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BYTE

OCTOBER 1993

THE WORLDWIDE COMPUTING AUTHORITY

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Apple's Workgroup Server 95

Electronic Documents: Acrobat vs. Common Ground

STATE OF THE ART

HOW WE'LL CONTROL TOMORROW'S COMPUTERS

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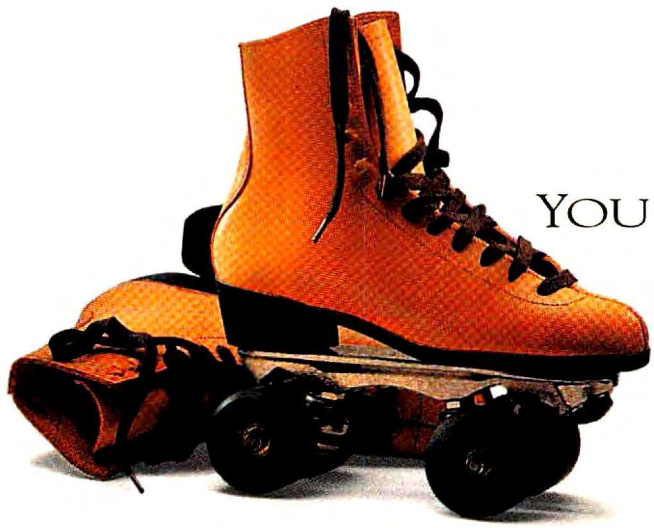

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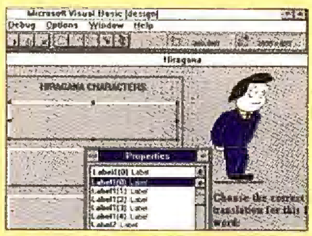

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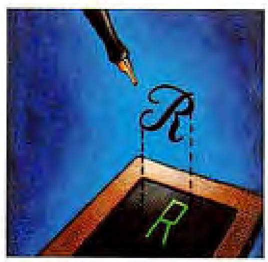

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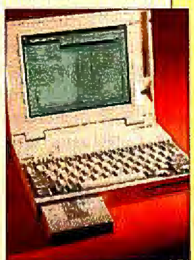

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BY MATT PIETREK Good support at the operating-system level is essential to developing OS/2 and Windows NT applications.

BYTE (ISSN 0360-5280) is published monthly with additional issues in April and October by McGraw-Hill, Inc. U.S. subscriber rate $29.95 per year. In Canada and Mexico, $34.95 per year. European surface mail subscriptions $60, airmail $80. Non-European subscriptions, $60 surface mail or $85 airmail. All foreign subscriptions are payable in U.S. funds that can be drawn on a U.S. bank. Single copies $3.50 in the U.S., $4.50 in Canada. Executive, Editorial, Circulation, and Advertising Offices: One Phoenix Mill Lane, Peterborough, NH 03458. Second-class postage paid at Peterborough, NH, and additional mailing offices. Postage paid at Winnipeg, Manitoba. Registration number 9321. Registered for GST as McGraw-Hill, Inc., GST #123075673. Printed in the United States of America. Postmaster: Send address changes and fulfillment questions to BYTE Subscriptions, P.O. Box 552, Hightstown, NJ 08520.

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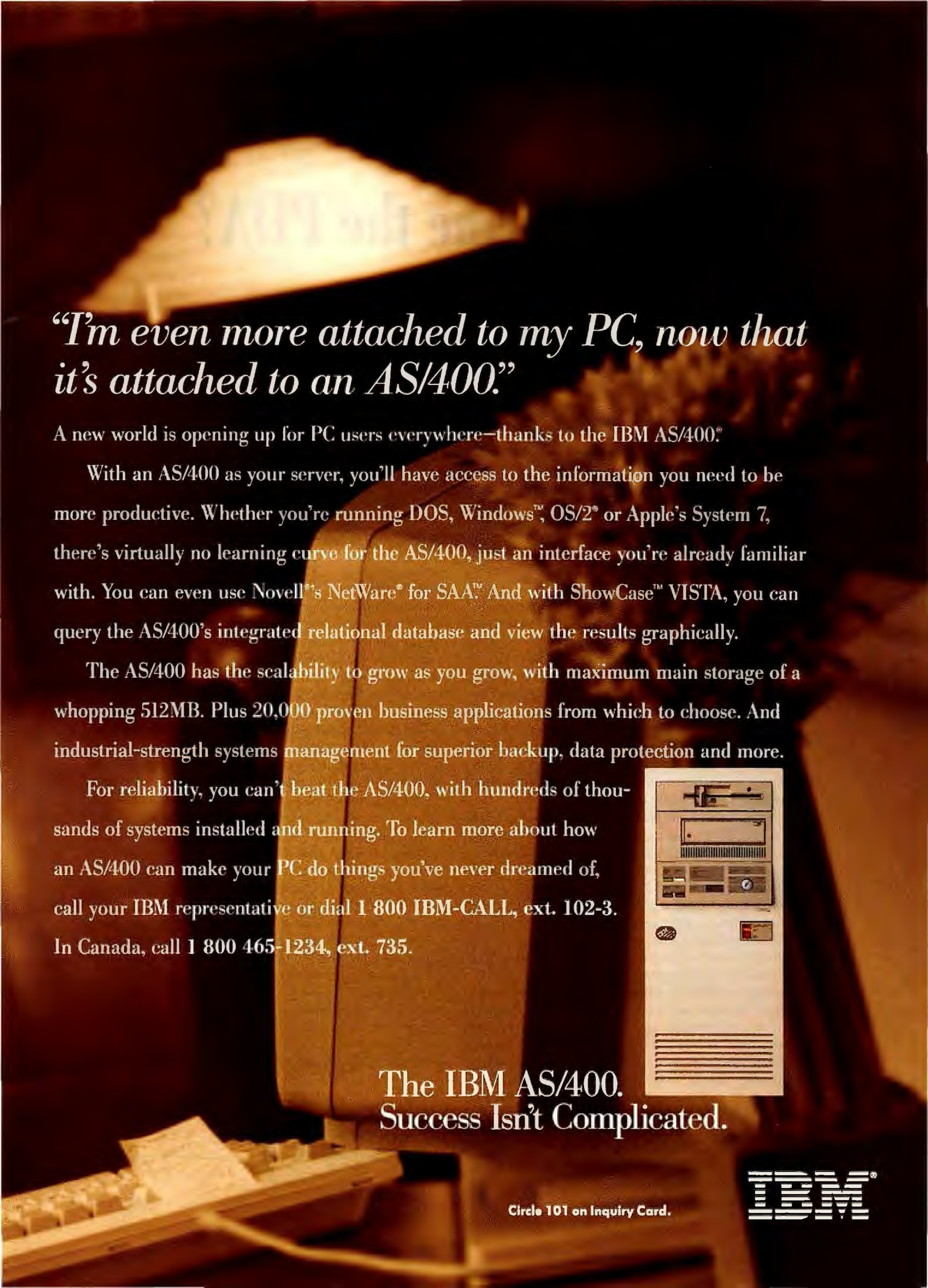

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Who Will Define the PDA?

Apple has the Newton, but AT&T has the technology

At the recent official rollout of Apple's Newton technology in Boston, I spoke to a couple of folks that were more than just a little excited about Apple's new PDA (Personal Digital Assistant) (our coverage starts on page 66). One was a doctor who had traveled from Long Island just to buy one of the first machines—an event for which he had waited six months. After seeing the real thing, however, he decided to go home Newtonless, saying there just wasn't enough memory in the MessagePad to do anything useful. Another fellow who wanted desperately to buy a Newton so that he could develop software for it, talked at length about the virtues of Apple's gadget. He couldn't buy one, though, because the price was too high. I asked him, "If someone gave you the money, would you buy one then?" He thought a moment and said, "No" and that he would rather use the money to upgrade his desktop Mac first.That's the problem with the first PDAs—they stir the imagination but fail to deliver. The MessagePad, like its distant cousin, the Tandy Zoomer, has too little memory, and its communications ability falls short of being truly useful.

Strangely, though, the Newton devices and other PDAs have succeeded in drawing attention to the Eo Personal Communicator. The Eo—developed with the assistance of AT&T—is much larger than true PDAs, and it doesn't have Apple's Intelligent Assistance software. In fact, compared to the Newton and the Zoomer, the Eo doesn't look like a PDA, and it doesn't try to be one—it's the size of a notebook and costs between $2000 and $3000. Nonetheless, the Eo comes closer than the MessagePad or the Zoomer to fulfilling the promise of PDAs.

Consider what the Eo offers. It has enough memory to *do* things. Because the Eo has enough memory, it doesn't have to put its Hobbit processor through hoops managing memory like the Newton does to its ARM (Advanced RISC machine) processor. Its extra memory and storage provides the capacity to handle multiple applications.

Even more important is the Eo's communications ability. It has real cellular phone support—not the gimmicked infrared "beaming" link offered on the Newton that so far works about as well as the original IBM PC Jr. wireless keyboard. (You do remember the IBM PC Jr., don't you?) With cellular phone support, your faxing and data communications become, well, portable.

It's the latter point that interests me most. Communications is the essential link to making a portable computer worth carrying. If you remember the highly regarded AT&T Safari laptop, you'll know that the Eo is not the company's first attempt at wireless mobile computing. To the contrary, AT&T has been at this for a very long time, and, frankly, I doubt that any company knows communications better than AT&T.

So what about AT&T? It has tried to be a player in the computer arena before and failed—such as with the famed Unix-based 3B2 in the 1980s, for example. Now, AT&T seems to be headed in the right direction, and it's not happening by accident.

First was the merger with NCR, the underrated computer giant. While IBM wavered with worries of how to keep its mainframe business alive, NCR dumped its mainframe business in favor of a microprocessor-based, multi-CPU file server strategy. Some may fault NCR with making the change prematurely, but few, if any, fault it for its vision. Add to that NCR's point-of-sale and transaction-based knowledge, and NCR's vision looks pretty good from any corporate viewpoint. Next, consider AT&T's recent deal with McCaw Cellular. If the deal goes through, AT&T's stake in the cellular business will be bigger than Dallas. To put it another way, AT&T will virtually own mobile communications, per se, and PDA makers will be standing in line to make communications deals with AT&T. That puts AT&T in a very enviable position—and places it several steps ahead of the competition.

My point is simple: AT&T is the company to watch. It has the technology (just think about all those Unix-based phone systems that run in overheated closets without errors), and it now has the breadth to make things happen.

If you haven't seen the Eo yet, you ought to check it out. No, I'm not saying that the Eo is the ultimate PDA, and it doesn't *really* compete with the Newton. But the Eo is more of what a PDA ought to be than the Newton or the Zoomer—it has portable communications.

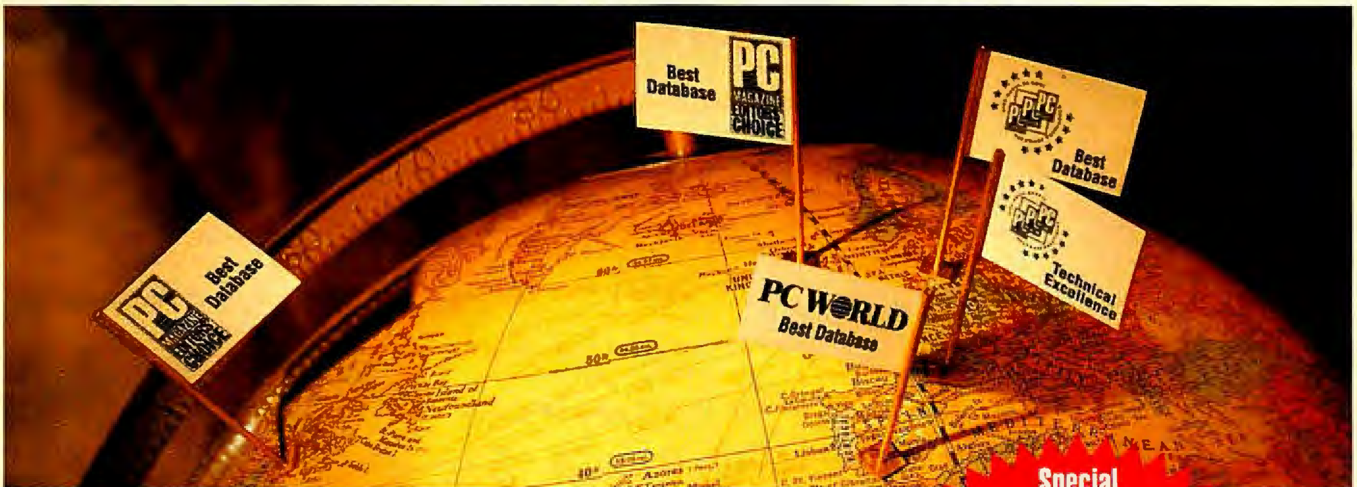
The Eo also provides a glimpse of bigger things to come from one of the biggest companies in the world. If you have written off AT&T as a computer provider, it's time to rethink your position. Meanwhile, Apple has a formidable foe in defining what a PDA ought to be.

DENNIS ALLEN, EDITOR IN CHIEF

THE LEADER IN OBJECT TECHNOLOGY

PARADOX FOR WINDOWS

Universal Appeal



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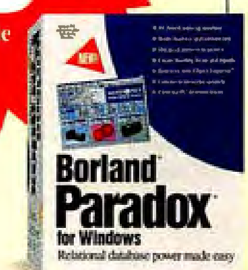

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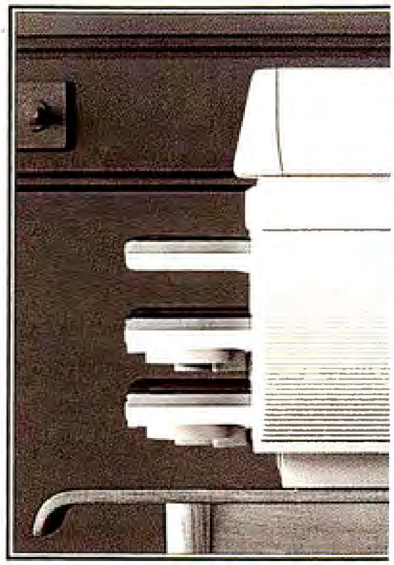
This Should Give You
Of Why We Created An

The image you see over there started out attached to the image you see over here. But as it made its way to the printer, the computer it was created on recognized a problem: 11 x 17 pages can't fit on 8 ½ x 11 paper.

And so, out came the electronic scissors.

Now, if you're like a lot of people, you know all about this routine. And you know how it feels to walk into a meeting with a presention that contains hours of blood, sweat and tears, and a big fat strip of tape going right down the middle of it. Enough said.

COMPAQ PAGEMARQ Network Laser printers were built to help put an end to all of that. They can print 11 x 17 pages in a single pass. They come with up to three paper



trays, which lets you switch between paper sizes without leaving your desk, so you don't have to pull one paper tray out and replace it with another, only to have your neighbor

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COMPAQ PAGEMARQ Printers can be directly connected into the following environments: NetWare, EtherTalk, LocalTalk, LAN Manager, LAN Server, Windows NT, and TCP/IP (including Sun, HP, SCO, IBM, DEC and lpd compatible hosts).

BYTE

See listing on page 283.

How to Contact the Editors

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Two w
make a

If patience is a virtue, it would be tough to find anyone more virtuous than a 386 user.

Of course, you're not waiting to be canonized. You just want to get your spreadsheet crunched, printed and e-mailed before your boss's boss calls you looking for it.

Now if you had a 486, you wouldn't have this problem. But all that wishful thinking goes out the window when you consider the double-knots on your company's purse strings.

Performance Benchmarks		
(figures indicate relative performance)	Intel i386	Cyrix 486 Upgrade
MS Excel 3.0	1.0x	2.1x
MS Word 2.0	1.0x	2.8x
Micrografx Designer 3.1	1.0x	2.6x
Benchmark tests run on IBM PS/2 Model 70/20MHz.		

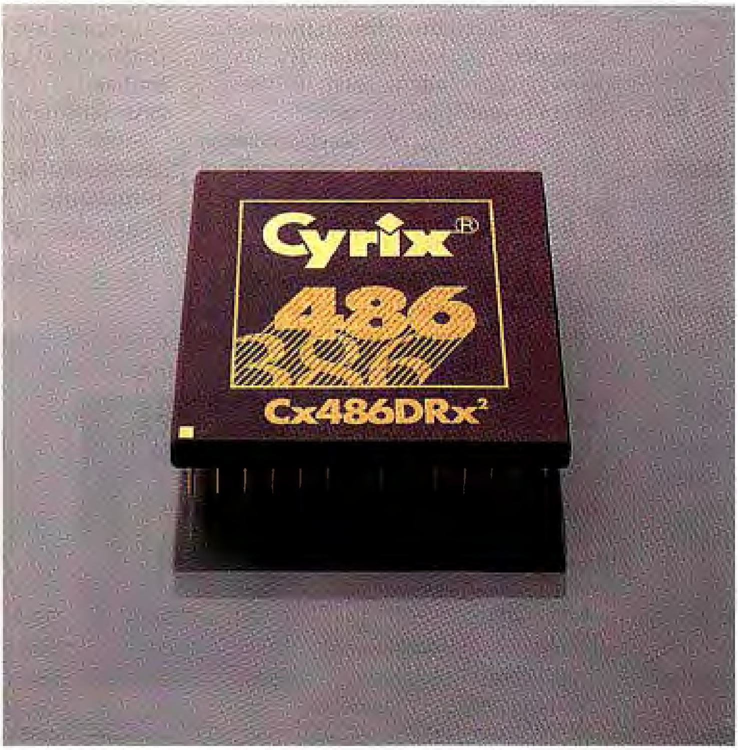
The new Cyrix 386-to-486 Upgrade Microprocessor delivers application performance that's twice as fast. And that's twice as smart.

Fortunately, there's a smarter alternative to the downward migration path pictured above. It's called the 386-to-486 Upgrade Microprocessor.™ And it's only available from Cyrix,® the smarter microprocessor company.

It's smarter because it's the only single-chip upgrade solution of its kind. And as such, the most cost-conscious way to replace the pedestrian 386 computer you have, with the searing 486 power you want.

Our upgrade chip acts just like a 486, and with good reason. It has Clock Doubling, a 1K on-chip cache

ays to 386 fly.

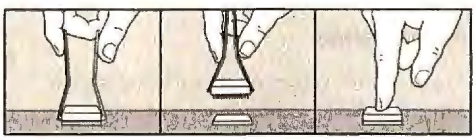


and enhanced Cx486 technology. Which means it delivers *twice* the application performance, and 100 percent compatibility with all your software. Like DOS, Windows and OS/2. Even Windows NT. It's also certified software compatible in Novell, Banyan and Lan Manager nodes.

MICROSOFT. WINDOWS COMPATIBLE

yes It runs with NetWare

What's more, it's easy to install (it takes all of 15 minutes), and costs under $400. So it's also easy to justify to even the stingiest bean counters.



Talk about immediate gratification. Just use the chip removal tool provided to pull out your 386DX chip (16, 20, and 25 MHz versions only at the moment), and plug our Cyrix Upgrade Microprocessor into the empty socket. Then get ready for screaming 486 power.

Every Cyrix upgrade chip comes with the reassurance of a limited lifetime warranty, toll-free telephone support, and a money-back guarantee.

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High-Speed Modems

Your Lab Report on modems was superb ("V.32 or Better: 69 Modems," July).

I noticed you forgot to mention one thing: purchase from a reliable source. My fax modem broke two months after I purchased it. It took the manufacturer eight months to return my modem, and the reseller claimed that the 30-day warranty was past. The repaired modem failed in less than two weeks. The modem manufacturer has since gone out of business. Nobody will claim liability.

Ricardo Landrau
Carolina, Puerto Rico

With regard to your article on modems, nowhere could I find reference to the type of line service available. Most "real" modems can operate in programmed mode or permissive mode.

Your article talks about the most common problem in analog communications: the local loop. How do you ensure that your signal reaches the central office at the optimum signal level of –12 decibels above 1 milliwatt? Permissive operation means that the modem transmits at either –9 or –10 dBm. Programmable units can vary their transmission level such that the signal reaches the central office at the optimum level. This ensures that A/D converters in the central office handle the signal in an optimum manner.

Your failure to even mention this feature is not acceptable.

Calvin E. Reames Jr.
Boyds, MD

You are right in noting our testing focused exclusively on two-wire dial-up configurations. This is by far the most common application of these modems, though many of these modems can also be used in two- and four-wire leased-line configurations for special applications like networking automated teller machines and remote data acquisition tasks. Thanks for your feedback.—Eds.

Conspiracy Theories

Paul Saffo's Commentary on dangerous EMF (electromagnetic field) emissions from CRTs ("A Conspiracy of Silence," July) really revved me up. The U.S. takes so much pride in being humanity's crusader. It's really a shame that the same government has to wait for its own citizens to become sick and even die before any action is taken.

I doubt that EMF radiation will be regulated any time soon, unless more scientists and health officials get involved and raise public awareness.

Paul Bourmatnov Jr.
Tappan, NY

Would you please refrain from giving space to ecocrazies like Paul Saffo. His Commentary is a complete piece of rubbish. He has no idea what he is talking about and has no concept of statistical relevance.

David L. Hanson
Naperville, IL

For more information on EMF:

Becker, Robert O. Cross Currents: The Perils of Electropollution, the Promise of Electromedicine. *New York: J. P. Tarcher, 1991.*

Foster, Kenneth R., David E. Bernstein, and Peter Huber, eds. Phantom Risk—Scientific Inference and the Laws. *Cambridge, MA: MIT Press, 1993.*

Microwave News/VDT News, *New York, (212) 517-2800.*

NUTEK (for information on government labeling in Scandinavia), +46 8 681 91 00; fax +46 8 681 95 85.

—Paul Saffo

Pournelle's Inferno

I can't thank you enough for bringing me Jerry Pournelle's column every month. As a Mac user, it often distresses me to see the meager percentage of shelf space devoted to Mac software in stores. But all it takes is one look at Jerry's monthly Danteish descent into the hoary netherworld of PC hardware incompatibilities, software incompatibilities, EMM configurations, aborted installation attempts, and cryptic modifications to SYSTEM.INI, AUTOEXEC.BAT, and CONFIG.SYS to realize what a bargain my Mac is.

John Arft
San Antonio, TX

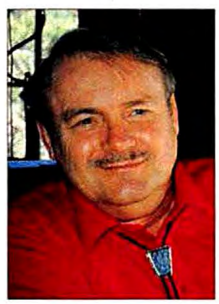
Jerry's article on whether to go to MS-DOS 6 or not ("The DOS 6 Question," July) exemplifies the attitude of most PC magazines, and it's costing the industry and business millions.

Jerry's preferred solution is DOS 5, QEMM, and WinStore. Sure, spending the extra $300 is no problem if you're a single user. But what about business installations with 500 or more machines? MS-DOS 6 gives you the $300 solution for $30 (with bulk licensing). On 500 machines, that's a $150,000 solution for $15,000. And the savings are much higher because you also get backup in MS-DOS 6.

I'm moving my organization to MS-DOS 6 ASAP, not because it is something brilliantly new, but because it gives the best value for the money.

A very large chunk of sales go into organizations that manage more than five or 10 machines. Your recommendations should take that into account.

Stephen Norton
Victoria, British Columbia, Canada



I said that I wouldn't quarrel with those who like MS-DOS 6, and I won't; on that scale, it makes a great deal of sense. In my case, where my time and work have a value that's largely compared to the cost of computers and software, I have a different solution. Incidentally, by the time this comes out, they may have fixed some of the MS-DOS 6 compression difficulties; but it still doesn't make optimum use of fragmented disk space, as Stacker does. If I couldn't use hardware solutions for file compression, I'd use Stacker.—Jerry Pournelle

Fixes

In the August What's New section, the telephone number for Laptop Solutions was incorrect. The correct number is (713) 789-0878.

The correct phone number for information on Hewlett-Packard's OmniBook 300 (News&Views, July) is (800) 443-1254. ■

We want to hear from you. *Address correspondence to Letters Editor, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458; send BIX mail c/o "editors," or send Internet Mail to letters@bytepb.byte.com. Letters may be edited.*

Even a *free* memory manager may not be a bargain—especially if it can't give you all the memory you need.

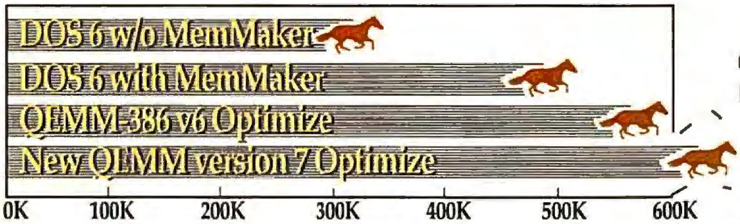
Introducing QEMM 7
The Memory Manager Worth Paying For

The newest version of the Quarterdeck Expanded Memory Manager (QEMM), version 7, once again is extremely innovative in using the critical area between 640K and 1024K. It finds space for more TSRs and drivers in this area than anyone thought possible. It optimizes this area, taking into account the many drivers that need more memory at start-up than when running; instantly calculating millions of possible memory configurations to find still more memory for your programs to use. And it treats the rest of memory as a giant pool to instantly fulfill the needs of all of your programs—whether they use extended or expanded memory. Whether your PC has 1 megabyte or 16, you can benefit from new QEMM 7.

Instant Riches

What does more memory mean in a practical sense? It means that your DOS and MS Windows programs run faster, smoother and more reliably. It means you can continue to add valuable utilities, drivers, TSRs and new capabilities to your PC. Whether it's workhorse drivers like LAN utilities and fax drivers; productivity-enhancers like disk caches and disk compressors; or fun and exciting capabilities like sound boards, CD ROM drivers, graphics tablets, etc. The better your memory is managed, the more versatility and flexibility your PC has. QEMM 7 lets you have it all without fear of 'out of memory' messages or crashes.

How to Look a Gift Horse in the Mouth



We tested DOS 6 with and without MemMaker and with QEMM 6 and our new QEMM 7 runs away from all of them. See details of test conditions listed below.

