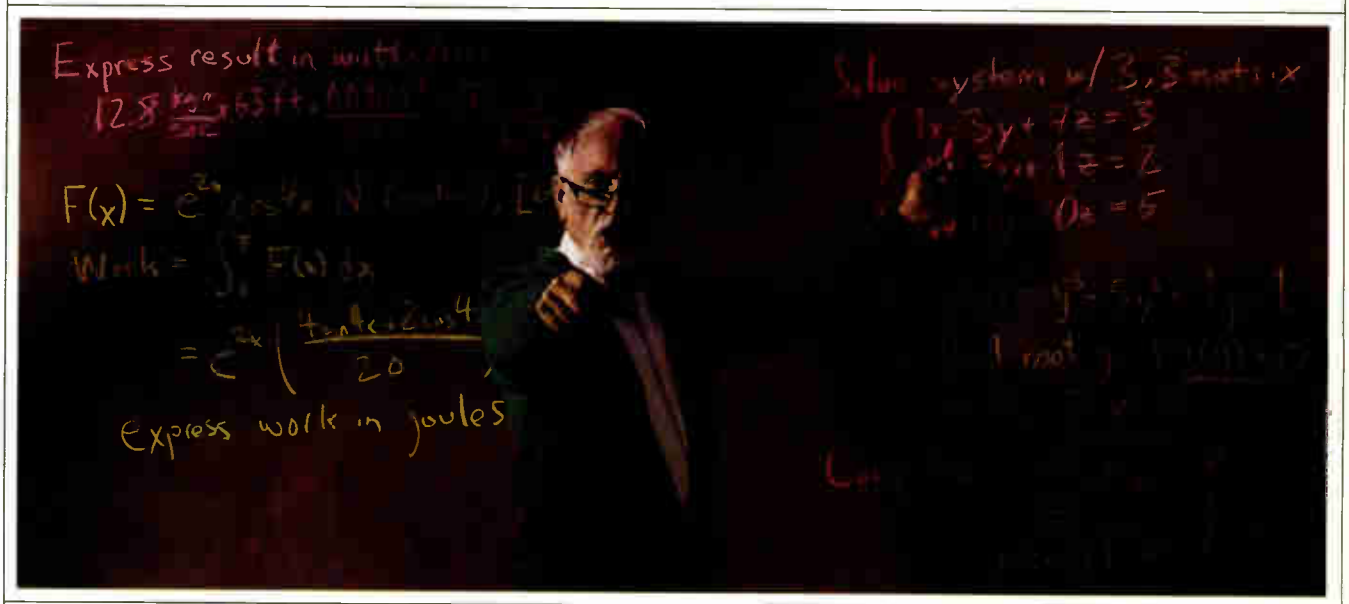

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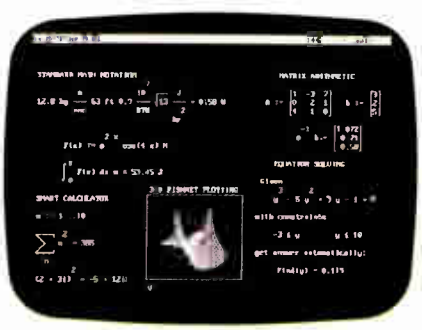

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PACKET DRIVER CALLING CONVENTIONS

Table 2: *All packet driver calls enter with the function number in register AH and return with the carry flag set to indicate error. The error code is in register DH in that case.*

driver_info
IN
AH 1
AL 255
OUT
AL functionality
1 basic
2 extended
5 high performance
6 high performance and extended
255 not installed
BX version
CH class
CL number
DX type
DS:SI name

access_type
IN
AH 2
AL class
BX type
CX type description length
DL number
DS:SI type description
ES:DI receive handler
OUT
AX handle

release_type
IN
AH 3
BX handle
OUT
no returns

send_pkt
IN
AH 4
CX length
DS:SI packet
OUT
no returns

terminate
IN
AH 5
BX handle
OUT
no returns

get_address
IN
AH 6
BX handle
CX buffer length
ES:DI buffer for address
OUT
CX length of address

reset_interface
IN
AH 7
BX handle
OUT
no returns

get_parameters H
IN
AH 10
OUT
ES:DI parameter structure
byte major version
byte minor version
byte length of structure
byte address length
word maximum transmission unit
word multicast address buffer size
word back to back receive
word successive transmits
word post-eoi interrupt

set_rcv_mode E
IN
AH 20
BX handle
CX mode
1 turn off receiver
2 receive only unicast packets
3 mode 2 plus broadcast
4 mode 3 plus limited multicast
5 mode 4 plus all multicast
6 all packets
OUT
no returns

get_rcv_mode E
IN
AH 21
BX handle
OUT
AX mode

set_multicast_list E
IN
AH 22
CX address length
ES:DI address
OUT
no returns

get_multicast_list E
IN
AH 23
OUT
CX length of address list in bytes
ES:DI address list

get_statistics E
IN
AH 24
BX handle
OUT
DS:SI statistics structure
dword packets received
dword packets transmitted
dword bytes received
dword bytes transmitted
dword errors received
dword errors transmitted
dword packets lost

set_address E
IN
AH 25
CX address length
ES:DI address

E = extended function
H = high-performance function

network address stored in ROM on the board, but they can also override that address under software control.

In short, applications calling a network device driver need to perform the following operations:

- identify the network device
- read the device's network address
- send a packet
- receive a packet
- stop receiving packets
- manipulate multicast addresses

The packet driver interface supports all these operations.

First Things First

Before an application can use a packet driver, it has to figure out which software interrupt the packet driver has attached itself to. Although some programs may mandate a specific interrupt, other programs use the driver's facility for automatically locating the interrupt. It works by scanning interrupt vectors 0x60 through 0x80 and looking for a special signature string. The interrupt handler for the packet driver interrupt will point to a 3-byte jump instruction (or any 3 bytes; what they are doesn't matter to the application) followed by a null-terminated ASCII text string `pkt drvr`. The application then uses this interrupt to call the packet driver.

Calls to the packet driver set processor register AH to the op code for the call. The op code determines which operation the driver will perform. On return, the carry flag will be set if an error occurred, and DH will have the error code, or return results will be placed in registers. Table 2 details register passing conventions for all the packet driver calls.

Identifying the Network Device

After the application finds the packet driver, it can find out more about it by making two calls: `driver_info` and `get_parameters`. The `driver_info` call returns an indication of which packet driver calls are supported. Calls fall into three categories: basic, extended, and high performance. All packet drivers support basic calls. Most Clarkson collection drivers support all three modes.

The `driver_info` call also tells the application the version of the driver that is loaded, the class of network device being accessed (*class* is the network media, such as Ethernet), the type of network device being used (the model of the network interface), the number of the card (e.g., the first driver is 0; the next is 1), and the address of an ASCII string describing the interface. See table 3 for a list of currently defined classes.

CLASSES OF NETWORK MEDIA

Table 3: *The newest release of the Clarkson collection enables Class 1 (DIX) drivers to accept Class 11 (IEEE) access-type calls. This allows simultaneous use of IEEE and DIX framing through one packet driver and solves a long-standing problem related to the use of packet drivers on Novell networks.*

1	DEC-Intel-Xerox "Bluebook" Ethernet
2	ProNET-10
3	IEEE 802.5/ProNET-4
4	Omninet
5	AppleTalk
6	Serial line
7	StarLAN
8	ARCnet
9	AX.25
10	KISS
11	IEEE 802.3 with IEEE 802.2 headers
12	FDDI with IEEE 802.2 headers
13	Internet X.25
14	N.T. LANSTAR (encapsulating DIX [Ethernet framing])

A program calling the packet driver should scan the interrupt table and issue `driver_info` calls until it finds a driver with appropriate characteristics. (Perhaps it can run only with an Ethernet driver and should, therefore, ignore any non-Ethernet packet drivers loaded into the system.) When it finds one, it must register itself with the driver by calling `access_type`.

Setting the Receive Mode

Most network cards can be in one of several *receive* modes. Each receive mode specifies which packet the card will keep, based on its destination address. The receive mode can be set by calling the `set_rcv_mode` function. The simplest mode, mode 1, turns off the receiver. Applications are unlikely to want to do this.

In mode 2, the card receives only packets that are addressed directly to it. No broadcast or multicast packets are accepted. Again, applications are unlikely to do this, but this mode is included for completeness.

In mode 3, the card receives packets addressed to it and broadcast packets. Since few existing applications use network multicast addresses, most will want to run in this mode.

Mode 4 is equivalent to mode 3 plus multicast packets filtered by the card's in-hardware multicast address list (set by `set_multicast_list`). Some applications will use multicast to send data to a group of hosts without having to burden all hosts on the network as they would with broadcast. They would use this mode or mode 5.

Mode 5 is equivalent to mode 3 plus all multicast packets. The difference between mode 4 and mode 5 is that mode 4 depends on support for multicast filtering on the network adapter. Not all network adapters support multicast filtering, and those that do support it usually allow the application to register only a few addresses. If the application wants to listen to a lot of different multicast addresses, it can use mode 5 at the expense of extra software overhead to check if the received packet matches a desired multicast address. In mode 4, this is done in hardware.

Mode 6 tells the driver to receive all packets regardless of their destination address. This is useful mainly for network analyzers and monitors. An application can also find out the current receive mode by calling the `get_rcv_mode` function.

Receiving Packets

To receive packets, an application must tell the packet driver which packets it wishes to receive and which handler to call when one shows up. The function `access_type` registers the handler and returns a handle, which is required by some other functions.

The packet type is specified by passing the driver a string of bytes that tell it which packet type to watch for. Different network media have different ways of determining the type of a packet. For instance, a DIX Ethernet driver (Class 1) has a 2-byte Type field, starting at the twelfth byte in the packet. A packet is determined to be a TCP/IP packet only if these 2 bytes are 0x800.

However, an IEEE 802.3 Ethernet stores the packet length in this field and uses a SAP field after the 14-byte Ethernet header to determine how to dispatch

the packet. A SAP header can further indicate that a following Sub-Network Access Provider header must be consulted. With TCP/IP, the SNAP header is followed by a final header that carries a Type field indicating if the packet is an IP packet or an ARP packet (ARP is used to translate 32-bit IP addresses into 48-bit IEEE addresses). But only IP will have all these headers. Other protocols may not require the SNAP header or the IP-specific one. Thus, an IEEE 802.3 packet driver must be prepared to check a range of bytes to find which protocol stack a received packet is for.

The recent release (8.x) of the Clarkson collection solves a long-standing problem related to DIX versus IEEE formats. The new drivers may act as Class 1 (DIX) *and* Class 11 (IEEE) drivers. When an application calls `access_type`, it specifies a driver class. The Clarkson release 8.x drivers allow Class 1 drivers to accept Class 11 `access_type` calls and decide, by remembering the class each receiver is using, where in the packet to match Type fields. This allows simultaneous use of IEEE and DIX framing through one packet driver.

The Clarkson drivers also support a mode that allows the BYU Novell shell to pass Novell DIX format packets to the driver, which then converts them to IEEE-format packets for transmission and fixes up received Novell packets. Novell servers and clients use IEEE framing by default but violate the IEEE rules on SAP usage. A Novell system can be switched to DIX framing (where it properly uses the Type field) with the ECONFIG command. By having the packet driver do the conversion, the -n option to the Clarkson packet drivers allows use of the BYU shell (internally using DIX framing) without requiring users to convert the rest of their network to DIX framing.

After an application calls the `access_type` function, and any time a packet of its type is received, the handler is first called to get a buffer to store the packet. Register BX holds the handle the packet was received on, and register CX has the packet's length. AX is set to 0 on the first call. The application must return a buffer, pointed to by DS:SI, for the driver to store the packet in. If the application has no buffer space left, it can return 0:0, and the driver will discard the packet. Otherwise, the driver copies the packet into the memory DS:SI points to and calls the driver again, this time with AX set to 1 and DS:SI set to the address of the buffer the application passed to the driver. When the call returns, the driver is finished with this packet. Applications must be careful when handling these calls, as they may be called from an interrupt handler.

When an application is finished receiving packets, it should call the `release_type` function, passing it the handle that's returned by `access_type`. It's especially important that an application do this before exiting to DOS. Otherwise, the receive handler will be invalid and the system will probably crash the next time it receives a packet.

The application must return a buffer for the driver to store the packet in.

Transmitting Packets

An application must present packets for transmission by the packet driver as continguous chunks of memory. To transmit a packet, an application must first fill in the MAC header (for instance, the destination and source address and Type fields on a DIX Ethernet, or the destination and source address and SAP fields on an IEEE 802.3 Ethernet). It then calls the `send_pkt` function, passing it the address of the packet and the packet's length. When `send_pkt` returns, the application may reuse the memory where the packet was stored.

For higher-performance applications, recent packet drivers have supported a second function, `as_send_pkt`. This call operates like `send_pkt`, except that it takes an extra argument: the address of a function to call when the packet transmission is complete.

The function is called with the address of the packet that has been transmitted and an indication of the success or failure of the transmission. This new function allows applications to take advantage of dead time while the network card is waiting for the packet transmission to complete. The old call would sit and wait for the completion; the new one queues up packets for transmission and returns immediately, letting the application get on with other work (such as filling up other packets to be sent, reading a disk file, or writing to the display).

With `as_send_pkt`, the application must not modify the packet until the completion function has been called. This way, the packet driver can keep a queue of outgoing packets.

Address Handling

The packet driver supports several functions for manipulating addresses. They are `get_address`, `set_address`, `get_multicast_list`, and `set_multicast_list`.

Applications that need to know the address of their network card can find out by calling `get_address` and passing the driver a buffer in which to copy the address. They can also find out the length of their network address by calling `get_parameters` (most networks use fixed-length addresses; for instance, Ethernets use 6-byte addresses). All TCP/IP applications must do this. Applications that need to change their network address can do so by calling `set_address` and passing the driver a pointer to the new network address.

A packet driver may also provide multicast support. An application can get the list of multicast addresses currently listened for by calling `get_multicast_list`; then, it can set them by calling `set_multicast_list`. These functions are intended to work with multicast support provided by the hardware. If the application asks for more multicast addresses than the network card can support, the set function may return failure. In that case, the application should change the receive mode to mode 5 by using the `set_rcv_mode` call described above and filter multicast packets itself.

Miscellaneous Control Functions

The packet driver specification also provides some miscellaneous control functions. They include the following calls:

- `terminate`: asks the driver to unload itself from memory. Not all drivers can support this call. All handles should be released before calling this function.
- `reset_interface`: allows the application to reinitialize the network interface. This call is useful if the interface appears to be jammed or otherwise not functioning correctly.
- `get_parameters`: allows the application to find out information about both the driver and the hardware, such as the version of the packet driver specification implemented by the driver, the length of an address, the maximum size of a packet for transmit or receive, and the number

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of multicast addresses the hardware supports for receive filtering.

- `get_statistics`: allows the application to read counters, maintained by the hardware or driver, that indicate how many successful and how many failed transmit and receive operations have been accomplished.

What Is the Packet Driver's Future?

Russell Nelson, a software development engineer for Clarkson University and a notable packet driver author/enthusiast, thinks the packet driver movement threatens promoted efforts such as 3Com's NDIS and Novell's ODI.

"I don't see how [3Com and Novell] can catch up, because with every new release of ODI and NDIS drivers, there's another packet driver," Nelson says. "I would be willing to guess that there are more packet drivers than ODI and NDIS drivers combined."

Others dispute this claim. Richard Watson, 3Com's manager of enabling software, says that NDIS has more "corporate" acceptance, such as from IBM and Banyan. Furthermore, most commercial software vendors that have traditionally supported packet drivers intend to support NDIS and ODI. Wollongong's WIN/TCP already supports NDIS, as does FTP Software's PC/TCP (albeit by way of a packet-driver-to-NDIS converter). Even Kelly McDonald, who spearheaded the development of BYU's popular packet-driver-compliant NetWare shell, expects eventually to switch over to Novell's new ODI-based LAN Workplace for DOS.

Ultimately, the ideas promulgated in the packet driver specification are what matter the most. They will persist—probably in a variety of forms—and will continue to serve vendors and users. "You can argue back and forth about the details," says Russ Nelson. "Practically, fundamentally, to the user there's no difference, and they will see benefits. So long as they have a driver and the software talks to the driver, they're home free." Thanks to the packet driver specification and the grass-roots effort that surrounds it, those benefits became freely available years before their widespread commercial implementation. ■

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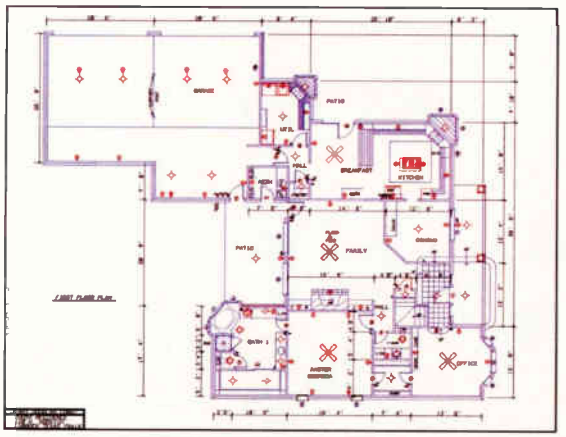

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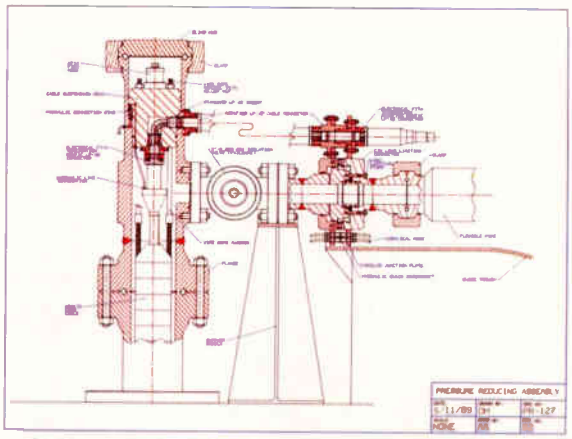

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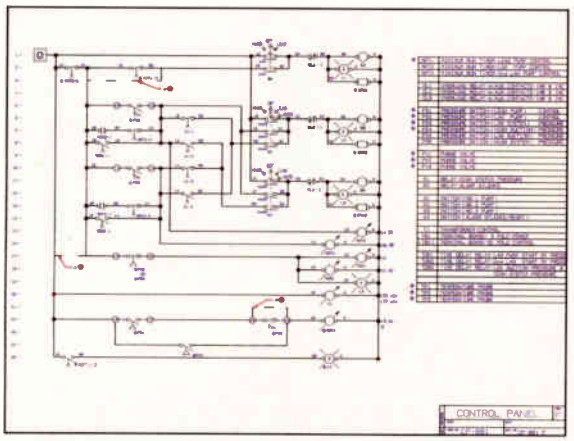

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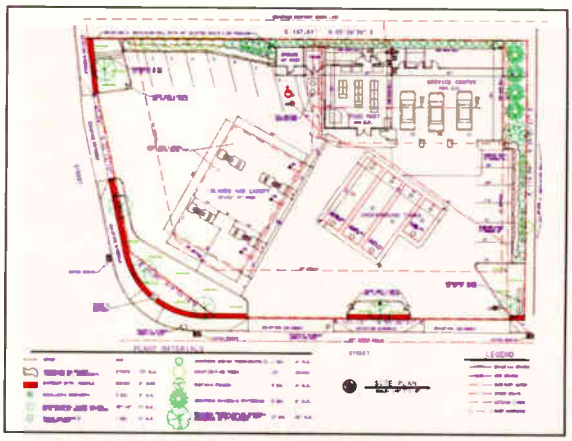

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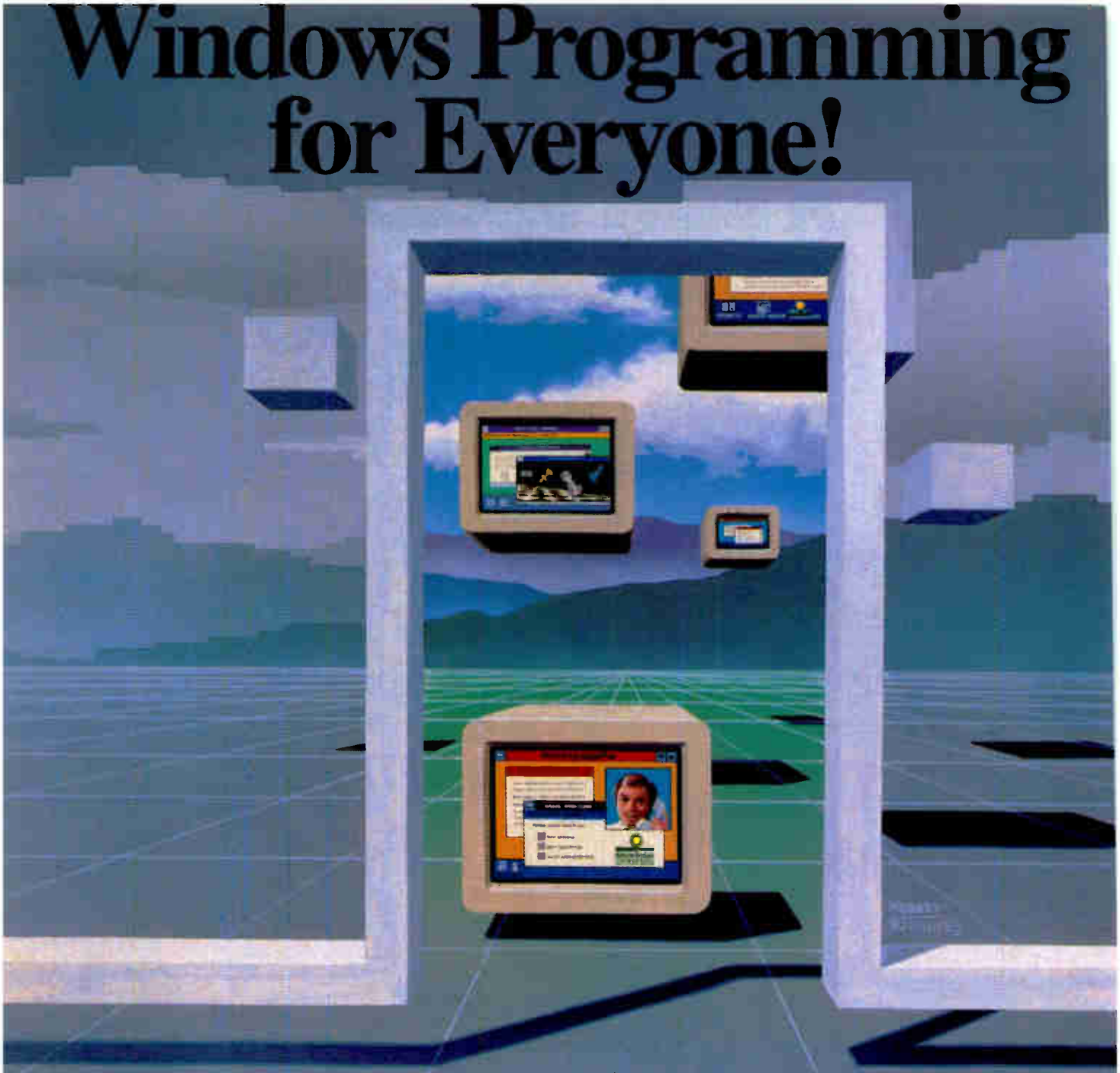

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A LOOK AT REMOTE PROCEDURE CALLS

RPC—Sun's method of interprocess communications across a network—offers some convenient abstractions

I sometimes think of what's happened to the computing environment over the last 10 years as a big bang that spread little bits of power away from the data center and onto the desktop. We're left with heavily populated local networks, but, paradoxically, we're spending lots of effort trying to make it all look like one big computer.

Most organizations operate with networks of systems and resources that, in reality, constitute a very poor multisystem model. Applications (and users) making use of intersystem communication must often have explicit knowledge of a network composed of individual systems. Network file systems alleviate this problem by returning to a mainframe view of on-line storage. The network is hidden; everything is synchronized through the file-system name space.

A similar coordination of other resources may never happen—at least, not with the current distribution. But projects such as Amoeba (a design for loosely coupled multiprocessors) and Plan 9 at Bell Labs may result in a reversal of the big bang, bringing together these distributed resources to offer a consistent mainframe view of a single, powerful system, without the problem of mainframe contention. In the meantime, though, computers need to talk to each other.

Why RPC?

At the client/server programming level, socket-oriented protocols represent the aforementioned poorly formed network view. For a client to request processing of a server task, it must explicitly open a connection to that task, perform data transactions to get the desired job done, and close the connection—just to do what amounts to some processing on another computer.

From an abstract view, this is an elaborate function-call interface to an opaque procedure: Pass some data, expect some well-defined processing to occur, and retrieve the results. High-level languages are supposed to hide all this from you: You don't provide code to link together the procedures of your local application; why should you be expected to know the details of executing a function remotely?

The method of remote procedure calls does for procedure-level programming what the Network File System does for data sharing: It attempts to hide the view of the total system as discrete components. Where NFS abstracts the view of data through a single file-system name space, RPC abstracts the view of client/server requests in the programming domain: the procedure name space.

An RPC system makes it convenient to treat a server request with semantics similar to a local procedure request. A number of competing mechanisms support RPCs; I'll describe a system from Sun Microsystems.

continued

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Sun's RPC provides several different components. One is the external data representation (XDR) protocols, a mechanism that provides for the common understanding of data between different systems. Another component provides for the exchange of request and response information that makes up the RPC mechanism. Another one is the subsystem that coordinates and delivers messages. The last one consists of the tools that help to automate the production of code that makes use of RPCs.

External Data Representation

A fundamental objective in intercomputer communication is to make sure that the data flying around means the same thing to all systems involved. Data confusion can occur in many places and for many reasons, due to both software and hardware considerations.

The most common example of uncommon ground in data communications is the gnatty problem of byte order. Where some systems store integer data with the least significant byte at lower byte addresses, others store the same data in the opposite byte order. (The argument concerning which is a better form is never-ending, prompting the names "little-endian" and "big-endian," a pun on an argument in *Gulliver's Travels* about which end of the egg to open.)

At any rate, a 4-byte value of 3 on one system would be a value of 13,959,936 on another system (0x00000003 versus 0x03000000). Other representation issues include floating-point number format, address values, structure packing, and other language-related issues (e.g., the size of an `int` type in C).

XDR works by defining a system-independent form for all these kinds of data items. For two systems to communicate via XDR, each system must be able to translate to and from this standard form. Many of the size and packing problems are covered by making the smallest data size 4 bytes: A 2-byte `int` on one system is converted to a 4-byte quantity for transmission and reconverted to a 4-byte `int` on the other system.

The best part about XDR is that you don't have to know all that. The process of forming and unforming data is abstracted in terms of XDR routines. Each data type finds expression in a single XDR routine that can be used for sending, receiving, or deleting data. This also applies to aggregate types. A base XDR implementation provides the routines for primitive types; an application can build descriptions of more complex

BASIC DATA TYPES

Table 1a: *Primitive XDR routines, provided by a basic implementation, that are used to represent basic types.*

Routine	Type
xdr_char	char
xdr_u_char	unsigned char
xdr_int	int
xdr_u_int	unsigned int
xdr_long	long
xdr_u_long	unsigned long
xdr_short	short int
xdr_u_short	unsigned short int
xdr_float	float
xdr_double	double
xdr_bool	Boolean (TRUE or FALSE)
xdr_enum	Enumerated constant (basically an int)
xdr_void	No data

XDR ROUTINES

Table 1b: *XDR routines for basic aggregate types.*

xdr_string(xP, strPP, maxlength): A NUL-terminated string with a maximum length. The data item, strPP, is the address of a variable that points to the string.

xdr_bytes(xP, bufPP, lenP, maxlength): A counted byte array, where bufPP points to a variable that holds the address of the array, lenP is the address of a variable that contains the number of bytes to send or receives the number of bytes received, and maxlength is the maximum length to deal with.

xdr_array(xP, dataPP, lenP, maxlength, datasize, procP): A counted array of data of any type, where dataPP is the address of a variable that points to the first array element, lenP points to the length variable, maxlength is the maximum number of elements, datasize is the size of each array element, and procP is the address of an XDR routine that can deal with each array element. This routine takes only the XDR stream and data pointer as arguments.

xdr_vector(xP, dataP, len, datasize, procP): A fixed-length array, where dataP is the address of the base of the array (not a variable that points to it), len is the number of array elements, datasize is the size of each element, and procP is the address of an XDR routine that defines each element.

types using them.

XDR functions operate on an XDR stream and a data item, and sometimes on other optional parameters. An XDR stream is like an `stdio` file stream: It's used as an object in sending, receiving, or deleting data, encapsulating the methods for performing these operations. Unlike `stdio` streams, though, the XDR stream also dictates the function. You can open a `stdio` stream and perform `reads` and `writes` on it by applying the corresponding function to that stream. With an XDR stream, you specify the function (i.e., `read`, `write`, or `delete`) when you create the stream, and this function is performed when you reference the stream in an XDR routine.

This leads to some interesting properties. Most significant is that the syntax involved in performing all operations is almost always the same.

For this reason, XDR routines always reference their data by address, not by value. This lets the data be stored as well as fetched or deleted. For example, the primitive function `xdr_int` is used for data of type `int`:

```
xdr_int( xdrP, dP );
```

where `xdrP` is the address of an XDR stream block, and `dP` is the address of the data item. Depending on the mode of the stream, this routine will send, receive, or delete an item of type `int` (although, in fact, deletion of these primitive C types is a no-op; deletion applies only to pointer references). The routine returns a Boolean `True` (nonzero) if it succeeds and `False` (zero) if it doesn't. Other primitive XDR routines are provided by any base XDR implementation; table 1a lists those primitive routines that are related to basic types.

Some primitive XDR routines are provided for simple aggregates (see table 1b). For example, `xdr_string` turns a pointer to a string into the string's XDR, and vice versa.

When data is being sent, the pointer is followed, and the bytes of the string are placed on the stream. When data is being received, the bytes are counted to make sure they don't exceed the maximum length; new storage is allocated if necessary (i.e., if the pointer value is `NULL`), and the bytes are stored in the buffer pointed to by the referenced variable. On a delete operation, the buffer is deleted and the pointer reset to `NULL`.

Because of a universality in XDR routine operations, you can build up XDR routines for complex types. Consider a structure containing several basic types:

```
struct bounds {
   unsigned char flags;
   int min;
   int max;
   };
```

You can easily write an XDR routine to encapsulate this structure by building on other XDR routines. For instance,

```
bool_t xdr_bounds( xP, boundsP )
    XDR *xP;
struct bounds *boundsP;
   {
   return (
  xdr_u_char( xP, &boundsP->
          flags ) &&
  xdr_int( xP, &boundsP->min ) &&
  xdr_int( xP, &boundsP->max )
  );
  }
```

The XDR routine is named after the type it represents. Here, the routine describes its members, in order, in terms of lower-level XDR routines. This will work whether the routine is sending or receiving the type in question.

An important offering of XDR is that of discriminated unions (à la Pascal). A C union offers multiple components, only one of which can be valid at a given time. A discriminated union is a union whose interpretation depends on an integer value. This usually matches the use of unions: The interpretation of a union depends on a current state, which can be represented as an integer. When communicating between processes, this is a very useful format. XDR provides the routine `xdr_union` for this:

```
xdr_union( xP, dvP, unionP,
     ttableP, defaultP )
```

where `dvP` is the address of a variable that contains the discrimination value, `unionP` is the address of the union, and `ttableP` is the address of a table that contains pairs of (`value`, `proc`), with `proc` the address of an XDR routine that encapsulates the union when the discriminant matches the value. The end of this table is indicated by a `proc` of `NULL`. And `defaultP` is the address of an XDR routine that handles the default case (i.e., when no match is found in the table).

Those are the basics of XDR, although there are a number of nits for which there isn't space here. XDR is commonly used in conjunction with a network stream—using TCP/IP or User Datagram Protocol (UDP)—but it can also be used with an `stdio` stream (for file I/O) or with memory streams.

Sun's RPC Programming

Sun's RPC model provides for three levels of programming, from a high, hands-off level to a low, hands-on level.

The highest level of RPC programming is basically the consumer level. It's the interface that you provide by implementing an RPC service using the other levels.

The user of this interface doesn't have to know anything about the underlying communication, and, as such, it has little to do with RPC at all. However, if you are writing RPC routines to abstract the client/server relationship, it makes sense to provide this sort of interface.

Suppose, for example, that one of your computers controls and monitors an environmental test chamber. You could provide a set of RPC routines corresponding to the chamber interface. One routine might find the current climate in one of the bays:

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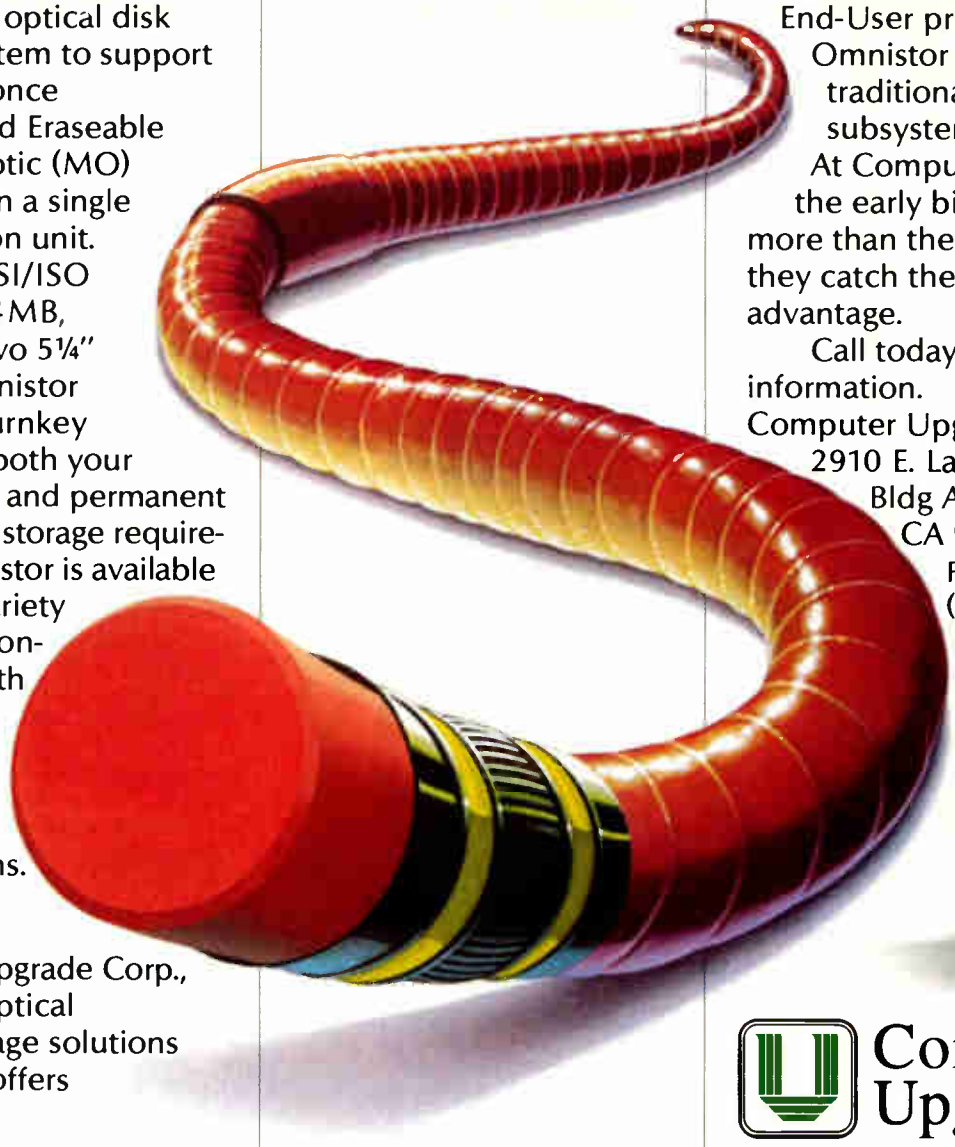

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```
climateP = evc_climate
     ( bay_number );
```

The implementation of `evc_climate` would use an RPC procedure to find the climate in a particular test bay and return it to the caller. It would know which machine to poll; an alternative implementation would supply the system ID, as well.

RPC procedures are always identified in terms of an implementation program, a program version, and a procedure number. On the server side, a single program unit implements a suite of related service procedures. There can be more than one version of a server program, to provide for enhancements in functionality. With explicit version information, the client is not subject to surprises when an RPC no longer works or, worse, apparently succeeds but results are not consistent with expected behavior.

Note that multiple versions don't require separate server programs; the same server can take care of more than one version and even more than one program definition. Each procedure within a program/version set is identified by its procedure number (0 through *n*).

The middle layer offers a fairly simple RPC implementation style. A client makes a service request by calling the routine `callrpc`. The client provides eight pieces of information to the routine: name of the server system, program number, program version, procedure number, an argument for the procedure call, the address of an XDR routine that describes it, the address of a return variable, and an XDR routine describing the return information. The `evc_climate` routine might be implemented as

```
climate *evc_climate( bay_number )
{
   int status;
   static climate climate;

   status = callrpc( TESTSYS,
      EVC_PROG, EVC_VER,
      EVC_CLIMATE, xdr_int,
      &bay_number, xdr_climate,
      &climate );

   if ( status != 0 ) {
      clnt_perrno( status );
      exit( 1 );
   }

   return( &climate );
}
```

On the server side, a program starts by registering all the procedures for which it is responsible. This is done by calling

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Low-level RPC services make use of a transport handle that represents a connection between the client and the server.

the routine registerrpc once for each service routine to be registered. For instance,

```
registerrpc( EVC_PROG,
 EVC_VER, EVC_CLIMATE,
 climate, xdr_int, xdr_climate );
```

The first three arguments are the program number, program version, and procedure number, as with callrpc. Next is the address of the routine (i.e., climate) that processes the request. This is followed by the address of the XDR routine that receives any passed argument and the XDR routine that sends any return data.

With this form, each service routine takes a single argument that's the result of the XDR input and returns a pointer to data to be sent via XDR output. These are always declared as char pointers. The climate service routine would look something like this:

```
char *climate( dataP )
   char *dataP; /* Input data */
{
   int bay_number;
   static climate climate;

   bay_number = (*int *)dataP;

   /* Code here to fetch
    information */

   /* Return the data */
   return( (char *) &climate );
}
```

After a server has registered all its procedures, it calls the routine svc_run(),

which loops, waiting for and processing requests; it never returns a value.

Lower Levels of RPC

You may be able to get by on just the middle-layer functions described above. But there are a number of reasons for using the lower layer. One is that the middle RPC implementation layer is based on UDP. UDP messages are fast but are not guaranteed to be delivered, and even then, not necessarily in order. In reality, UDP messages rarely go undelivered. Even so, the `callrpc` function incorporates retry logic to help make sure that requests get delivered and answered. Another reason is that you might want more explicit control of the way your messages are interpreted and answered.

Low-level RPC services use a transport handle that represents a connection between client and server. It can be used for multiple service requests without closing the connection between the two. It can use UDP, as with `callrpc`, or TCP/IP for reliable delivery of messages.

On the client side, this transport handle is a `CLIENT` type, created by a call to either `clntudp_create` (for UDP) or `clnttcp_create` (for TCP/IP):

```
CLIENT *clientP;
int     sock;

sock = RPC_ANYSOCK;
clientP = clntudp_create( &srvr,
   EVC_PROG, EVC_VER, timeout,
   &sock );
```

where `srvr` is an `int sockaddr struct` (`sockaddr_in`) describing the server system, `timeout` is a `timeval struct` with a `timeout` value for UDP retries, and `sock` is an `int` that receives a socket handle. Here, it's initialized to `RPC_ANYSOCK` so that the `clntupd_create` call will create the socket. If you have a valid socket already, you can pass it, and the function will use it rather than opening a new one.

If you want a TCP/IP handle, you might use `clnttcp_create` as follows:

```
clientP = clnttcp_create( &srvr,
   EVC_PROG, EVC_VER, &sock,
   insize, outsize );
```

where `insize` and `outsize` specify the size of input and output buffers receiving and sending.

To call a remote procedure with a client handle, use the routine `clnt_call`:

```
status = clnt_call( clientP,
   EVC_CLIMATE, xdr_int,
```

continued on page 384

Listing 1: *A sample RPC definition file.*

```
/* evc.x -- Sample RPC definition file for the get_climate example. */

/* The climate structure, returned by get_climate */
struct climate {
        int             temp;           /* Degrees C */
        int             humidity;       /* Relative humidity */
};

/* Definitions of service routines */
program EVC_PROG {                      /* Define the program */
    version EVC_VER {                   /* EVC_VER version of it */

        climate                         /* The get_climate routine */
        get_climate( int ) = 1;         /* Give it proc #1. */

    } = 1;                              /* Version is 1 */
} = 9999;                               /* Program number is 9999 */
```

Listing 2a: *The parts of listing 2 show the output produced by* `rpcgen` *for the* `evc.x` *file. This part shows the type definitions,* `evc.h`.