DOS 6 Giveth; DOS 6 Taketh Away

The best feature of new DOS 6 is the stable of utilities it includes. Trouble is, they all eat up memory. DoubleSpace file compression needs 43K, Vsafe anti-virus needs 7-45K, Smartdrv disk cache needs 28K and even Undelete takes 10-14K as a resident program. Using Microsoft's free memory utility, MemMaker, you could easily end up with a net loss of available 'conventional' memory in DOS 6.

New QEMM 7 takes the best of the new DOS 6 features into account, finding ways to give you more free memory for your program while taking full advantage of DOS 6. One new QEMM 7 feature, DOS-Up, moves the DOS 6 kernel, its data and resources to memory above 640K (this feature also works with DOS 3-5), freeing 7-70K. Another new QEMM 7 feature, Stealth DoubleSpace, frees 40K of the memory addresses used by DoubleSpace and makes them available for other drivers and TSRs. Both features ensure that the all-important memory below 640K is free for your programs. And QEMM 7's seemingly small feature of supporting multiple configurations gives you the flexibility and ease of setup that you expect. (MemMaker doesn't work well with this important DOS 6 feature.) That's why it makes more sense than ever to put your money on the best memory manager.

Page Frame: the Key to Your Future

There's been a lot of talk about our patent-pending Stealth technology. Jealous talk, mostly. Because nobody else can touch its performance. Our Stealth ROM feature, pioneered in QEMM 6, frees 48-115K of ROM addresses for use by TSRs and drivers. Our Stealth DoubleSpace feature, described above, frees another 40K. And as you might imagine, there's more to come.

Prior versions of QEMM won just about every competition in sight, as well as remaining the #1 best-selling memory manager 5 years straight.

The key to Stealth is its use of a 64K reserved area above 640K called the page frame. Besides being used by Stealth, the page frame is used by Lotus 1-2-3 r2.x for larger spreadsheets and WordPerfect 5.x for larger documents, DESQview for multitasking, Novell Netware, IBM LAN Server and DECnet for reducing the network driver memory footprint, plus games like Wing Commander, Car and Driver, Ultima Underworld II, Wolfenstein and others for fast action. You sacrifice all this when you turn off the page frame (which other memory managers do to maximize available memory above 640K). It's this use of the page frame by Stealth that lets you set up your PC with a mouse, CD ROM, sound board, a network such as Novell NetWare, reserve 8-24K of extra memory for optimal MS Windows performance, use all of DOS 6's memory-hungry utilities and still have more than 630K available for your programs. (Compared to DOS 6's 527K available in the same configuration, after using MemMaker).

There's lots more to QEMM 7:

- Tuned for MS Windows
- New ability to use Vidram inside MS Windows
- DPMI Host
- Pentium Support
- Laptop suspend/resume support
- PS/2 micro channel adapters
- Compaq support
- Fine tuning tools for power users
- 32-bit architecture for speed
- Enhanced compatibility in response to hardware needs of our millions of users:
  - Detects adapter RAM and ROM and bus-mastering hard drive controllers
  - Monitors DMA access into memory
  - Supports Shadow RAM

Easier to use for Novices, More Power for Experts; More Memory for All

Our seventh-generation thoroughbred QEMM has improved ease-of-use, with Express Install and Help features. And for power users, Advanced Install and editable parameters and troubleshooting hints.

And QEMM 7 comes with Manifest, the award-winning memory analyzer—enhanced for more flexibility with Pentium testing, laptop battery reporting, network analysis and editable configuration files.

The new and ever more exciting capabilities coming to your PC will all compete for memory with your favorite applications, TSRs and drivers. And that makes QEMM 7 the front runner in your efforts to get get the best performance out of your PC today—and tomorrow.

Quarterdeck

Quarterdeck Office Systems, 150 Pico Boulevard, Santa Monica, CA 90405 (310) 392-9851 Fax (310) 314-4219
Quarterdeck International Ltd., B.I.M. House, Crofton Terrace, Dun Laoghaire Co. Dublin, Ireland Tel. (353) (1) 284-1444 Fax: (353) (1) 284-4380

QEMM Users: upgrades are available from dealers.

You can also buy direct from Quarterdeck. Call (800) 354-3222 ext. 1D7 and ask about our special Game Pack offer with your upgrade!

How we got the chart numbers: CPU—486/33 ALR Power/business VEISA machine equipped with 16 megs of RAM and running MS-DOS 6. Comparisons were done using the following memory managers: QEMM 7, QEMM 6.02, MS-DOS 6 MemMaker. In addition to the driver (or drivers) required by each memory manager, the following drivers, DOS resources and programs were loaded for all comparisons: in the CONFIG.SYS file: SETVER.EXE, DOS=HIGH, FILES=20, BUFFERS=10, STACKS=0,0, MVSOUND.SYS, SNDBK12.SYS, SLCD.SYS, DOS SHELL=statement, in the AUTOEXEC.BAT file: VSAFE, MSCDEX, UNDELETE, LSL.COM, NE2000.COM, IPXODI.COM, NETX OR EMSNETX, MOUSE.COM, SMARTDRV.COM, PRTSCCAP.COM.

Circle 131 on Inquiry Card.

News & Views

NETWORKS

High Stakes for High-Speed Ethernet

Two sides couldn't agree. Now, the battle lines are drawn in the 100-Mbps Ethernet showdown, and the market will decide the winner.

DAVE ANDREWS

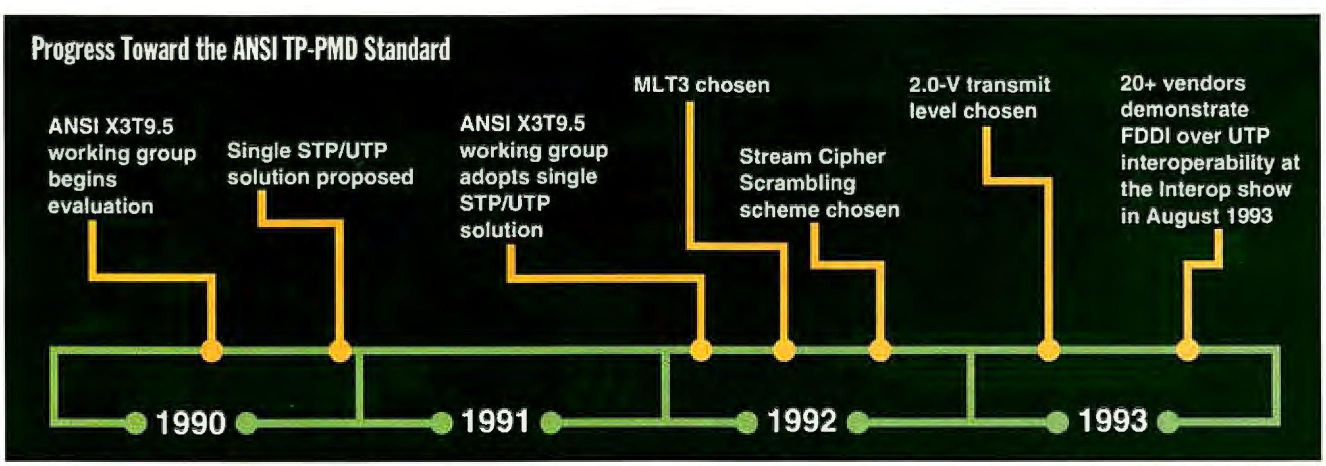
You go your way, and I'll go mine. And may the better high-speed Ethernet networking standard win. That's the position many networking companies are taking in the high-stakes, 100-Mbps Ethernet competition. This is happening because the high-speed study group of the IEEE 802.3 committee, which is the official gatekeeper of the Ethernet standard, decided in July after months of vigorous debate to proceed with two separate and competing proposals.

The 100BaseVG proposal, based on technology originally developed at AT&T and Hewlett-Packard, is under the guidance of the 802.12 committee. This proposal preserves the Ethernet frame but discards traditional Ethernet's CSMA/CD data-transmission technique for a demand priority method that proponents say better serves time-sensitive applications like full-motion video. A second proposal is supported by 17 companies, including Synoptics Communications, 3Com, Grand Junction Networks, and Sun Microsystems. It preserves CSMA/CD and mates it to the FDDI (Fiber Distributed Data Interface) physical-medium-dependent layer. Proponents of the second proposal (which is now in the 802.14 committee) argue that its fast Ethernet solution will let developers quickly come to market with low-cost 100-Mbps networking products. The two sides could not agree on how to proceed. Now the market will decide which technique it favors.

Both 100-Mbps schemes will require changes to your adapter cards and hubs. Both preserve different parts of the traditional 10-Mbps Ethernet specification. But neither one will likely reach the draft stage until 1994. (For more information on 100-Mbps proposals, see "Pumping Up Ethernet," August BYTE.)

Standardization can take years—an eternity in this business—which is why numerous companies are introducing prestandard 100-Mbps NICs (network interface cards) and hubs. Customers who run data-intensive CAD, desktop publishing, and other applications and don't want to deal with the added complexities of implementing 100-Mbps FDDI over copper wiring can't afford to wait months for a formal standard. "Our customers have an extreme need to send a lot of data back and forth," says Neil Mehta, president and CEO of Fremont, California–based MicroAccess, which already sells 100-Mbps Ethernet hubs and $399 16-bit ISA cards. "Our philosophy is to give them what they want now."

The lengthy standardization



process is equally incompatible with companies that are funded by venture capitalists. "The cycle time is much longer than a commercial enterprise can usually tolerate, especially a start-up company," says Jack Moses, who is vice president of marketing at Grand Junction (Union City, CA). "When the [802.14] standard is done, we'll make our products compatible with it."

In the networking world, the shipping of prestandard products has numerous precedents. The FDDI-UTP (unshielded twisted-pair) standard for implementing FDDI over UTP and shielded copper wires is only now inching toward finalization (see the figure). Yet Crescendo Communications (Sunnyvale, CA) has been shipping 100-Mbps FDDI-UTP hubs and $995 adapter cards since January 1992. Jayshree Ullal, vice president of marketing, says that when the standard is final, Crescendo will upgrade its adapters and hubs.

The Race Is On

Grand Junction's FastSwitch 10/100 ($7250, expected to ship by the end of the year) is an SNMP-manageable workgroup switching hub that provides two switched 100-Mbps Ethernet ports for servers and 24 private 10-Mbps Ethernet ports. The company will complement its affordable hub with its FastNIC 100-Mbps EISA card, which at $395 is about four times as expensive as a low-end 16-bit Ethernet card while offering roughly 10 times the performance.

As for the 100BaseVG proposal, you can expect companies like Kalpana, HP, AT&T Microelectronics, Proteon, Ungermann-Bass, and Accton Technology to begin shipping products in 1994.

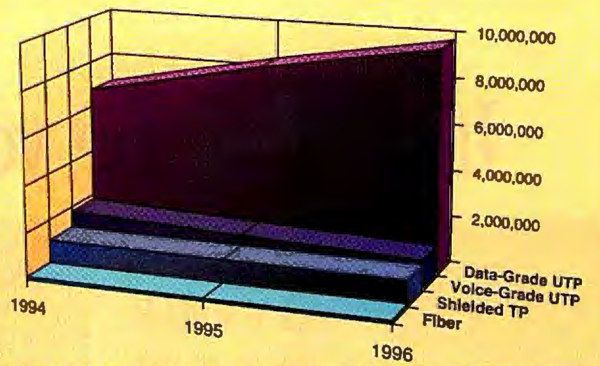
Down the Road

What's a network administrator to do? Todd Dagres, director of data communications at Boston-based Yankee Group, advises you to determine what your requirements are going to be five years from now. Make sure your hub vendors can support the various emerging schemes, like switched and fast Ethernet, FDDI, ATM (Asynchronous Transfer Mode), and beyond. Companies like 3Com and Cabletron recently outlined broad strategies encompassing networking connectivity and management solutions designed to bring their customers into the twenty-first century.

But unless you really need 100-Mbps performance now, you probably want to wait a year, according to Dagres. "I'd say if you can wait a year, you're going to have a bonanza of choices." With International Data estimating that the number of worldwide Ethernet installations will double from 20 million in 1992 to over 40 million by 1995, the competition is sure to be fierce.

Down to the Wire

Estimated U.S. Cable Connection Shipments
Source: Forrester Research (Cambridge, MA)



Along with different medium access and physical layers, the various 100-Mbps network schemes support differing types of wires. The main difference between Voice-Grade (Category 3) and Data-Grade (Category 5) copper wire is in resistance to crosstalk, or unwanted signals that interfere with a wire's signal. Category 5 cable has a higher resistance to crosstalk than Category 3 cable does. The FDDI-UTP and Grand Junction fast Ethernet proposals work over Category 5 UTP and shielded TP. The 100BaseVG proposal works over those two wire types and Category 3. However, Santa Clara–based 3Com says it will roll out a family of CSMA/CD-based 100-Mbps Ethernet products for all cable types in 1994.

SPREADSHEETS

Quattro Pro for Windows Pulls Ahead

Borland's Quattro Pro 5.0 for Windows packs enough new features to drive users to distraction. You'd expect features like the new Scenario Manager, help facilities, and @functions, given the strength of Lotus 1-2-3 release 4.0 for Windows and Microsoft's forthcoming Excel 5.0 for Windows. Other features, like the Improv-like Data Modeling Desktop, might surprise you. Whatever the case, QP5W moves, temporarily at least, into the lead in the Windows spreadsheet feature wars.

News for Beginners

One type of customer that spreadsheet vendors are competing for is the new user moving from a DOS spreadsheet to Windows. Conventional wisdom is that if you have the easiest spreadsheet to use, beginners will choose your spreadsheet over the others. QP5W (Borland has brought the Windows version's numbering conventions in line with the new DOS version) tries to make life easy for new spreadsheet users, as well as seasoned pros, through its context-sensitive help facility, Object Help and Function Help, Interactive Tutors, and Experts.

In QP5W, if you're not sure about the purpose of an object (e.g., a cell, a notebook page, or any other spreadsheet control), you can place the cursor on that object, hold down the Control key, and click on the right mouse button. A box of text appears to explain the object. Along with this Object Help feature, Borland's Interactive Tutors offer more than 20 short on-line lessons in how to use various features. For those who don't want to learn how to use the spreadsheet but just want to get something done quickly, Experts might prove liberating. An Expert is a canned procedure for building a graph, creating scenarios, and consolidating spreadsheets.

QUATTRO PRO 5.0 FOR WINDOWS

- **Lotus Improv-like Data Modeling Desktop**
- **10 new graph types**
- **Control + Right Click Object Help**
- **Intelligent graphing**
- **Multiuser computing**
- **Consolidation Manager merges disparate 3-D worksheets**
- **More than 360 @functions**

Subtle Changes

QP5W offers nifty changes at the most fundamental levels. For example, the automatic graphing capability that's standard in spreadsheets is intelligent in QP5W. The software evaluates the size of a selected cell block and the types of entries in the block and draws a graph

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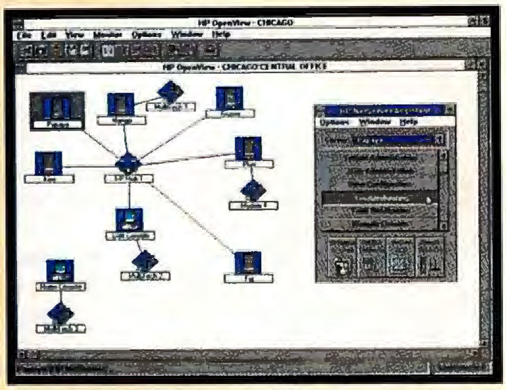

HP NetServer Assistant

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- 128-KB and 256-KB external cache
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- 8 EISA-2 with Enhanced Master Burst bus-master I/O slots
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- HP NetServer Assistant software included
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- Tested and certified on major network operating systems

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- 3-year on-site, next-business-day limited warranty
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Open architecture facilitates adding specialized third-party or HP management utilities.

*U.S. list price for HP NetServer LM Model 530, including 486/33DX processor, 16-MB RAM and 535-MB SCSI hard drive. **U.S. list price for HP NetServer LE Model 240, including 486/33SX processor, 4-MB RAM and 340-MB IDE hard drive. Prices subject to change without notice. Pentium and the Intel Inside logo are U.S. trademarks of Intel Corporation. PPG686

HEWLETT PACKARD

using the graph type most appropriate to the selected data. The same graphing tool in QP5W might draw a bar chart for one data set and a pie graph for another set.

The object inspector for a selected spreadsheet block offers quick access to settings that affect the appearance of the cells and the data they contain. Through its Object Help and Function Help, Interactive Tutors, and Experts, Quattro Pro makes it easy to do things.

Once you have created a graph, you can call on a feature called Analytical Graphs. Here, QP5W automatically calculates a moving average, exponential fit, linear fit, or aggregation of a data series and graphs the result. This means you don't need to perform analytical calculations in the spreadsheet to plot statistical projections of your data series. Analytical Graphs don't return their calculations to the spreadsheet, but they enable users without a statistics background to produce visually impressive reports.

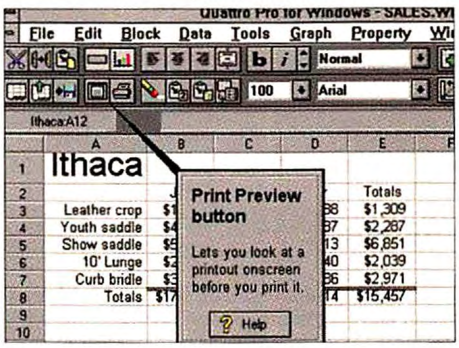
You might overlook one of QP5W's most generally useful improvements: As you type an @function for use in a formula, a function template appears at the bottom-left corner of the display, identifying the function's syntax. If the function requires multiple arguments, the template shows each argument highlighted in turn as you create the formula. What's more, QP5W highlights unmatched parentheses and macro command braces, so you spend less time tracking down these common errors.

Once you've built formulas, you might decide to compile them. This concept has been around for years in stand-alone products like Frontline Systems' 3-2-1 Blastoff, but it has not been built into a spreadsheet package. An on-line Expert can help decide whether you'll get an advantage from compiling the formulas. If the answer is yes, compiling can significantly reduce the spreadsheet's recalculation time.

Multiuser Computing

QP5W lets you share notebooks, or portions of notebooks, with other users on your network. It also lets you share data via MCI Mail. The capability is especially useful in conjunction with the Scenario Manager, a tool that lets you create several versions of a model within a single workbook, so you can quickly switch from one version to another without having dozens of files running at once.

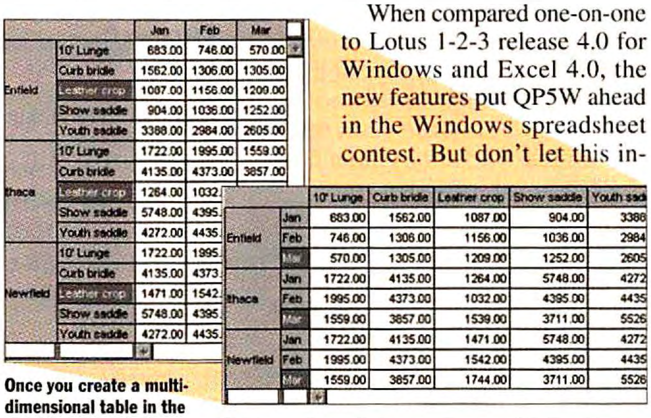
Borland will likely release two versions of QP5W, one for $99 that can query databases like dBase and Paradox, and a $495 workgroup version that can also issue SQL queries. But at press time, pricing wasn't finalized.



When you point at a control in one of the SpeedBars and click on the right mouse button while holding down the Control key, QP5W rewards you with an Object Help box. If the information in the box doesn't satisfy, you can click on the box's help button for more details.

The Assault on Improv

When Lotus Development generated a lot of hoopla over its release of Improv for Windows, it was only a matter of time before Microsoft and Borland would answer the call. A new facility in QP5W called the Data Modeling Desktop lets you zap spreadsheet data into an Improv-like environment and instantly flip categories around to provide alternative views of the information.



Once you create a multidimensional table in the Data Modeling Desktop, a quick drag or two with the mouse completely transforms the table. When you discover a useful view of the data in the Data Modeling Desktop, you can quickly copy it back to the spreadsheet notebook. There, you can apply formatting and styling options, add formulas, and graph the information in its new configuration. To go from the arrangement on the left to the one on the right took about a second and a half.

Data for the Data Modeling Desktop originates from a QP5W notebook, but you can't write formulas within the Data Modeling Desktop, nor does the module offer extensive formatting and reporting capabilities. In a sense, Data Modeling Desktop is a cut-rate data slicer and dicer. As such, it's a handy new tool, but it takes practice to organize data appropriately.

The Suite Spot

I've barely scratched the surface of QP5W's new features. Borland has added a spreadsheet spelling checker, a host of new @functions, a formula auditing facility, and a utility that rapidly consolidates data from several disparate notebooks or notebook pages into a single page.

QP5W's heavy reliance on objects—each with its corresponding object inspector, context-sensitive help, SpeedBars, and so on—conspires to make it feel as if you are working in several software programs rather than in one package. You can use the product extensively and still be surprised at the object inspectors that come to light when you right-click on a data element. Until you get used to it, the environment is disorienting.

When compared one-on-one to Lotus 1-2-3 release 4.0 for Windows and Excel 4.0, the new features put QP5W ahead in the Windows spreadsheet contest. But don't let this influence your purchasing decision too strongly. Microsoft and Lotus each produce a suite of Windows products—spreadsheet, word processor, presentation graphics, and E-mail programs designed with similar user interfaces and sold in a single package. Borland's Windows bundle includes WordPerfect for Windows. It also includes Paradox for Windows, a database manager you may not need in 1-2-3 or Excel because you can use DataLens in 1-2-3 or Q+E in Excel to create and manage external database tables. QP5W's Database Desktop external database management facility can't create new external tables.

If you're already a Quattro Pro user, Borland's upgrade will make it worth your while to stick around. The new version offers a host of features for the first-time Windows spreadsheet user. But its integrated offering is not as strong as the competition's.

—Daniel Gasteiger

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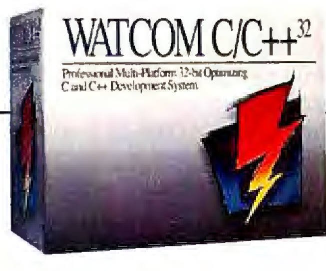

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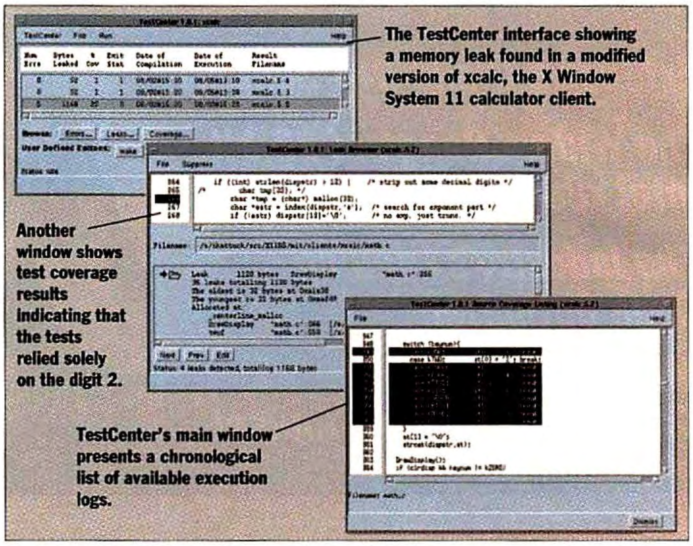
SOFTWARE DEVELOPMENT

Programming Tools Catch Memory Misuse



One of the hardest problems in writing software, particularly in languages like C and C++ that depend heavily on pointers, is finding the places where you misuse memory. If you're programming in such languages, you're all too familiar with pointers that don't point to legal memory or, even worse, point to the wrong block of memory. These types of errors are often nonfatal—at first. When undetected, however, memory-related bugs can eventually cascade to cause fatal errors that are virtually impossible to diagnose in isolation.

Current debuggers provide limited help in finding memory problems because they are tied to the source code. When you know which part of a program is misbehaving, you can zero in on the problem. However, when your program is misusing memory, you generally have only a vague idea of which section of your code you should examine.

Two new Unix software development tools let you automatically discover a wide variety of memory-related errors. They will flag code that refers to illegal parts of memory, fails to free memory that is no longer being referenced, or deallocates the same memory several times.

CenterLine Software, a major developer of programming tools for Unix systems, provided some help in its earlier products. CodeCenter, a C environment that first shipped in July 1988, and ObjectCenter, a C++ environment that first shipped in November 1990, include source language interpreters as well as compilers. The interpreter flags a variety of memory-usage errors, including nonfatal ones, which are difficult to discover and track down. The drawback to interpretation is that it is much slower than compiled code, making it impractical to use on large or time-consuming applications.

After CenterLine had whetted programmers' appetites for development tools, Pure Software released Purify ($1298 per user), demonstrating that many of the same error-checking benefits could be achieved more efficiently. The key is a technique Pure calls object code insertion, but it's more often known as code-patching. (Although code-patching appears to be the technology of choice for Unix systems, PC error-checking tools like Nu-Mega Technologies' Bounds Checker—for Windows and DOS—can also achieve high efficiency by using built-in features of the 80x86 processor family to insert breakpoints and memory page protection; see our review of Bounds Checker on page 159.)

Purify intervenes between compilation and linking, patching the instructions that allocate and reference memory with error-checking code. This lets Purify work with libraries you don't have the source code for (e.g., system libraries or libraries bought from another vendor). You simply add the command "purify" before the invocation of the compiler, and Purify creates the debugging version of the program automatically. Purify calls the compiler, looks at the machine code, and inserts instructions that catch memory errors in both libraries that you link in and the code you wrote and compiled. Typically, the problem of misusing memory occurs when you pass a bad memory block to a library routine.

When you run a "Purify'd" application, it prints a message whenever an illegal memory reference or other run-time error occurs. The message gives the source code location of the error as well as a stack trace to help track it down. When the application has finished, Purify prints a list of *leaks*—memory blocks that have been allocated and can no longer be deallocated.