```
struct climate {
        int temp;
        int humidity;
};
typedef struct climate climate;
bool_t xdr_climate();

#define EVC_PROG ((u_long)9999);
#define EVC_VER ((u_long)1);
#define EVC_CLIMATE ((u_long)1);
extern climate *evc_climate_1();
```

Listing 2b: *The client stub routines,* `evc_clnt.c`.

```
#include <rpc/rpc.h>
#include <sys/time.h>
#include "evc.h"

/* Default time-out can be changed by using clnt_conrtol() */
static struct timeval TIMEOUT = { 25, 0 };

climate *
evc_climate_1(argp, clnt)
        int *argp;
        CLIENT *clnt;
{
        static climate res;

        bzero((char *)&res, sizeof(res));
        if (clnt_call(clnt, EVC_CLIMATE, xdr_int, argp, xdr_climate, &res,
                        timeout) != RPC_SUCCESS ) {
                return (NULL);
        }
        return (&res);
}
```

Listing 2c: *The server skeleton,* `evc_svc.c`.

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

continued

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Stars of the Show

David Fiedler

The annual UniForum show is the place where the entire commercial world of Unix software and hardware gets together. This year was a special treat because it was also the tenth anniversary of the UniForum trade association that sponsors the show. Any firm that is involved in Unix past the "Hmmm... what about it?" stage should seriously consider joining the association, because its vendor and product information alone can save a great deal of time and money. (You can contact UniForum at 2901 Tasman Dr., Suite 201, Santa Clara, CA 95054, (408) 986-8840, fax: (408) 986-1645.)

Close to 300 vendors exhibited at UniForum, which was held at the Dallas InfoMart. In some ways, I'm glad that I didn't have to cover the show on a "real-time" basis, because the thought of even attempting to do more than the most shallow coverage would be daunting.

If I went to every booth during the show, I could spend only 5 minutes at each, while writing a simple 25-word paragraph about each booth would take four months' worth of these columns! Thus, this column is by no means "what I saw at UniForum"; rather, it's simply a look at a few items that I thought were interesting.

Interactive Unix

By the time you read this, Unix System V release 4.0 (SVR4) for the 386 and i486 should be available—the whole enchilada, including the new Virtual File System (Remote File System, Network File System [NFS], and more), virtual memory, and full internationalization. It will support Xenix, SunOS, Berkeley Standard Distribution (BSD) 4.2 and 4.3, and current System V programs. Also, almost every user interface known will be supported, including the X Window System version 11, release 4, X11/NeWS, Motif, and Open Look... and their toolkits!

Although this was the biggest UniForum trade show ever, some announcements and products are of special significance

The most important thing is that this *won't* be available from Intel (which was aggressively pushing its shrink-wrapped Unix last year). Intel has given its entire customer base to the new "principal publisher" of Unix SVR4: Interactive Systems.

Don't read that last sentence wrong. Interactive is certainly not new to Unix. In fact, it was the first commercial Unix licensee ever, way back in 1977. Intel, together with Unix System Laboratories (the current developer and marketer of Unix, formerly AT&T's Unix Software Operation), decided for business reasons that Interactive was the best entity to support Unix SVR4 on the 386 and i486.

This puts Interactive in a pretty good position, because Unix SVR4 is positioned to be *the* Unix of the 1990s. While some may consider it almost too large for a 386-based machine (and who could have dreamed *that* four years ago?), it should be a perfect match for the computing machines we're actually going to be using in the 1990s. This move certainly adds a new wrinkle to the Interactive versus The Santa Cruz Operation (SCO) market-share battle for

---

David Fiedler is executive producer of Unix Video Quarterly *and coauthor of the book* Unix System Administration. *He has helped start several Unix-related publications. You can reach him 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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Unix on Intel-based computers.

It's Not Unix, But...

While Interactive has been supporting and working with AT&T Unix for a long time, a company by the name of Mt Xinu has done the same for BSD Unix (the company's name and logo seem to refer to a mountain, but read the name backward). Mt Xinu has now released the interesting Mach kernel for ISA 386-based computers. Along with the kernel, the release includes some "free" GNU utilities, the BSD Unix 4.3 interface, BSD NFS, and X11.4 for VGA monitors.

Mach is almost-but-not-exactly Unix, with a threaded architecture that makes it an interesting subject to study in computer science courses and a likely base for multiprocessor machines (see "Mach: The Model for Future Unix" in the November 1989 BYTE). The complete package costs $1995, which puts it out of the reach of most hobbyists. However, it's well within the budget of serious system software and hardware developers. With all the current interest in multiprocessors, I expect that Mt Xinu will have its hands full merely getting disks duplicated.

Home Sweet Suite

Some of the most interesting things at UniForum weren't on the show floor. A new firm called Clarity Software was showing a hot new product it calls Rapport, but you could see Rapport only by invitation to Clarity's hotel suite. At first glance, I thought I had walked into a porting lab. A half dozen different workstations littered the room, all running the same software. Contrary to most hotel-suite software introductions (where the developers have sweated blood to get the product running at all), Rapport was actually running fairly stably on all these machines. This is no small task for a product that needs 12 megabytes of RAM and 300 MB of disk space (predictably, Clarity used C++ in development).

Rapport is billed as "a document editor," but that's like calling California simply "a Western state" and describing it no further. Aside from regular text in an assortment of colors, Rapport users can put graphs, spreadsheets, raster images, drawings, fax images, and audio sound bites in their documents (and some video will be supported). This is made easier by the fact that Rapport has a built-in spreadsheet, drawing program, graphing tool, fax server, and audio editor.

More important than simply a list of features, however, is the intuitive way that these separate media work together within Rapport. Unix software hasn't had the reputation of being easy to use; Rapport can destroy that stereotype. While some of the icons may not be completely clear at first glance, working with Rapport seems to come naturally.

Commendably, Clarity has resisted the temptation to call Rapport a multimedia product. While it probably qualifies as multimedia under certain definitions of the term, Clarity refers to it as mixed-media instead, which is more accurate and less confusing.

But Rapport isn't just a fancy desktop publishing program. Anything you can do in a Rapport document can be sent via E-mail—and input and output converters let you exchange E-mail with people

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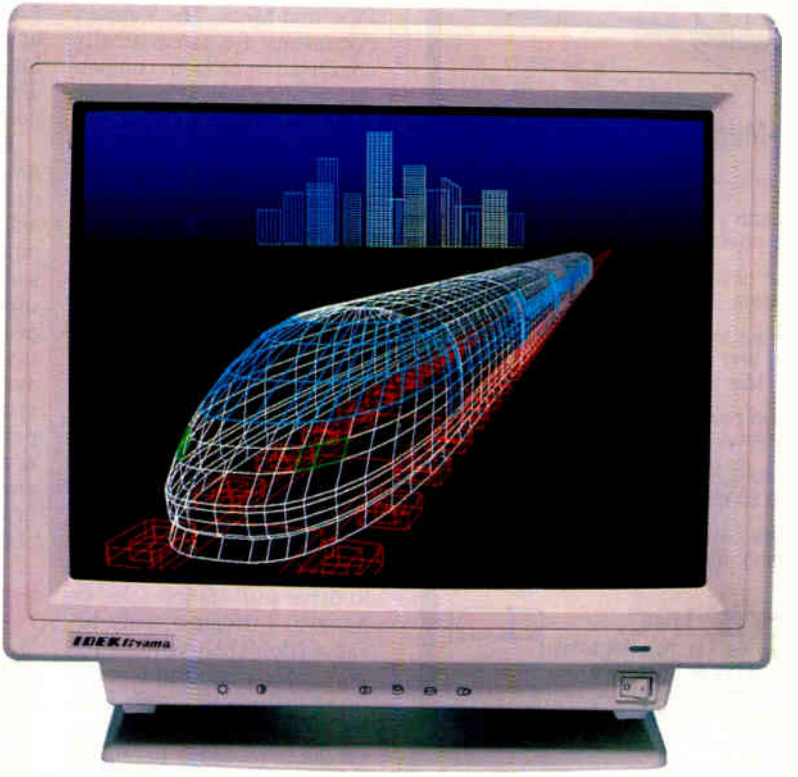

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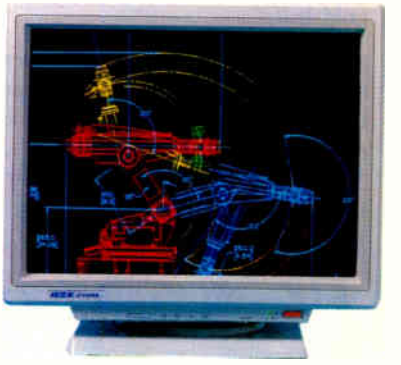

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on standard Unix machines, PCs, and Macs. The Rapport documents are automatically converted to or from compatible applications files on the target machines. This means that a complex Rapport document might arrive on a PC as a WordPerfect file and a Lotus spreadsheet, or on another Unix machine as an Interleaf document. If the recipient has no E-mail address, Rapport sends a fax! Rapport supports lots of formats, including ASCII, Microsoft Word, IBM DCA-RFT, WordStar, Lotus 1-2-3, Excel, MacWrite, troff, Uniplex, SCO Lyrix, Interleaf, and IslandWrite.

Clarity refers to Rapport as a killer application, similar to Lotus 1-2-3, with the potential to drive workstation sales on its own. I disagree, only because I don't believe that Rapport can be perceived as something different enough from traditional desktop publishing products to cause people to choose workstations instead of PCs.

Marketing hype aside, what I saw of Rapport certainly qualifies it as a well-integrated, open-ended application with the potential to spread rapidly over the installed base of workstations. Its price ($895 "per seat") and initial availability on the most popular systems from Sun, IBM, DEC, Apollo, Hewlett-Packard, and Silicon Graphics shouldn't hurt its acceptance one bit. And Clarity's support of both Motif and Open Look means that you don't have to choose between graphical user interfaces, either.

Another Observation

Pick Systems had a very jazzy booth with neon colors and rap-music dancers. All this hoopla served to lure vistors, yet many stayed to see demonstrations of the Pick operating system. Pick is more than an operating system; it's an applications environment that excels in user-oriented database queries (see "Pick: OS or DBMS?" in the November 1990 BYTE). Over the years, Pick has attracted its share of supporters due to its portability, efficiency, and small size—things that Unix was once known for!

But you no longer have to agonize over the decision, because Pick itself is now available as an application that runs on top of Unix. This opens up some of the excellent vertical-market end-user application programs on Pick to the Unix market. Whether or not this is as exciting to you as a threaded system like Mach is beside the point: So-called "boring" old applications are what make any operating system a success or failure in the real commercial world. ■

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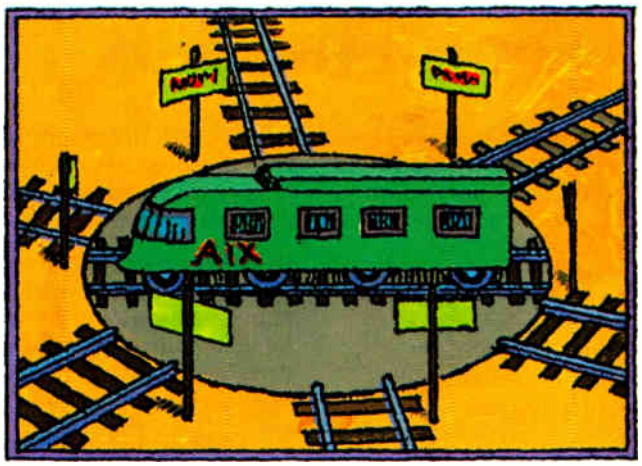

IBM's other network operating-system environment gets a vote of confidence

Not long ago, Wausau Insurance asked my company to port our DOS insurance-rating application to a networked, distributed Unix environment. Wausau wanted to use IBM RISC System/6000 workstations running AIX (IBM's Unix) as file servers, with PS/2 and PC workstations running DOS or Unix. The RISC System/6000 had to act as a host computer as well as a file server; we'd have to restructure our application into a client/server architecture. All the background tasks would run under AIX.

Our DOS application, written in a mix of assembly, compiled BASIC, and C, was already LAN-aware. We had designed it to perform file sharing and record locking on top of such network operating systems as NetWare, IBM's PC LAN Program, and LAN Manager. Background tasks ran on dedicated, unattended workstations. Our starting point wasn't too far away from Wausau's DOS-and-Unix-combined client/server goal, so we felt confident we could do the job. Our first step was to use the RISC System/6000 successfully as a file server; then we would port the background tasks to run under AIX on that same machine.

Why AIX?

Wausau decided to use AIX rather than the more traditional, Systems Application Architecture–compliant OS/2-MVS combination. It cited several reasons, the biggest of which was scalability. OS/2 runs only on microcomputers (although IBM may be developing a version of OS/2 for the RISC System/6000).

Unix, on the other hand, runs on the PS/2, the RISC System/6000, and even mainframes. AIX also has many connectivity features, including Token Ring, Ethernet, X.25, asynchronous, and synchronous communications. AIX, on a RISC System/6000, supports IBM 3270 and 3151, DEC VT100, X Window System, and many other communications modes. On a PC, you can run DOS as a task under Unix. These are all important considerations when you want to keep your options open.

Wausau's plan also saves the company money by reducing the load on its mainframes, while distributing significant processing power to its 17 regional offices and more than 100 service offices. By sticking with common Unix facilities and system calls, we could provide Wausau with an application it wouldn't have to rewrite every three to five years—a typical problem under DOS, OS/2, and, to some extent, MVS.

Wausau briefly considered Novell's NetWare as a development platform and file server network operating system. However, it decided that the resulting server code, in the form of NetWare loadable modules, would be NetWare-specific and thus not as portable as code designed to run under AIX. Another scalability factor was that, with Unix, a PC can be a file server, a DOS workstation, or a terminal for RISC System/6000 applications without rebooting the machine. With only ordinary Unix-style coding techniques, tightly integrated client/server applications become possible between the Unix host and DOS workstations. The programmer does not have to think in terms of programming a file server. The server becomes just another Unix box.

In summary, Wausau could have its cake and eat it, too. It could strike out in a new technological direction, yet maintain its considerable investment in IBM-compatible computer architectures.

NFS vs. AADU

Not everything was honey and roses with Wausau's decision to use Unix as its base operating system. First off, we ran into the thorny design issue of choosing network support software. IBM offers several environments for file sharing under AIX. We distilled the choices down to two: IBM's version of Sun Microsystems' Network File System and its version of Locus Computing's PC Interface, which IBM calls AIX Access for DOS Users. Both NFS and AADU run on top of TCP/IP; we had to decide which would be the best tool for the job.

IBM licenses NFS 3.2 from Sun. The *AIX Communications Handbook* calls NFS "a de facto standard system for sharing directories across TCP/IP networks." IBM implementations of NFS are available for DOS, AIX, and for the MVS and VM host operating systems. That these implementations were interoperable impressed us; NFS became an early favorite.

NFS gives you the means to mount remote directories over empty local directories (i.e., directory *stubs*). Local programs access files on the remote computer as though they resided in the local directory. A *client host* mounts directories from remote computers; a *server host* lets other hosts mount its directories.

The server host exports a file system with an entry in `/etc/exports`. When a client host accesses a file in the mounted directory, NFS redirects the file request over the network to the remote server host. It supports only the exporting of entire file systems, however, and does not support inherited mounts.

NFS has no mechanism to

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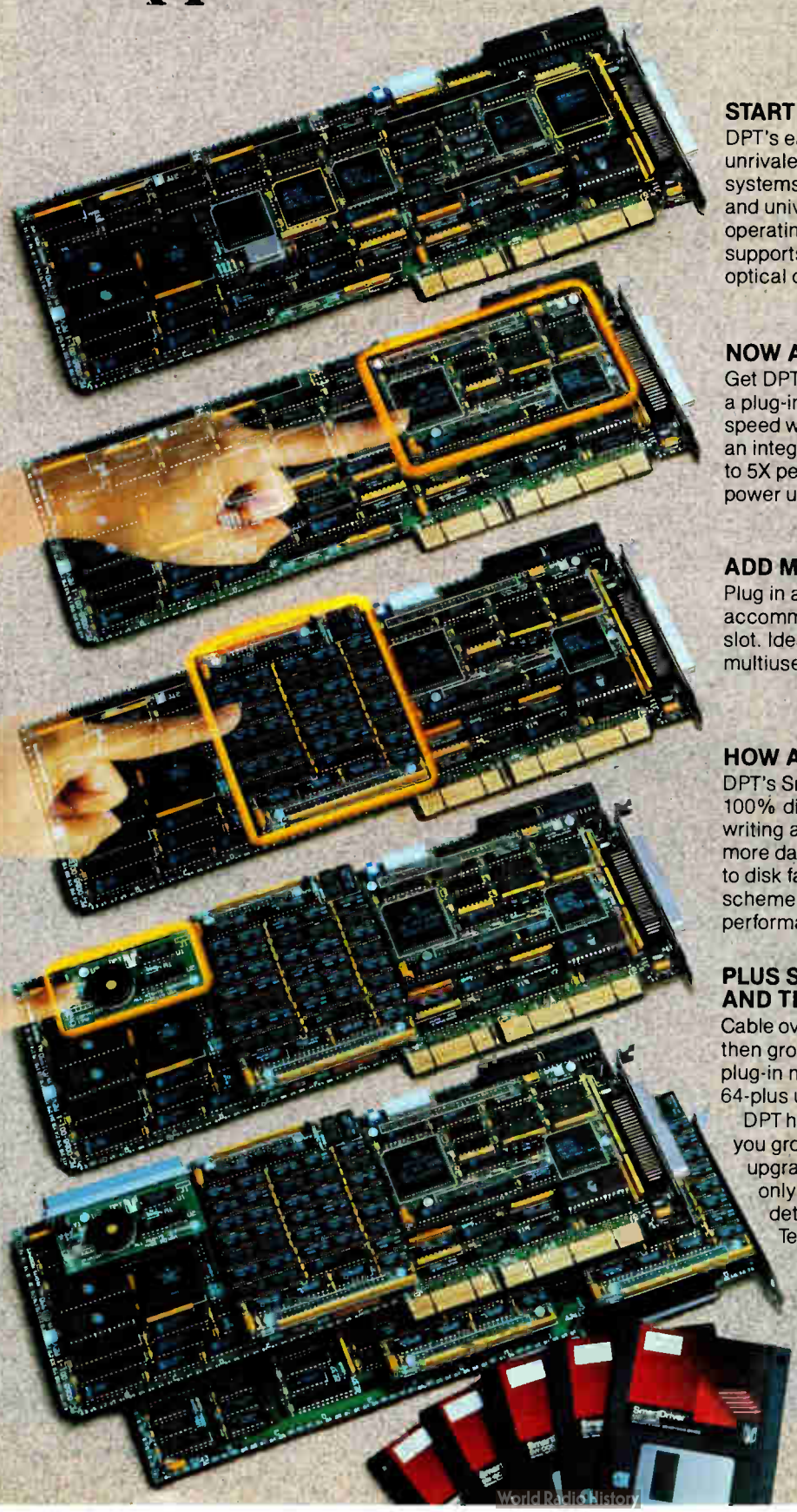

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map user names and permissions across the network. For security, administrators and programmers must configure networks that use NFS by conservatively restricting exports to file systems that everyone can access or by setting up separate, segregated file systems for shared access. You can set up various levels of Single System Images via a companion product called Yellow Pages. Yellow Pages provides a distributed network-lookup service and maintains a database of network maps that clients can query.

I found NFS and Yellow Pages extremely difficult to administer, however. For example, the superuser (root) on one system cannot remotely exercise powers on a host system; NFS maps the client `root` to the host `nobody`, who by default has no privileges on the host. If a Yellow Pages server dies, applications, utilities, and users hang endlessly waiting for the server to respond. And you need to take great care when setting up the parameters for the NFS and Yellow Pages `mount` commands.

NFS is a stateless protocol. It avoids complexity by deliberately forgetting about recent file requests from workstations and forcing each workstation to completely specify each file request. This approach goes hand in hand with the connectionless User Datagram Protocol that current implementations of NFS use for transport services. Although fine for reducing the chances of data loss when a server crashes, this technique gave me pause—it meant that NFS had to pass lots of extra information inside every file server request packet. The resulting extra LAN traffic might not be worthwhile.

One of NFS's strong points is that it lets programs on different machines exchange data using the External Data Representation standard. This is a big consideration when you want an Intel-based PS/2 to talk to a RISC System/6000. Even something as simple as a 2-byte integer needs to be transformed between the two machines, because the Intel architecture puts the high-order byte last in memory, while the RISC System/6000 puts it first. If we didn't use NFS, we'd have to worry about the numeric representation of nearly every field in our application.

The `lockd` daemon is an option in NFS 3.2. Without it, record and file locking aren't possible. Unfortunately, IBM chose not to incorporate `lockd` into its NFS products, except as a component of AIX/370. To use NFS as a network operating system, I'd have to code the locking routines myself (I do most of the low-level coding within our application). Tentatively, I designed a daemon that would use the Unix `lockf()` system call on the AIX machine to implement locking, and I prepared to make the DOS workstations coordinate with the daemon by way of TCP/IP. I figured I could make it work well enough for our application, but I knew the approach was awkward and a kludge.

On any LAN, the device drivers and TSR programs that accomplish file redirection take up memory. NFS, we found, uses about 90K bytes. Our application isn't small, and we found precious little room left after we loaded TCP/IP and NFS on the DOS workstation.

Solving this problem—which is not unique to NFS—

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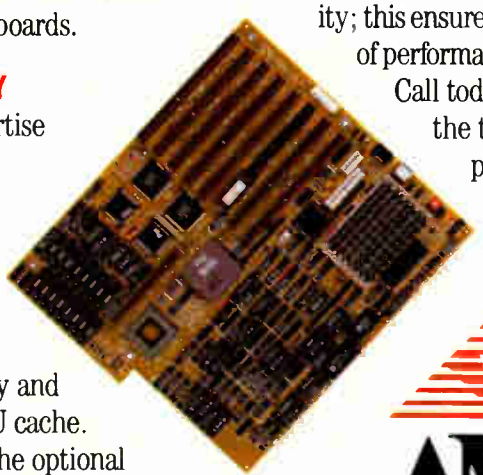

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was tougher than creating a new locking mechanism. Because we couldn't find a way to configure NFS to take up less memory, the answer we discovered was to use a 386 memory manager (e.g., QEMM-386 or 386Max). I used one to load all the device drivers and TSRs into the high-memory area between 640K bytes and 1 megabyte. This solution absolutely requires that DOS workstations be 386 machines. That was the tough part.

Another drawback to NFS is that it's slow. You need a little more CPU power than you otherwise might if you want to get good performance. I suspect the slowness is a result of NFS's statelessness; it obviously must spend time refreshing its memory about what it last did for a client.

I'm out of space, so I'll defer telling you the good and bad points of AADU—and letting you know which one we chose—until next month. It wasn't an easy choice. I'll also describe how we interfaced to the RISC System/6000 version of Oracle from within our application. Our nonstandard approach to dealing with Oracle is designed to save workstation memory, and it will also save Wausau a great deal of money. ■

BEYOND DOS

Windows Tips and Tricks

Mark J. Minasi

Inside information on crashing hard disks, running out of RAM, changing icons and defaults, and understanding priorities

I teach an awful lot of advanced Windows classes these days; it seems that everyone is using Windows 3.0. Teach anyone about anything, and you'll get asked a lot of questions. When you get asked the *same* questions, however... Here are a few Windows questions that everybody asks (and, of course, the answers).

I've installed Windows, and it killed my hard disk drive. What caused this?

The two most common possibilities are that you're using a drive that Windows doesn't understand, or you've hit the path bug.

If you're using a third-party device driver like Disk Manager, SpeedStor, or Vfeature, Windows gets confused when in 386-enhanced mode. Your system locks up at the initial Windows screen. The fix is simple: Look in the SYSTEM.INI file (it's in the same directory as Windows) and find the line `[386Enh]`. Create a new line immediately after it and type the following command:

```
VirtualHDIrq=false
```

By the way, if you are using such a driver, you cannot create a permanent swap file on the part of the disk controlled by that driver.

What does `VirtualHDIrq` do? The hard disk drive controller generates hardware interrupts when it has data that's ready for the CPU to transfer to memory. The program that responds to the interrupt is called an interrupt handler, and it's generally located in the BIOS on most machines while running DOS.

When it's in 386-enhanced mode, however, Windows attempts to "virtualize" all interrupt handling, and so provides a replacement for the BIOS interrupt handler. But that handler won't work when you're using Disk Manager or similar software. Therefore, Windows provides a back door: `VirtualHDIrq`. When set to false, `VirtualHDIrq` tells Windows not to virtualize disk interrupts and to route them through the normal handler. You pay a price in that it slows things down a bit.

Another problem that seems to occur with Windows, although it's not a Windows bug, is the path bug. As you add a lot of Windows programs, you'll end up running the installation programs that, among other things, lengthen your PATH statement. Now, you may know that your path cannot exceed 128 characters. But you may not know (here's the bug) that when a batch file (e.g., AUTOEXEC.BAT) extends the path beyond 128 characters, DOS doesn't notice. In the process, the overlong path overwrites part of DOS, leading to some interesting side effects. Once I saw the system start doing print screens; other times, it seems that the hard disk drive is dead. Be sure to double-check your path length.

I get a "not enough memory to load program" error, even though I clearly have plenty of memory. How can I fix this?

An extremely annoying message. One machine I saw this happen on had 8 megabytes of RAM and an 8-MB swap file. Running Word and Excel, there was no room left for Designer. What gives?

It turns out that there's more to running a Windows application than memory. Two programs that do a lot of system management—GDI.EXE and USER.EXE—each have a 64K-byte stack that keeps information about every program that is running in the system (64K bytes because of a limitation of the 8088 through 286 chips). These stacks summarize all the activity in the system. Each Windows program's local heap comes out of USER.EXE's stack. The local heap for each program must be

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preallocated upon program start-up.

Some programs just love heap space, and they'll gobble up lots of it if they see that no other programs are loaded. So you end up with a situation where you've got megabytes and megabytes of free RAM, but no space left in one of those two tiny 64K-byte stacks, and no more Windows programs will load ("for want of a nail...").

When you pull down the About Program Manager window in the Program Manager's Help menu, the Free System Resources number is telling you the amount of free space in the GDI.EXE and USER.EXE stacks. When it drops below 15 percent, Windows will refuse to launch any new applications.

The answer is to try loading the Windows programs in a different order. Load a stack-hog later in the sequence, and it will (if written well) allocate less stack space. This may not solve the problem, but it is worth trying. Again, buying more memory will not help here: The problem is Windows' reliance on the 286 chip. This is another reason why we need OS/2 2.0.

Can I change the way an icon looks?

Yes and no. A program's icon is a bit map (similar to a file created by PC Paintbrush) that's embedded in its .EXE file. To change it, you'd have to extract the bit map, change it, and reembed it in the .EXE file. The Whitewater Resource Toolkit (WRT) can edit icons (as well as dialog boxes, menus, string tables, and more) in place. It's the Windows version of the Mac's ResEdit. But what can you accomplish with Windows alone?

Windows does let you assign an alternate icon to a Windows application. Briefly, here's how. Click on the program's icon in the Program Manager (just single-click to select) and select File and Properties... from the Program Manager menu. Then click on the Change Icon push button in the Properties window. A Change Icon window will appear. One field shows the name of the program; that's where Windows looks to find the icon.

By default, Windows looks in program *x* for program *x*'s icons. But it doesn't have to. If you overtype *x*'s filename with another program's filename (call it *y*), you can associate any icon found in *y* with *x*. Unfortunately, this technique isn't a total solution. This new icon works only in the Program Manager. When the program is minimized, Windows reverts to the default icon. You'll need a true resource editor (e.g., WRT) to fix things so they'll stay fixed.

How do I make Notepad (or Write) default to a directory other than `C:\WINDOWS`*?*

Notepad is a pretty convenient little editor: two clicks and it's there. But it always defaults to `C:\WINDOWS` or whatever directory you've got Windows in. You can change that default in two ways; one is somewhat well known, the other is a bit off beat.

Everybody who has played with Windows for a while has figured out that you can give a data file its own icon. Click on the icon, and Windows uses the file's extension to load the program that goes with the data file.

For example, I've got a file called TTD.TXT, a "things to do" list. It has its own icon.

When I click on it, Windows knows that .TXT is the extension for Notepad files; so it starts up Notepad and loads TTD.TXT.

Here's a sneaky trick. Click once (not twice) on the Notepad icon in the Program Manager. Click on File in the Program Manager and then Properties.... You'll see that the command line contains NOTEPAD.EXE. Just change that to:

```
d:\subdir\NOTEPAD.EXE
```

where `d:\subdir` is the drive and subdirectory that you want Notepad to default to. Don't click OK yet, however. Click on Change Icon. The new window will include the filename `d:\subdir\NOTEPAD.EXE`. Change it to NOTEPAD.EXE; get rid of the `d:\subdir`. You will see the generic DOS icon rather than the Notepad icon. Click on Next icon, and the regular Notepad icon will appear. Then click OK, and OK. You'll get a warning message, but ignore it.

By the way, does it annoy you that Notepad and Write always default to *.TXT and *.WRI in their respective File Open dialog boxes? Do you often override those defaults with *.*? Try this (courtesy of BIX user Jeff Detray): Save copies of NOTEPAD.EXE and WRITE.EXE, fire up Write, open each .EXE file (specifying no conversion), and do a search-and-replace to change *.TXT or *.WRI to *.*. Important: Put two spaces after *.* so you don't change the length of the strings embedded in the .EXE files. Could you use WRT to solve the problem more cleanly? Nope. The *.WRI and *.TXT strings are not defined as resources—naughty, Microsoft—so WRT cannot get at them.

Windows is a multitasking platform for Windows programs: Its scheduler can juggle several programs.

What do those background priority and foreground priority numbers mean when you're running Windows in 386-enhanced mode?

You know that Windows is a multitasking platform for Windows programs: Excel can share the desktop with Corel Draw and Windows Tetris, with the Windows scheduler juggling them all. The 386-enhanced mode adds another layer of juggling. It views Windows and all Windows programs collectively as one virtual machine (VM). The 386-enhanced part of Windows isn't worried about how much time to give WinWord versus WingZ, and it leaves that job to the very same Windows scheduler that exists in Windows standard mode.

Windows is one VM. Each DOS program that is running is also a VM. So, if you're running WordPerfect 5.1 (a non-Windows program), dBASE IV (another non-Windows program), PageMaker, Excel, and WinWord, you've got three VMs: WordPerfect is in one VM, dBASE is in another VM, and the three Windows

programs all exist in the Windows VM.

The background and foreground priority numbers answer the question, "What proportion of the CPU's time should be spent on each VM?" Here's how it works.

First, each VM has a background and foreground priority number. The Windows background/foreground pair can be set from the 386-enhanced option in the Control Panel. For non-Windows programs, these numbers are set in the Advanced dialog box under the program information file (PIF) editor or in the Settings... menu in the DOS program's Control icon (accessed with Alt-space bar).

Second, only one VM—the one you see on the screen—has the foreground at any point in time. When you see the Windows desktop, Windows has the foreground. When you see the familiar blue WordPerfect screen, WordPerfect has the foreground. The others are in the background. If you've selected the Background check box in a program's PIF file, it will continue to run, even if it's in the background. (The PIF editor's default is *not* to check the Background, so none of your programs will run—and this discussion is irrelevant—if you have not checked Background.)

With that background (no pun intended) in mind, here's how priorities work.

Sum up all priority numbers. For the foreground VM, use its foreground number. For the background VMs, use their background numbers. That's the priority total.

For all VMs, divide the VM's priority number (background or foreground, whichever is relevant at the moment) by the priority total. That is the percentage of CPU time allotted to that VM.

Here's an example. Suppose you've got dBASE and WordPerfect running with Windows. Give Windows a foreground of 100 and a background of 50. Say dBASE gets FG=150 and BG=25, and WordPerfect has FG=200 and BG=100. Remember that you control all these numbers with the Control Panel or the PIF editor.

When Windows is in the foreground, the total is 100 (Windows' foreground number) plus 25 (dBASE's background number) plus 100 (WordPerfect's background number), for a total of 225. Windows gets 100/225 of the CPU time, almost one-half; dBASE gets 25/225, or one-ninth; and WordPerfect gets as much time as Windows.

Now put dBASE in the foreground. The priority total is then 50 (Windows) plus 150 (dBASE) plus 100 (WordPerfect), or 300. Windows gets 50/300, one-sixth of the CPU time; dBASE gets 150/300, one-half; and WordPerfect gets the rest.

And with WordPerfect in the foreground, the total is 50 (Windows) plus 25 (dBASE) plus 200 (WordPerfect), or 275. Windows sees 50/275 of the CPU time, there's 25/275 for dBASE, and 200/275 goes to WordPerfect.

By adjusting these priorities, you can tune your Windows system to make the best of your various applications. Want a snappier Lotus 1-2-3? Increase its foreground priority. Want your word processor to print faster in the background? Play with its background priority. But be careful and keep notes; sometimes you can make the system run much worse by fiddling with these numbers! ■

ITEMS DISCUSSED

Whitewater Resource Toolkit $195
The Whitewater Group, Inc.
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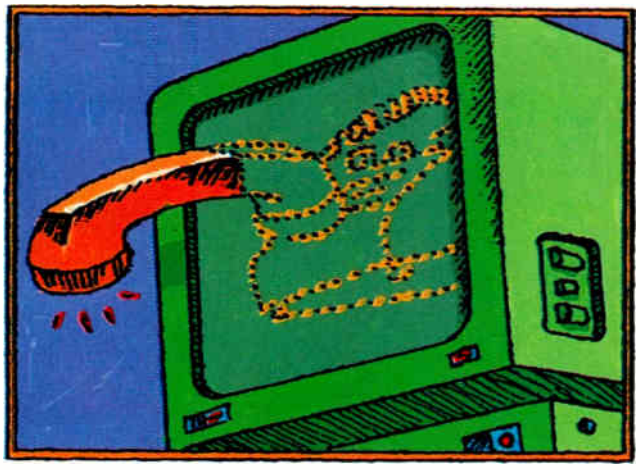
MACINATIONS

Professional 3-D Graphics on the Mac

Don Crabb



How good is the Mac as a 3-D engine? Paracomp proves it's superb.

By the time I got to Paracomp's office in San Francisco, I was a wreck. First of all, I had to drive like a maniac from the hotel to get there close to my appointed time, due to a last-minute incoming phone call. I trotted over to the Paracomp building and bolted up the stairs, arriving a mere 45 minutes late. I must have looked like a wild man, hair dripping wet, heart pounding, completely out of breath.

By the time I was finished with my private briefing (it was on the morning of the first day of the MacWorld Expo; these guys deserve a medal for putting up with me), I was considerably calmer, much drier, and very much impressed. Really impressed.

While I had played around with Paracomp's bevy of graphics products before, I had never really gotten the complete picture on them as a whole. The Paracomp people fixed all that by giving me guided tours of Swivel 3D and 3D Professional and ModelShop 1.1 and II (in a beta version).

Armed with this knowledge and copies of the Paracomp software that had been sent to me, I spent most of the rest of January reimmersing myself into three-dimensional graphics, Paracomp-style. While many good 3-D products are available, I can't think of a single vendor that has its head screwed on as straight as Paracomp when it comes to making all its products work together. This is no mean feat considering that most of its stuff has been acquired from outside sources.

Even though ModelShop 1.1 isn't my favorite graphics program (ModelShop II fixes most of the interface goofs), it all manages to work together quite nicely. Once I saw how it worked and got into the mindset of the architects who use it, it seemed simple to build 3-D models of buildings and cities, move around outside and within them, and change the scale, display, perspective, and other parameters.

I quickly learned how to export my ModelShop creations to Swivel 3D Professional, where I could give them photorealistic rendering (which is Pixar's MacRenderMan's claim to fame, about which I'll have more to say in future columns) and use its Tween command to create dynamic animations (see the screen shot). I even learned how to take these Swivel creations and output them in all kinds of formats, from AutoCAD DXF to MacRenderMan RIB to 24-bit PICT files. I also figured out how to output files to more mundane formats: EPSF, PICT, PICT2, PICS, Paint, and Scrapbook files, so I could use images within HyperCard 2.0 stacks.

In fact, I liked using Swivel 3D Professional so much, and found it so straightforward and intuitive, that I almost wished I was a graphics designer and got to do this stuff all day long. I expect that I'll be using the program's animation tools—especially the multiple key frames, tweening, animated camera views, and smoothed 3-D panels—in my teaching, research, and consulting.

I have a lot more to learn about Paracomp's products, and about competing 3-D vendors, too. For my money, though, the Mac is proving to be the premier middle-cost/middle-performance 3-D graphics engine now available. It won't displace the Silicon Graphics machines, but even a loaded Mac IIfx doesn't cost $75,000.

There is one caveat, though: You shouldn't expect to use any of these Paracomp products without at least a 4-megabyte Mac IIcx. And you'll be a lot happier with faster iron, such as a 5- to 17-MB IIsi, an 8- to 32-MB IIci, or a 32-MB IIfx.

Software of the Month: Screen Capturers

Why do you need a screen-capture utility? After all, the Finder includes a built-in one that grabs a Clipboard/Paint file when you want it (typing Command-Shift-3) and then dumps it into a MacPaint file. Why, then? Because that built-in one is pretty lame: It works only in black and white, yielding a MacPaint file. Nor does it handle anything over 640 by 480 pixels.

This void has been filled by a lot of good third-party software. Three I use are Capture 3.0 from Mainstay, Exposure 1.0 from Preferred Publishers, and SnapJot 3.0 from Wildflower Software.

While all these utilities do a good job of capturing screens, each has its own special prowess, which is why I keep them all on my disks. Capture and Exposure are INIT cdevs; SnapJot does its magic from a System INIT and a desk accessory.

Capture 3.0 is probably the simplest of the three, and it's ultimately the most reliable. I've yet to have it crash any of my Macs, and I've got some pretty scary machines in my home and office computing plants.

Capture can grab full or partial screens as either Clipboard or PICT files in both 8- and 24-bit color. About the only problem I've encountered with it was at start-up, when it conflicted with the IDs of some other INITs. A simple renaming fixed that problem. Capture 3.0 costs $79.95.

Preferred Publishers has thrown in all kinds of useful

Don Crabb is the director of laboratories and a senior lecturer for the computer science department at the University of Chicago. He can be heard regularly on the Bob Lassiter Show *on WLS Radio AM 89 in Chicago. He is also a contributing editor for BYTE. He can be contacted on BIX as "decrabb."*

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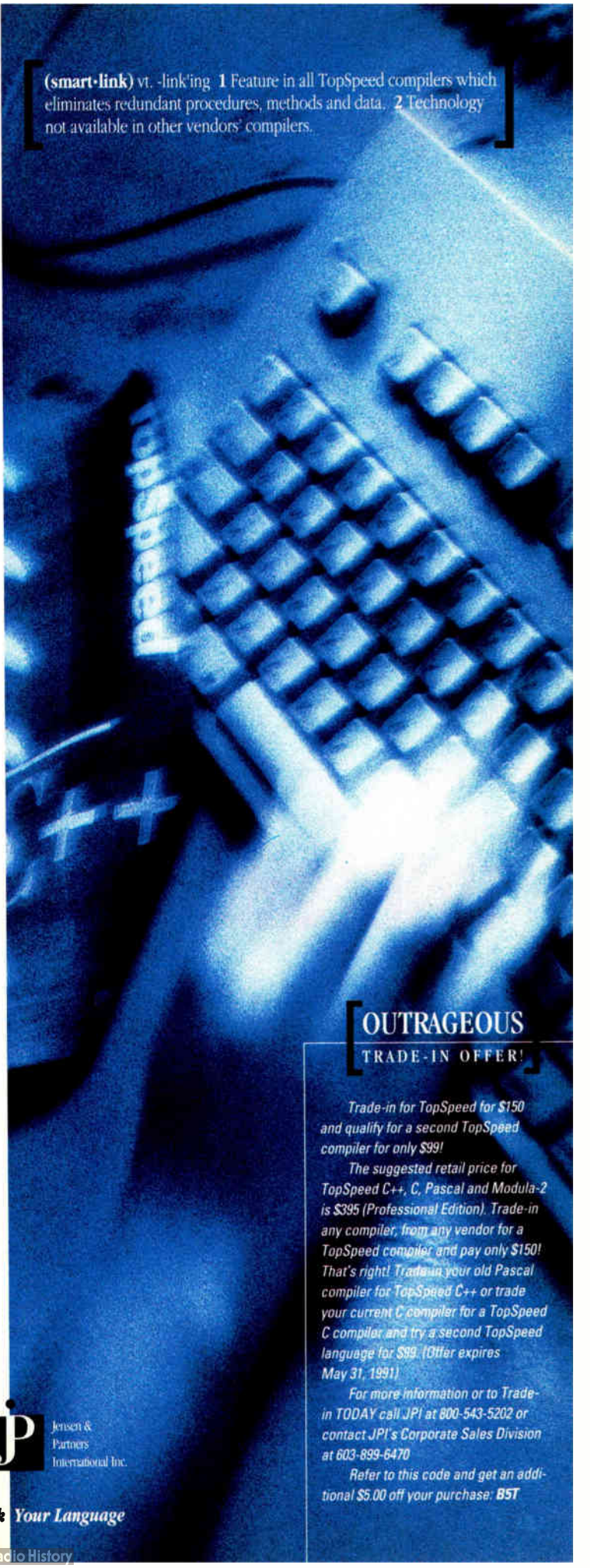

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features with Exposure 1.0. The most interesting one is the movable palette menu bar. With it, you can not only capture a screen, but edit and annotate it as well, since Exposure is something of a mini Paint program, too. You can capture files to disk or send them to the printer directly. Exposure saves files in Scrapbook, Paint, StartupScreen, and PICT formats. Exposure costs $149.95.

Mark Edel of Wildflower Software kindly took the time to search me out at an Apple product preannouncement some months back to tell me about SnapJot. Since then, I've been a SnapJot fan.

I use SnapJot to capture the screens that appear in this column. It can handle simple and more complex screen capturing (e.g., capturing portions of the screen), and it can save files in the usual Paint/Clipboard and PICT formats. But if that's all you use SnapJot for, then you've missed the whole point of this superhandy utility.

An object rendered in 8-bit color using Swivel 3D Professional.

SnapJot makes it trivially easy to micromanage your MultiFinder environment. If you're like me, you keep several programs up and running all day long. I personally tend to run VersaTerm-Pro, Nisus, FileMaker Pro, HyperCard, Inspiration, and Prograph every day.

Since I'm often working on different projects that have allied purposes, it's useful for me to cut and paste between different documents easily (yes, I can hardly wait for System 7.0's Inter-Application Communication hot links!). But if I have to keep the full windows of all these things displayed, I run out of screen real estate, even on my 19-inch SuperMac Technology 24-bit color monitors.

Enter SnapJot. I can capture part of a screen from a document, leave it on display in one corner of my monitor, and refer to it within another document. I use SnapJot as sort of the screen equivalent of Post-It Notes, because its captured screens remain actively displayed as long as you want them to. This is so handy, it's

a wonder Apple didn't build it into the Finder long ago! SnapJot costs $59.95 and is well worth it.

Tip of the Month

I spent much of 1990 writing a book, *Using FileMaker Pro*, for Brady Books. For a variety of reasons that are too depressing and Byzantine to go into here, that book won't be appearing anytime soon. But my year of being immersed in things FileMaker has stood me in good stead here at the University of Chicago and among some of my consulting clients. I've become something of a FileMaker expert as a result of researching and writing the book.

One of the things I've found is that if you use FileMaker Pro a lot, you need some help, or else you spend too much time designing forms and diddling with all the clever layout features of the program. While I love to diddle around, it sure doesn't get the bills paid, so you can imagine how happy I was when I stumbled across the Elk Horn Library.

Elk Horn Publishing distributes a catalog full of FileMaker templates, data files, and other goodies. Not only are these doodads good, they are also sublimely cheap. An example is Network Messaging. This is a clever little FileMaker Pro template that lets you use FileMaker's multiuser file sharing capability to set up a simple mail/messaging server on your AppleTalk network. No, it won't replace Microsoft Mail, cc:Mail, QuickMail, or any other full-blown E-mail system. But it costs only $4. Or $2, if you are a subscriber to Elk Horn's excellent newsletter called *FileMaker Report*.

Continuing the networking theme, another Elk Horn Publishing template is the Network-To-Do-List 1.2, which will set you back $22. This handy little template comes in versions for FileMaker II (the old system) and FileMaker Pro. It works nicely as an appointment and task list for a workgroup. The template handles both people and facilities, as well as private and public information. Serious reporting layouts are also included with the package.

The Elk Horn catalog lists more than 100 templates, data files, and other FileMaker add-ons, costing between $2 and $125. If you use FileMaker, you owe it to yourself to call this company and get on its catalog list. ■

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Agoura Hills, CA 91301
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fax: (818) 991-4587
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Elk Horn Library ..... $2 to $125
Elk Horn Publishing
P.O. Box 1300
Freedom, CA 95019
(408) 761-5466
fax: (408) 761-5468
Circle 1148 on Inquiry Card.

Exposure 1.0.....$149.95
Preferred Publishers, Inc.
1770 Moriah Woods Blvd., Suite 14
Memphis, TN 38117
(800) 829-3383
(901) 683-3383
fax: (901) 683-4983
Circle 1149 on Inquiry Card.

ModelShop 1.1 .....$595
Swivel 3D Professional.....$695
Paracomp, Inc.
1725 Montgomery St., Second Floor
San Francisco, CA 94111
(415) 956-4091
fax: (415) 956-9525
Circle 1150 on Inquiry Card.

SnapJot 3.0 ..... $59.95
Wildflower Software
21 West 171 Coronet Rd.
Lombard, IL 60148
(708) 916-9360
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Joanne Dow, Exchange Editor

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amiga.hw	Amiga hardware design, use, and hookup
amiga.arts	Artistry using the Amiga
amiga.int	Developing for the international Amiga
amiga.special	Special guests and events
amiga.dev	Commodore's conference for developers

■ IBM Exchange

Barry Nance, Exchange Editor

ibm.pc	The venerable PC
ibm.at	The AT series and workalikes
ibm.ps	The PS/2 series
ibm.os2	OS/2 operating system
ibm.dos	PC/DOS & MS/DOS operating systems
ibm.os.386	Alternative 386 operating systems
ibm.utils	Utility software for IBM computers

ibm. repairshop	Garage and Tune-up Shop
ibm.new. prods	New products for IBM computers
ibm.exchange	IBM Exchange clearinghouse
ibm.listings	Index to program files in the Exchange
ibm.other	Apps, printers, modems, etc.
microsoft	Products from Microsoft

■ Writers' Exchange

Wayne Rash, Jr., Exchange Editor

desktop.pub	Using microcomputers for publishing
elfquest	Find out about things elven with Richard Pini
journalism	Reporting and writing news
journalism. pro*	Interaction for working press only
lexicon	About words
marketing	Promos, sales, public relations and high tech
new.writers	Getting started in the writing business
poetry.prose	Writing both types of English
sf	Science Fiction, Star Trek, and fantasy fans
sfwa*	Science Fiction Writers of America
tech.news	Discuss Microbytes, product reports, items
word. processor	Word-processing programs
writers	The original writers conference
write.fiction	How to write fiction
writers.pros*	Interaction for professional writers only
writers.talk	Conversations with professional writers

■ Macintosh Exchange

Dr. Larry Loeb, Exchange Editor

mac.apple	The word from Cupertino
mac.business	Macs in the office
mac.desktop	Publishing with a Mac
mac.external	Information from all over
mac.hack	Technical information about the Mac
mac.hypercard	Using the HyperCard programming environment
mac.news	Up-to-the-minute information
mac.novice	For beginners
mac.products	Listings of new hardware and software
mac.sandbox	For off-hours fun

■ Tojerry Exchange

Jerry Pournelle, Exchange Editor

tojerry	Messages for and from Jerry Pournelle
chaos.manor	Computing at Chaos Manor
astronomy	A star party for amateur astronomers
contact	Science fiction meets science
disasters	Natural and man-made disasters
education	Computers in American classrooms
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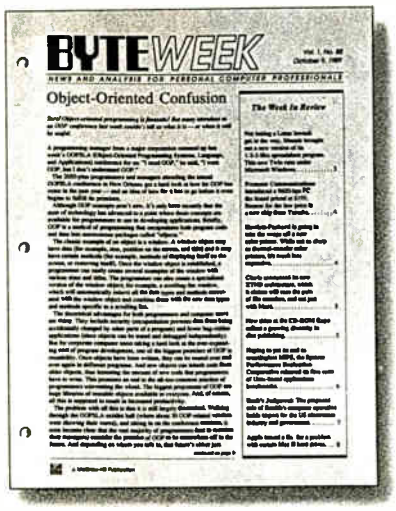
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ASK BYTE

The Cable the Cat Dragged In

I need help in locating a cable/connector and the pin-outs for a Mitsubishi MP 286L laptop computer. Its external floppy disk drive port is a female DB-26 connector. Although Office Depot, a local vendor, sells the laptop, it doesn't sell—and refuses to order—the accompanying 5¼-inch floppy disk drive. All the computers in my wife's office contain only 5¼-inch floppy disk drives. Thus, she can't use the laptop for the purpose for which it was purchased.

I called the Mitsubishi Electronics America Information Systems Division for help in locating a cable so I could hook up a 5¼-inch floppy disk drive. The company claimed I couldn't get a cable unless I bought the disk drive for $700. I asked, "What if my cat ate the cable, and I needed a new one?" The answer was, "Sorry." I asked a technician if he knew the pin-outs, and he said he didn't. Since Mitsubishi retailers don't sell the cable, it is not entirely unreasonable to expect a large company like that to support customers when its vendors don't.

Jules Bartow
Clayton, OH

According to Mitsubishi technical support, the cable you're after will work only with a Mitsubishi 5¼-inch floppy disk drive. The external floppy disk drive port on the MP 286L is a proprietary design. Even if you got your hands on the cable, you would not be able to hook a different floppy disk drive to it. I'm afraid the pin-outs wouldn't do you much good, either.

If you want to use that port, you'll have to buy the cable and the drive from a Mitsubishi dealer or from a third-party reseller that handles Mitsubishi-compatible drives. You should check the mail-order ads in BYTE or other computer magazines. I found an external 5¼-inch floppy disk drive for the MP 286L sold by Telephone Product Center (12603 Hoover St., Garden Grove, CA 92641, (800) 383-3199). The drive I found sells for $245. I'm sure you can find other dealers with such drives.

You do have a good point, though. If you sink $700 into an external drive, you should be able to replace a defective cable. I would check with some other Mitsubishi dealers in your area. You might call the following:

- *J&R Enterprises, (513) 671-0339*
- *Tristate Data Supplies, (513) 891-4666*
- *NCC Systems, (513) 745-0190*

Or you can call Mitsubishi at (800) 441-2345, ext. 54M, for the names and phone numbers of other dealers in your area. If you can't find a replacement cable for the external drive, you have a valid complaint. I would not buy a disk drive if I could never get another cable for it. If all else fails, you could buy the drive and muzzle your cat.

Fortunately, you have other options. The easiest and least expensive way to go? Buy a copy of Traveling Software's LapLink III (or a similar file transfer product). Your wife can then bring her laptop to work, plug one end of the included LapLink cable into the Mitsubishi's serial or parallel port, and connect the other end to either port of any IBM-compatible desktop system. She can then transfer files to or from the desktop system. It's fast (especially if she uses the parallel port and enable turbo mode) and simple. It will also let her transfer files that are greater than the storage capacity of a 5¼-inch floppy disk drive.

LapLink III costs about $95 and is available from most mail-order software houses. Check the ads in BYTE for a LapLink dealer.

Micro Solutions Computer Products (132 West Lincoln Hwy., DeKalb, IL 60115, (815) 756-3411) can also set you up. For $349, it sells an external floppy disk drive called the Backpack. It plugs into any standard PC parallel port, and the company offers a 5¼-inch 1.2-megabyte model. You can also get a break on the list price by comparing mail-order sources. Micro Solutions can give you a list of its mail-order outlets. If you order through Computer Options ((800) 424-7678) or Central Computer Products ((800) 456-4123) and say that you were referred to them by Micro Solutions, you'll get an additional $10 discount. The Backpack will work with any laptop that has a standard parallel port.—S. D.

Of Computers and Phones

Although I count myself in the ranks of IBM PC users, seeing the new Macs with built-in microphones has brought a product idea to mind. My hope is that someone has already implemented it.

With a microphone and the appropriate add-in board, what's to keep the PC from working as a telephone? If you want to declutter your desk, you put your fax and telex into your PC, and, of course, the PC takes the place of the typewriter and calculator. What about the phone? That's about the only thing left to incorporate.

Until now, to my knowledge, there has only been software for maintaining phone lists and for keeping records of phone activity. My idea is a complete phone substitute: It would do all the statistical call analysis, automatic dialing, prerecorded calls, call filtering, call routing to internal extensions, and voice-mail functions. A network version would be indispensable, with client and server versions of the add-in board, the server replacing the main phone, and the clients replacing the traditional phone extensions. The voice signal would travel by network, and all nodes could communicate by voice.