CenterLine has responded with TestCenter ($1295; $2995 for a floating license that lets you share the program on a network), which provides the same features together with a GUI and a code-coverage tool. TestCenter is currently available for Sun Microsystems' workstations running Solaris 1.x; a version slated for release later this year will support Solaris 2.x. TestCenter's code-coverage tool shows you which lines of the program have and have not been executed. The system can also combine coverage results from multiple executions. This is helpful in developing a comprehensive test suite that thoroughly exercises the application. An advantage to the TestCenter interface is that it simplifies archiving, comparing, and browsing execution error logs.

As these two companies fight over the market for testing tools, developers are sure to benefit. Expect significant improvements in both product lines during the upcoming months. Both companies will also be using the technology in these tools as a basis for other products. Pure has already done so with Quantify, a performance profiler, and PureLink, a fast incremental linker.

—Othar Hansson

CenterLine Software, Inc., Cambridge, MA, (617) 498-3000; fax (617) 868-5004.

Pure Software, Sunnyvale, CA, (408) 720-1600; fax (408) 720-9200.

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AP

"Tandy's Sensation is aptly named. I urge anyone looking for a good all-around MPC system to test-drive the Sensation."

-Greg Loveria
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-Selby Bateman
CD-ROM Today

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Hardware Review, United Feature Syndicate

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SMALL OFFICE/HOME OFFICE SOFTWARE

SOHO Software Follows Low-Cost Hardware

While most large and midsize companies began computerizing their offices a decade or more ago, many small offices and home-office workers are just now getting started. That presents new challenges, not only for these SOHO users but also for software publishers accustomed to dealing with experienced, well-heeled corporate customers.

Increasingly, publishers are discovering that SOHO users are a different—and in some ways more demanding—breed when buying software. They want programs that are easy to use, work well together, and don't cost hundreds of dollars apiece. Big-business users want these qualities in their software, too. But unlike their corporate counterparts, many SOHO buyers will stand on the sidelines until they get what they want.

"People in small businesses and home offices want solutions to very specific problems, and the money is coming out of their own pockets," explains Kevin Howe, president of DacEasy, which has been selling accounting programs primarily to small businesses since 1985. "If you don't give them what they want, they won't computerize."

While there's been no dramatic shift in the types of programs that software publishers are producing, many companies have begun introducing new products or tailoring old ones to meet the demands of SOHO customers. DacEasy, for instance, borrowed pieces of its namesake accounting program to fashion streamlined subsets dubbed Instant Accounting, Instant Payroll, and Instant Rolodex. Intuit crafted small-business bookkeeping (QuickBooks) and payroll (QuickPay) programs from its popular Quicken personal-finance software.

Larger companies (e.g., Microsoft and Computer Associates) have introduced new lines of solution-oriented software aimed at SOHO customers. AutoDesk, known for its powerful AutoCAD program, has introduced programs through its Bothell, Washington–based retail products division that generate 2-D floor plans for homes, decks, kitchens, and landscapes. It is competing with companies like Abracadata, Expert Software, and Green Thumb Software. Judy McNary, president of Green Thumb (Boulder, CO), said programs like her company's DOS-based LandDesigner landscaping program offer capabilities for the home user that aren't possible using a pencil and a pad of paper (e.g., in buying materials, quickly calculating the number of cubic yards and cost of a needed material).

In addition to their problem-solving approach, these products have something else in common: They're inexpensive—generally less than $100, sometimes less than $50, and in rare cases, free! Companies like Computer Associates and Central Computer Products (Fillmore, CA) have promoted their respective home-finance and double-entry accounting programs by literally giving these programs away for a limited time.

"Price is really the second battlefront," says AbhiJeet Rane, a research analyst who follows SOHO trends for Link Resources in New York City. "Software prices may not come down as quickly as they have with hardware, but they are definitely dropping."

To some extent, price-conscious SOHO users were already being served by the many integrated or "works" packages on the market (e.g., Microsoft Works, LotusWorks, and ClarisWorks). For those who need more than the basics of word processing, spreadsheet, graphics, database, and telecommunications functions, the latest trend in integrated packages is "office" or "suite" bundles that put three to five applications in one box for less than $500. These include Lotus's Smart Suite, Microsoft Office, and Borland's Office.

—Christopher O'Malley

SOFTWARE DEVELOPERS HEAD FOR HOME

CATEGORY	PERCENT OF REVENUE
Word Processing	Small Business ... 19.2 Home Office 11.2
Spreadsheets	Small Business ... 22.7 Home Office 14.5
Graphics	Small Business ... 25.6 Home Office 18.8
Desktop Publishing	Small Business ... 12.5 Home Office 11.7
Integrated	Small Business ... 18.8 Home Office 25.5
Communications	Small Business ... 22.3 Home Office 25.5
Database	Small Business ... 16.4 Home Office 9.2

Source: BIS Strategic Decisions (Norwell, MA)

The SOHO market accounted for 34.8 percent of the overall estimated $3.06 billion of 1993 U.S. sales for these seven software categories. BIS defines a small business as being outside a home, with under 100 employees.

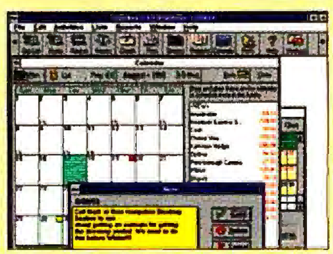
DID YOU KNOW?

- In 1993, the estimated total number of home workers in the U.S. grew 5.4 percent to 41.1 million, more than double the growth rate of the prior 12-month period.
- Telecommuters, company employees who work from home part- or full-time during normal business hours, increased by 1 million from 1992, a 15 percent growth rate.
- The PC penetration rate into the homes of workers who do company work at home after normal business hours is 70 percent.

Source: Link Resources (New York City)

FINANCES

THE ULTIMATE IN FINANCIAL MANAGEMENT METAPHORS



The latest version of Quicken for Windows adds a host of features. One of the most interesting is the Financial Calendar. This feature provides the ultimate in intuitive financial management, as it lets you work in something with which everyone can identify: a daily planner.

Intuit (Menlo Park, CA, (415) 322-0573) should have released its Quicken 3.0 for Windows and Quicken 7.0 for DOS (about $69.95 each) by now. Both will include improved investment-tracking and financial-planning tools and the Financial Calendar. Both still let you work in the familiar checkbook metaphor that makes it easy to balance your checkbook. The new versions of Quicken let you enter one-time or recurring transactions directly in the Financial Calendar; once you do this, the transaction is recorded to the register. You can also add reminders in the calendar. Based on my use of a prerelease version of Quicken for Windows, Intuit is on-track when it comes to home finances.

—Dave Andrews

FAST
VS HALF-

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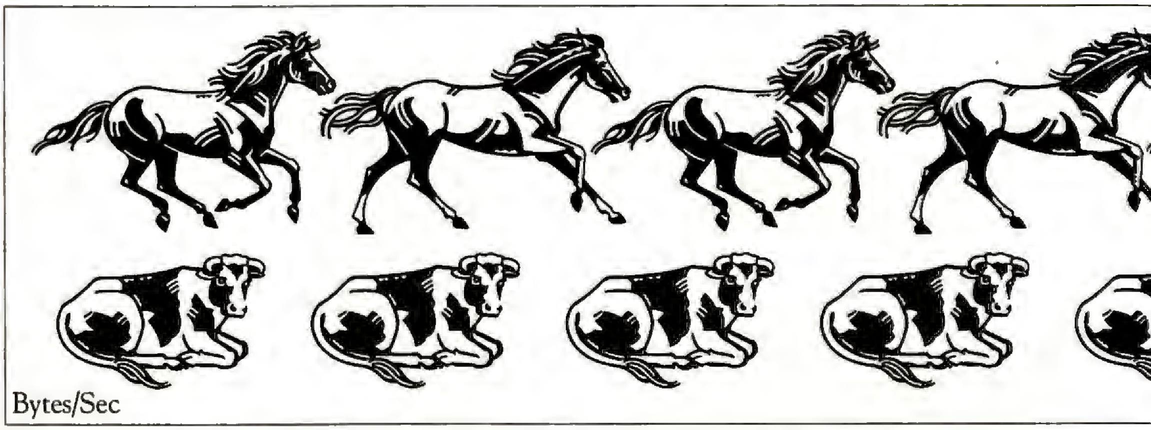
GATEWAY



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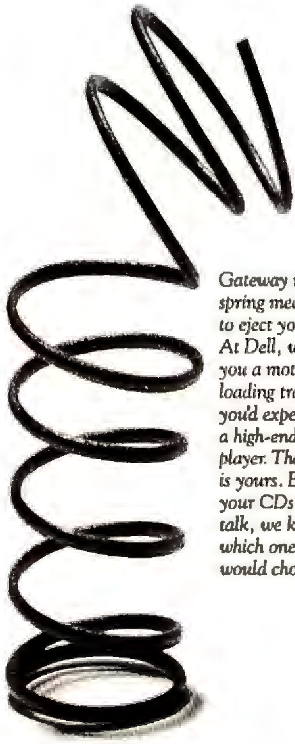

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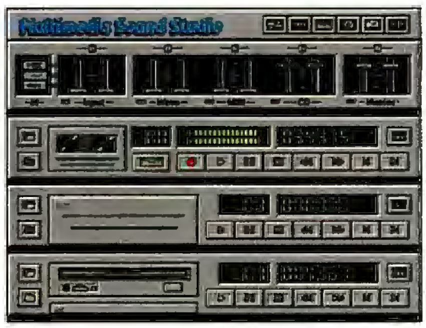

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**All comparisons based on manufacturers' specifications. The Dell CD ROM is the Panasonic 563. Gateway's CD ROM is either a LMSI CM205 or a Sony CDU-31A. Dell disclaims proprietary interest in the marks and names of*

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News & Views

SECURITY

PCs Catch Criminals Using Fingerprint Analysis

TAIPEI—When it comes to industrial espionage, spies can disguise their identity, alter ID cards, and crack passwords, but they cannot change their fingerprints. With that immutable fact in mind, two companies have developed products that use advanced image-processing techniques to capture, encode, and match fingerprints to identify criminal suspects and prevent unauthorized entry.

The idea behind the products of Hsinchu, Taiwan–based Startek Engineering (+886 35 785388) is to use a fingerprint identification system to control access into a computer, transaction-processing equipment, or a physical location like a laboratory. To achieve this, Startek's technology combines optics and accurate matching algorithms to compare a new fingerprint to ones stored in a computer.

Startek offers two products, each of which can store 1000 fingerprints. The FC100 is used for computer and transaction-processing security applications. It consists of a standalone FingerCheck fingerprint verifier, an AT-bus interface card, and a software application interface and library. The second product is the FC200, which is an embedded version of the FC100. The FC200 consists of FingerCheck and an RS-232 interface. Both systems are for access control applications and can process a fingerprint in 2 to 3 seconds.

In computer security applications, FingerCheck is connected to a 386 or 486 PC through the AT-bus card. To use the FC100, you place your finger three times on the reader window, a small, red LED screen that's located on top of FingerCheck. A CCD (charge-coupled device) camera inside the unit takes optical snapshots of your fingerprints at one-thirtieth of a second. Fingerprint images are digitized in an image-grabber processing module, resulting in 2-D images of your fingerprints on a computer screen.

Startek's fingerprint identification system connects to a PC through the AT-bus card. The red LED fingerprint reader is at the top left.

Meanwhile, Startek's software automatically extracts 13 feature points of your fingerprint images. Each feature point is translated into binary images and stored in the software library. A single fingerprint is stored in a file of up to 256 bytes. The next time you attempt to gain access to the PC, it will accept or reject your fingerprint.

The company's proprietary matching algorithms perform the accept/reject operation. By using an automatic planar-point-pattern device, the program compares the vectors of your binary images to those in the PC. Startek claims the false rejection rate is less than 1 percent. Startek's FC100 costs $2700. Prices for the FC200 depend on configuration.

New Delhi, India–based CMC also uses fingerprint verification, but to solve a different problem. Startek's products are designed to control access to sensitive data and locations. CMC's FACTS (Fingerprint Analysis and Criminal Tracing System) uses the power of the computer to reduce the amount of time required for a person to compare fresh fingerprints to thousands of fingerprints in an existing database, a task that—when performed manually—is herculean. Agencies like the FBI use mainframe computers to store and match fingerprints, but Tim Fontenot, spokesman for CMC, says FACTS is a scalable solution that can run on a 386 or 486. This makes it suitable for small cities or developing countries.

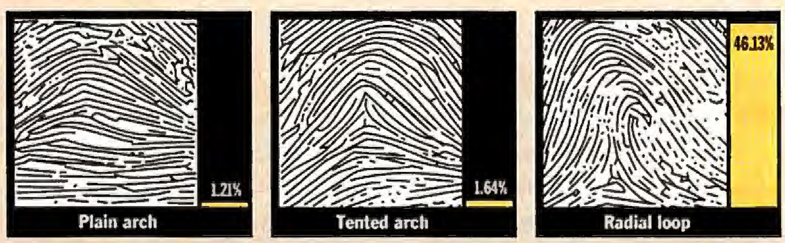
FACTS consists of several components that connect over a network. A control machine handles the matching and encoding functions. An input workstation converts a fingerprint received on paper or as a photograph to a digital image. Once FACTS has extracted the important features from a fresh fingerprint, the system compares it to those in the database and gives a short list of likely matches. At that point, a human expert can examine the list and identify the correct match. CMC, which has a subsidiary in the U.S. called Baton Rouge International ((504) 296-8440), says FACTS is being used by the National Crime Records Bureau in New Delhi.

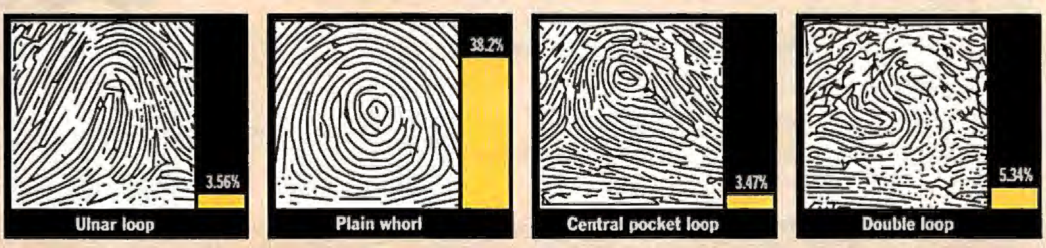
Although Startek and CMC are solving different problems, both are combining the power of the PC with mathematical algorithms to catch criminals by their own hands.

—Mark LaPedus and Dave Andrews

Fingerprint Classifications

Startek's program automatically breaks down a fingerprint into seven different classifications (e.g., plain arch, radial loop, and plain whorl). The software locates 13 feature points based on a fingerprint classification system developed by E. R. Henry. The figures show fingerprint types and the percentage of people who have them.





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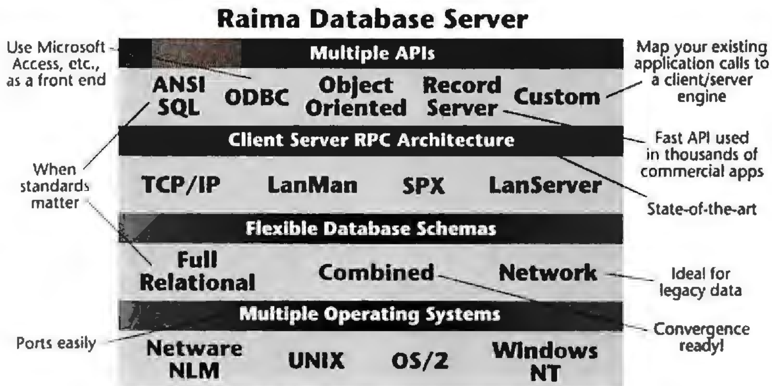

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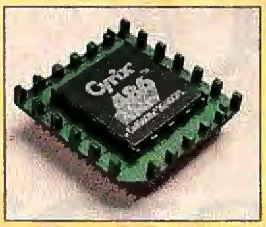
PROCESSORS

I'll See Your Chip and Raise You One

Obsolescence is the greatest fear of computer buyers, and that fear has been focused mainly on the heart of the system: the microprocessor. To alleviate these worries, chip makers such as Intel, Cyrix, and Weitek have devised processor upgrade options to help PC and workstation buyers protect their investments.

Intel's well-publicized program lets users upgrade systems through its OverDrive family of processors. Cyrix's (Richardson, TX) newest family of 486 processors is designed for those who want to upgrade 386DX PCs to 486 performance for only $299. The company's Cx486DRx2 16-/32-, 20-/40-, and 25-/50-MHz clock-doubling processors that upgrade 386DX processors to 486 processors list from $299 to $399. Weitek (Sunnyvale, CA) should now be shipping its $1500 Power uP processor, which the company claims improves performance of SparcStation 2 and IPX workstations by as much as 1.9 times.



When installing Cyrix's Cx486DRx2 upgrade, I found that the hardest part of the task is pulling the old processor out of the system's motherboard. Once that was accomplished, installation was fairly easy. Cyrix supplies a chip puller (which resembles a shoehorn) that makes the job easier.

Are users actually upgrading? Or do processor upgrades amount to a security blanket that's destined to sit in a closet? Chip makers insist the benefits are real and that people are taking advantage of the opportunity to inject an added dose of speed into their computers. Less biased observers say the benefits are more about peace of mind than megahertz.

"It's more of a marketing ploy than a real need expressed by users," asserts Bill Ablondi, who is vice president of the research firm BIS Strategic Decisions (Norwell, MA). "It's become a checklist item now that both buyers and sellers feel they have to satisfy."

Ablondi estimates that fewer than 5 percent of PC owners have replaced their processor. One reason for the hesitancy, he explains, is that BIS surveys indicate that a majority of users still do not feel comfortable about opening up their PCs to add a circuit board—much less swap processors.

Cost is another factor. With the price of Intel 486-based PCs dropping below $1000, it's sometimes difficult to justify spending $500 or more on a clock-doubling OverDrive upgrade. New computers are also engineered to work optimally with a faster chip, notes Ablondi, often outperforming similar systems that have been "cobbled together."

Indeed, the need for a new processor is often a sign that it's time to upgrade the whole system, notes Mike Feibus, editor of *MicroSystems Report*, a newsletter published by research firm MicroDesign Resources (Sebastopol, CA). "If the processor is sputtering," he says, "then chances are, there's a half dozen other things in the system that are sputtering, too—memory, hard disk, video, and so on." Feibus estimates that perhaps 15 percent of users with processor upgrade options might eventually exercise them.

Jim Chapman, vice president of marketing at Cyrix, disagrees with these assertions. "Clearly, there's a camp that's going to buy new machines," he concedes. But he also says upgrades are an attractive option for corporations that want to extend the life cycle of their machines by 12 to 18 months. Chapman says one benefit of Cyrix's chip upgrades is that—unlike Intel's OverDrive—the Cyrix upgrades don't require a special socket. Chapman says the Cyrix upgrades will work on "99.5 percent of the [386DX] systems out there." Cyrix is currently testing a clock-doubling chip for 16-MHz 386SX chips and a 33-/66-MHz 386DX upgrade chip.

Intel, which has likened the OverDrive socket it supplies to PC makers to a "vacancy" sign inside the computer, won't divulge sales numbers for its OverDrive chips but says its high-profile upgrade campaign is meeting expectations. The net percentage of people upgrading is small, concedes Mike Fister, general manager of Intel's End User Components division. But because the OverDrive processors are intended mainly as a "mid-life boost" for PCs that are depreciated over five or six years, he insists it's too early to judge their success. "If you bought an OverDrive chip a month after you bought a PC, then I'd say you probably bought the wrong system to begin with," says Fister.

The real key to the widespread acceptance of processor upgrades may be bringing down prices, agrees Fister. Math coprocessors that once sold for more than $500 now sell for less than $100, and the same thing could happen to CPU upgrades. If it does, expect to see a lot of "no vacancy" signs.

—Christopher O'Malley

HANDS ON

BYTE DOS BENCHMARKS: CPU TESTS (VERSION 2.4)

	CYRIX/CACHE	COMPAQ 386/20	486/33 MHZ
Sieve*	85.25	27.98	123.54
Sort*	10.60	3.18	12.09
Integer Math*	463,597.33	225,631.07	505,880.80
Move (byte)*	55.41	55.41	185.78
Move (word-odd)*	141.43	138.36	356.68
Move (word-even)*	145.35	145.32	370.14
Move (doubleword-odd)*	78.99	66.44	226.98
Move (doubleword-even)*	125.00	125.02	570.84
CPU Index (Desktop Class)	0.73	0.49	1.60

*measurments in ips = iterations per second

When installed in a Compaq 386/20, Cyrix's $349 Cx486DRx2 ran BYTE's benchmarks about 1.5 times as fast as the original processor, but less than half as fast as a 486. When evaluating whether to upgrade, you need to consider more than just CPU performance. For example, if you have an 8-bit graphics card, you probably won't see any increase in screen performance after you upgrade. Tests were run using version 2.4 of the BYTE DOS benchmarks. For all tests and all indexes, higher numbers indicate better performance. Desktop Class indexes are calculated relative to a Compaq Deskpro 386/33L.

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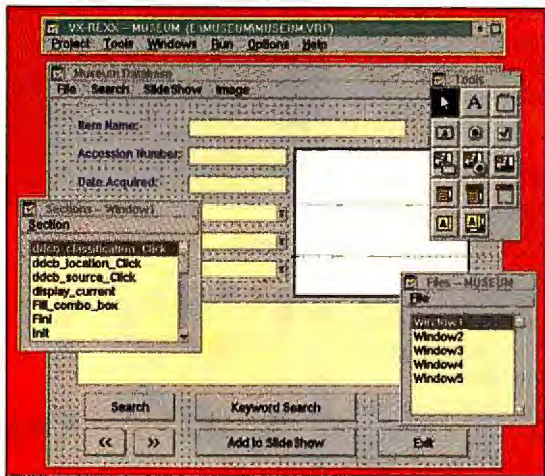

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EMERGING TECHNOLOGY

Optical-Computing Power Coming to Light

Researchers see optical computing as an emerging technology with a bright future. Recently, Stephen A. Kupiec, chief engineer at Dove Electronics, Rome, New York, achieved several breakthroughs in this field. The essence of his project, scheduled for completion late this year, is the production of an OPLA (optical programmable logic array) computer, which is capable of implementing a seemingly unlimited number of digital logic operations.

Among the payoffs from Kupiec's undertaking could be greatly improved associative processors and holographic memories with the potential of holding gigabytes of information with negligible seek times and no moving parts. Other long-term results include lessened power consumption (as low as 5 to 10 W), increases in system performance on the order of one to 100 times, and the ability to maximize the use of the almost unlimited degree of parallelism that computing with light allows.

According to project adviser H. John Caulfield, professor of physics at Alabama A&M, while all-optical computing may never come about, optical-digital and optical-analog ways of processing information surely will, and they provide many advantages. "In electronics, the number of operations a given logic element can perform at one time usually is only one or two. But in optics," Caulfield explains, "it can be around 1 million."

Special algorithms are in the works to take full advantage of Kupiec's technique, he says. Support is being provided for this effort by Dove Electronics, the University of Alabama at Huntsville, Alabama A&M, and Griffiss Air Force Base's Rome Laboratory. Methods that scientists are considering to compute photonically include OPLA, SEED (self-electro-optic effect device), and bit-serial architectures.

The OPLA architecture is being proposed by Kupiec, Valentin Morozov (visiting scholar, University of Colorado), and Peter S. Guilfoyle (president of OptiComp, Lake Tahoe, Nevada). This type of system should perform optimally when dealing with image decomposition, analysis and compression, network analysis, and flag algebra (used in CAD and virtual reality).

Alan Huang and his colleagues at AT&T Bell Labs (Holmdel, NJ) are proponents of the SEED architecture. It consists of a set of planar gates connected by simple fixed patterns. This arrangement performs many simple operations rapidly in parallel using very compact gates. One of its most appropriate uses would be as an efficient network switch.

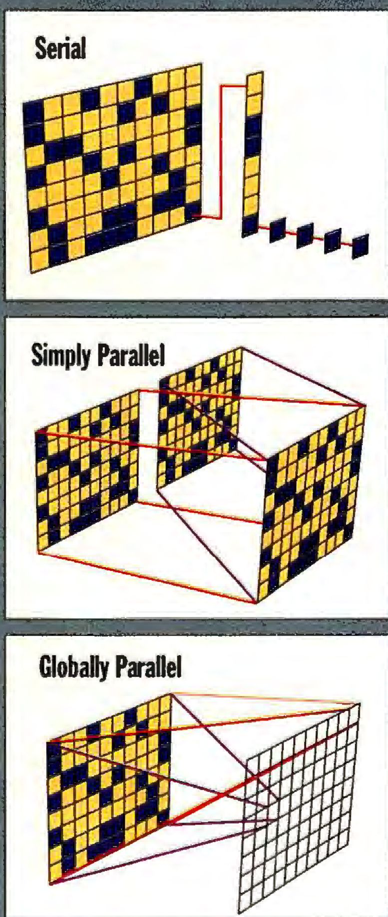
Harry Jordan, program manager of digital-optical computing at the University of Colorado, advocates a bit-serial architecture. This is an electronic design implemented with optical flip-flops that differs just slightly from architectures used in conventional computers. Communications would be a good application for such a system, because it would be fast, immune to interference, and able to use optical fiber as its transmission medium.

Optical systems encode signals for true (1) and false (0) as the presence or absence of light. Another goal of Kupiec's project is to validate the use of N^4 interconnects within OPLAs. He also intends to verify the degree of fan-in that optical computers are capable of achieving.

—Janet J. Barron

Differing Degrees of Parallelism

Conventional serial computers process information (e.g., images) in a one-by-one fashion leading to serious bottlenecks. Simple parallelism performs a large number of one-by-one operations simultaneously, eliminating some bottlenecks, but data operations are localized. But global parallelism allows each data element to broadcast information to many resulting outputs, achieving a much higher potential throughput, as well as eliminating localized data.



DATA HIGHWAY

DIGITAL SIGNATURES: NOT SO FREE

WASHINGTON—The National Institute of Standards and Technology has avoided a potentially messy court battle over a public-encryption standard, but the solution has angered many who believe it lets one company profit from a standard that was promised to be free to the public. When NIST unveiled the Digital Signature Standard, Public Key Partners (Cupertino, CA) announced that DSS violated its patents and that anyone using the proposed standard would need to pay royalties to PKP.