Finally, if someone has already implemented this idea, I hope it will be compatible with telecommunications regulations in Portugal.

Campos Santos
Figueira da Foz, Portugal

While no one to my knowledge has put together a PC-based telephone system that doesn't require a handset, several vendors are working on the more sophisticated functions you suggest.

PC-based Touch-Tone voice-mail systems are already on the market. However, two maturing technologies, voice recognition and ISDN, have the potential to deliver

sophisticated applications like the ones you seek.

Voice recognition should make it possible for the PC controlling the phone to handle a number of functions for any caller (e.g., call routing and message receiving). Alternatively, the digital data provided by ISDN can give you caller information, make it easy to maintain statistical databases, and aid in integrating voice and network applications.—S. A.

Forget-Me-Not

In the company where I work, we have one IBM XT and one IBM AT clone, the AT being used to run financial software. Every once in a while, the AT loses its CMOS setup information. At first I thought it was because of the battery. I replaced that, but the setup information kept getting erased.

I called the dealer, who said the software was erasing the CMOS. But the software vendor claimed it wasn't possible for the software to affect CMOS settings. I got the hardware dealer to replace the motherboard, but no luck. After three motherboards from three different manufacturers, the AT still loses its setup information.

Is it possible that the financial software could accidentally change the CMOS contents? For once, it seems my computer's problem isn't hardware.

Renato Simoni
Belo Horizonte, Brazil

The people who wrote your financial software are wearing blinders. Yes, it's very possible for software to wipe out the CMOS setup information. On a standard AT compatible, the CMOS storage is accessed by a pair of I/O ports at 70 and 71 hexadecimal. Badly behaved software that accidentally touches one of those ports could easily wipe out your settings.

Unfortunately, there isn't any easy way to either protect your CMOS or find out how it's being damaged. I'd suggest you go back to the software vendor, mention the three motherboard swaps, and ask the vendor to take another look at the software.—H. E.

Power to the Palmtop

As a BYTE subscriber, I have noticed the care your technical people take in testing various products.

I own a palmtop computer that is not 100 percent IBM compatible, the Atari Portfolio. It uses a DOS-compatible operating system, DIP-OS, rather than DOS itself; nonetheless, a variety of character-based programs written for DOS run on it. The Portfolio uses RAM cards rather than a conventional disk drive, and ROM cards for preconfigured applications.

This computer can be outfitted with a parallel port, and I am curious to know if the Micro Solutions Backpack is compatible with the Portfolio, its operating system, and its parallel port. Do you know whether this particular combination has ever been attempted? If the two will work together, the Portfolio suddenly becomes much more useful. You could keep a database on a floppy disk and access it from the Backpack drive; when the database isn't needed, you wouldn't have to carry the Backpack. To carry the same database on RAM cards might be prohibitively expensive. I suspect that Atari vendors would be very interested.

I don't need a Backpack for my desktop computer, so I hesitate to test this hypothetical configuration for myself. I recently sent a query to Micro Solutions Computer Products about this matter and am enclosing a copy of the reply.

Harry C. Hutchins
Carbondale, IL

For maintaining a database, you would probably want more than a floppy disk drive. By the time you read this, XoteriX ((818) 888-7390) should be selling a 20-megabyte hard disk drive that fits onto the bottom of the Portfolio, adding 12 ounces of weight and ¾ inch of height to the unit. It's expensive at $899, but it would give you access to a significant chunk of storage space as well as another 512K bytes of RAM and rechargeable batteries. XoteriX also sells modems, RAM cards, and software for the Portfolio. If you need a relational database, it has one.

As for your specific question, I'm afraid I can't give you a better answer than the one you received from Micro Solutions. As its letter pointed out, the two major stumbling blocks would be loading the necessary Backpack software drivers onto the Portfolio and the possibility of BIOS conflicts (the port address of the parallel printer adapter must be located at a particular BIOS data address).

Unfortunately, neither Micro Solutions nor Atari can say for sure if the combination will work. Atari says that its $79 Smart Parallel Interface conforms to the IBM standard, but the company has never tested it with a Backpack. My advice is to buy both products with the clear understanding that you can return them if they do not solve your problem. Micro Solutions will give you 30 days to return an item for a full refund; Atari will give you only 15 days to check out the Smart Parallel Interface. Even if the Backpack doesn't work with the Portfolio parallel port, you may want to keep the Smart Parallel Interface for printer support and file transfers.—S. D.

A Hand for the Handicapped

I am a physician who customizes Macintoshes for use by spastics and other handicapped individuals (e.g., subjects with reduced motor, audio, and phone ability). I'd like to get more information on dedicated devices, such as special keyboards, phone/voice controllers, speech-recognition units, Bliss language aids, and braille printers. I'm interested in devices for both the Mac and the IBM PC.

Dr. Raffaello de Masi
Atripalda, Italy

There's a fairly large group of companies listed in "Opening Doors for the Disabled" in the August 1990 BYTE. Other magazines specifically cover this type of information. You might contact Exceptional Parent *(1170 Commonwealth Ave., Boston, MA 02134). Besides its usual coverage of products and techniques,* Exceptional Parent *runs annual technology issues. The November/December 1990 issue has its latest technology directory, and it may have the information you seek.*—H. E. ■

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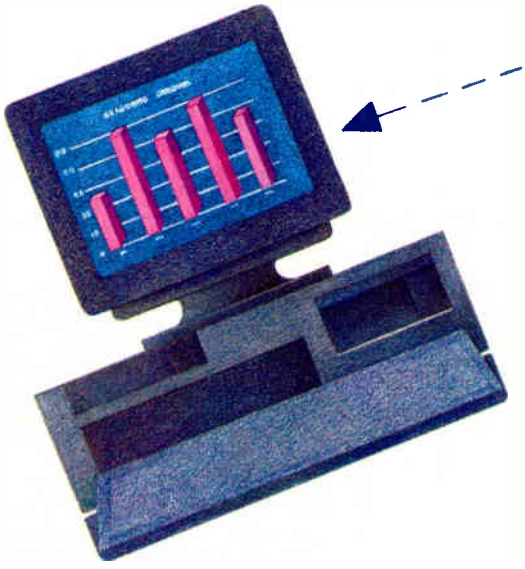

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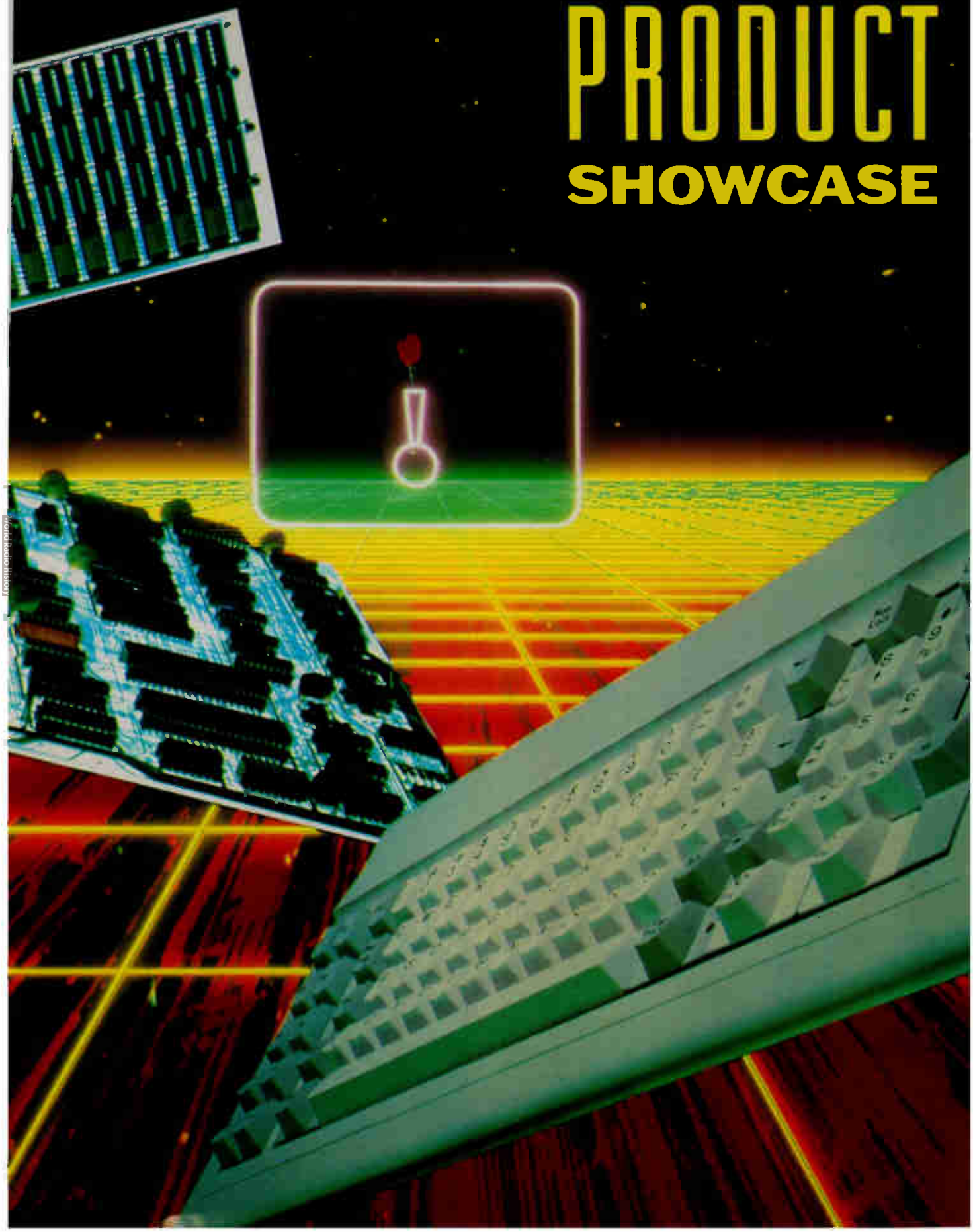

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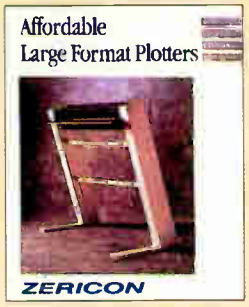

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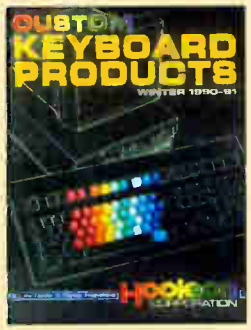

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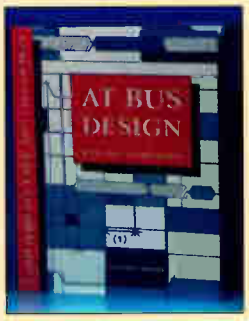

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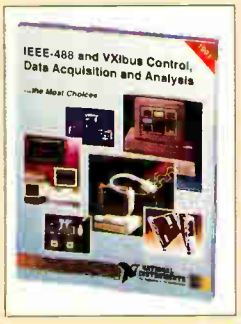

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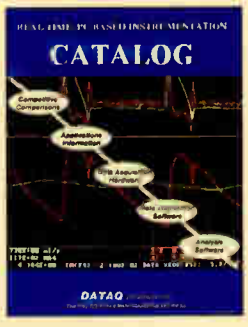

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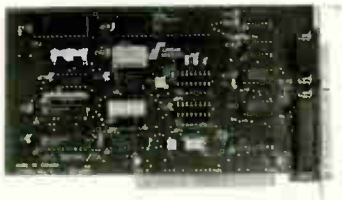

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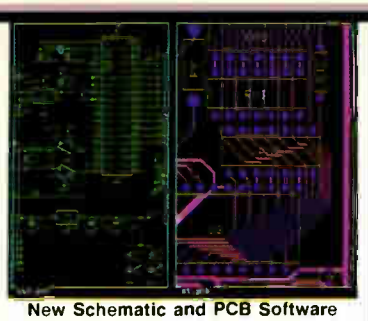

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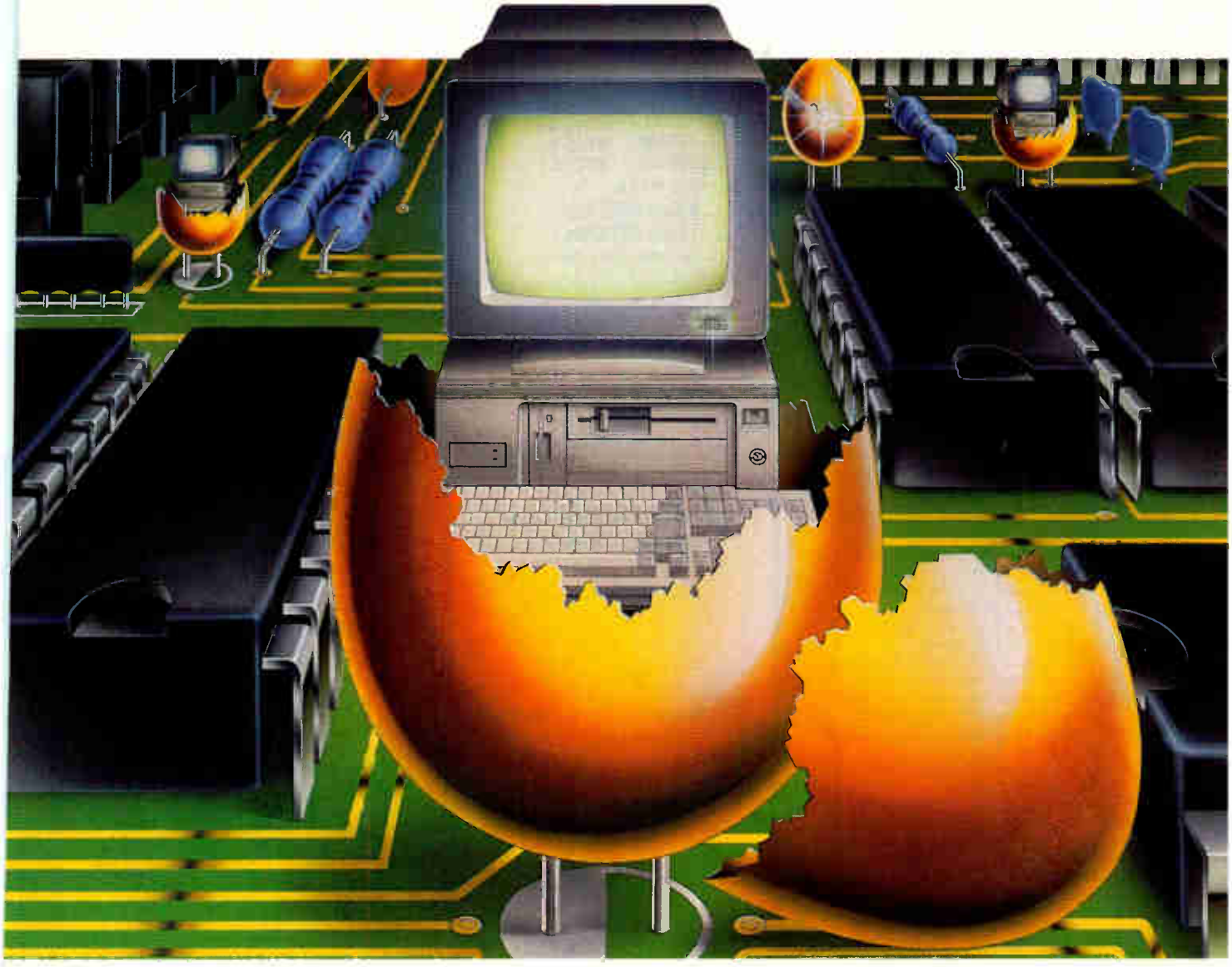

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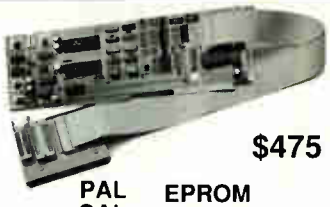

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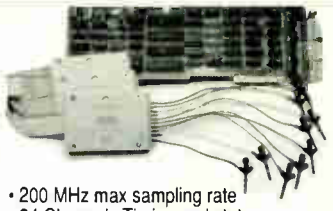

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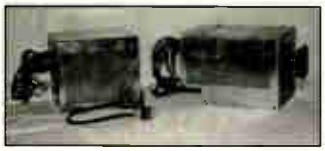

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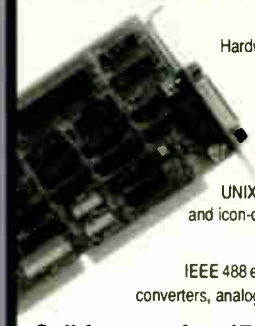

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IBM

Part # EQ	Works With	PRICE
78X8955 (128K)	PS/2 25	$ 19.00
1057035 (512K)	PS/1	$ 79.00
1057036 (2MB)	PS/1	$ 299.00
30F5348 (512K)	30/286	$ 49.00
30F5360 (2MB)	30/286	$ 139.00
6450603 (1MB)	50Z, 55SX, 70-EG1, 70-121, P-70	$ 79.00
6450604 (2MB)	50Z, 55SX, 70-EG1, 70-121, P-70	$ 139.00
6450608 (2MB)	70-A21, A61, B21, B61	$ 149.00
34F2933 (4MB)	55SX, 65SX, 55LS, 65LS, 34F3077	$ 329.00
6450375 (1MB)	80-041	$ 119.00
6450379 (2MB)	80-111, 311	$ 199.00
6451060 (4MB)	80-A21, A31, A61	$ 469.00
6450902 (2MB)	90, 95	$ 229.00
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6450605 (2–8MB)	70, 80	$ 429.00
34F3077 (2–16MB)	70, 80	$ 499.00
6450609 (2–16MB)	50, 50Z, 55SX, 60, 65SX	$ 539.00

COMPAQ

Model	Memory Added	Part # EQ	PRICE
DP 386/33, 486/25, 33 & Systempro	2MB MODULE	115144-001	$ 159.00
	8MB MODULE	116561-001	$1,069.00
DP 386/20e, 20, & 25e, 25	1MB BOARD	113644-001	$ 159.00
	4MB BOARD	113645-001	$ 409.00
	1MB MODULE	113131-001	$ 109.00
	4MB MODULE	113132-001	$ 319.00
DP 386s/16	1MB BOARD	113633-001	$ 159.00
	4MB BOARD	113634-001	$ 409.00
	1MB MODULE	113646-001	$ 109.00
	4MB MODULE	112534-001	$ 319.00
DP 286N, 386N & 386SX/20	1MB MODULE	118689-001	$ 99.00
	2MB MODULE	118689-001	$ 149.00
	4MB MODULE	118690-001	$ 459.00
	0K BOARD	118700-001	$ 99.00
DP 386/16	1MB BOARD	108069-001	$ 279.00
	2MB BOARD	108069-W/71	$ 399.00
	4MB BOARD	108070-001	$ 599.00
	8MB BOARD	108070-W/72	$ 899.00

NEC

Model	Memory Added	Part # EQ	PRICE
Powermate SX Plus	1MB BOARD	APC-H850E	$ 279.00
	2MB BOARD	& APC-H851E	$ 479.00
	4MB BOARD	APC-H852E	$ 759.00
	8MB BOARD	& APC-H853E	$1,299.00
Powermate SX/20			Call
Powermate 386/20	2MB BOARD	APC-H655E	$ 499.00
Powermate 386/25	2MB BOARD	APC-H655X	$ 499.00
	8MB BOARD	APC-H656X	$1,399.00
	8MB BASEBOARD	APC-H657X	$1,449.00
Powermate 386/25S	2MB KIT	OP-410-8103	$ 249.00
	8MB KIT	OP-410-5202	$ 699.00
Powermate 386/33E 486/25E	2MB MODULE	OP-410-5101	$ 379.00

Apple

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MAC Classic	1–3MB BD	M6361LL/A	$ 119.00
	2MB KIT	M0514LL-A	$ 109.00
MACIIci, IIsi	1MB KIT	M0291LL-A	$ 79.00
MACIIsi	2MB KIT	M0514LL-A	$ 199.00
MACIIci, IIsi	4MB KIT	M0292LL-A	$ 229.00
MACIIsi	8MB KIT	M0513LL-A	$ 799.00
MACIIci, IIsi	16MB KIT	No # Available	$1,099.00
MACIIfx	4MB KIT	M0376LL-A	$ 249.00
	16MB KIT	No # Available	$1,199.00
MAC SE, SE30, Plus, II, IIcx, IIx	4MB KIT	M02707	$ 229.00

AST

Model	Memory Added	Part # EQ	PRICE
BRAVO 486/25	2MB SIMM	500718-004	$ 229.00
PREMIUM 386SX/16, SX20 & 386/25, 33	1MB MODULE	500780-003	$ 89.00
	4MB MODULE	500780-004	$ 499.00
	8MB KIT		
PREMIUM 386C, WKST & BRAVO	1MB KIT	500510-007	$ 89.00
	4MB KIT	500510-008	$ 279.00
PREMIUM 286 Fastram	512-2MB BD	500394-001	$ 289.00
Fastram Kit	512 UPGRADE	500510-001	$ 55.00
Adv. Fastram	2–8MB BD	500565	$ 629.00
Adv. Fastram Kit	2MB UPGRADE	500510-002	$ 139.00
PREMIUM 386	1MB KIT	500510-003	$ 89.00
	4MB KIT	500510-004	$ 299.00

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Part#	PRICE
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256 X 9-70	$ 21.00
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1 X 8-80	$ 51.00
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1 X 9-80	$ 56.00
1 X 9-70	$ 58.00
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256 X 4-80	$ 6.00
4464-10	$ 2.20
4464-80	$ 2.50
4164-10	$ 2.00

LASER PRINTER MEMORY

Model	Memory Added	Part # EQ	PRICE
H.P LASERJET IIP, III, IIID	1MB MODULE	H33474B	$ 89.00
	2MB MODULE	H33475B	$ 149.00
	3MB MODULE	H33476B	$ 199.00
	4MB MODULE	H33477B	$ 249.00
H.P LASERJET II, IID	1MB MODULE	H33443B	$ 89.00
	2MB MODULE	H33444B	$ 149.00
	4MB MODULE	H33445B	$ 249.00
H.P DESKJET	256K MODULE		
IBM 4019, 4019e	1MB MODULE	1039136	$ 149.00
	2MB MODULE	1039137	$ 209.00
	3.5MB MODULE	1038675	$ 289.00
OKi LASER 400	1MB MODULE	70014701	$ 179.00
	2MB MODULE	70015801	$ 249.00
OKi LASER 800, 820	1MB MODULE	70016501	$ 179.00
	2MB MODULE	No # Available	$ 249.00
	4MB MODULE	No # Available	$ 359.00
PANASONIC 4450	1MB MODULE	KXP440	$ 190.00
PANASONIC 4420, 4450i	1MB MODULE	KX443	$ 169.00
	2MB MODULE	KX441	$ 219.00
	4MB MODULE	No # Available	$ 329.00
CANON LBP-4	1MB MODULE	S63-2240	$ 189.00
	1MB EXP	S63-2230	$ 189.00
CANON LBP-8II	1MB BOARD	S63-1300	$ 99.00
	2MB BOARD	S63-1880	$ 149.00
	4MB BOARD	No # Available	$ 269.00
APPLE LASERWRITER	1MB KIT	M6005	$ 89.00
	4MB KIT	M6006	$ 299.00
EPSON EPL6000	2MB MODULE	IBS401	$ 199.00
	4MB MODULE	IB401/4	$ 329.00
TI MICROLASER	1MB MODULE	2559810-8001	$ 89.00
TOSHIBA PAGELASER 6	2MB MODULE		$ 219.00
	4MB MODULE		$ 349.00
QMS PS410	1MB UPGRADE	2600090-903	$ 169.00
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3C87SX-16	$ 249.00
3C87SX-20	$ 269.00
3C87-20	$ 289.00
3C87-25	$ 359.00
3C87-33	$ 449.00

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Model	Memory Added	Part # EQ	PRICE
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	2MB KIT	PC14-PA8312U	$ 299.00
	4MB KIT		$ 699.00
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T1200XE	2MB KIT	PC-PA8306U	$ 175.00
T1600	2MB KIT	PC8-PA8302U	$ 175.00
T3100SX	2MB KIT	PC15-PA8308U	$ 175.00
	4MB KIT	PC15-PA8310U	$ 449.00
T3100	2MB KIT	PC9-PA8341U	$ 175.00
T3200SX	2MB KIT	PC12-PA8307U	$ 175.00
	4MB KIT	PC12-PA8309U	$ 449.00
T3200	3MB KIT	PC6-PA7137U	$ 279.00
T5100	2MB KIT	PC7-PA8301U	$ 175.00
T5200, 5200C, 8500	2MB KIT	PC10-PA8313U	$ 175.00
	8MB KIT	PC10-PA8313U	$ 999.00
COMPAQ			
Portable III	Modem/Interface	107808-001	$ 89.00
	0-6MB BD	107811-001	$ 189.00
	512 KIT	107331-001	$ 39.00
	2MB KIT	107332-001	$ 129.00
Portable 386/20	Modem/Interface	107707-001	$ 89.00
	1MB KIT	107651-001	$ 239.00
	4MB EXP	107653-001	$ 699.00
Portable LTE286	1MB BOARD	117081-001	$ 129.00
	2MB BOARD	117081-002	$ 179.00
	4MB BOARD	117081-003	$ 699.00
Portable LTE386S/20	1MB BOARD	121125-001	$ 349.00
	4MB BOARD	121125-002	$1,199.00
SLT/286	1MB BOARD	110235-001	$ 159.00
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SLT/386	1MB BOARD	118303-001	$ 169.00
	2MB BOARD	118304-001	$ 309.00
	4MB BOARD	118305-001	$ 699.00
NEC			
Prospeed SX/20	1MB BOARD	PC-43-21	$ 289.00
	4MB BOARD	PC-43-22	$ 679.00
Prospeed 286, 386SX/16	1MB BOARD	PC-21-21	$ 289.00
	2MB BOARD	PC-21-26	$ 459.00
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Prospeed 386	2MB CARD	PC-31-21	$ 459.00
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Slimport, 286e	2MB CARD	ZA-180-64	$ 279.00
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Turbosport 386e	1MB BOARD	ZA-3034-ME	$ 249.00
	4MB BOARD	ZA-3034-ME/4	$ 599.00
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	3MB BOARD	M0248/3	$ 999.00
	4MB BOARD	M0248/4	$1,299.00
AST Executive Notebook	1MB SIMM	500814-001	$ 129.00
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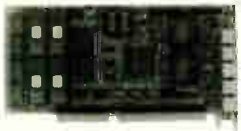

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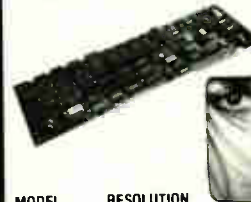

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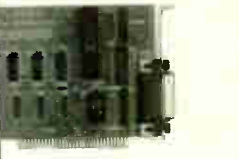

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- **Digital I/O**: 16 Input / 16 Output channels; All I/Os TTL compatible.
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- **Digital I/O**: 16 Input / 16 Output channels; All I/Os TTL compatible.
- **Counter**: 1 channel programmable interval counter/timer; Uses Intel 8254.
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- **Digital I/O**: 16 OUT, 16 IN; TTL compatible; All I/Os TTL compatible.
- **Counter**:16 bit progr. interval counter/timer; Uses Intel 8254; Pacer clock;
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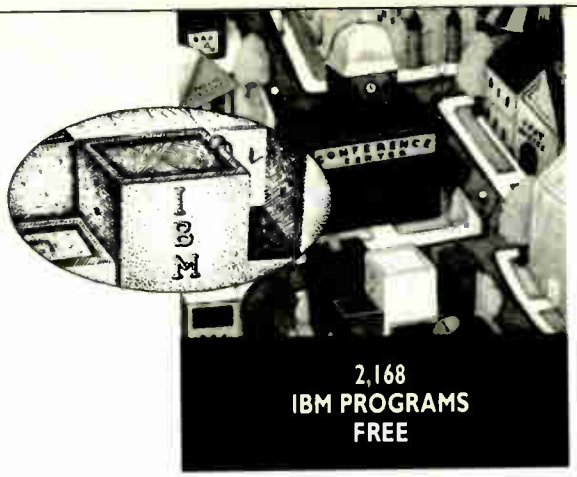

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e.arc	ibm.utils	Public-domain text editor, with source code.
secrets2.arc	ibm.dos	Condensed and edited messages from the ibm.dos/secrets topic. Tricks and undocumented internals of MS/DOS.
tetris2.zip	microsoft	KLOTZ, a Tetris® clone for Microsoft Windows 3.
2zip25.zip	ibm.utils	Converts a variety of archive formats (including ARC, PAK, ZOO, LZH) to PKWare's ZIP format.
w3icons.zip	microsoft	40 new icons for the Windows 3 Program Manager.
firework.zip	microsoft	Fireworks display in a window, for Windows 3.
monitor.arc	ibm.os2	Continuous display of CPU load for OS/2 Presentation Manager.
abort.exe	ibm.utils	TSR that aborts any program when you press Alt-C.
dis386.zip	ibm.utils	Full-screen interactive machine language disassembler for 8086, 80286, 80386, NEC V20.

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IRSD002

Inquiry Numbers 1-493

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Inquiry Numbers 494-986

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( ) Phone ( ) Fax

Company

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City State Zip

A. What is your primary job function/principal area of responsibility? (Check one.)

1 ☐ MIS/DP
2 ☐ Programmer/Systems Analyst
3 ☐ Administration/Management
4 ☐ Sales/Marketing
5 ☐ Engineer/Scientist
6 ☐ Other

B. What is your level of management responsibility?

7 ☐ Senior-level 9 ☐ Professional
8 ☐ Middle-level

C. Are you a reseller (VAR, VAD, Dealer, Consultant)?

10 ☐ Yes 11 ☐ No

D. What operating systems are you currently using? (Check all that apply.)

12 ☐ PC/MS-DOS 15 ☐ UNIX
13 ☐ DOS + Windows 16 ☐ MacOS
14 ☐ OS/2 17 ☐ VAX/VMS

E. For how many people do you *influence* the purchase of hardware or software?

18 ☐ 1–25 20 ☐ 51–99
19 ☐ 26–50 21 ☐ 100 or more

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MAY
IRSD002

Inquiry Numbers 1-493

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Inquiry Numbers 494-986

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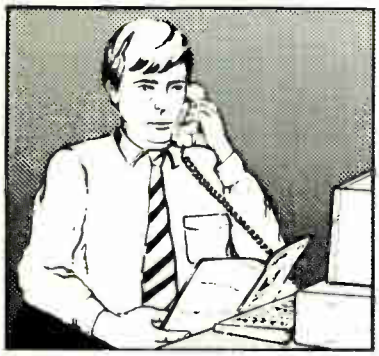

In an effort to make your telephone purchasing a more successful and pleasurable activity, The Microcomputer Marketing Council of the Direct Marketing Association, Inc. offers this advice, "A knowledgeable buyer will be a successful buyer." These are specific facts you should know about the prospective seller before placing an order:

Ask These Important Questions

- *How long has the company been in business?*
- *Does the company offer technical assistance?*
- *Is there a service facility?*
- *Are manufacturer's warranties handled through the company?*
- *Does the seller have formal return and refund policies?*
- *Is there an additional charge for use of credit cards?*
- *Are credit card charges held until time of shipment?*
- *What are shipping costs for items ordered?*

Reputable computer dealers will answer all these questions to your satisfaction. Don't settle for less when buying your computer hardware, software, peripherals and supplies.

Purchasing Guidelines

- *State as completely and accurately as you can what merchandise you want including brand name, model number, catalog number.*
- *Establish that the item is in stock and confirm shipping date.*
- *Confirm that the price is as advertised.*
- *Obtain an order number and identification of the sales representative.*
- *Make a record of your order, noting exact price including shipping, date of order, promised shipping date and order number.*

If you ever have a problem, remember to deal first with the seller. If you cannot resolve the problem, write to MAIL ORDER ACTION LINE, c/o DMA, 6 E. 43rd St., New York, NY 10017.

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the MICROCOMPUTER MARKETING COUNCIL of the Direct Marketing Association, Inc.
6 E. 43rd St.,
New York, NY 10017

MMC
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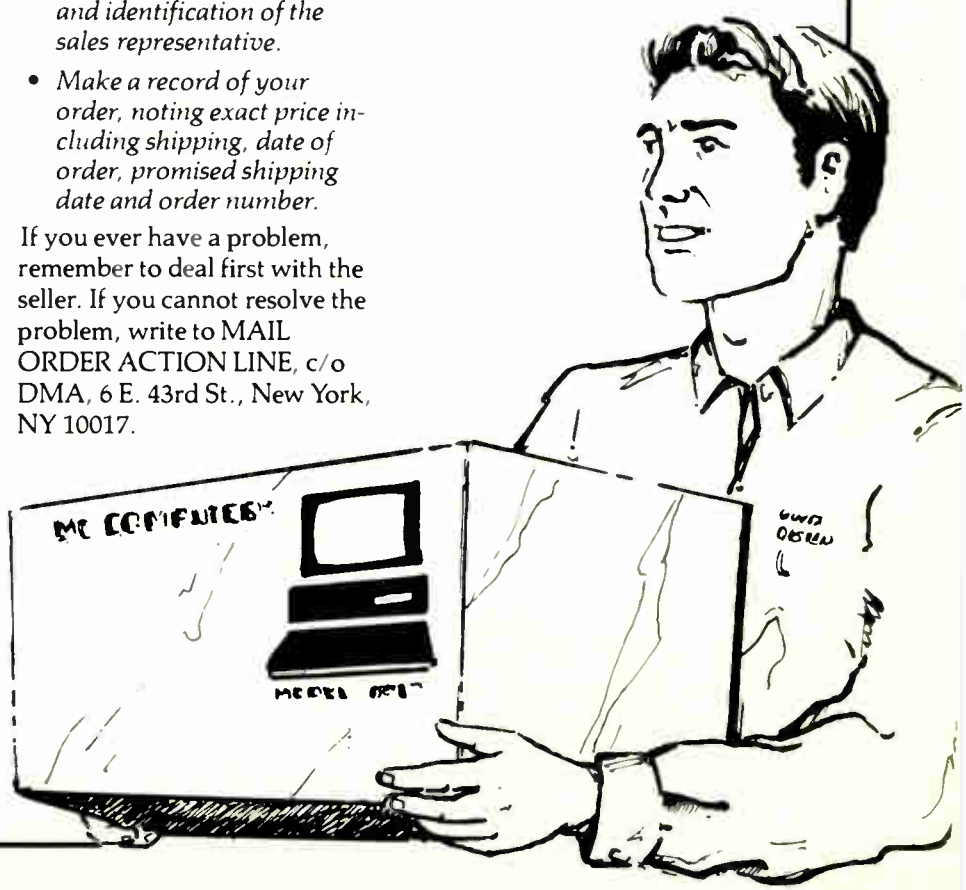

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DYNAMIC RAMS

PART#	SIZE	SPEED	PINS	PRICE
4116-150	16384x1	150ns	16	1.49
4164-150	65536x1	150ns	16	2.49
4164-120	65536x1	120ns	16	2.89
4164-100	65536x1	100ns	16	3.39
TMS4464-12	65536x4	120ns	18	3.95
41256-150	262144x1	150ns	16	1.95
41256-120	262144x1	120ns	16	2.15
41256-100	262144x1	100ns	16	2.25
41256-80	262144x1	80ns	16	2.75
414256-100	262144x4	100ns	20	8.95
414256-80	262144x4	80ns	20	9.95
1MB-120	1048576x1	120ns	18	7.95
1MB-100	1048576x1	100ns	18	8.95
1MB-80	1048576x1	80ns	18	9.95
1MB-70	1048576x1	70ns	18	10.75
1MB-60	1048576x1	60ns	18	11.05

SIMM/SIP MODULES

PART#	SIZE	SPEED	FOR	PRICE
41256A9B-80	256K x 9	80ns	SIMM PC	33.95
421000A8B-10	1MB x 8	100ns	SIMM MAC	79.95
421000A9B-10	1MB x 9	100ns	SIMM PC	79.95
421000A9B-80	1MB x 9	80ns	SIMM PC	89.95
421000A9B-60	1MB x 9	60ns	SIMM PC	99.95
256Kx9SIP-80	256K X 9	80ns	SIP PC	33.95
256Kx9SIP-60	256K X 9	60ns	SIP PC	39.95
1MBx9SIP-10	1MB x 9	100ns	SIP PC	79.95
1MBx9SIP-80	1MB x 9	80ns	SIP PC	89.95

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- Manual
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- 5 Year Warranty

PART#	SPEED	PRICE
8087	5 MHz	89.95
8087-2	8 MHz	129.95
8087-1	10 MHz	169.95
80287-XL	12 MHz	199.95
80387-16	16 MHz	339.95
80387-20	20 MHz	399.95
80387-25	25 MHz	499.95
80387-33	33 MHz	549.00
80387-SX	16 MHz	249.95
80387-SX20	20 MHz	399.95

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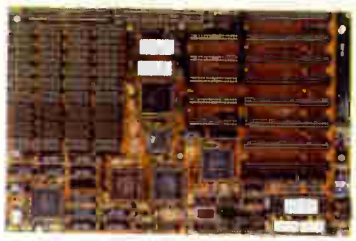
83D87-20	20 MHz	319.95	83S87-16 (SX)	16 MHz	269.95
83D87-25	25MHz	419.95	83S87-20 (SX)	20 MHz	329.95

YOUR MOTHERBOARD CONNECTION!



16MHz MINI 386-SX $399.95

• NORTON SI 15.3 • LANDMARK AT SPEED 20.8

• USES 16MHZ INTEL 80386SX CPU • EXPANDABLE TO 8MB ON BOARD • AMI BIOS • CHOOSE FAST 0 WAIT STATE OR 1 WAIT STATE FOR ECONOMICAL USE OF SLOWER RAM • FIVE 16-BIT AND THREE 8-BIT EXPANS ON SLOTS • CHIPS & TECHNOLOGY NEW ENHANCED ADVANCED TECHNOLOGY (NEAT) CHIPSET • SOCKETED FOR 80387SX CO-PROCESSOR • 8.5" X 13" SIZE FITS IN MINI-286 AND FULL-SIZE 286 CASES

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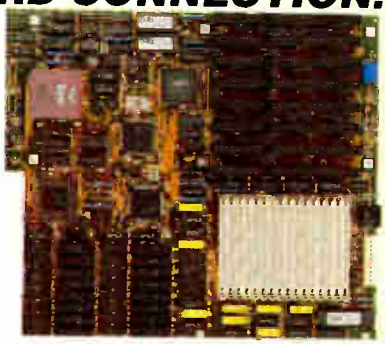
MCT-M286-12 ..... $199.95



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PS-200	200 WATT PS FOR 286/386 (110/220V)	$89.95
PS-250	250 WATT PS FOR 286/386 (110/220V)	$129.95

EPROMS

PART#	SIZE	SPEED	Vpp	PINS	PRICE
2716-1	2048x8	350ns	25V	24	4.95
2732A	4096x8	250ns	21V	24	3.95
2764	8192x8	450ns	12.5V	28	3.95
2764-250	8192x8	250ns	12.5V	28	3.95
2764-200	8192x8	200ns	12.5V	28	4.49
27128A-200	16384x8	200ns	12.5V	28	4.95
27256	32768x8	250ns	12.5V	28	4.95
27C256	32768x8	250ns	12.5V	28	5.95
27512	65536x8	250ns	12.5V	28	5.95
27C101-20	131072x8	200ns	12.5V	32	17.95

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JDR-PR2-PK PR2 BUFFERING/DECODE PARTS KIT $8.95
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KITS INCLUDE HARD DRIVE, DRIVE CONTROLLER, CABLES & MANUAL

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42 MB $299 — 122 MB $699

FORM	MODEL	SIZE	FORMAT	MS	PRICE
3-1/2"	ST-125A	21.4MB	IDE	28MS	$259
3-1/2"	ST-138	32.1MB	MFM	40MS	$269
3-1/2"	ST-138R	32.1MB	RLL	40MS	$289
3-1/2"	ST-138A	32.1MB	IDE	28MS	$269
5-1/4"	ST-251N	42.8MB	SCSI	40MS	$399
5-1/4"	ST-251-1	43.1MB	MFM	28MS	$299
3-1/2"	ST-157A	48.6MB	IDE	28MS	$299
3-1/2"	ST-157N	48.6MB	SCSI	40MS	$359
5-1/4"	ST-277N-1	64.9MB	SCSI	28MS	$439
5-1/4"	ST-277-1	65.5MB	RLL	28MS	$349
5-1/4"	ST-4096	80.2MB	MFM	28MS	$569
5-1/4"	ST-296N	84.9MB	SCSI	28MS	$449
5-1/4"	ST-4144R	122.7MB	RLL	28MS	$699
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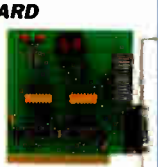

- WORKS WHEN SOFTWARE CANNOT
- 286/386/486 COMPATIBLE
- PLUG INTO SLOT, READ LED DISPLAY AND CHECK YOUR BIOS MANUAL FOR ERROR CODE
- VIEW LEDS ON-BOARD OR ON BACK-PANEL

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MF355X	3-1/2" MITSUBISHI 1.44MB, BLACK	$129.95
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FD-55B	5-1/4" TEAC DOUBLE-SIDED DD 360K	$89.95
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MON.-FRI. 7 A.M. TO 5 P.M., SAT. 9 A.M. TO 3 P.M.

Circle 6 on Inquiry Card (RESELLERS: 7).

Listing 2c continued