When it announced DSS, NIST promised the new standard would be available for everyone royalty-free, and the stage was set for a major battle over who would control the signature system. The algorithm at the core of the system promises to be essential to modern, digital transactions, as it lets people create unforgeable signatures in the digital domain and thus sign contracts, transfer money, or close deals without ever using paper.

In the end, NIST capitulated. The standards maker has announced plans to give the technology to PKP in return for a published licensing-fee structure for manufacturers who choose to ship products with the capability of using this standard. Royalties range from 2.5 percent of the cost of hardware and 5 percent of the cost of software.

Michael Rubin, attorney for NIST, said the deal with PKP is similar to the compact between a public utility and the people, where the utility gets a monopoly in return for a set rate structure. However, the monopoly angers some people. Stephen Walker, president of Trusted Information Systems (Glenwood, MD), estimates that the deal could generate between $400 million and $2 billion for PKP because the standard could become a part of everyday life.

Rubin, however, believes that the patents held by PKP were fundamental enough to lead to a long court battle with an uncertain outcome. The PKP hand was strong, and the government needed to settle. It is uncertain whether people will choose to use this new standard and pay the price for the technology.

—Peter Wayner

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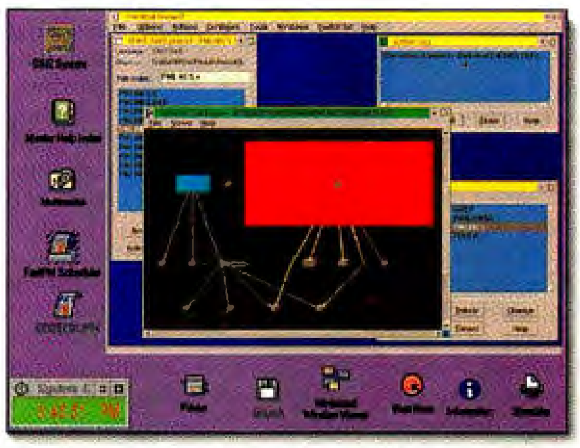
C Set++

mission



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SYSTEMS

IBM's Ambra: Virtual Corporation... Logical Move

AMBRA VS. DELL: A DESKTOP SAMPLING

SYSTEM	CPU	CONFIGURATION	PRICE
Ambra S450SL	486SLC-2/50	4 MB of RAM, 64-KB L2 cache	$1069
Ambra D466BL	Blue Lightning 66	4 MB of RAM, 256-KB L2 cache	$1559
Dell Dimension XPS 450V	486DX2/50	4 MB of RAM, 128-KB L2 cache	$1778
Dell Dimension XPS 466V	486DX2/66	4 MB of RAM, 256-KB L2 cache	$1978

How low is low? Ambra, the new direct-response IBM subsidiary, has announced two notebook computers and 14 PCs—including a dual 60-MHz Pentium tower PC with a CD-ROM drive and a 540-MB SCSI hard drive for $6559. The chart shows the low end of the Ambra line and similar products that Dell announced the same day. Ambra configurations include a mouse, DOS, Windows, a 256-color graphics card, and a 240-MB hard drive. Dell's minimum systems include a 230-MB hard drive and a #9 GXE VL video card but no monitor. The Blue Lightning 66 is IBM Technology Products' (Somers, NY) processor subsystem. IBM expects to start sampling a clock-tripled 33-/100-MHz computer in this quarter.

A number of company names (i.e., Merisel, SCI Systems, Acer, and Wearnes Technology) are mentioned in the same breath as Ambra, the new IBM subsidiary that will sell lower-than-low-end PCs. Ambra president David Middleton says that the new division hopes to capture at least 10 percent of what he says is a $10 billion market of people who prefer to buy their PCs by phone.

However, the companies listed above will contribute as much to the manufacturing, distribution, and support of Ambra's PCs as IBM will. For example, SCI will build Ambra's motherboards, Acer is providing systems development and subsystems technologies, and Merisel is handling the order taking. With IBM playing a less dominant role than ever before, analysts say one question that users will inevitably ask is: Can Ambra maintain the quality they expect of IBM systems?

Rival Compaq boasts in-house manufacturing across its product line. Dell says it has brought all its manufacturing in-house, giving Compaq one less point of contrast, and Gateway 2000 has brought in all its desktop manufacturing as well. Necessity or good marketing? "There's no reason why you should have lousy quality whether you outsource or not," says David Wu, analyst for market research firm S. G. Warburg in New York City. The key, he adds, is how well products are tested.

What remains to be seen is the effect Ambra will have on the competition, billed "a tough call" by Infocorp analyst Scott Miller. Also open is how Ambra sales might dip into those of IBM's own ValuePoint, particularly in a mail-order channel that generates 10 percent of that line's sales—a sizable portion considering the profit margins of low-end systems. "It almost seems like the company is duplicating effort," says Miller. "You have two direct-response organizations. How do you retool that?"

The biggest wait-and-see, however, is Ambra's business model, the virtual corporation, which shows a major company outsourcing perhaps more than the industry has ever before seen to beat lowball clone makers at their own game. "It certainly is a new way to do business," says Miller. "If a company like IBM can be successful at this, it raises the questions: 'Do I really need to be in the manufacturing business? Does it make more sense to spend my resources doing other things?'"

—Ed Perratore

Ambra Computer Corp., Raleigh, NC, (800) 252-6272.

EMBEDDED PROCESSORS

PowerPC Goes Underground

IBM Technology Products plans to begin volume shipments in mid-1994 of a line of embedded processors that are based on the PowerPC architecture and designed for applications like printer and I/O control, PDAs (Personal Digital Assistants), and consumer electronics devices. Designated the PowerPC 400 family, to differentiate it from the PowerPC 600 family under development by IBM and Motorola for general-purpose computing platforms, the processors in the 400 family will be made available in chip form, on board-level controllers, and as ASIC (application-specific IC) cores.

The last variation is particularly interesting because it lets manufacturers add custom control circuitry to the same chip containing a PowerPC processor, thereby eliminating the design problems and performance hit you take when you move signals off-chip. The ASIC core is also an important competitive advantage: AMD and Intel don't offer an ASIC core for their first-line embedded architectures, the 29K and 960, respectively.

IBM has not released design details for any member of the PowerPC 400 family, nor even a count of the number of different processors in the family.

In addition to the PowerPC 400 family, IBM announced two important development tools for the PowerPC. The first is OS/Open, a real-time operating system that includes a development environment for embedded systems. OS/Open will be available in December for $19,500. The second development tool is RiscWatch-601, an expansion card for IBM RS/6000 workstations that contains a PowerPC 601 processor. RiscWatch-601 is a complete development environment for the 601. It will be available in December for $22,500.

With its announcement of the PowerPC 400 family, IBM takes a giant step forward into the merchant chip market. By leveraging its internal experience in creating microprocessor-based controllers and its design experience with the PowerPC 600 family, IBM intends to create a line of embedded processors and controllers that will span both low-cost (greater than $10) and high-performance applications.

—Bob Ryan

Catch the latest news.

This just in. Applications Manager, best known as *AM*,™ has just added OS/2® 2.1 support. We repeat, the flagship client/server application development software from Intelligent Environments is now available for OS/2 2.1 environments.

For the latest-breaking developments, we take you to corporate America, where *AM* and OS/2 offer a tried and tested mechanism for building 32-bit, multitasking, line-of-business client/server applications. *AM*'s visual programming environment streamlines the development and maintenance of mission-critical client/server applications by teams of programmers. And Static SQL support makes *AM* a real headliner.

This recent news is becoming quite a feature story. By interfacing with MMPM/2, included with OS/2 2.1, *AM* lets programmers employ innovative team development capabilities like dynamically linked programming—simplifying reuse and maintenance of program code. DDE support allows programmers to paste information, including *AM* code, comments and *AM*-generated documentation, into Windows™ 3.1 applications easily. And there's also quicker screen interaction and improved productivity through support for OS/2's new high-performance 32-bit graphics engine.

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Don't wait. Put one of our Image™ Series 486 PCs on your desk immediately. You'll get Windows performance that really screams.

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NEC pioneered local bus video technology to speed up graphics-based applications like Windows. Today, as other makers develop first-generation local bus video, we offer advanced, second-generation technology.

Making it fast. Our ingenious Image Video™ technology combines second-generation local bus video with a powerful graphics accelerator, so even the most complex, most demanding graphics applications run full blast. And with our True Color support for over 16.8 million colors and photo-realistic images, those applications will have the impact of a speeding freight train. The bottom line: Your productivity takes a fast turn skyward. Our new Image PCs are built for easy, 238-pin ZIF-socket upgrades to the next generation of Pentium-based Intel OverDrive™ processors. We've also given them an on-board SCSI II interface, for quick connections to a wide range of peripherals.

But wait: it gets even better. In addition, NEC's OptiBus™ technology can make those peripherals perform up to 30% faster than ordinary systems. While our ImageSync™ feature delivers flawless, flicker-free images with no adjusting when used with one of our award-winning MultiSync® FG™ monitors.

The NEC Image Series. Just part of a whole family of great personal computers, from our affordable PowerMate® PCs, to our expandable Express™ servers. So (why wait?), call 1-800-NEC-INFO or NEC FastFacts™ at 1-800-366-0476, request document 46243.

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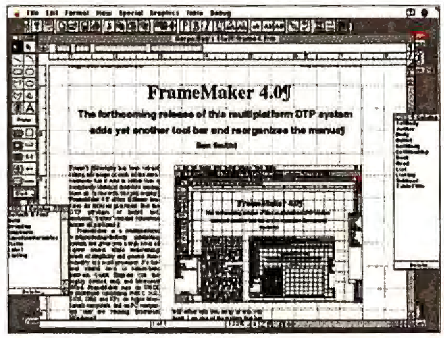
DESKTOP PUBLISHING

Frame Puts on a New Face



FrameMaker 4's new organization of menus takes time to get used to, but it's a valuable improvement.

In a major rollout planned for mid-September, Frame will have released simultaneously its new FrameMaker 4 for Sun Microsystems and Hewlett-Packard Unix workstations, the Mac, and PCs running Windows. Frame ((408) 433-3311) reasons that by releasing all these versions at the same time, its customers—typically corporations, government agencies, and schools who want to share complex documents over different operating systems—can upgrade their platforms simultaneously.

Many of the new features in FrameMaker 4 will be common to all the versions. Other features (e.g., support for Publish/Subscribe on the Mac and new document-import filters on the Windows version) are unique to a certain version. The main thing that remains consistent across all the platforms is the desktop publishing model of linked and anchored "frames."

FrameMaker 4's most important improvements are common to all systems: a better organization of functions and menus, context-sensitive help, paragraph format design by example or by specification, and new capabilities that make it easier to format pages and paragraphs and use fonts. For example, when you change a master document, the program immediately applies those changes, instead of requiring you to go through the extra step of applying the changes.

Even though the drawing tools remain limited when compared to full-featured drawing programs like Aldus FreeHand and Illustrator, FrameMaker 4 supports more image and graphics import functions with greater control. One particularly nice new feature is a built-in international thesaurus.

FrameMaker gives you a high level of layout control while maintaining much of the simplicity and general functionality of a word processor. Its format control level is somewhere between QuarkXPress (on the highly detailed end) and Microsoft Word. The frame concept will either turn you away or win your heart. I am one of those who has been won over by FrameMaker. I evaluated version 4.0 on a Mac Quadra, but I use FrameMaker as my primary writing tool both at home (on a Mac IIci) and at BYTE (on a Silicon Graphics Indigo). FrameMaker is as easy to write with as a word processor but is actually a desktop publishing program. Thus, I can actually see how my text will look in the pages of BYTE as I write it.

—Ben Smith

FRAMEMAKER 4 HIGHLIGHTS

ALL VERSIONS

- Creates automatic hypertext links (clicking on a page number in the table of contents brings you to that page)
- Supports RGB, HLS, CMYK, and Pantone color models
- Document comparison
- Customizes menus in three ways
- Equation editor good for math-intensive documents
- Rotates text and graphics in 0.001-degree increments
- Side heads now supported

MAC VERSION

- QuickAccess toolbar lets you easily access commands
- Support for QuickTime, Apple Events, and Publish/Subscribe
- Thumbnail preview of documents and images
- Ungroups imported PICT images for further editing

WINDOWS VERSION

- QuickAccess toolbar
- Can import CorelDraw and GEM graphics files
- More document-importing filters

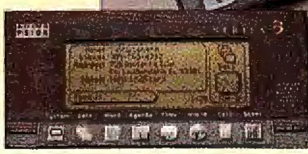
UNIX VERSIONS

- Import and export text through the XClipboard utility
- HP VUE and OpenWindows support for drag-and-drop and double-click file launching

PSION'S NEW POCKET COMPUTER IS TWICE AS NICE

PSION HAS TAKEN THE BEST features of its Series 3 pocket computer (e.g., a multitasking operating system, long battery life, and diminutive size) and improved upon them by doubling the screen, internal system RAM (now 512 KB), and the speed at which its processor runs (now 7.7 MHz).

Because Psion redesigned its applications to take advantage of the new system's improved graphics capabilities, it has also increased the internal application ROM to 1 MB. The Series 3a also lets you record reminders and other brief voice messages for later replay through its built-in microphone. The result is an improved version of a very capable computer that easily slips into your pocket. The Series 3a will sell for about $499.



Instead of the Series 3's screen that displays 40 columns and nine rows (middle photo), the Series 3a (bottom and top photos) offers an 80-column, 18-row display.

The bigger screen lets you view more information in the built-in spreadsheet, word processing, database, scheduling, and other applications. Even better is the zoom function that lets you enlarge type from 6 points to 14 points in all the programs.

Due to its keyboard, the Series 3a remains, like the Series 3, a pocket computer more suited to managing appointments and contacts than a system for heavy-duty text input. But the Series 3a represents a nice improvement to a product that Psion says has already passed the million mark in unit sales internationally.

—Dave Andrews

Psion, Inc., Concord, MA, (508) 371-0310; fax (508) 371-9611.

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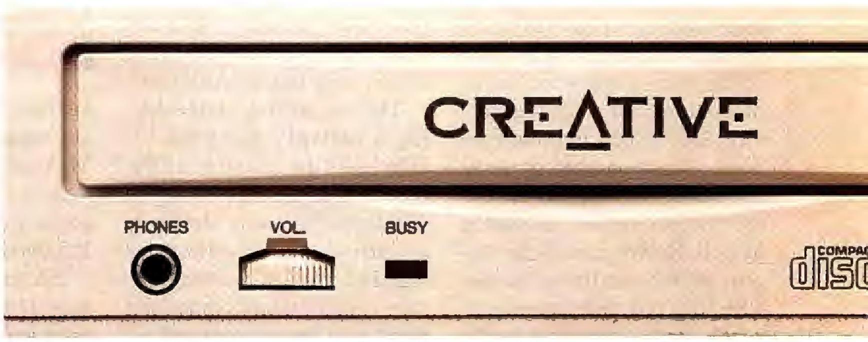

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SAEED VAHID

Moving Forward—Cautiously

At the climax of the Islamic revolution 14 years ago, the ruling government generally regarded computers as luxury equipment that offered little benefit to a country in which almost 40 percent of the population was employed in the agrarian sector. Before the revolution and the overthrow of the Shah of Iran, mainframe and minicomputers were mostly used by large organizations. But Iranians in all sectors of business now recognize the benefits of computerization.

When western countries applied economic sanctions to Iran after the U.S. embassy was seized, buyers of cast-off mainframes in Iran lacked support in the area of software, documentation, and after-sale service. Due in part to these economic sanctions and political upheaval, Iran lagged behind the microcomputer revolution as well. However, with the August 1988 cease-fire in the war with Iraq and the adaptation of a free-market economy by the new government, Iran is trying to keep pace with the world.

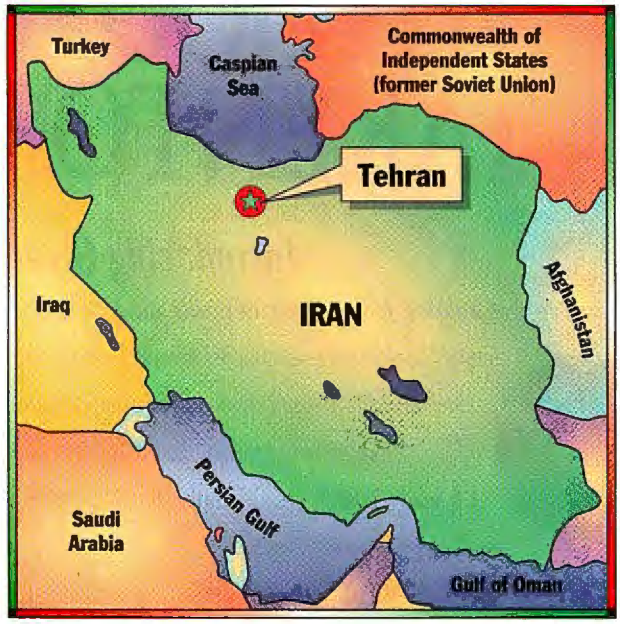
The U.S. government prohibits U.S. companies from exporting computers with a rating of more than 6 MTOPS (million theoretical operations per second) to Iran. Iranian buyers can nevertheless purchase such equipment from companies like Tatung that are headquartered in East Asia, as well as through European channels. Lower powered 386-based PCs are also available through resellers for U.S.-based companies. Although the majority of PCs in use come from East Asian countries, firms like Dell, ALR, NCR, and IBM now have resellers in Iran. Companies in Iran have also been able to obtain Mac Quadras and R4000-based workstations.

Iran's own indigenous computer industry has suffered to some extent due to changing policies. For example, in the early 1980s, a group of Iranian engineers at a company called Pooya began to build a natively designed minicomputer, as well as write the system's own operating system. However, just as they finished the system, the state ban on importing PCs was lifted, and it was no longer economically justifiable to manufacture the expensive minicomputer. Pooya now offers Samsung's PCs and ICL's DRS-6000 RISC machines to its Iranian customers.

The last attempt at developing a natively designed PC failed with the rollout of a Z80-based PC to a market in which 286-based PCs were already in extensive use. Despite these failed attempts at creating a native system, many companies remain in the business of assembling components and making quality clone computers.

As in a number of countries, the internationalization of English-language software poses a unique set of challenges to software developers in Iran. Five Persian character sets exist in the market, each one introduced by a different company for use in its own software.

About 90 percent of the microcomputers in Iran run Microsoft's MS-DOS. A Tehran-based software company called Computer Software, working in collaboration with Microsoft, has begun a project to add Persian language capabilities to the popular operating system. A beta version of Persian DOS has been released, but it has not yet been formally announced. Microsoft is also developing a version of Windows that is capable of handling the right-to-left Persian script.



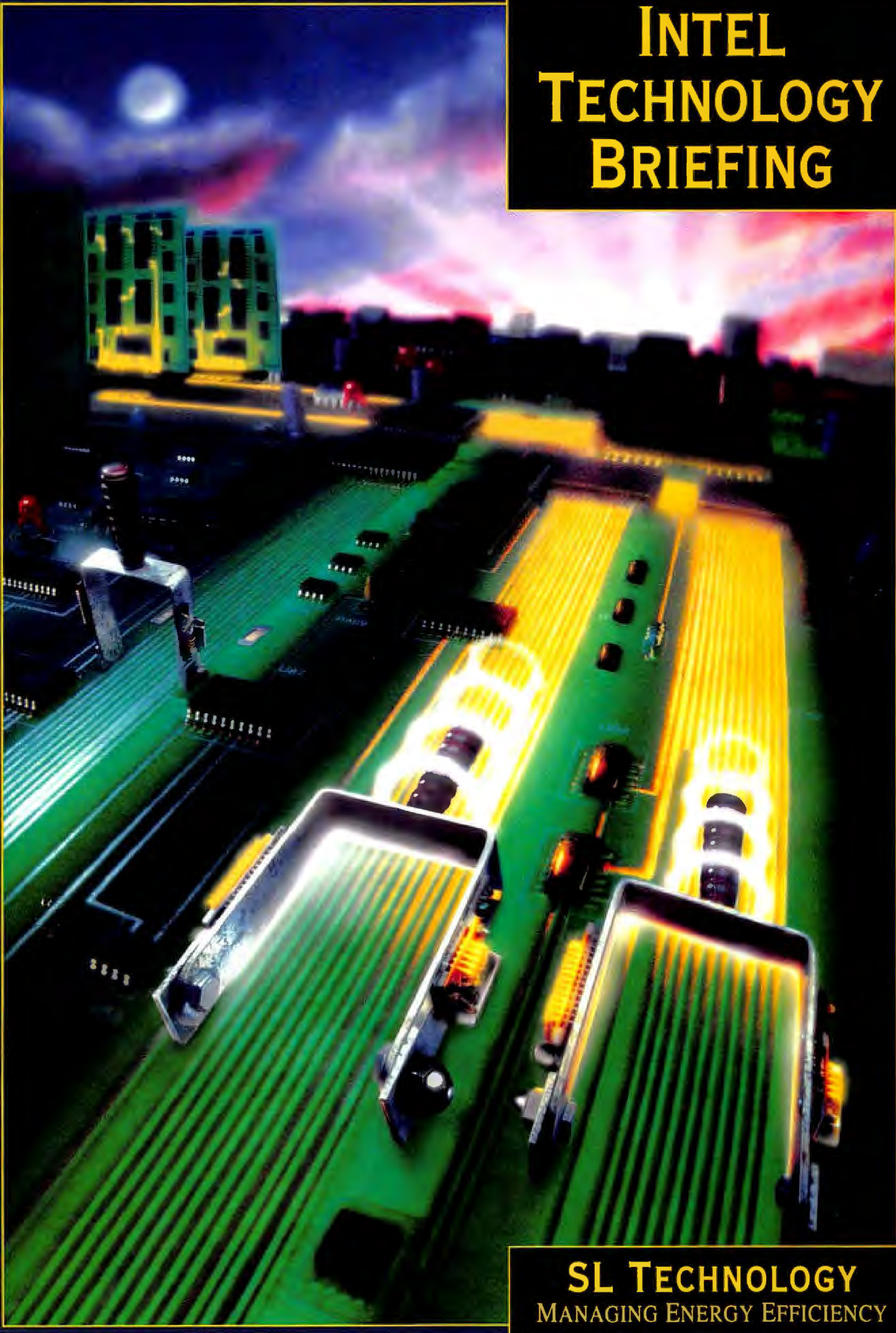
MANUEL KING © 1993

Despite a slow initial start and the lack of a standard Persian character set, the Iranian computer market is growing steadily.

Because none of the companies developing Persian software in Iran are strong enough to influence the other software companies, each of their proprietary Persian character sets will continue to be used in parallel. Perhaps Microsoft's Persian DOS will be a powerful enough force in the market to make the DOS character set the dominant one. But if software companies continue to introduce proprietary products and the government continues to implement confusing policies, the dominant characteristic of Iranian computing may be one of chaos. ■

Saeed Vahid is a freelance technical writer based in Tehran. You can reach him on BIX c/o "editors" or on the Internet at isi@irearn.bitnet.

INTEL TECHNOLOGY BRIEFING



SL TECHNOLOGY
MANAGING ENERGY EFFICIENCY

HOW WE'RE SWITCHING TO ENERGY SAVINGS.

Now notebooks can deliver Intel486™ DX2 processor performance without compromising battery power. And desktop PCs can save energy by automatically shutting down the entire system when not in use. In this fourth Intel Technology Briefing, we'll show you how these capabilities are possible with Intel's SL Technology.

SL Microprocessor Technology was originally developed for mobile computers to provide a reliable technique for conserving battery power. This technology has now been integrated into Intel's entire i486™ microprocessor family.

Today's desktop systems are being designed to utilize the same technology. These new desktop systems reduce energy consumption, saving on annual electricity costs. Energy efficient systems based on SL Technology will also easily meet the Environmental Protection Agency's new Energy Star program guidelines (see back page).

Simply put, the SL Enhanced Intel486 processor family brings a new level of performance and functionality to today's computers.

PC NOTEBOOK

FOR NOTEBOOK USERS, ENERGY EFFICIENT FEATURES ARE CRITICAL BECAUSE EVERY MILLIWATT OF POWER SAVED EXTENDS BATTERY LIFE. NOTEBOOK USERS ALSO DEMAND DESKTOP PERFORMANCE. TO ACCOMPLISH THIS, INTEL HAS NOW INCORPORATED SPECIAL POWER MANAGEMENT FEATURES INTO ITS LINE OF PROCESSORS:

- SYSTEM MANAGEMENT MODE (SMM)— EXPLANATION AT RIGHT.
- STATIC TECHNOLOGY—ALL SL ENHANCED i486 PROCESSORS ARE DESIGNED TO BE STATIC. THIS ENABLES THE PROCESSOR CLOCK TO BE STOPPED AND STARTED WHILE RETAINING THE STATE OF THE MICROPROCESSOR AND SYSTEM.
- PROCESSOR CLOCK CONTROL— THE POWER MANAGEMENT LOGIC TAKES ADVANTAGE OF STATIC TECHNOLOGY BY PUTTING THE PROCESSOR INTO A LOW-POWER STANDBY STATE. IT DOES THIS VIA THE *STPCLK* PIN ON THE PROCESSOR. OPERATING SYSTEMS AND APPLICATIONS CAN ALSO CONTROL THE PROCESSOR CLOCK THROUGH A *HALT* INSTRUCTION.
- 3.3 VOLTS—THE SL ENHANCED i486 PROCESSOR CAN BE DRIVEN BY 3.3 VOLTS. THIS TRANSLATES TO A 60% POWER SAVINGS OVER PROCESSORS OPERATING AT 5 VOLTS.

ENERG

1. THE POWER MANAGEMENT LOGIC MONITORS THE SYSTEM LOOKING FOR INACTIVE PERIPHERAL DEVICES.
2. WHEN AN INACTIVE DEVICE IS LOCATED, THE POWER MANAGEMENT LOGIC GENERATES A SYSTEM MANAGEMENT INTERRUPT (SMI) AND SENDS IT TO THE MICROPROCESSOR.
3. UPON RECEIPT OF SMI, THE PROCESSOR SWITCHES FROM REAL, PROTECTED OR VIRTUAL MODE TO SMM.
4. SMM TAKES A "SNAPSHOT" OF THE SYSTEM, REMEMBERING THE PERIPHERAL SETTINGS, AND STORES THE INFORMATION IN A DEDICATED SEGMENT OF MEMORY CALLED

ADVANCED POWER MANAGEMENT

JOINTLY DEVELOPED BY INTEL AND MICROSOFT, ADVANCED POWER MANAGEMENT (APM) SOFTWARE DRIVERS COMPLEMENT THE HARDWARE POWER MANAGEMENT LOGIC. THIS SOFTWARE RESIDES IN THE OPERATING SYSTEM. BASED ON THE APPLICATION'S ACTIVITIES, APM PASSES INFORMATION TO THE POWER MANAGEMENT LOGIC ALLOWING POWER LEVELS TO BE FINE TUNED. APM ENHANCES HARDWARE-BASED POWER MANAGEMENT.

Y EFFICIENT DESIGN

HOW INTEL'S POWER MANAGEMENT WORKS

SMM

SYSTEM MANAGEMENT MODE IS A NEW OPERATING MODE FOUND IN ALL SL ENHANCED INTEL486™ PROCESSORS AND PENTIUM™ PROCESSORS. IT REDUCES ENERGY CONSUMPTION BY AUTOMATICALLY TURNING OFF PERIPHERALS, OR THE ENTIRE SYSTEM, WHEN NOT IN USE. SMM ENSURES SOFTWARE COMPATIBILITY IN ENERGY EFFICIENT DESIGNS. PLUS, SMM HAS A UNIQUE BULLET-PROOF POWER MANAGEMENT FEATURE—I/O INSTRUCTION RESTART—THAT ENSURES CODE SENT TO A TURNED OFF DEVICE WILL NEVER BE LOST.

SMRAM. THIS PROTECTED AREA CANNOT BE ACCESSED BY EITHER THE OPERATING SYSTEM OR APPLICATIONS ENSURING PROTECTION.

5. PROCESSOR EXECUTES POWER MANAGEMENT CODE FROM ROM BIOS TO TURN OFF THE PERIPHERAL DEVICES OR SYSTEM. THEN, A SPECIAL SMM INSTRUCTION, *RESUME*, IS EXECUTED TO RESTORE THE PROCESSOR TO ITS PREVIOUS MODE.

- TO TURN ON THE DEVICE, THIS SEQUENCE OF EVENTS IS REPEATED. THE ENTIRE PROCEDURE IS VIRTUALLY INSTANTANEOUS, SO PERFORMANCE IS NEVER COMPROMISED.

PC DESKTOP

MANY DESKTOP PC USERS NEVER TURN THEIR COMPUTERS OFF BECAUSE OF DELAYS IN RELOADING THEIR OPERATING SYSTEM OR APPLICATIONS. AN ENERGY EFFICIENT DESKTOP PC COMBATS SUCH ENERGY WASTE BY USING SYSTEM MANAGEMENT MODE (SMM), STATIC TECHNOLOGY, AND PROCESSOR CLOCK CONTROL TO CONSERVE ENERGY.

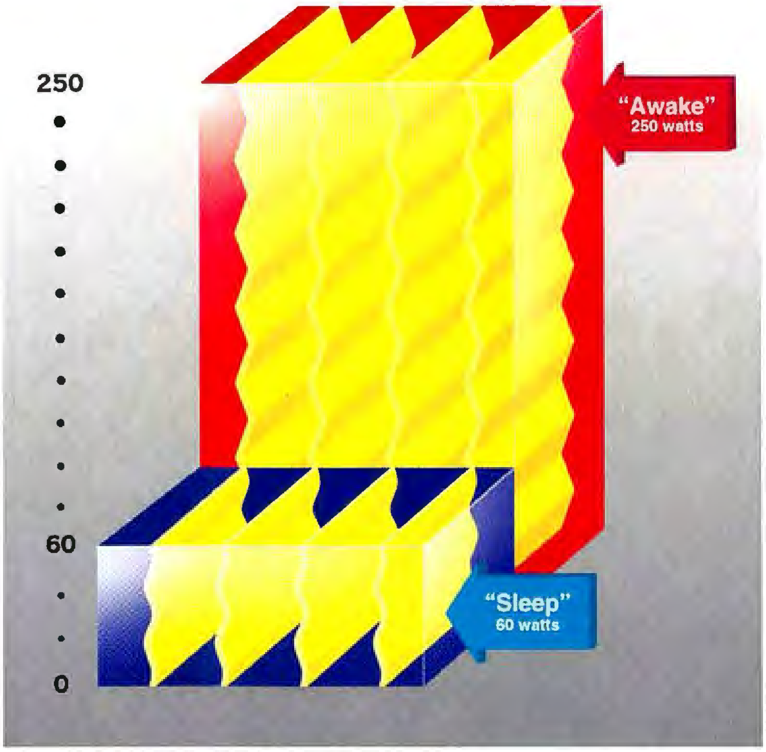
- DURING PERIODS OF SYSTEM INACTIVITY, SMM AUTOMATICALLY INITIATES A "SLEEP" MODE, REDUCING BOTH SYSTEM AND MONITOR POWER FROM UP TO 250 WATTS TO LESS THAN 30 WATTS EACH.
- SMM CAN DECREASE POWER CONSUMPTION WHILE THE SYSTEM IS IN USE BY TURNING OFF INACTIVE PERIPHERALS, LIKE FAX CARDS, MODEMS AND DISK DRIVES—ALL WITHOUT COMPROMISING SYSTEM PERFORMANCE.
- USING ENERGY EFFICIENT FEATURES, 1500 KW HOURS PER SYSTEM CAN BE SAVED PER YEAR. THAT'S THE EQUIVALENT OF UP TO $120 PER YEAR IN ELECTRIC COSTS FOR U.S. USERS, OR UP TO $360 PER YEAR FOR EUROPEAN USERS.

WHY IS ENERGY EFFICIENCY IMPORTANT TO THE DESKTOP?

THE U.S. ENVIRONMENTAL PROTECTION AGENCY ESTIMATES COMPUTERS TODAY ACCOUNT FOR ROUGHLY 5% OF ALL COMMERCIAL ENERGY USE, AND BY THE YEAR 2000 THIS WILL LIKELY DOUBLE TO 10%. STUDIES ALSO SHOW MUCH OF THIS ENERGY CONSUMPTION IS WASTED; 30 TO 40% OF ALL DESKTOP COMPUTERS IN THE U.S. ARE LEFT ON OVERNIGHT.

SL TECHNOLOGY POWER SAVINGS

INTEL HAS WORKED CLOSELY WITH THE ENVIRONMENTAL PROTECTION AGENCY ON THE ENERGY STAR PROGRAM. THIS PROGRAM SETS GUIDELINES TO REDUCE POWER CONSUMPTION BY INACTIVE COMPUTERS AND MONITORS FROM UP TO 250 WATTS COMBINED TO LESS THAN 30 WATTS EACH. THIS CHART SHOWS THAT SYSTEMS DESIGNED WITH AN SL ENHANCED i486® PROCESSOR FALL WITHIN THE ENERGY STAR PROGRAM GUIDELINES.



THE REST OF THE SL TECHNOLOGY STORY.

Soon, SL Enhanced Intel486™ processor-based systems will incorporate an even wider array of capabilities to help desktop PC users reduce energy consumption. For example, each computer will have a built-in "alarm" that utilizes the Intel486 processor's System Management Mode to automatically turn on a user's computer each morning and then turn it off, if inactive, at a pre-set time in the evening.

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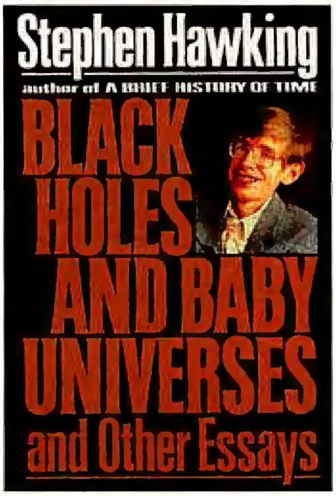
Hawking Returns



HUGHES PACK

Stephen Hawking's *Black Holes and Baby Universes and Other Essays* is a collection spanning 16 years of fascinating scientific thought. Cleanly written, it lets you examine the progress of Hawking's work and study from 1976 to the present day. Hawking describes this book as writings ranging from "autobiographical sketches through the philosophy of science to attempts to explain the excitement I feel about science and the universe." No small subjects here.

The first portion of the book is devoted to personal glimpses into Hawking's life and attitudes in essays titled "Childhood," "Oxford and Cambridge," "My Experience with ALS," and "A Brief History of *A Brief History*." Readers who are not among the elite Hawking fans will enjoy learning more about this person many are calling "the most brilliant theoretical physicist since Einstein." After this insight into his personal history, Hawking delves into a discussion of a "theory of everything." He then proceeds to take potshots at philosophers of science, labeling many of them "failed physicists."

Physicists, astronomers, and cosmologists who don't live in a cave will not find any new physics in the more technical essays, but they may find a new way to understand physics. Hawking acknowledges in the preface that "there is inevitably a certain amount of repetition" among this collection of essays. Despite the repetition, the presentations are not identical, and each is phrased slightly differently. These differences can be extremely valuable to those who seek a more concrete grasp of highly abstract concepts. Each presentation can serve to patch a small hole in the wall of understanding, and as these holes are filled, one's knowledge ends up on a more solid foundation.

One recurring topic, the uncertainty principle, appears in "Is the End in Sight for Particle Physics?" to explain the lack of radiation from an accelerating electron in the ground state of an atom. "Is the End in Sight" is actually a reprint of Hawking's essay given when he was inaugurated as Lucasian Professor of Mathematics at Cambridge in 1980. The uncertainty principle reappears in "The Quantum Mechanics of Black Holes," when Hawking finally gives in to the realization that black holes can indeed emit particles.

In the essay "Black Holes and Baby Universes," the uncertainty principle is used again to deal with the emission of particles from black holes, but this time we get into a little-known science fact of faster-than-light travel. Does this mean *Star Trek* has it right? No, it simply means that many seemingly strange things aren't that strange after all, especially when brilliant minds work the laws of physics.

The reader must keep in mind that these are short essays, and most of the topics covered in the scientific essays are covered much more thoroughly in Hawkings' previous book, *A Brief History of Time*. For those who have not read the earlier work, this winning collection of essays will very likely provide the stimulus to go on. ■

Hughes Pack is the Theodore R. Carpenter faculty fellow in science at Northfield Mount Hermon School in Northfield, Massachusetts. He is involved with the Hands-On Universe Project, which is attempting to bring astronomical image processing into the high school classroom via personal computers. You can reach him on BIX c/o "editors."

BLACK HOLES AND BABY UNIVERSES AND OTHER ESSAYS

Stephen Hawking,
Bantam Books
ISBN 0-553-09523-4

$21.95

MULTIMEDIA BEATLES

A HARD DAY'S NIGHT

The Voyager Co., 1351 Pacific Coast Hwy., Santa Monica, CA 90401, (310) 451-1383, $39.95

The Voyager Co. has garnered a reputation for its innovative approaches in transferring books to electronic media. Its latest CD-ROM, the Beatles' *A Hard Day's Night*, breaks new ground by proving how effective this technology is with a movie. This CD-ROM contains the Fab Four's entire 1964 film of the same name—all 90 minutes of it—as a QuickTime movie. You can view, stop, or pause the black-and-white movie's action and sound in a 160- by 120-pixel screen from within a HyperCard stack. A button lets you expand the movie to a 320- by 240-pixel screen, but the image becomes grainy—enough so that my test subjects switched to the smaller window. A pop-up menu lets you jump to different spots within the movie, similar to the chapter feature on laserdisc players.

Also included in the HyperCard stack is an essay by Bruce Eder, as well as the movie's original script. The script's text can be displayed beside the QuickTime window, and it stays in sync with the movie's action with hardly a glitch. Bracketed text indicates lines or scenes that were never used, while text in parentheses indicates improvised dialogues. The script supplies a fascinating glimpse of the creative process involving the Beatles and Richard Lester, the movie's director.

Today, Lester's nearly 30-year-old visual montages and stop-frame trickery seem remarkably prescient of MTV. *A Hard Day's Night*, the CD-ROM movie, shows how far CD-ROM has come and where it will go.

—Tom Thompson

IMAGE FROM A HARD DAY'S NIGHT CD-ROM

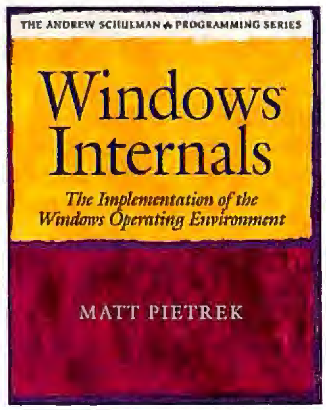
Books & CD-ROMs

WINDOWS DISSECTED

WINDOWS INTERNALS by Matt Pietrek Addison-Wesley,
ISBN 0-201-62217-3, $29.95

When I run Windows from a DOS prompt, I type WIN, and in a few seconds, the Windows user interface appears. I had a pretty good idea of what happens in between, but I was never quite sure. *Windows Internals* solved that mystery for me. From the moment I opened this book, I was transformed from a mere programmer to a Windows systems designer. It explains every aspect of Windows, including start-up and shutdown, memory management, program loading, the windowing system, the GDI (Graphical Device Interface), the scheduler, messaging, and dynamic linking. Each component is examined in great detail with the aid of C p-code.

Reading the first chapter was a real education for me, as it explains how the system goes from a simple DOS-based configuration to a complex multitasker while still relying on DOS. Each sentence is like tracing into a line of code, and this chapter provides a step-by-step process of explaining exactly how Windows works.



I was pleased to see that, unlike similar books, *Windows Internals* does not contain a discussion of basic programming fundamentals such as protect mode and selectors. It assumes that you are already familiar with them. Beginning programmers or readers not familiar with Windows programming should probably start with something more basic before reading this book.

The text is balanced with just the right amount of humor, and the book is surprisingly easy to read for such a highly technical subject. It includes listings for some handy little programs, but don't look for fancy diagrams or pictures—this is hard-core development material. Every experienced Windows programmer should read *Windows Internals* and keep it on the shelf for future reference.

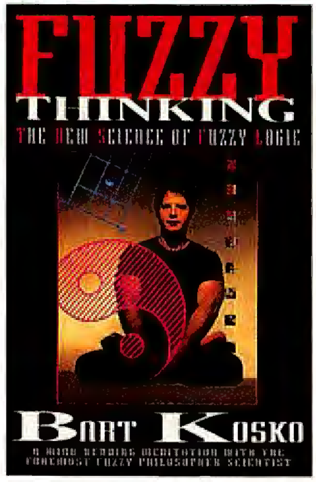
—Steven J. Mastrianni

WARM AND FUZZY LOGIC

FUZZY THINKING: THE NEW SCIENCE OF FUZZY LOGIC by Bart Kosko Hyperion, ISBN 1-56282-839-8, $24.95

Fuzzy logic, more than any recent technical topic, is in dire need of a marketing overhaul to make it more understandable to a wider audience. Bart Kosko's *Fuzzy Thinking: The New Science of Fuzzy Logic* is not the required solution. Although I found the book stimulating, provocative, informative, and thought-provoking, it does a much better job of explaining the philosophy of fuzzy logic to the believer than to the skeptic.

Although Kosko's scientific arguments and explanations are



stellar, he discounts his credibility by glibly assuming that everyone raised under a Western philosophy is fundamentally unable to deal with "the Tao of fuzzy," while those raised in a predominantly Eastern culture will take to it naturally. An insult to both cultures. Kosko is at his best when he tells how certain mathematical principles can be applied to make smart decisions in smart products, such as a washing machine that knows for each load how much soap to use and how hot the water needs to be.

Kosko believes that the slow acceptance of fuzzy-logic design techniques in the U.S. as compared to the rapidly increasing practical usage of the technology in Japan is directly related to deep-seated cultural differences. Western culture and science have long been based on truth. Statements are true or false. An item is or it isn't. Computer bits are on or off. Rarely (even in the depths of political debate) is there a middle ground, a degree of truth, a concept of *almost*. Eastern philosophy is more accepting of shades of gray—degrees of truth, existence, and reality.

In recent years, the bivalent Western world view has started to shift. We now describe the world in terms of fractals and chaos theory—neither of which have well-defined borders. Our view of the world has become more accepting of imprecision. Fuzzy logic is simply another method of coping with this increasingly complex world view. *Fuzzy Thinking* ranges from philosophy through hard science to metaphysical futures. The book is not an introduction to fuzzy logic, the science. Rather, it is an introduction to fuzzy logic, the mind-set.

I thoroughly enjoyed *Fuzzy Thinking* and the ideas it has generated. Linking fuzzy logic with Eastern philosophy, however, will do little to convince the advocates of "hard" facts that it is a solution who's time has come.

—Raymond GA Côté

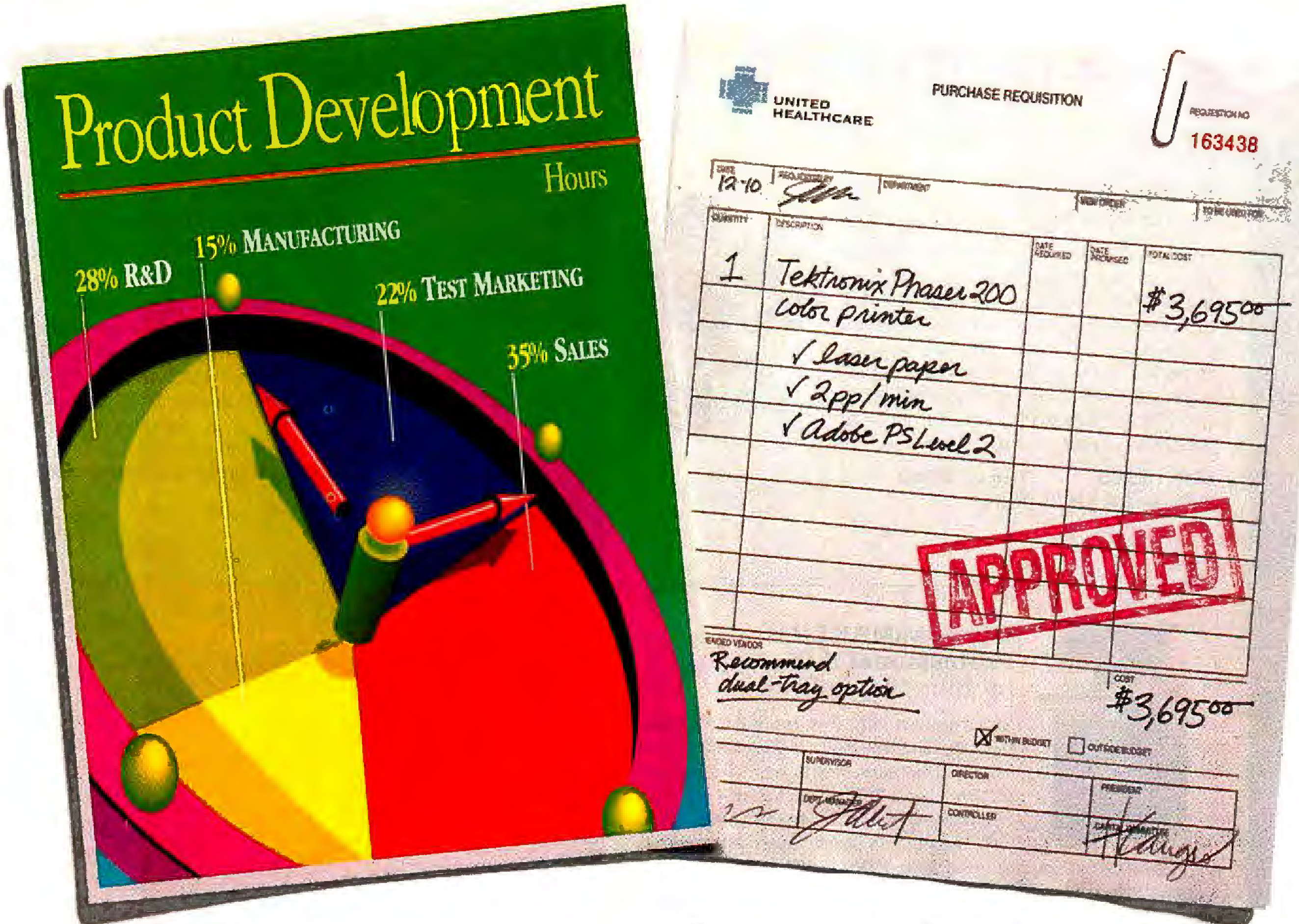
POWERBOOK BY THE BOOK

THE POWERBOOK COMPANION, 2d ed., by Richard Wolfson and Sharon Zardetto Aker **Addison-Wesley, ISBN 0-201-62621-7, $24.95**

For those MacFolk who never leave home without their PowerBooks, *The PowerBook Companion* should be packed along with the computer. It provides a technical overview of the PowerBook line (remarkably, it was up to date on the PowerBook 165c and 180c), with numerous tips on paring down the essential operating system (to conserve disk space) and extending battery life. If your PowerBook mysteriously conks out, the step-by-step troubleshooting chapter can be a lifesaver.

Based on my own travel experiences, the advice for connecting to a variety of telephones with or without RJ-11 jacks is right on. Highly recommended. ■

—Tom Thompson



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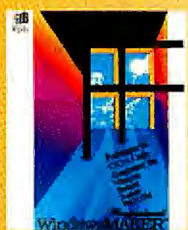

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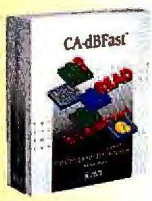

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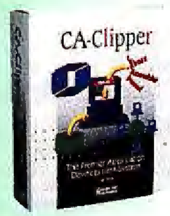

Yes, the newly released CA-Clipper version 5.2 is being offered to Xbase language product owners at the low retail price of $199. This competitive upgrade is available for a short time only! What a great opportunity to get the power of CA-Clipper, at a super price! And now when you buy, get your choice of dBFast, Clipper Tools or dBASE Compiler Kit—*FREE* from CA when you register!

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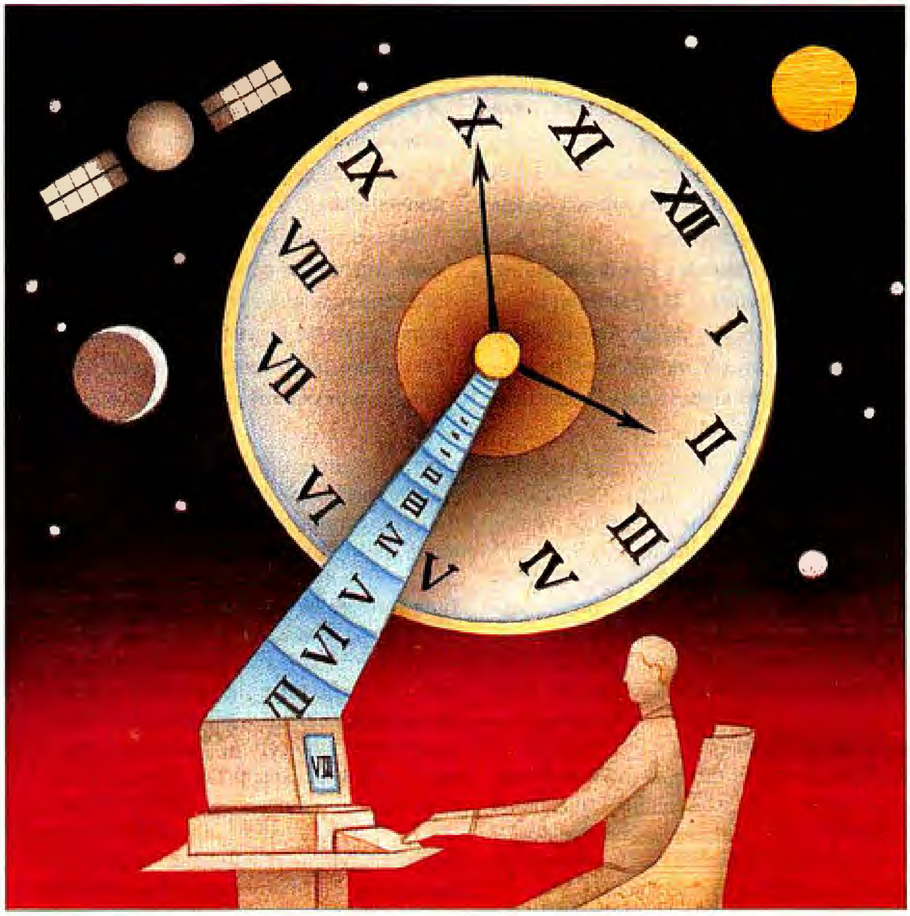
Keeping Time on Your PC



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MICHAEL A. LOMBARDI

If you've ever relied on your computer's clock for timekeeping, you know that it's not particularly accurate. Most people aren't concerned if their computer's clock is off by a few seconds (or even minutes, or hours) so long as they can tell when a file was last revised. However, many applications, such as manufacturing process control, synchronous communications, and financial recordkeeping, require timekeeping that's accurate to the nearest second or better.

How can you make your computer keep accurate time? The answer lies in setting your clock to a reliable time source and then frequently polling that source for time updates and resetting your clock as often as necessary.

Accurate time information is easy to get through your modem or a network time service. You can also "keep time all the time" using a radio clock or a precision real-time clock board to capture accurate time information broadcast by government agencies. Whatever method you choose, you no longer have to be satisfied with your PC's marginal timekeeping abilities.

Your PC's clock was never meant to be an accurate timepiece. But that doesn't mean you can't turn it into one.

Accurate Time by Modem

Since 1988, the National Institute of Standards and Technology, or NIST, a branch of the U.S. Department of Commerce, has operated ACTS (Automated Computer Time Service) out of Boulder, Colorado. Anyone can access ACTS through a modem and simple telecommunications software (see the text box "How to Set Your PC Clock by Modem"). When you connect to ACTS via modem, it sends out a highly accurate and reliable time code that you can use to set your computer clock to the correct time according to NIST's clock.