```
#include "evc.h"

static void evc_prog_1();

main()
{
        SVCXPRT *transp;

        (void)pmap_unset(EVC_PROG, EVC_VER);
        transp = svcudp_create(RPC_ANYSOCK);
        if (transp == NULL) {
                (void)fprintf(stderr, "Cannot create udp service.\n" );
                exit(1);
        }
        if (!svc_register(transp, EVC_PROG, EVC_VER, evc_prog_1,
                        IPPROTO.UDP)) {
                (void)fprintf(stderr, "unable to register {EVC_PROG,
                        EVC_VER, udp}.\n");
                exit(1);
        }

        transp = svctcp_create(RPC_ANYSOCK,0,0);
        if (transp == NULL) {
                (void)fprintf(stderr, "Cannot create tcp service.\n" );
                exit(1);
        }
        if (!svc_register(transp, EVC_PROG, EVC_VER, evc_prog_1,
                        IPPROTO.RCP)) {
                 (void)fprintf(stderr, "unable to register {EVC_PROG,
                        EVC_VER, tcp}.\n");
                 exit(1);
        }

        svc_run();
        (void)fprintf(stderr, "svc_run returned\n");
        exit(1);
}

static void
evc_prog_1(rqstp, transp)
        struct svc_req *rqstp;
        SVCXPRT *transp;
{
        union {
                int evc_climate_1_arg;
        } argument;
        char *result;
        bool_t (*xdr_argument)(), (*xdr_result)();
        char (*local)();

        switch(rqstp->rq_proc) {
        case NULLPROC:
                (void)svc_sendreply(transp, xdr_void, (char *)NULL);
                return;

        case EVC_CLIMATE:
                xdr_argument = xdr_int;
                xdr_result = xdr_climate;
                local = (char *(*)())evc_climate_1;
                break;

        default:
                svcerr_noproc(transp);
                return;
        }

        bzero((char *)&argument, sizeof(argument));
        if (!svc_getargs(transp, xdr_argument, &argument)) {
                svcerr_decode(transp);
```

continued

continued from page 317

```
    &bay_number,
    xdr_climate, &climate,
    timeout );
```

The procedure number, XDR routines, and `call` and `routine` values are the same as with the `callrpc` function. The `timeout` value is a `timeval struct` providing the retry time for UDP communications. It's ignored for a TCP/IP link.

The corresponding server arrangement uses an `SVCXPRT` transport handle, which is created by `svcudp_create` or `svctcp_create`:

```
SVCXPRT *svcP;

svcP = svcudp_create
    ( RPC_ANYSOCK );
```

The single argument is the network socket that is used for the handle; passing `RPC_ANYSOCK` will cause `svcudp_create` to open a socket. Two additional arguments are required for `svctcp_create`: the sizes of the receive and transmit buffers it should allocate (you can specify 0 to use defaults). The server then registers its functions via `svc_register`:

```
svc_register( svcP, EVC_PROG,
  EVC_VER, evcfunc, IPPROTO_UDP );
```

specifying the program number and program version, a routine to handle all requests for that program, and the type of transport. Once the services have been registered, the server calls `svc_run`.

The `svc_register` function, like `registerrpc`, actually registers a service with a server program, the *port mapper*. The port mapper accepts RPC requests and delivers them to the appropriate program so registered. Before registering the function, you may wish to unregister it to erase any lingering trace of an old incarnation:

```
pmap_unset( EVC_PROG, EVC_VER );
```

A big difference in this server arrangement is that the registered function takes care of all the procedure numbers for a particular program number. The function (in this case, `evcfunc`) is passed the address of a `svc_req` structure and the transport handle. The function then must check the `rq_proc` member of the `svc_req` structure to find out which procedure was requested and handle it appropriately.

By convention, all servers respond to a procedure number of 0, as a sort of "are you there?" request. The return value is

simply a void. If the procedure number is invalid, the server should respond by calling svc_noproc with the transport handle as the argument.

In processing valid requests, two procedures are used to get arguments and send replies:

```
svc_getargs( svcP, xdrproc,
    dataP );
```

fetches the argument described by the XDR procedure xdrproc; dataP is the address of a variable to receive the data (e.g., a basic type or a pointer to a struct).

```
svc_sendreply( svcP, xdrproc,
    dataP );
```

returns data using the same calling convention. To execute the deletion XDR function (if any pointer or variable-length data was received), use:

```
svc_freeargs( svcP, xdrproc,
    dataP );
```

You can also arrange to have your server program started automatically by inetd (the internet server daemon) when requests come in for it. This is controlled by information in the inetd configuration file; inetd runs the server program with a socket already opened on file descriptor 0. Thus, when you create the transport handle, you pass the socket number 0 instead of, say, RPC_ANYSOCK.

All this demonstration merely touches on the lower levels of RPC, enough to make use of the rpcgen RPC compiler. Some other low-level aspects include broadcasting, callbacks, and access authentification.

Automating All the Above

Some of what I have discussed looks pretty daunting, but it is really no more difficult than using any other abstracted I/O mechanism. Even so, a powerful tool helps automate the construction of RPC programs. It's called rpcgen, and you can use it to generate both XDR procedures and RPC server routines.

You describe your XDR data and service procedures in a file with, by convention, an extension of .x. This file contains C-like descriptions of data and procedure information. For example, when you give foo.x to rpcgen, the file is passed through the C preprocessor (so you can include regular preprocessor directives such as #include and #if). Then, rpcgen produces up to four files: an .h file (foo.h) describing the data types produced from the XDR descriptions, a C file (foo_xdr.c) containing the XDR routines that represent those types, a C file (foo_clnt.c) containing stub routines for client calls, and a C file (foo_svc.c) containing a skeleton server routine.

Listings 1 and 2 show how it would work for the evc_climate routine. Listing 1 is the rpcgen input file; listings 2a through 2d are the generated output files. Note that the generated code uses a low-level interface making use of a transport handle.

Good, but Not Perfect

Sun's RPC system is not perfect by any means. It is, however, for many applications, a cut above explicit socket-oriented network request methods.

A colleague, speaking of RPC, once expressed the opinion that "abstraction ought to mean more than just hiding the ugliness." If you buy that philosophy, the test of any abstract system is whether its abstraction provides better ways of doing things or merely sweeps the details under the rug. Sun RPC does some of each.

One of the more interesting problems in working with this RPC model is to provide the appropriate levels of glue to make the interface to the RPC client routines the same as to the actual implementation routines. After all, it's that level of abstraction you're after. One test is to see if you can provide equivalent glue that simply calls the real routines and link your client and server routines together with this glue.

If you want to look at a toy example of RPC programming, a simple program is available electronically (see page 5 for details). The server side provides a few routines that access a set of definitions for conference rooms and meeting schedules. The client side uses the list-manipulation functions to provide commands that inquire and modify these lists. (Presumably, the server would be intelligent enough to schedule meetings based on the matches among room features, meeting requirements, and availability of invitees—but that is beyond the scope of this contrived example.) ■

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

```
                return;
        }
        result = (*local)(&argument,&rqstp);
        if (result != NULL && !svc_sendreply(transp, xdr_result, &result)) {
                svcerr_systemerr(transp);
                return;
        }
        if (!svc_freeargs(transp, xdr_argument, &argument)) {
                (void)fprintf(stderr, "unable to free arguments\n");
                exit(1);
        }
}
```

Listing 2d: *XDR routines for described data*, evc_xdr.c.