ACTS is referenced to an atomic clock located at NIST that functions as the U.S. national standard for civilian time and frequency. ACTS provides far more accuracy than your typical PC clock can handle (see the text box "The Clocks Inside Your PC"). It's capable of setting your computer clock to within 1 millisecond of NIST time. The software clock in your PC, however, ticks about once every 55 ms. Thus, you can be assured only that your clock has been set to within 55 ms of the correct time. Even then, your clock won't stay set properly for long. For example, a PC clock that gains 5 seconds per day advances 1 ms every 17 seconds.

You can also set your computer clock to NIST time through the Internet at the following address: time_a.timefreq.bldrdoc.gov (absolute Internet address 132.163.135.130). You can access the server and obtain the software and documentation needed to use the Internet time service. This service is less accurate than the modem service, since it is difficult to estimate network delays. However, it's well suited for keeping your clock set to the nearest second.

continued

The Clocks Inside Your PC

Every DOS-based computer has a built-in software clock. Generally, it's driven by a Motorola 146818 real-time clock chip, Intel 8253/8254 timer-counter chips, or equivalent devices. Your BIOS tells the chip to generate an interrupt every 54.936 milliseconds, or about 18.206 times per second. Another BIOS routine counts the interrupt requests and generates a time-of-day clock that can be read or set by other software. DOS uses the software clock to date- and time-stamp files.

The software clock is a poor timekeeper. Its accuracy is limited by the stability of the interrupt requests. Any change in the interrupt-request rate by, say, an ill-behaved application causes the clock to gain or lose time. Further, the clock's time can drift by a minute or more each day you leave your computer on.

Another problem is that your software clock cannot display all possible time-of-day values. Its resolution is limited to the interval between interrupts. Only times that are even multiples of 54.936 ms can be displayed. For example, your clock cannot display 00:00:01.00; the closest it can get to this is 00:00:00.98 or 00:00:01.04.

Since the 286, PC-type computers have come with battery-backed hardware clocks that are considerably more accurate than software clocks. But these, too, have problems. For example, they cannot display fractions of a second, so they cannot be read or set with any degree of accuracy better than a second.

A hardware clock's accuracy is determined by the quality of its time-base oscillator, which typically is a 32.768-kHz crystal. These crystals are economical, costing less than $1 in single quantities. However, they offer only marginal timekeeping performance, and they are sensitive to temperature changes, voltage fluctuations, and vibrations.

Even under the best conditions, these oscillators are not likely to be stable to better than 1 part per million—about 0.1 second per day. In actual operation, most hardware clocks seem to gain or lose time at a rate of about 1 to 15 seconds per day, with 5 or 6 seconds per day being typical.

ACTS isn't the only source of accurate time accessible by modem. The USNO (U.S. Naval Observatory) operates a computer time service similar to ACTS. USNO time is available via modem at (202) 653-0351 (1200 bps only). Several commercial software packages enable you to call the USNO service, including TimeChecker from Zephyr Services (Pittsburgh, PA).

Time All the Time

A shortcoming of modem services is that you have to make a telephone call (often a toll call) to set your clock. But by using a radio clock, you can get accurate time all the time, without the expense.

Radio clocks are designed to receive and decode time signals broadcast over radio by many national governments. Your applications can use the radio clock to constantly set your computer's clock, or they can get all timing information directly from the radio clock, ignoring your computer's clock entirely.

Radio clocks cost anywhere from as little as under $500 to as much as $5000 or more. Some are stand-alone devices with a digital display, while others are plug-in expansion cards. Stand-alone units connect to your PC, Macintosh, or other computer through RS-232, RS-422, or IEEE-488 interfaces.

All radio clocks provide enough accuracy for PC timekeeping, and most provide greater accuracy than ACTS. However, you need to make sure that the radio signal of the clock you choose can be received in your area. Also, nearly all radio clocks require an outdoor antenna to operate properly, so you'll need to make sure that you can mount the right type of antenna for your radio signal.

Time Through Airwaves

In the U.S., you can set your radio clock to receive broadcasts from at least four different radio time signals, although not all are receivable throughout the country. In Germany, the official time signal from the Physikalisch-Technische Bundesanstalt is broadcast over a long-wave transmitter, DCF 77. The signal is aired from the Frankfurt/Main area and can be received throughout Germany and in a number of neighboring countries.

In the U.S., NIST broadcasts time information over radio stations WWV and WWVH in Colorado and Hawaii, respectively. You can tune in to either station with an ordinary shortwave radio set to 2.5, 5, 10, or 15 MHz. WWV is also aired on 20 MHz.

Under the right conditions, WWV and WWVH can be heard just about anywhere in the world, including the Southern Hemisphere. However, 5, 10, and 15 MHz are allocated for time and frequency stations by international agreement. Consequently, at least 15 other stations broadcast on these frequencies, often blocking out WWV's signals. For example, near India you'd hear the Indian Republic's broadcast, not WWV, on 5 MHz.

When you tune in to a WWV/WWVH broadcast, you hear audio tones that sound like a clock ticking. At the beginning of each minute, a voice announces the current time. WWV and WWVH also broadcast a binary-coded decimal time code on a 100-Hz subcarrier that can be read and decoded only by a radio clock. The time code provides the current hour, minute, second, month, day, year, and other information. The time is accurate to within 1 to 50 ms, depending on your distance from the transmitter and signal-propagation conditions.

Radio clocks designed specifically to receive WWV/WWVH signals, such as those from Odetics (Anaheim, CA), are an economical source for obtaining accurate time. However, they have limitations. One potential shortcoming with using a WWV/WWVH radio clock is that you may need a large outdoor antenna to get good reception.

Another limitation is that, since these stations use shortwave radio signals, reception can be difficult during some parts of the day. As a general rule of thumb, frequencies above 10 MHz work best during daylight hours, while lower frequencies work best at night. Some radio clocks, such as the one from Chrono-Log (Havertown, PA), get around this problem by taking advantage of the fact that WWV and WWVH broadcast on several frequencies. They scan these frequencies and tune in on the one currently providing the best reception.

Other Time Sources

Some radio clocks, such as those from Spectracom (East Rochester, NY) and

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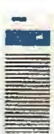

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How to Set Your PC Clock by Modem

You can dial in to ACTS (Automated Computer Time Service) at (303) 494-4774. Set your communications software for 300 or 1200 bps, with 8 data bits, 1 stop bit, and no parity. The 1200-bps time code is transmitted every second (see "The 1200-bps ACTS Time Code"). It contains more data than the 300-bps time code, which is transmitted every 2 seconds.

After you connect with ACTS, it sends you a simple ASCII time code. The last character in the time code is an asterisk (*), which is called the OTM (on-time marker). The time values sent by the time code refer to the arrival time of the OTM. In other words, if the time code says it is 12:45:45, this means it is 12:45:45 when the OTM arrives at your computer.

ACTS assumes telecommunications delays between the time the OTM leaves Colorado and when it arrives at your computer. Consequently, it sends the OTM out 45 milliseconds early. This 45-ms figure represents the sum of the following conditions: 8 ms for transmitting the OTM at 1200 bps, 7 ms to allow for the OTM to travel to the average caller in the U.S., and 30 ms for modem-processing delays.

The 45-ms OTM advancement typically removes most telecommunications delays. Say you are calling ACTS from Chicago, and the actual delay is 50 ms. The OTM then arrives at your computer only 5 ms late, with about 90 percent of the delay already removed.

But if you are making an overseas call or if your call goes through a satellite, the delay can be 300 ms or more. Fortunately, ACTS lets you measure the actual line delay, so you can remove as much of the delay as possible.

To measure your actual delay, your software must return the OTM to ACTS after receiving it. Each time the OTM is echoed back, ACTS measures the actual delay. After four consecutive measurements, ACTS begins advancing the OTM by an amount of time equal to the delay. Thus, if your actual delay is 50.4 ms, ACTS sends out the OTM 50.4 ms early instead of 45 ms early. Once ACTS begins using the measured delay, the OTM changes from an asterisk to a pound sign (#). Now the OTM arrives at your computer within 1 ms of the correct time.

In rare instances, ACTS can't measure the actual delay. For example, if the modem connection goes by satellite (i.e., a long delay) in one direction and by land (i.e., a short delay) in the other direction, the standard 45-ms advancement is used, even if your software returns the OTM.

A number of commercial and shareware software packages are available for calling ACTS. Among them are TimeSet from Life Sciences Software (Stanwood, WA) and Time-Sync from SolaCamp Software (Lutherville, MD).

ACTS uses UTC (Coordinated Universal Time). UTC is a 24-hour clock based on the local time in Greenwich, England. It differs from your local time by an integral number of hours only; the minutes and seconds remain the same.

A call to ACTS takes just seconds (see editor's note). Since the time-setting process is so quick, ACTS limits your on-line time to 56 seconds, or 28 seconds if all incoming lines are in use.

Editor's note: *NIST-developed MS-DOS and QBasic programs for accessing ACTS are available electronically. See page 5 for details.*

The 1200-bps ACTS Time Code

After you connect with ACTS, your screen will display the following information, which is explained below:

JJJJJ YR-MO-DA HH:MM:SS TT L UT1 msADV UTC(NIST) <OTM>

JJJJJ is the MJD (modified Julian date). The MJD is the last five digits of the Julian date, which is simply a count of the number of days since January 1, 4713 B.C. To get the actual Julian date, add 2.4 million to the MJD.

YR-MO-DA is the date. It shows the last two digits of the current year, month, and day.

HH:MM:SS is the time in hours, minutes, and seconds. The time is always sent as UTC. An offset needs to be applied to UTC to obtain local time in the U.S. For example, mountain time in the U.S. is seven hours behind UTC during ST (standard time), and six hours behind UTC during DST (daylight saving time).

TT is a two-digit code (00 to 99) that indicates whether the U.S. is on ST or DST. It also indicates when ST or DST is approaching. This code is set to 00 when ST is in effect, or to 50 when DST is in effect. About 48 days prior to a time change, the code starts counting the days until the change. When ST is in effect, the code counts down from 99 to 51 in the 48 days prior to the time change. When DST is in effect, the code counts down from 49 to 01 in the 48 days prior to the time change.

L is a one-digit code that indicates whether a leap second will be added or subtracted at midnight on the last day of the current month. If the code is 0, no leap second will occur this month. If the code is 1, a positive leap second will be added at the end of the month. This means that the last minute of the month will contain 61 seconds instead of 60. If the code is 2, a second will be deleted on the last day of the month. Leap seconds occur at a rate of about one per year. They are used to correct for irregularity in the earth's rotation.

UT1 is a correction factor for converting UTC to an older form of universal time that is still used in navigation. It is always a number ranging from –0.8 second to +0.8 second. This number is added to UTC to obtain UT1.

msADV is a five-digit code that displays the number of milliseconds that NIST advances the time code. It is originally set to 45 ms. If you return the OTM four consecutive times, it will change to reflect the actual line delay.

The label **UTC(NIST)** is contained in every time code. It indicates that you are receiving UTC from NIST (National Institute of Standards and Technology).

The on-time marker **(OTM)** is a single character sent at the end of each time code. The OTM is first an asterisk (*). It changes to a pound sign (#) if ACTS has successfully measured the line delay.

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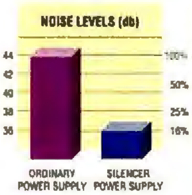

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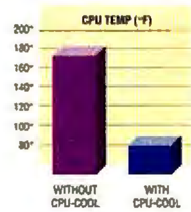

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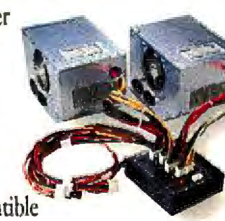

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Circle 123 on Inquiry Card (RESELLERS: 124).

Franklin Instrument (Warminster, PA), receive signals from WWVB, a NIST radio station transmitting from Colorado. WWVB is a low-frequency station, broadcasting on 60 kHz. No voice or other aural announcements are made on WWVB. WWVB broadcasts a time code capable of 0.1-ms accuracy.

The coverage area of WWVB is smaller than that of WWV and WWVH. However, you can receive its signals in nearly all of the contiguous 48 American states with only a small antenna and equipment that's easy to set up and use.

You can also get NIST time from GOES (Geostationary Operational Environmental Satellites), which is operated by the National Oceanic and Atmospheric Administration. GOES broadcasts from two different satellites on a frequency of about 468 MHz. Only a small antenna is necessary to receive the signal in most parts of North and South America. The signal includes a time code accurate to about 0.1 ms. Arbiter Systems (Paso Robles, CA) makes a radio clock that is capable of receiving GOES signals.

The most accurate radio clocks available can tune into signals relayed by the U.S. Department of Defense's GPS (Global Positioning System) satellites. GPS provides worldwide coverage. With the aid of only a small outdoor antenna, a GPS radio clock can receive time accurate to within less than 1 microsecond, which is about 1000 times the accuracy you can get from ACTS.

The price of GPS radio clocks has fallen dramatically over the past few years, to about $1000 from highs of well over $10,000, and their use is becoming widespread as a timing source for both computer and telecommunications networks. Many new GPS products have been released recently, ranging from hand-held navigation receivers to receivers that plug into a PC or AT expansion bus. In fact, a recent survey in the January issue of *GPS World* lists more than 50 manufacturers of GPS receivers, including Odetics and TrueTime (Santa Rosa, CA).

More Stable Clocks

To keep the most accurate time on a PC, you can replace its clock with a precision real-time clock board. These boards, such as those from Bancomm and Guide Technology (both in San Jose, CA), include high-quality time-base oscillators. They also let you use an external oscillator to get superior results. This means that if you have access to a frequency standard, such as a quartz, rubidium, or cesium oscillator, you can use it as your time base by connecting it to your real-time clock board.

Precision clock boards greatly increase the stability of your PC clock, but you still need to set and check on the time using ACTS or another service. But if you use a good oscillator as a time base and your system is undisturbed, these boards will keep the correct time for many years. You may never need to set your PC clock again.

Precision clock boards are expensive, costing from $1000 to $2000. External frequency-standard oscillators can cost thousands of dollars more. But the potential performance of a precision real-time clock is unequaled. If you work in a laboratory or industrial setting where a frequency standard is already available, this may be the ideal method for getting accurate time.

Smarter Clocks

NIST recently invented its Smart Clock technology, the basic premise of which is simple: If a clock knows the rate at which it gains or loses time, it can correct itself. Clocks usually drift at about the same rate from day to day. A microprocessor-controlled Smart Clock, however, automatically corrects your clock's drift based on the clock's past performance. For example, if you call ACTS at the same time each day, you might discover that your PC's clock is always fast by 4 seconds. Using this information, your Smart Clock, working much like a memory-resident program does, would gradually move the time back 4 seconds per day (i.e., ⅙ second every hour).

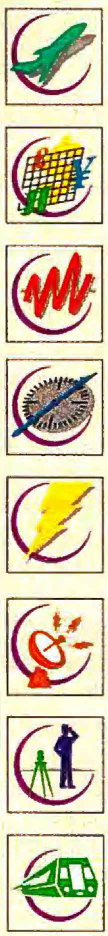
Software that uses concepts similar to those of Smart Clock is starting to appear on the market. For example, RighTime from Air System Technologies (Dallas, TX) is a memory-resident program that automatically adjusts your PC's clock, keeping it on time to within a half-second per week.

Whether you use RighTime's algorithms, your modem, or a precision real-time radio clock board augmented with an external oscillator, it's easy to change your PC clock into a reliable timekeeper. But you have to adjust your clock and measure its performance against a trustworthy time source. That's the benefit provided by ACTS and other time services. ■

Editor's note: *NIST wants you to know that the mention of products in this article does not constitute a NIST endorsement.*

Michael A. Lombardi is a computer specialist for the Time and Frequency Division of the U.S. Department of Commerce's National Institute of Standards and Technology in Boulder, Colorado. You can contact him on BIX c/o "editors."

APPLICATIONS FOR PRECISION TIMEKEEPING



ENTERPRISE	ASSIGNMENT	TASK EXAMPLE
Aviation	Air traffic control	Air traffic can be routed through air corridors at precise intervals
Finance	Record keeping	Provides a legal audit trail of the dates and times when transactions are completed
Laboratories	Data acquisition	Temperatures can be monitored over a defined time slice
Navigation	Position location	Locations can be determined by observing a star's position at precise times
Power utilities	Power flow	Synchronized power-flow networks send electricity where and when it is needed the most
Radio/TV	Communications	Satellite linkups for network news feeds can be coordinated
Surveying	Measurement	Provides the accurate time required to measure distances and locations
Transportation	Vehicle control	Synchronizes mass-transit vehicle dispatch, location, and schedule control

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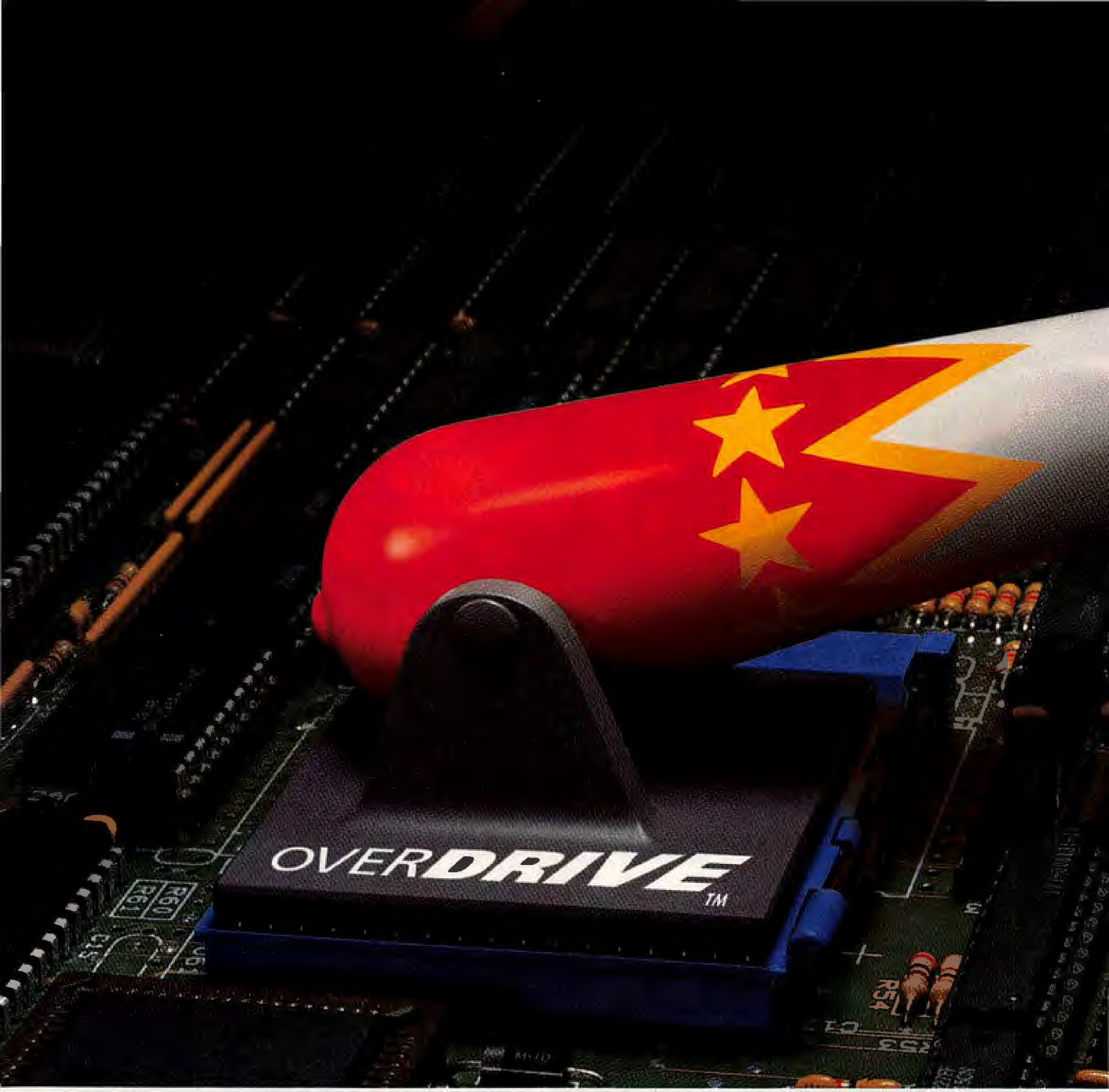

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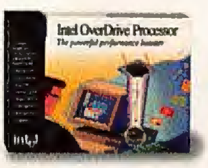

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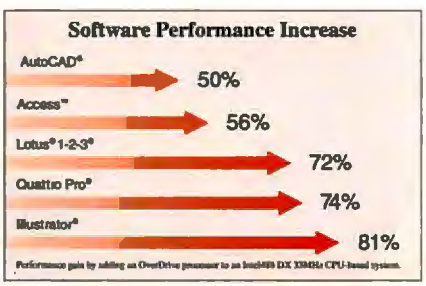

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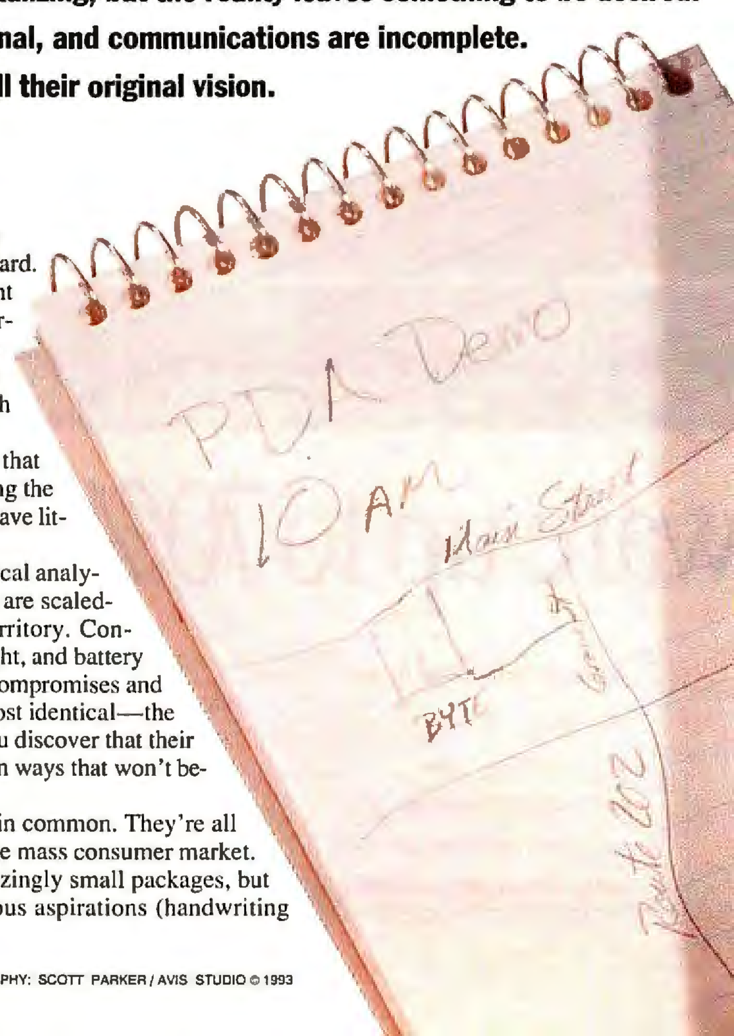
Cover Story

PDAs ARRIVE But Aren't Quite Here Yet

Technically impressive, Apple's Newton MessagePad and the Tandy/Casio Zoomer are the first true Personal Digital Assistants. Their potential is tantalizing, but the reality leaves something to be desired. Prices are high, handwriting recognition is marginal, and communications are incomplete. Yet with technology advances, PDAs may yet fulfill their original vision.

TOM R. HALFHILL



The first personal computers all looked the same: a box with a video screen and a keyboard. Beneath the surface, however, were significant differences in terms of microprocessors, operating systems, and system architectures. Likewise, the first pen-based PDAs (Personal Digital Assistants) all look very much the same, too: a tiny box with an LCD screen and a stylus.

But appearances, once again, are deceiving. Some devices that claim to be PDAs aren't PDAs at all without absurdly stretching the definition. They're aimed at widely different markets, and they have little in common but portability.

Their differences become even more apparent after a technical analysis of their underlying architectures. Some PDA-type devices are scaled-down desktop computers, while others explore bold new territory. Constraints of cost, compatibility, memory, CPU power, size, weight, and battery life have forced their designers to make very different sets of compromises and trade-offs. Even if you isolate the two devices that appear almost identical—the Apple Newton MessagePad and the Tandy/Casio Zoomer—you discover that their supporting architectures are sharply divergent, though perhaps in ways that won't become obvious to casual users until future iterations.

At the same time, the early PDAs also have several things in common. They're all rather pricey compared to other electronic gadgets aimed at the mass consumer market. They all squeeze large amounts of computing power into amazingly small packages, but in some cases it's not enough power to satisfy their ambitious aspirations (handwriting recognition in particular). They all come with a suite of useful applications, such as notepads, address books, and appointment calendars, but no "killer application," such as VisiCalc or WordStar, that dramatically reveals new possibilities.

Are PDAs ready for prime time? Are they worth the price? Can they justify their existence by doing anything important? Or will they be doomed to early failure, banished to their design labs until the technology catches up with our expectations?

This partially depends on what you expect from a PDA and how much you're willing to pay. Most people will probably be disappointed with the early PDAs or will guard their wallets until prices drop. But a remarkable number of companies are gambling on hopes that thousands of people will think PDAs are the best thing since sliced silicon.

PDAs are seeking a niche, but they're not just niche products. They're ultimately aimed at the millions of people who will probably never buy a personal computer, and they're destined to have a major impact on personal computing at large. PDAs already are accelerating the trend toward wireless communications and will encourage the on-line distribution of software. More important, one of these tiny devices adopts a new approach to system software that foreshadows the object-oriented operating systems that will be coming to desktops later in the decade.

What's a PDA?

Not surprisingly, there is no industrywide consensus on what constitutes a PDA. Because Apple chairman John Sculley coined the term in January 1992 and guided the Newton architecture's development, it's tempting to let Apple define the grounds of this debate. However, that wouldn't be fair to Apple's competitors, and it may not take into account the expectations of users.

Apple's MessagePad, the first in a family of products based on the Newton architecture, is the most interesting early example of the genre. If successful, the MessagePad will be widely imitated because, unlike the proprietary Macintosh, the Newton architecture is openly licensed to all comers. The list includes Cirrus Logic, Matsushita, Motorola, Sharp, and Siemens. Sharp, which manufactures the MessagePad for Apple, is also selling a variant called the ExpertPad.

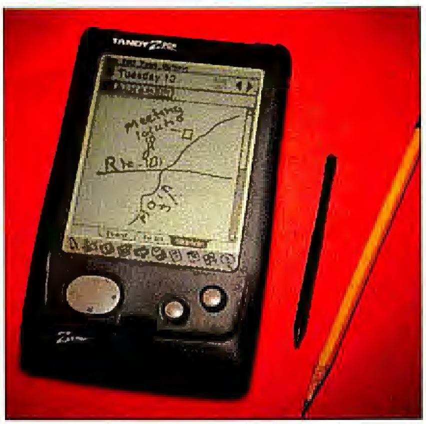
However, Sharp is hedging its bets with a tablet-size device called the PT 9000 that isn't based on Newton technology (see the text box "Sharp's Non-Newtonian PDA"). Instead, the PT 9000 uses the GEOS operating system from GeoWorks (Berkeley, CA).

Another important GEOS-based system is the result of a partnership between Tandy (Fort Worth, TX) and Japan-based Casio, with significant input from GeoWorks and Palm Computing (Los Altos, CA). Nicknamed the Zoomer (the Tandy version is actually called the Z-PDA; the Casio model is called the XL-7000), it is

perhaps the MessagePad's closest competitor in terms of appearance, user interface, and intended audience (see "Ease of Use Is Relative" on page 89).

Eo, Inc. (Mountain View, CA) makes the Eo 440 and 880 Personal Communicators, a pair of clipboard-size pen computers based on AT&T's Hobbit chip and Go Corp.'s PenPoint operating system. The Eo 440 and 880 perform many of the same functions as the MessagePad and the Zoomer, and in some ways they do a better job of it. For instance, their larger screens are more suited for creating documents, they can receive faxes as well as send them, and they can be equipped with cellular phones. Nevertheless, the Eo devices are not PDAs. Unlike the Zoomer and the MessagePad, they make no pretense about being consumer products.

Other contenders in this category include the Hewlett-Packard 100LX, a DOS-based palmtop computer; pocket-size personal organizers, such as the Sharp Wizard OZ-9600 and the Casio Boss; and content-oriented reference tools, such as Franklin's Digital Books. For various reasons, however, they fall short of what we expect from a true PDA (see the table "What Makes a PDA?" on page 72).



Tandy and Casio *collaborated on the Zoomer, a PDA that strongly resembles the Apple MessagePad but is built on a completely different hardware and software architecture.*

Sculley risked inflating those expectations over the past two years by making Newton the most visible work-in-progress in Apple's 17-year history. But users' expectations have also been influenced by Gene Roddenberry, the late creator of *Star Trek*.

Roddenberry first introduced PDAs to the public in 1966. When *Star Trek* was still in its conceptual stages, he decreed that no paper or pencils were to appear anywhere on the sets of the starship *Enterprise*. Instead, crew members jotted notes on electronic tablets that eerily resemble an Eo 880, and they used a hand-held device called a tricorder to gather, process, and display information. On *Star Trek: The Next Generation*, the sequel to the original series, crew members communicate remotely by speaking into active-badge-like devices worn on their tunics.

This futuristic vision of multifunction hand-held computers, wireless communications, and an effortless user interface is the inspiration for today's PDAs, even if some designers do not acknowledge or are not consciously aware of the pop-culture source. Unfortunately, they have to meet twenty-fourth-century expectations with twentieth-century technology.

Apple's MessagePad *is promised to be the first in a family of products based on the Newton architecture. Newton licensees are planning to introduce everything from smart telephones and fax machines to advanced cable TV converters.*

Still, the vision yields a practical definition of a PDA. At a minimum, a PDA should have significant computing power and be capable of performing a number of different functions, which rules out high-end calculators and dedicated language translators. It should be easily held in one hand, usable almost anywhere while you are standing or sitting, and capable of running on battery power for extended periods of time, which rules out laptop and notebook computers. It should offer flexible communications, at least within the bounds of today's rapidly evolving but still-limited infrastructure, which rules out most personal organizers. And, most challenging of all, it must be so affordable and easy to use that it will attract the millions of people who have thus far steadfastly resisted desktop PCs.

"We're not talking about a downsized personal computer," says Michael Tchao, manager of product planning and strategy for Apple's Newton Group. "We're not talking about Lotus 1-2-3 in the palm of your hand. We're not talking about pocket PageMaker. We're not talking about a little-bitty Microsoft Word with little-bitty keys and little-bitty menus. We're talking about a new class of device and a new category of users."

However, no device currently available meets all these criteria, especially at an affordable price. Like color TVs, VCRs, CD players, and other consumer electronics gadgets, PDAs won't become genuine mass-market items until prices drop below $300, and ideally even lower.

The Mighty Pen

Not everyone will agree with this definition, however, particularly those whose PDA-like products it excludes. For example, the Eo 440 and 880 are capable machines, but at $2000 to $3300, they're clearly not intended for mass consumption. The HP 100LX and Sharp Wizard are often considered PDAs, but they have QWERTY keyboards. Although there's disagreement on this point, those who target the mass market convincingly argue that keyboards are simply too intimidating for the computer-illiterate.

"If you're designing a device for broad consumer acceptance, you've got to have a pen interface," says Joe Ratner, Zoomer project manager for Radio Shack. "From the very beginning, we decided the Zoomer had to have a pen interface. It couldn't have a keyboard."

Ratner explains that it's impossible to fit a touch-typeable QWERTY keyboard on a pocket-size device, and crowded keyboards that have dozens of multifunction keys are even more intimidating to consumers than a full-size desktop keyboard. His counterparts at Apple, who interviewed more than 1200 consumers while designing the MessagePad, came to the same conclusion.

The Eo 440 Personal Communicator *is too big and too expensive to be a true PDA. However, it handles wireless communications in a complete and compelling manner.*

Gerry Purdy, vice president and chief analyst for mobile

Sharp's Non-Newtonian PDA

ED PERRATORE

When it comes to hand-held computing, Sharp seems determined to cover all the bases. The company is largely responsible for building the personal organizer market with its Wizard series, and it is the first Newton licensee to announce a MessagePad-type product, the PI-7000 ExpertPad. Sometime in October, Sharp will announce another type of small computer with PDA-like functionality

gy. Standard are 1 MB of RAM, which is upgradable by way of plug-in cards to 3 MB, and 6 MB of ROM for the operating system and applications. The power button takes you to suspend mode only.

Sharp claims the six AA batteries give you a cumulative 22 hours of typical use—that is, turning the unit on and off at regular intervals. Sharp will also sell rechargeable lithium-ion batteries, which are currently used in some video camera equipment and manufactured by a company called ATI (not the video-card maker). Sony is

book, a scheduler, a note taker, a to-do list, a calendar, a calculator, and a world clock. Relevant mini-applications let you invoke a sketch pad with a mini-toolbar of editing functions. Traveling Software's LapLink and America Online access software are included as well.

A column of buttons runs down the side of the screen—three of the buttons are assigned, five are customizable. You can use these five for shortcuts to commonly used applications, and you can even assign an icon to a file.

It all started when you asked them to share an HP LaserJet

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HP's JetDirect card solves the problems of shared printing.

Shared printing has been a great way to make the most of your resources. Unfortunately, it also made printing a hassle. Until now.

With HP's JetPrint utility, printing status is delivered to each user's PC.

This powerful Windows™-based utility for Novell Netware networks, included with HP's JetDirect card, provides users easy access to printer information. Users no longer have to jog over to the printer to check on job status. Just a simple click of the mouse and they can find out everything they need to know:

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- Toner low.
- Printer cover open.
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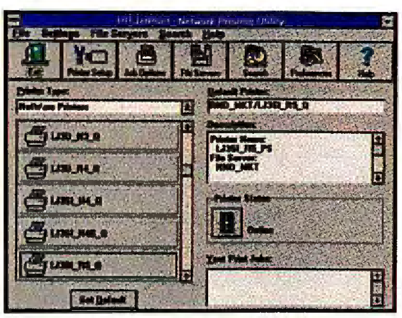
And no more network performance degradation or PC parallel-port bottlenecks. Print data zips along. Even graphics move along at breakneck speed. Network printer performance is maximized. It just doesn't get any better. Or faster.



HP's JetDirect card makes your printer easy to manage.

How easy? Installation takes just minutes. And implementation is a breeze.

HP's JetAdmin utility provides remote management capabilities for Novell networks. Now printers can be placed anywhere on your network. Users can even automatically download Windows drivers for most popular PC applications. Which all makes the HP JetDirect card the preferred solution. With users. And with people like you.

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HP Printer Compatibility:

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Network Topologies:
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Network Operating Systems*:
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Supports industry-standard SNMP-based network management software.

*Multiple network operating systems are supported simultaneously with the HP JetDirect card when installed into an HP LaserJet 4Si or 4Si MX printer.
[†] Only NOS supported by JetDirect EX interface.
[††] Not supported with Token Ring topology.

HEWLETT PACKARD

WHAT MAKES A PDA?

	Portability	Battery life	Low price	Mass market	Ease of use	Wireless communications	Applications	Pen
Apple Newton MessagePad	●	○	◒	●	●	◒	●	●
Tandy/Casio Zoomer	●	●	◒	●	●	◒	●	●
Eo Personal Communicator 440/880	◒	○	○	○	●	●	●	●
Sharp PT 9000	◒	●	◒	◒	●	◒	●	●
Organizers (Sharp Wizard, Casio Boss)	●	●	●	◒	◒	○	◒	○
DOS-based hand-helds (HP 100LX, Fujitsu Poqet PC)	●	●	◒	○	○	◒	●	○

●=well suited ◒=adequate ○=not well suited

PDAs are defined *as highly portable, easy-to-use computing and communications devices aimed at the mass market. To be highly portable, the unit must be easily held in one hand and able to be carried in a pocket. Long battery life is also an important portability factor; you don't want to worry about being near a power outlet all the time. Ease of use assumes no keyboard; most people don't type well. For now, a pen interface is the preferred means of input, although someday voice input might supplement it. To appeal to the mass market, PDAs must be low in cost, preferably $300 or less, and they must come with a good suite of general-purpose applications. Finally, PDAs must deliver seamless two-way wireless communications for fax and data access.*

computing at Dataquest (San Jose, CA), predicts that QWERTY-based devices such as the 100LX and Wizard are "going the way of the slide rule:" PDAs will eventually replace them.

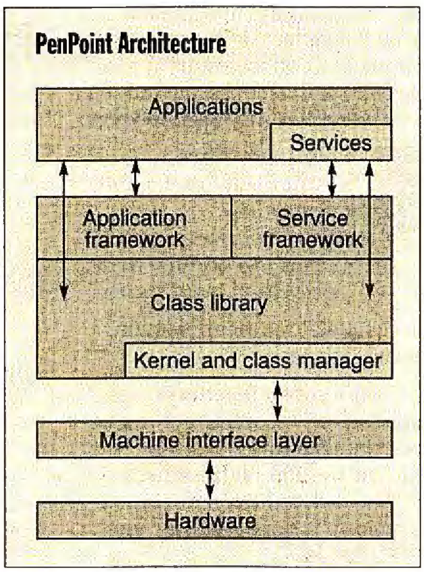
The point is that PDAs aren't substitutes for PCs; they're different devices aimed at a different market. "I'm not expecting to replace my desktop computer or my laptop with a PDA, but I'm definitely going to have a PDA," says Jeff Hawkins, founder of Palm Computing, who first conceived the Zoomer while working at Grid Systems. "For heavy-duty text writing, pen input won't replace a keyboard."

PDA designers think their devices are more likely to be used by *consumers* of information than by *creators* of information. Therefore, user input will tend to be brief and frequently limited to selections from menus. Those who need to enter lots of data will use conventional computers, although some PDAs, such as the Sharp PT 9000, will offer keyboards as an option.

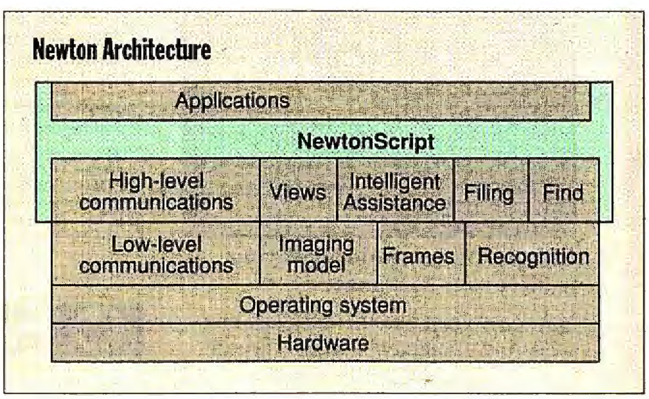
"But a pen interface doesn't necessarily mean the same thing as handwriting recognition," Ratner points out. "For some applications, you don't need recognition. Digital ink is good enough."

Digital ink—storing the image of the user's handwriting instead of translating it into ASCII text—is one of the trade-offs juggled by designers of today's PDAs (see the text box "Ink vs. ASCII").

PDAs tend to look alike, so one way of telling them apart is to peel back the surface. Their underlying architectures determine not only what they can do now, but also what they'll be capable of doing in the future as the technology advances.



PenPoint, like Newton Intelligence, is object-oriented, but it maintains ties to a file-based structure.



Newton Intelligence is object-oriented from the ground up. Most programmers will access MessagePad resources and write applications using NewtonScript.

Operating Systems of the Future

Some operating systems running on PDA-type devices are descended from those of desktops: DOS, GEOS, Windows for Pen Computing. Others are dedicated to proprietary hardware and don't attempt to duplicate the functionality of a full-fledged operating system: These include those of the Sharp Wizard and Casio Boss. Some operating systems, such as Magic Cap from General Magic and WinPad from Microsoft, look promising but haven't yet appeared in actual products.

Only two operating systems currently available were designed from the ground up to support PDAs: Go's PenPoint and Apple's Newton Intelligence. Both are heavily object-oriented and depart from the traditional model used by today's operating systems for desktop computers.

Newton Intelligence borrows a few of its components from the Mac: Portions of QuickDraw (the Mac imaging engine) handle the MessagePad's display, and an AppleTalk protocol stack supports name lookup, zones, data streams, and printing, although there's currently no support for AppleTalk Remote Access. Newton Intelligence is multitasking and extensible, and Apple plans to distribute software updates and extensions via on-line services.

The Newton operating system consists of four major components: the Recognition Architecture, the Communications Architecture, the Information Architecture, and the Intelligent Assistance. Most of it is written in C and C++, with a small portion of the low-level kernel written in assembly language. The

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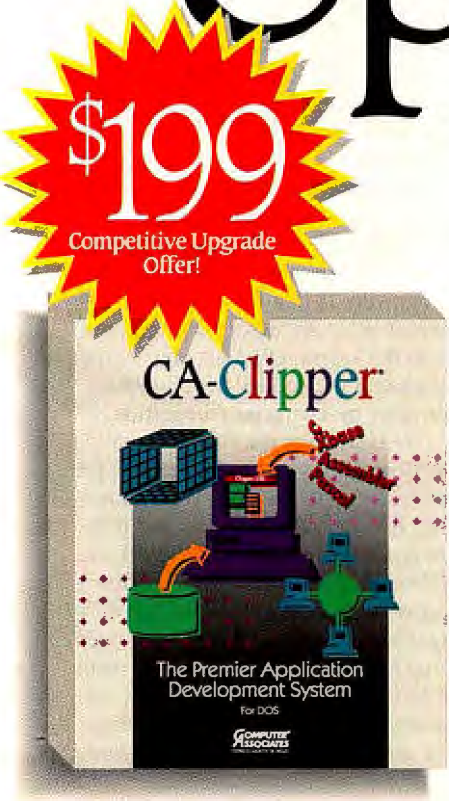

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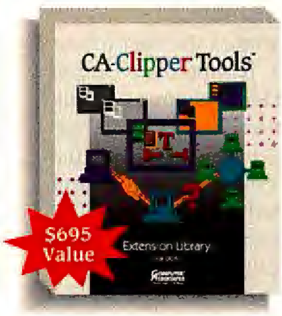

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Predefined Object Classes	YES	NO	NO
Variables Modifiable in Debugger	YES	NO	NO
Customizable Reactive Error Handling	YES	NO	NO
Reads and Writes FoxPro (.CDX) Files	YES	YES	NO
Reads and Writes dBASE IV (.MDX) Files	YES	NO	YES
Reads and Writes Paradox (.DB/.PX) Files	YES	NO	NO

Comparison based on FoxPro Version 2.5 for DOS and dBASE IV Version 1.5.

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user-interface layer is coded in C, C++, and NewtonScript, a new language that combines features of C and Pascal. NewtonScript is the development tool for all Newton applications software, including the programs that are burned into the MessagePad's ROMs. Drivers and other low-level functions that access the MessagePad's hardware directly are best written in assembly language.

The Recognition Architecture has a recognizer engine that translates your printing, cursive writing, or any combination of the two. The recognizer was designed by ParaGraph International, a U.S./Russian joint venture based in Moscow and Sunnyvale, California (see "Pen Computing Catches On" on page 105). It's trainable, automat-

Ink vs. ASCII

It'll be a long time before handwriting recognizers are as good as pharmacists at interpreting anybody's sloppy scrawl. Therefore, the designers of today's PDAs must compromise the ideal of always recognizing everything a user writes. One alternative is to minimize freehand pen input by offering selections in menus. Another is to capture an image of the user's handwriting without attempting the difficult translation into ASCII text.

The latter approach is known as *digital ink*. Some PDA designers contend that digital ink is not a compromise or a workaround. For certain applications, they say, ink is an entirely appropriate data type. Often-cited examples include brief reminder notes and entries in appointment calendars. In neither case, they argue, is a user likely to need full-text searching or sorting, the main advantages of ASCII text.

"There's an underlying assumption that 'before I can do useful work, it's gotta be in ASCII,' " notes Gregory Stikeleather, president of Aha Software (Mountain View, CA), which makes an ink-oriented word processor called InkWriter. "That isn't always the case."

Still, it's hard to believe that universal recognition wouldn't be implemented if it were reliable, adaptable, and didn't tax a PDA's resources. For one thing, byte-coded text requires less storage space than digital ink—an important consideration for hand-held devices with small RAM-based file systems. And there's always the chance that a user might indeed want to search a series of reminder notes for a key phrase or look for a particular name in a large appointment book.

For the immediate future, though, digital ink will be an integral feature of PDAs, and designers are taking different approaches to it. These differences are typified by Apple's MessagePad and Tandy/Casio's Zoomer.

Both of these PDAs let you tap an icon to switch the handwriting recognizers off. This lets you write freely in digital ink, which the computer captures and stores as a graphical image. This image is not a simple bit map of pixels, however. Both PDAs save your writing as vectorized strokes, similar to the difference between bit-map fonts and outline fonts. When compressed, the strokes require less storage space than bit-map images and also preserve information that could be useful later (see the text box "Jot Defines Electronic Ink" on page 110).

The Zoomer makes the best use of this information. It supports *deferred recognition*, the ability to translate ink into text anytime after it's captured. You merely select the ink, turn on the recognizer, and confirm that you want to translate the writing into text.

This is where saving penstrokes becomes important. It's much easier for a recognizer to interpret stroke data instead of a plain bit map, because the strokes preserve the *way* in which a character is written, not just its image. If nothing more than a bit map were saved, the recognizer would be reduced to optical character recognition, which is not very reliable for handwriting.

The MessagePad doesn't support deferred recognition, although nothing in the Newton Recognition Architecture precludes it from being added in the future. Apple gives two reasons for this decision: Real-time recognition saves storage space, and usability testing has showed that people tend to write much sloppier when the recognizer is off, making it more difficult to recognize.

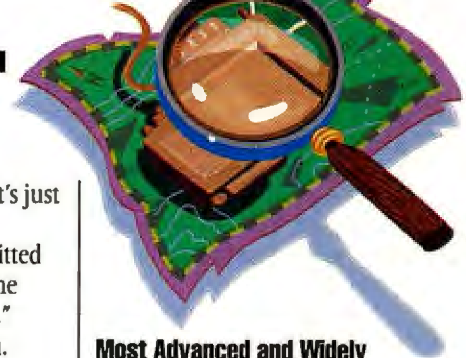
As a result, the MessagePad's approach to digital ink is somewhat less flexible than the Zoomer's. In truth, however, the Zoomer probably needs digital ink more than the MessagePad. The Zoomer's recognition is noticeably slower (a consequence of the Zoomer's 8088-compatible CPU versus the MessagePad's ARM610 RISC chip); it's less adaptive (it recognizes only printing, not cursive writing, and it isn't trainable); and it is somewhat less accurate (based on results of preliminary tests).

A key difference between the two recognizers is that the Zoomer interprets words character by character, while the MessagePad lets you choose between a dictionary-based system, character-by-character recognition, or a combination of the two. Normally, the MessagePad tries to find each word you write in its 10,000-word dictionary. If it can't find a match, and if the character-by-character option is off, the MessagePad makes a guess—often a very wild guess. For example, the MessagePad stumbled badly on the proper name *Halfhill*, even though both parts of the compound word were in its dictionary. Five attempts yielded these five guesses: *florists*, *teachers*, *forecasts*, *four their*, and *Clarence*.

One solution to the problem is to add the word to the dictionary by spelling it on a pop-up QWERTY keyboard. Once I added *Halfhill*, the MessagePad got it right every time. The other alternative is to activate the character-by-character option, which works fairly well but slows down the recognizer and reduces overall accuracy.

The Zoomer's answer is to always offer the option of digital ink—unlike the MessagePad, which offers it only in certain applications. "If I were writing poetry, a dictionary-based recognizer would be great," comments Jeff Hawkins, founder and chairman of Palm Computing. "But when you start writing names and other words that aren't in the dictionary, you start running into problems."

Why some software sells more than others.



Success. All software developers strive for it. Now, Don Gall was on top of the world. Software protection made all the difference. Especially in Europe and Asia. Sales were four times better than before. He is the founding father of Sentinel — the guru of software success.

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One day, trekking through the coffee fields of Java, Don ran into his old college buddy Simon Seagull. "Don, my sales are well below expectations." Simon explained his plight, "My software should sell like yours, Don!" Yet despite critical acclaim Simon's company, SimonSays Software, teetered on a financial tightrope. "What's your secret, Don?"

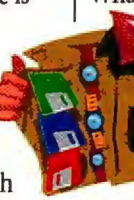
They spent hours analyzing potential problems. They looked at everything.

The Key to the Problem

Finally, Don leaned back and asked the assumptive question, "What about protection – are you using Sentinel?"

Nervously, Simon sipped his coffee. His hands shaking as his eyes darted the room. "No. I didn't think I needed to."

Don's chair slid out from under him and he crashed to the floor. Amazed in disbelief, Don cried, "You What?!" Grabbing his tattered scrapbook, Don pulled out photos of his travels. "Ever been to Seoul? Prague? Anywhere? Ten bucks will buy you anything, even bootlegged copies of software."



Don's Road to Success

Thumbing through the scrapbook, Don shared his experiences. "Back in the '80s, I was in your shoes – beaten, battered and bruised." Simon listened. "Then, after a heart breaking trip around the world, I called the Software Publishers Association (SPA)."

"I could hardly believe it. They told me developers lose billions of dollars each year. Why? Illegally copied software. In some countries there are nine pirated copies for each legal copy sold."

Simon was disgusted, "It's just not fair."

"That's why I committed myself to solving the piracy problem," explained Don.

Simon's eyes lit up. "The dongle!" he shouted. Don corrected him, "Not just any dongle — the dongle that paved the road to success for over 10,000 developers worldwide — Sentinel."

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Don pulled a stack of letters out of his gunny sack. "All of these people tell the same story." Don read about a successful developer from California who swears she wouldn't be in business without Sentinel. Another company says protection costs less than litigation, plus they don't have to spend time and money supporting illegal users.

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ically adapting to your handwriting style over time.

Similarly, a graphics interpreter detects specific objects and penstrokes as you sketch on the display. For example, it automatically transforms a round scribble into a perfectly formed circle; four perpendicular lines become a precise rectangle. Both the handwriting recognizer and the graphics interpreter detect several predefined gestures for manipulating words and shapes. You can move objects, resize them, and cut and paste them on a system clipboard.

Newton's Communications Architecture supports a wide variety of I/O devices via the MessagePad's RS-422 serial port, PCMCIA slot, and 19.2-Kbps infrared transceiver. The serial port connects to printers, fax modems, and desktop PCs. The Type 2 PCMCIA slot accepts wireless communication cards and other add-ons. The infrared link lets you beam data to another MessagePad or a Sharp Wizard OZ-9600. This architecture is extensible, so new communications options can be added in the future.

A Central Data Bank

What sets Newton Intelligence apart from the typical desktop operating system is the Information Architecture. It's datacentric, not filecentric, a radical departure from DOS, System 7, Unix, and other common operating systems. PenPoint has a very similar structure, although it doesn't go quite as far as Newton in abandoning the old file-oriented model. Both Newton and PenPoint give us a likely preview of the object-oriented operating systems from Microsoft (Cairo) and Taligent (Pink) that are coming to desktops.

Instead of storing data in discrete files organized in a hierarchical file system, Newton Intelligence lumps everything together in an object-oriented central repository that's accessible to all applications. Technically, this is known as a *persistent object store*, and it promotes datasharing among applications without the complex plumbing that's now being retrofitted to operating systems for desktops.