```
#include <rpc/rpc.h>
#include "evc.h"

bool_t
xdr_climate(xdrs, objP)
        XDR *xdrs;
        climate *objp;
{
        if (!xdr_int(xdrs, &objp->temp)) {
                return( FALSE );
        }
        if (!xdr_int(xdrs, &objp->humidity)) {
                return( FALSE );
        }
        return(TRUE);
}
```

PRINT QUEUE

HUGH KENNER

Up from Rosie

Self-similarity rears its head in cats and fractals, cities, and a new collection of essays

Cats, to take a handy example, are fractal. Between Rosie, *felis silvestris catus*, who leaps onto my shoulder, and MGM's *felis leo*, whose leap I hope never to experience, we observe discrete steps—for example, House Cats < Bobcats < Panthers < Big Cats. Nothing smaller than Rosie's kin, nothing larger than Leo's. And although there's a likeness, we've not identity of form: Enlarge Rosie to lion size, and you'd fool no one into thinking you were showing a lion. Apart from color, the mass about the shoulders is wrong, the size of the head. Still, similarity is evident at each scale, and we say, intuitively, "Cats."

Carl von Linné (better known as Linnaeus) knew, circa 1735, that all those creatures were cats, and in the durable system he was constructing, he assigned them to genus *felis*. His genera were based on lists of characteristics, which seem cumbersome since we can often tell by just looking. What we can tell by just looking got firmly accommodated by science only in the past two decades, when fractal theory began speaking of *self-similarity* and defined *similarity* as statistical.

(Not that just looking is infallible. The Greeks named a cumbersome beast *hippopotamos*, horse of the river, on the hunch that anything so big was horsey. They weren't looking at form, they were looking at size. Linnaean principle says it's an overscale pig.)

Similarity may resist rigorous proof, but the human eye is a similarity detector. Computers, which can choke on mismatched commas, are essentially difference detectors. If fractal science was made possible by the computer, that's thanks to the ease with which a computer can show us zones of color to map ranges of numbers; thus, the eye is offered a pattern in which it spots self-similarities at stepwise reductions of scale. It's amazing how much of the world of everyday experience answers to such analysis. Clouds, trees, rivers, coastlines... those are familiar examples. And there are more and more.

The discussion goes on refining its focus. *Fractals and Chaos* (edited by A. D. Crilly, R. A. Earnshaw, and H. Jones, Springer-Verlag, 1991, $39.50) grew from an international conference in London. It contains 13 papers and 146 figures, 57 in color. If you've only an hour, spend it with Michael Batty's chapter "Cities as Fractals: Simulating Growth and Form" (24 pages, 46 references, four diagrams, and 14 color plates). Batty's pages offer much of the gist of the book. He establishes that a city's growth is, ah, dendriform (my word, not his; a useful word, it means "tree-like").

The tree is a well-known fractal example. The trunk splits into limbs, limbs into branches, branches into twigs. A circulatory system, Rosie's or mine, is likewise structured, arteries down to capillaries. So is the system of airways in our lungs, the system of neural branches in our brains (where neurologists speak of "dendrites"). Self-similar on a small number of diminishing scales, dendriformity seems to govern growth wherever we look. The seemingly random changes of direction that keep any example from just photocopying any other all point to the magic word, *fractal*: Although the details mutate endlessly,

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the similarity of structure abides.

And how do cities grow? A few main roadways emanate from a core, drawn by who knows what dreams of advantage. Along them, developments, generating streets off which branch subdevelopments.... Dendriform! And the city grows slowly sparser as it grows outward: For myriad reasons, less and less of available space is built over. One reason may be that, remote from the core, developing gets chancier, developers cagier. That's unless the core starts dying, which is another story. We're watching what for Batty is the constant renegotiation of a balance "between the desire to be as far away from the city as possible and the need to be within it."

Here we encounter one of the dizzying leaps that characterize fractal discussions. For a mathematical model, we're to look up papers on "viscous fingering, where a fluid of lower viscosity permeates one of higher viscosity (e.g., water permeating oil)," and on "dielectric breakdown, where a charge is released from some source and attracted towards a more distant sink of high potential." So a population moves like a low-viscosity fluid, or a migrant to the suburbs like an electrical charge. That would have delighted the last group who tried to yoke New Science with common experience, the English "metaphysical" poets of the early 1600s. But Donne and Marvell and their like were not advantaged by a firm mathematical structure to hold disparate things together.

Discussions of fractals are often characterized by dizzying leaps.

By the way, if you have been puzzled by Mandelbrot's "fractal dimension," which is neither 1 (a line) nor 2 (a plane), but something in between, like 1.72, you may be helped by Batty's suggestion that the fractal dimension of a city simply measures how completely it fills the available space. If cities tend to get sparser as they grow outward, occupied space increases less fast than population. For a real city, a number near 1.6 seems to work.

Another enlightening paper is Alastair Horn's "IFSs and Tiling Structures." An IFS (iterated function system) is a tag associated with Michael F. Barnsley, who (with Alan D. Sloan) wrote about it in "A Better Way to Compress Images" in the January 1988 BYTE. It depends on the idea that a fern (the classic example) can be "tiled" into subferns. Eventually, a short mathematical description emerges, and if we simply rain random points upon the screen, turning on only those dots that fall inside the description, a plausible fern grows slowly visible.

As another contributor, John Lansdown, emphasizes, one parameter is "a probability factor, which determines the density distribution of the random points" everywhere in the image. That ensures, for instance, that veins and stems won't just sag into chaos but will receive due emphasis. And the payoff is, we can store a picture of a fern in a very small number of bytes. The trade-off? The time we'll spend getting it back.

Horn now moves to heavier math than I'm willing to face this afternoon (and Rosie asks to be fed), although his 15 diagrams remain persuasive. What he's moving toward is ISIS (Interactive System for Image Synthesis), which now runs on a Sun workstation and is open to "massively parallel" rendering that relies on the Sun as a host. We're approaching a new domain of image storage, of image generation.

And that brings us to a surprising piece of programming, Dick Oliver's Fractal Grafics (Cedar Software, Rt. 1-5140, Morrisville, VT 05661, (802) 888-5275, $79). This PC package is worth buying just for the 15 "History Lesson" pages of the manual that offer the cleanest short presentation I've seen of what fractal and chaos theory is all about. (I'd like to take Dick aside and impress on him the fact that "like" differs from "as." Otherwise, impeccably lucid.)

My only further complaint about Fractal Grafics is that the manual needs just one more page, up front, to clarify a few fundamentals. For several hours I was calling in image templates (from the extensive library provided), only to see them superimposed on an initial display. I eventually discovered that pressing PageUp would clear that background.

Likewise, a menu runs down the right of the screen, and you naturally expect your up- and down-arrow keys to move the cursor up and down beside it. No. Arrow keys move the image templates. To move the cursor down and up, you use space bar and Backspace, although intuition has those giving right and left movement. OK, if that is how Mr. Oliver wants it, but he might have told us up front. One spends too much time mastering such fundamentals (and forgetting them before the next session).

What makes the program worth the bother, though, is that it's chiefly an elaborate implementation of Barnsley-style IFS. The library is a library of templates. The first one you'll see is a cat's face (a travesty of Rosie's), and by electing Draw, you can equip it with a fright wig of hair; then by electing Paint, with cosmetic colored dotting.

A five-finger exercise, a trivial result. More rewarding: Load the Tree template. Examine the self-similarity of its four main elements (a sturdy trunk and three auxiliary members). Then Draw to get an elaborate tree with foliage; Paint to sprinkle it with dainty leaflets. Cut "paint" off with the Escape key if it's getting too fussy. You can clear your tree and then bring it back, for shifting, enlarging, shrinking, skewing, squashing. You can combine trees of different sizes and colors. Design a forest if you are so minded. All these operations are *fast*. You can also combine templates: Insert small Cheshire cats amid trees.

Dick Oliver deserves great credit for bringing the Barnsley system out to where PC users can lay hands on it. Apart from a few toy ferns and Sierpinski gaskets, it's hitherto been pretty inaccessible. And his manual, better on the big picture than on his own program, assumes a user who wants to understand the big picture. I'll hazard that it's as big a picture as this century has seen.

Numbers first described pyramids and temples, next the movement of stars. To draw the picture, you used a ruler or swung your arm. When Kepler's ellipses supplanted circles, you could still use two pins and a string. Numbers, ruling wherever Euclid's shapes pertained, next found Uranus and Neptune and then went chaotic: Cantor's "dusts," the "monsters" of Sierpinski and Koch. Then computer replaced string, ruler, pencil; and, lo, numbers describe a trans-Euclidean world we've always known and have always had to pretend was lacking in order.

Oh—Rosie has asked to go out. A tad dyslexic, even as Albert Einstein was, she'd misread "fractals" as "cattails" and supposed I was discussing something important. ■

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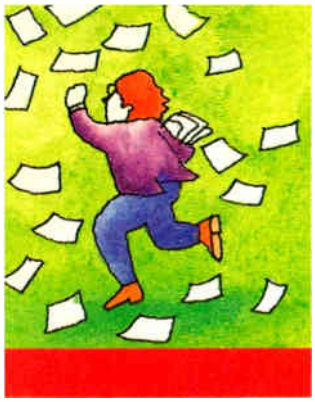

STOP BIT

KENNETH M. SHELDON

HUMAN FILTERS?

Dateline: 1995. NEW YORK. The Organization of Information Producing Nations met today in New York, in an attempt to deal with what it described as the current infoglut. According to information industry analyst Don Jorak, "Information providers have flooded the market with cheap, easily accessible information, sending the price of information to record low levels. Of course, much of this is low-grade information and requires a great deal of refinement before it can be used."

In related news, the FCC reported that several major communications areas are in grave danger of experiencing "infolock," a situation in which vast quantities of transmitted information overwhelm the capabilities of the systems that were designed to handle it. Messages sit stalled in network traffic, businesspeople devote all their time to returning phone calls to people who were returning their calls, and automated calling systems leave messages with answering machines. And the economy slowly grinds to a halt. . . .

The advent of the information age may turn us into little more than filters for useless data

You may laugh. But we are approaching the time when the tide of "useless information," as Mick Jagger called it, threatens to inundate us. We spend our days swimming against that tide, trying desperately to fit our work—whatever that may be—in between strokes.

For many years, the computer press has predicted the advent of the paperless office. Hah! We're beginning to realize that the phrase "paperless office" is an oxymoron, what with fax machines spewing endless pages of correspondence, laser printers cranking out multiple copies of E-mail messages that have been broadcast to everyone on the network, express mail packages arriving with mind-numbing regularity (remember when only *important* things got expressed?), and on, and on.

In the wake of this, separating the information wheat from the chaff is getting harder and harder to do. And we are increasingly reduced to being human filters for all that information. "Work" becomes what you fit in, in discrete chunks, between filtering out what you need to know from what you don't.

That kind of setting doesn't lend itself to long periods of deep thinking. Like our computers, we have learned to multitask—handling several projects at once, devoting small time slices to each one. It's becoming more and more difficult to accomplish anything that requires a long stretch of uninterrupted time, like creating, planning, or analyzing all that data.

Who's to blame for the current infoglut, the imminent infolock? Several culprits come to mind, but our own beloved personal computers are at the head of the lineup. The people who created the personal computer probably had no idea that their invention would become the Pandora's box of the information age, unleashing demons, awe-inspiring in their fecundity, terrifying in their omnipresence.

Don't get me wrong. I'm not arguing for a return to the dark ages (i.e., before we had laser printers). It is too late to close the box. We have already lost our innocence. We have been cursed with power. The question is, will we control that power?

To do so, we'll need new tools, like the Information Lens, a system developed at MIT that sorts through your incoming E-mail, organizing and prioritizing it for you (see "Through a Lens Smartly" on page 177).

We'll also need new attitudes, attitudes akin to those many of us are trying to adopt about the environment; a mind-set that makes us stop and think before we act. Do I really need to send this memo to *everyone* in the office? Do I need to print out that E-mail message? Is there anything of substance in the report I've just written, or am I just contributing to the deforestation of the wilderness and the clutter in my coworkers' offices?

There's a classic W. C. Fields film called *The Man on the Flying Trapeze*, in which Fields works in an office, with a desk that looks like mine—piled high with stacks of paper. At one point, an office boy tells Fields that his boss wants "a copy of that letter we wrote to Mr. Newt Schvendenborg. . .he thinks it was about four years ago." Fields turns to the desk, mutters about how people keep moving things on him, and proceeds to pluck the letter from the middle of a pile—adding that it was "three and a half years ago, to be correct."

Until we have systems that can do that for us, we're in danger of drowning in our own data. And we'd better think about filtering the flow *before* we let it out. ■

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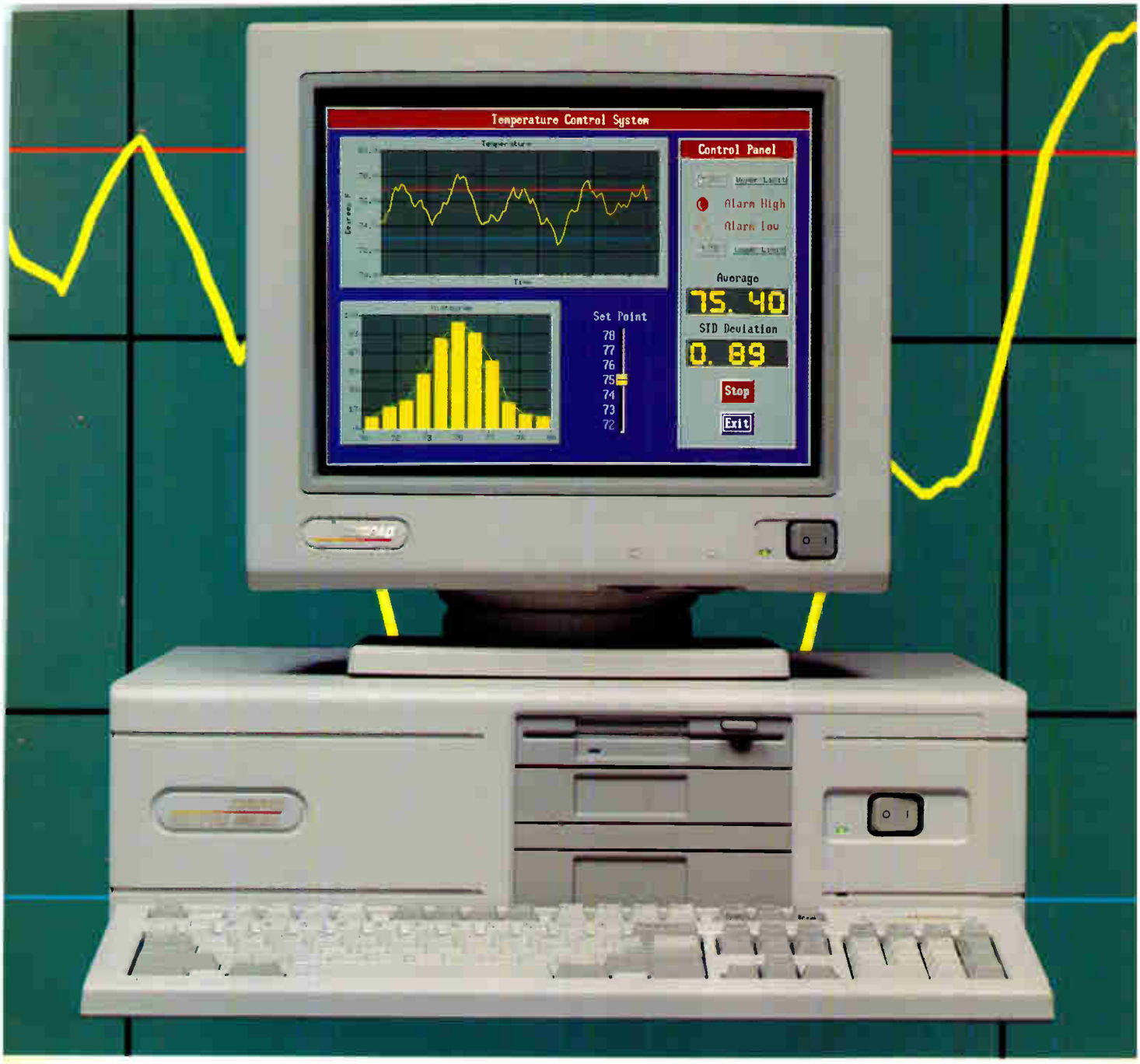

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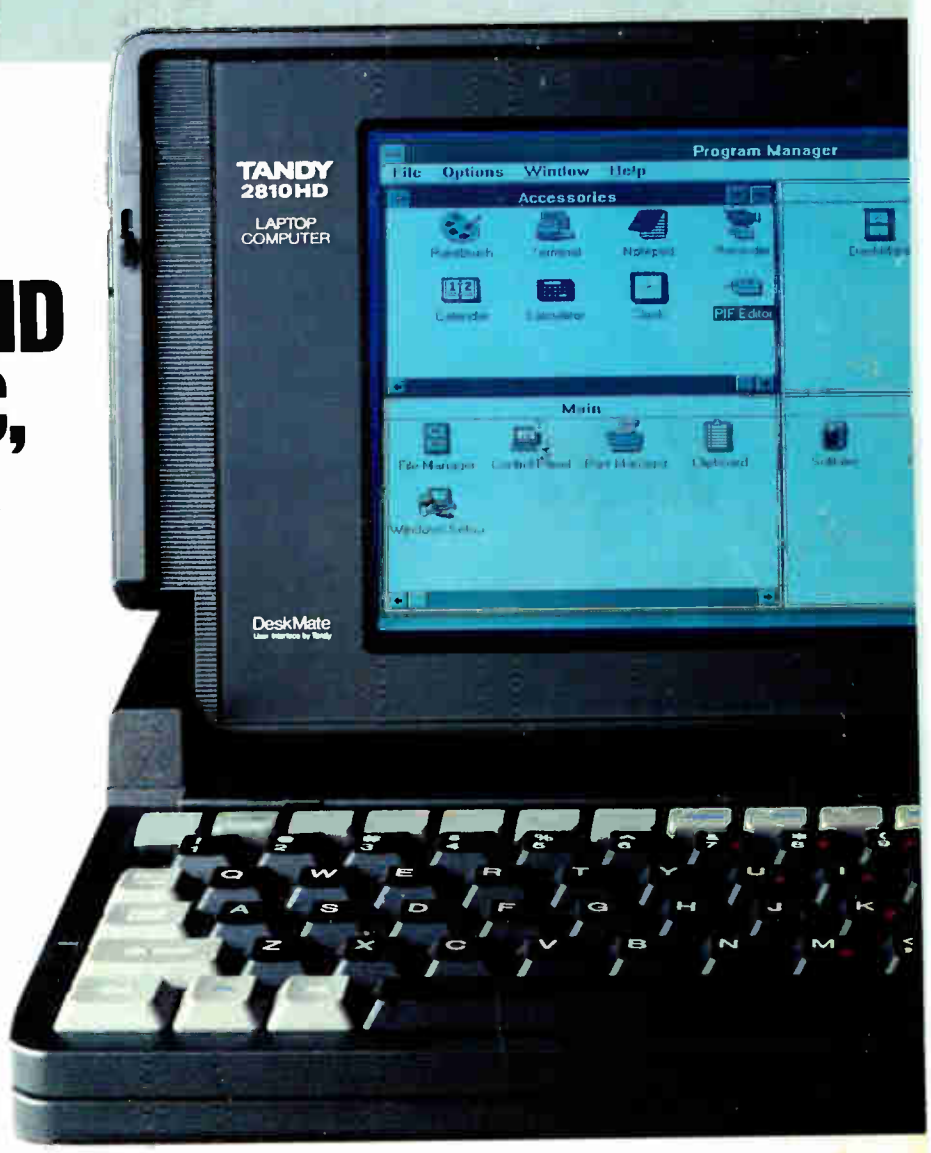

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