Because conventional operating systems segregate information in files, applications can't share live data until the operating system is equipped with a mechanism such as Microsoft's DDE or OLE, or Apple's Publish/Subscribe or Amber/OpenDoc. Although these mechanisms work, they add yet another thick layer of code that wasn't anticipated in the original architecture of the operating system. They also force developers who want to take advantage of the new features to modify their code to expose internal objects to other applications. If the code isn't already object-oriented, extensive rewriting may be necessary. Both Microsoft and Apple are in the process of pulling their respective developer communities in these new directions.

Newton's Information Architecture takes a different approach to data storage and sharing. When data enters the MessagePad, the Information Architecture automatically tags (i.e., names), compresses, and saves the data in an object called a *frame*. A frame is a structure composed of tagged locations called *slots*. Slots can contain user data, program code, and even other frames. As objects, high-level meanings can be attached to frames: for example, `address` can represent "1 Phoenix Mill Lane."

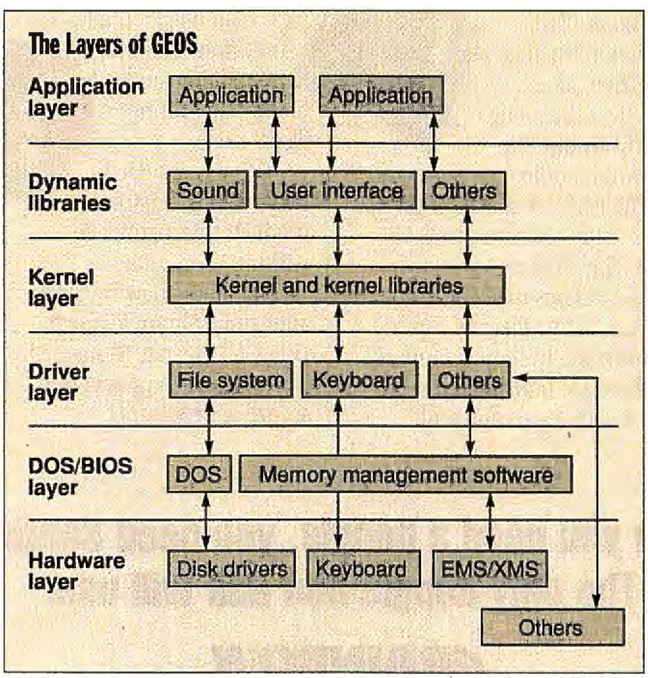
A collection of related data frames is known as a *soup*, and soups reside in physical locations called *stores*. For instance, a soup of contact names might exist in a store located on a PCMCIA RAM card. Soups automatically maintain indexes to their frames.

This unified model means that all information stored in the MessagePad automatically becomes part of an object database that Newton applications can search, modify, and display in countless ways. It eliminates the overhead of data translation and the redundant copies that often result from translation. Furthermore, because all information is processed as Unicode, the MessagePad readily adapts to foreign languages.

It's in the Soup

All of this dovetails with the final component of Newton Intelligence, the Intelligent Assistance. This component takes advantage of the data soup to make plausible connections between the information and your actions. For example, if you ask the MessagePad to "fax to Lisa," the Intelligent Assistance automatically assumes the sketch you just drew on the screen is what you want to send. Next, it locates all people named Lisa in the object database. If there's more than one, the MessagePad prompts you to make a choice. Then it retrieves Lisa's fax number and generates a fax document. The next time you connect your modem to a phone line, the MessagePad sends the fax. The Intelligent Assistance is also extensible.

Although all these capabilities can (and will) be bolted onto existing operating systems, Newton Intelligence was designed around this datacentric model in the first place, making it considerably more compact and efficient. For example, it easily fits within the MessagePad's 4 MB of ROM, leaving ample room for several other system components and all the built-in applications software.



The GEOS operating system is based on the familiar DOS architecture, but it does make use of some high-level objects for the sake of reducing code requirements for programmers.

Different Approaches to Objects

PenPoint is built on a similar object-oriented structure, but it doesn't appear to go as far as Newton toward discarding the traditional file-oriented model. PenPoint applications can store data as objects, much like Newton does, but they also have the option of saving documents in conventional file formats such as WKS or RTF. A systemwide import/export architecture translates those files as necessary when they are called by a PenPoint application. Newton applications, on the other hand, might provide backward compatibility with conventional file formats by encapsulating a file within a slot or a frame in the object store.

All these structural details will probably remain transparent to users—unless something goes

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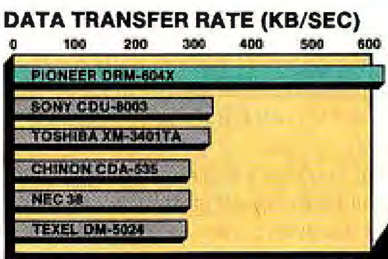

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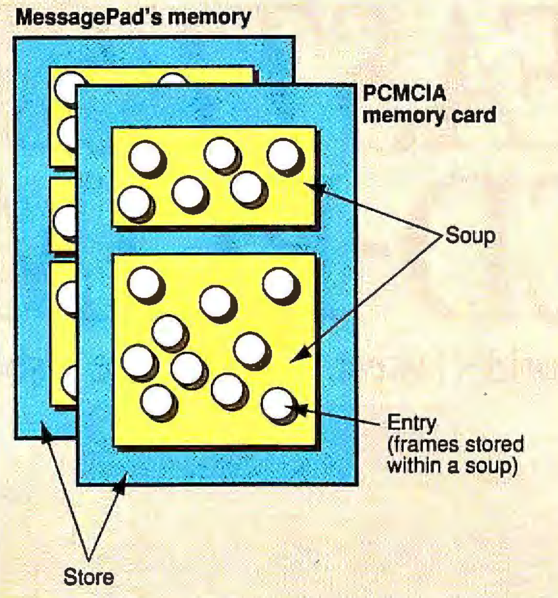
horribly wrong. That's when the subtle differences between Newton and PenPoint might become more obvious. Newton critics say that its centralized object database could backfire by compromising data integrity and that PenPoint has better safeguards in this respect.

Data integrity is paramount in a RAM-based system, because a crash could corrupt all of a user's accumulated data, not just a single file associated with a single application. PenPoint was designed with extensive memory protection, so applications are effectively "walled off" from each other. The walls keep one application from interfering with another application's data or from crashing the whole system. To keep those thick walls from impeding IAC (Interapplication Communication), PenPoint has a system-level messaging mechanism that allows PenPoint applications and their objects to interact with each other.

Newton Data Storage



A store is the physical location of data storage, either main memory or a PCMCIA RAM card. A soup is a collection of related data. Entries are tagged frames of information in a soup. Soups automatically maintain indexes to their entries and can update or remove them on demand.

Memory protection is receiving close attention in the design of multitasking operating systems, and it's a key feature of Microsoft Windows NT and IBM's OS/2 2.1. But Apple says the kind of memory protection found in PenPoint adds too much overhead to data-sharing between applications and that Newton's Storage Manager protects the integrity of the central repository in better ways.

Newton applications never access the object database directly, explains Larry Kenyon, principal engineer of Newton Intelligence. Instead, all reads and writes are handled as transactions and funneled through the Storage Manager's I/O system, where a sentry verifies the data before updating the object store. "Applications can't even touch the data," says Kenyon. "The sentry is always in place to keep that from happening."

Even if a system crashes or is switched off during a transaction, no data will be corrupted, he claims. Of course, no operating system can prevent loss of data if the hardware is physically damaged or if the MessagePad's main batteries and lithium cell go completely dead. Prudent users still need to back up their data.

The NewtonScript development language provides additional safeguards, says Apple's Michael Tchao. Unlike C, it automatically handles memory management and garbage collection. Applications programmers no longer have to allocate memory, and all references are to objects, not to handles or pointers. Tchao says 80 percent of crashes are caused by memory management problems and that NewtonScript makes the programmer's nightmare of memory leaks and dangling pointers a thing of the past.

NewtonScript objects also have latent typing, and all operations are type-checked before they're performed. This nails argument errors before they have a chance to trash the stack and cause problems dozens of instructions later.

Even if NewtonScript makes life easier for programmers and contributes to data integrity, will developers embrace the new language? Critics say that because NewtonScript is nonstandard and bucks the industry trend toward C and C++, porting code won't be as easy.

But Tchao predicts that programmers will adapt quickly to NewtonScript's hybrid C/Pascal syntax. Based on early experience, he claims development will be faster on the Newton than on other platforms, mainly because there's less code to write. Developers won't have to recompile their applications to run on Newton devices built around other microprocessors, because NewtonScript code is executed by a run-time interpreter. Apple has already received inquiries from about 1500 "serious" developers, says Tchao, and about 50 applications written in NewtonScript will be introduced by Christmas. By the end of 1994, Apple predicts that about 300 applications will be available.

"Anytime you invent a new language, the language zealots—and there are a lot of language zealots out there—run screaming from the room," says Tchao. "But we haven't found that to be the case with NewtonScript."

A New User Interface

Another consequence of Newton's datacentric architecture is that it discards the old data-processing model of booting an operating system, running and quitting application programs, loading and saving documents, and maneuvering through hierarchical file systems that mirror the layout of mass-storage devices. Although this model has served us well for decades, it assumes a certain familiarity with a computer system's underlying structure—the difference between an executable file and a data file, for instance, and the hierarchy of directories, subdirectories, and files. If PDAs are to successfully penetrate the mass market, these assumptions have to be abandoned.

The MessagePad has no start-up sequence, and you never explicitly load or run a program on it as you do on a desktop PC. Instead, you simply flick on the power switch, and you automatically return to the same application and document that was active during your last session. You move smoothly from one application to another by tapping its icon. To the casual user, it appears that all applications are always running, although actually the operating system is transparently swapping chunks of code in and out of the computer's RAM (640 KB on a standard MessagePad).

When you move to a different application, you find yourself at the exact spot in the last document that you created with that application. To switch documents, you simply tap on an icon. You never have to explicitly load or save a document; any changes you make are automatically updated in the central database.

Nor must you deal with a file system that exposes the detailed structure of the system's mass storage. You can call up a scrolling list of notes that you've created, but you can't view a "disk directory" that mixes data files with executable and auxiliary files. Newton saves documents chronologically, and you can organize them into folders if you want to do so, but the nuts-and-bolts framework of the storage system always remains hidden. This is a greatly abstracted extension of the Mac's file system, which shows only one icon for an executable file, even though it actually consists of separate files for the

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PDA CPUs: New Form Demands New Functions

DICK POUNTAIN

The new battery-operated, hand-held PDAs demand a new class of CPU, and semiconductor manufacturers are all rushing to pick up a piece of this potentially huge market. It seems like vendors announce new PDA-class chips every week, all offering different and non-Intel-compatible architectures. To understand how this has come about, consider the features a PDA processor chip should have.

Low cost. PDAs are aimed at the consumer market. In a unit that costs only a few hundred dollars, the CPU cannot cost more than $25 to $30. Thus, PDA designers can forget about using 486DXs and Pentiums, which cost hundreds of dollars each.

Smallness. Printed-circuit-board space is at a premium in any hand-held device.

Very low power requirements. Battery life for a PDA needs to be an order of magnitude better than that of a laptop PC, allowing weeks or months between battery changes. Another important threshold that PDA designers are aiming for is operation on just two AA-size batteries.

Power. Although PDAs are pocketable, don't confuse them with pocket calculators; the kinds of applications promised by, for example, Apple's MessagePad require as much processing power as a high-end desktop PC. Handwriting recognition in particular consumes lots of real-time computing power.

High integration. The chip should contain a lot of peripheral functionality, such as RAM, ROM, and various controllers, that would otherwise require external chips.

Ability to run compact code. This reduces the amount of ROM and RAM needed to store the software.

These requirements are not wholly independent; for example, smallness and low cost go together, as a chip's price in volume production is related to its die size (i.e., the amount of silicon it contains). On the other hand, smallness and high integration fall on opposite ends of the spectrum and call for trade-offs. "Small and powerful" nowadays means RISC, and almost all the PDA chip designers start with a compact RISC processor core (typically one with 30,000 to 40,000 transistors) and then add peripheral units to taste. Because PDAs represent a completely new software market in which PC or Mac compatibility is arguably not necessary, CPU makers are free to use leading-edge technology.

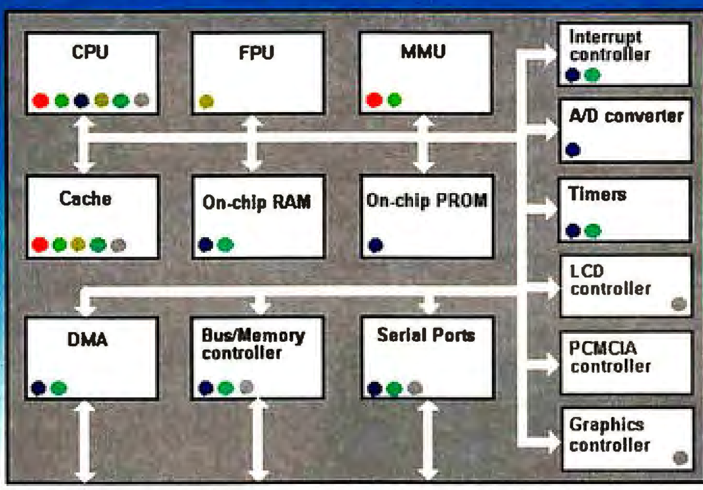


Fig.1 An idealized generic PDA processor. The colored dots indicate which of the features are implemented in actual processors (see legend). The grayed out boxes represent features that are desirable but are not yet implemented in any current products.

LEGEND: ARM610 Hobbit Hitachi SH NEC V810 Motorola Dragon 1 Intel/VLSI Polar

The Players

Although very few PDAs have actually been shipped so far, a second generation of processors is already being announced. The two first-generation PDA processors are the U.K.-designed ARM610 (Advanced RISC machine), which is used in Apple's Newton MessagePad, and the AT&T 92010 Hobbit, which is used in Eo's Personal Communicators. Both are 32-bit RISC designs, but the Hobbit is unusual in its use of an on-chip hardware stack, which is optimized for executing C function calls, instead of the large register file typical of a RISC CPU.

Both chips contain a cache and a memory management unit to support virtual-memory operating systems, but otherwise they show only modest integration. The Hobbit, for example, is part of a five-chip family that together make a PDA.

The second-generation PDA chips, which come from Japan, are Hitachi's SH7000 series and NEC's V800 series. While the ARM610 and the Hobbit are general-purpose RISC CPUs, these newcomers resemble microcontrollers on steroids. Both are based on 32-bit RISC cores with greatly simplified architectures.

Hitachi's SH7034 chip is a highly integrated device, with 4 KB of on-chip RAM and 64 KB of PROM, a DRAM controller, a four-channel DMA engine, twin serial ports, an eight-channel A/D converter, and a whole slew of timers and pulse generators. The SH7032 has no PROM, but it has a total of 8 KB of RAM. Both SH CPUs feature a 16- by 16-bit integer multiply-and-accumulate instruction that executes in one to three cycles, enabling fast digital signal processor–style signal and image processing. You could build a simple PDA around the SH by adding only display and PCMCIA controllers.

NEC's V810 is not as integrated, but it includes a single-precision FPU; a 16-bit-bus version, called the V805, is probably the smallest and lowest-powered

CPU chip currently available. The forthcoming V820 will have DMA, with serial ports and timers located on-chip, like the Hitachi SH series. Nintendo is rumored to be designing the V810 into a forthcoming CD-ROM games machine.

CISC chips are not entirely excluded from the PDA scene: Motorola designed its 68349 Dragon 1 in collaboration with General Magic for use in PDAs based around General Magic's Magic Cap operating system. The Dragon is 68000 compatible and has integrated data RAM and DMA and serial ports. However, Motorola also plans a fast RISC PDA chip based on the PowerPC.

CMOS a Must

All these chips are implemented in fully static CMOS so that you can slow or stop the clock and then restart it without losing the processor state. The Hitachi SH and Motorola Dragon chips include special sleep instructions that stop the CPU but continue to time the peripherals; the SH also has a standby mode that stops everything and reduces power consumption to a few microwatts. The Hobbit, ARM610, and V810 can be put into a similar state by external clock logic. All the chips come in low-power 3.3-V versions, but only NEC's V810 can currently operate reliably on the 2.7 V you get from two tired AA batteries.

Hitachi and NEC have made code density an issue for PDA processors, a reflection of their experience with embedded processors, where much of the software is held in on-chip ROM. The Hitachi SH employs a 16-bit instruction format, so its programs are only 60 percent to 70 percent the size they'd be on RISC chips with 32-bit instructions. The downside of these short instructions is some awkwardness, particularly with address arithmetic.

The NEC V810's instructions are mostly 16-bit with just a handful of 32-bit, while the Hobbit uses a variable-length encoding scheme that also yields good code density. The ARM610 uses all 32-bit instructions but shortens its code by condensing condition tests and operations into a single op code (e.g., `ADDEQ, add if Z flag set`).

Benchmark figures are even more contentious than usual in the PDA arena, as there's little agreement about the conditions under which power consumption, speed, or MIPS per watt should be measured. Rather than step into this hornet's nest, I'll just quote ballpark figures. Power consumption for the CPUs mentioned here all lie in the range bounded by the NEC V810's 100 milliwatts and the Dragon's 300 mW (all at 3.3 V), an order of magnitude less than the 3 to 5 W consumed by a typical desktop 486. NEC claims the V805 consumes only 28 mW at 2.2 V and 10 MHz. Apart from the Dragon, all the chips can process at 15 to 20 MIPS, placing them squarely in the 486 league.

Most observers agree that the NEC V805 offers the best MIPS-per-watt rating right now, but expect the lead to change continually as the CPUs are fabricated in better processes and with different degrees of integration. When comparing power consumption between a highly integrated CPU such as the Hitachi SH and one with fewer functions such as the NEC V805, you should add in the likely consumption of all the extra support chips that the latter chip requires. However, this is rarely feasible in practice.

An Integrated Future?

Adding more functions increases a chip's die size and hence its price, but so long as all those functions are useful there should be a net savings, thanks to the reduced external chip count. A highly integrated chip like the Hitachi SH will be cost-effective so long as you design a PDA precisely around the functions that it provides.

Another possible strategy, however, is to go with custom integration. Both ARM and NEC are offering their tiny RISC cores as macro cells for embedding into customized application-specific ICs, which could contain a set of peripheral functions precisely matched to a particular PDA's design. For example, by migrating to a 0.6-micron CMOS process, ARM should be able to fit most of the MessagePad's functionality (i.e., graphics, LCD, and PCMCIA controllers) onto a future CPU chip.

Intel and VLSI Logic recently revealed two PDA chip sets they're developing as a joint venture, based on Intel's 386SL and 486SL power-managed CISC processor cores. Code-named Polar (386) and Draco (486), both are twin-chip sets with one chip containing the CPU core, cache, memory and bus controllers, and a Windows-compatible graphics accelerator subunit, while the other holds keyboard, mouse, serial I/O, pen, and floppy and hard disk controllers and an HP-SIR infrared link.

Power management circuitry will be able to switch off individual peripherals according to demand, although no power or speed figures were available at press time. VLSI's high-bandwidth 25-pin ML bus is used to connect the chips together, which keeps the total pin count for the set to a reasonable 276. When the Polar and Draco chip sets become available this fall, you'll be able to design a PDA by just adding a PCMCIA controller chip.

In the end, it's likely to be consumer acceptance of PDA software that will determine the winners and losers among these CPUs, rather than their relative technical excellence. Those that achieve sales volume will survive. As PDAs come with most of their software built-in, the aftermarket for software may be small, making portability less of an issue than it is in the PC market. You might even see three or four different CPUs become established.

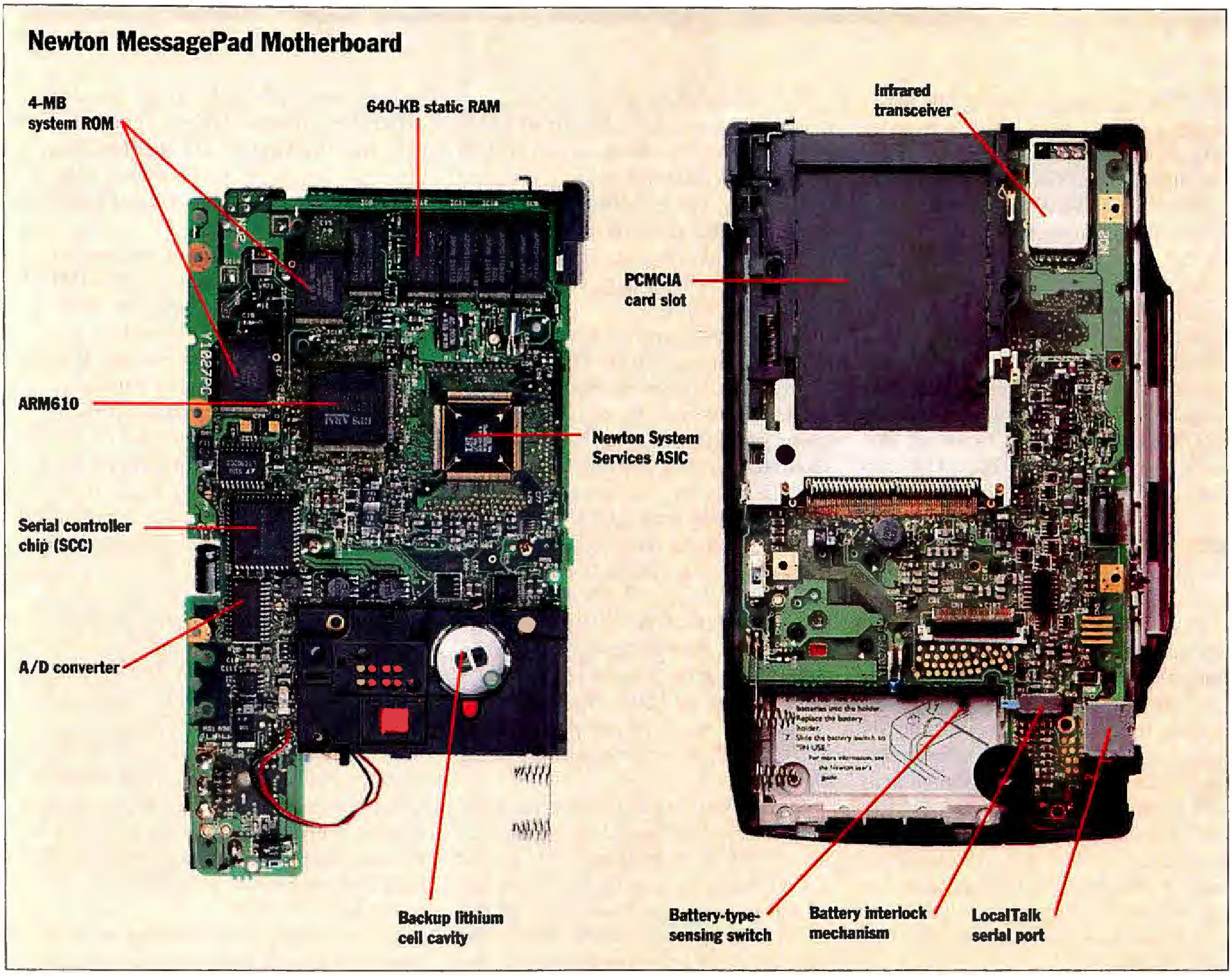
PDA PROCESSORS COMPARED

	ARM610	AT&T Hobbit	Hitachi SH series	NEC V810	Motorola Dragon	Intel Pentium
Die area (square mm)	71	92	92	53	100	294
Transistors	359,000	419,000	593,000	240,000	550,000	3.1 million
Cache	4K	3K	8K*	1K	1K	16K

* On-chip RAM.

Compared to the Pentium, *PDA CPUs seem puny in size, yet many deliver considerable punch. Small size and high performance are necessary for these small, battery-powered devices.*

Dick Pountain is a BYTE consulting editor based in London. You can reach him on BIX as "dickp" or on the Internet at dickp@bix.com.



resource and data forks.

PDA designers consider such details extremely important. Apple says it went so far as to hire a cultural anthropologist to observe people and notice how they use such things as Post-it Notes and other traditional tools. "You have to go beyond ease of use and provide assistance to the user," says Shifteh Karimi, user studies manager for Apple's Newton Group.

Again, PDAs are giving us a peek at the future. Desktop computers are moving toward the same datacentric philosophy, although retrofitted solutions such as OLE 2.0 and Amber/OpenDoc are not as elegant. Desktop PCs could also benefit from Newton's abstract file system, as mass-storage devices with gigabyte capacities strain users' ability to find individual files in deeply nested stacks of folders and subfolders.

The Zoomer's Architecture

Apple is by no means alone in recognizing the value of a new user interface for a product aimed at the masses. The Zoomer takes a strikingly similar approach, even though it's built atop an entirely different architecture.

While Apple spent millions of dollars infusing the MessagePad with the latest technology—an advanced operating system, an optimized development language, an ARM610 (Advanced RISC machine) RISC chip—Tandy tried to reduce costs by building the Zoomer with tried-and-true parts. Casio designed an Intel-compatible CPU that's equivalent to a 7.5-MHz 8088. GeoWorks adapted its desktop GEOS environment to reside in ROM. Palm Computing wrote almost all the applications software in assembly language and created an extremely compact handwriting recognizer that fits in 48 KB. Intuit contributed Pocket Quicken, a mobile version of its best-selling money management program.

But despite their different evolutionary paths, the MessagePad and the Zoomer could appear very much alike to casual users. Not only do they look like twins, but they'll also hit the street at about the same price ($700), and both conceal their internal complexities with remarkably similar user-interface layers.

Both the MessagePad and the Zoomer are instant-on/instant-off devices that automatically drop you at the same spot in the same document from your previous session. Both allow you to move transparently between applications by tapping on a row of "hard icons," affixed to the bottom of the screen, or "soft icons," displayed on the LCD. Both shield you from their underlying file systems, although the Zoomer lets advanced users run a File Manager that exposes the realities of DOS. Both have similar communications capabilities and a suite of applications in 4 MB of ROM.

Structurally, however, they're worlds apart. GEOS has high-level objects that save a lot of coding for applications programmers, but it has nothing like Newton's object-oriented database.

Applications share data the traditional way: by exchanging (and, if necessary, translating) discrete files or by sending

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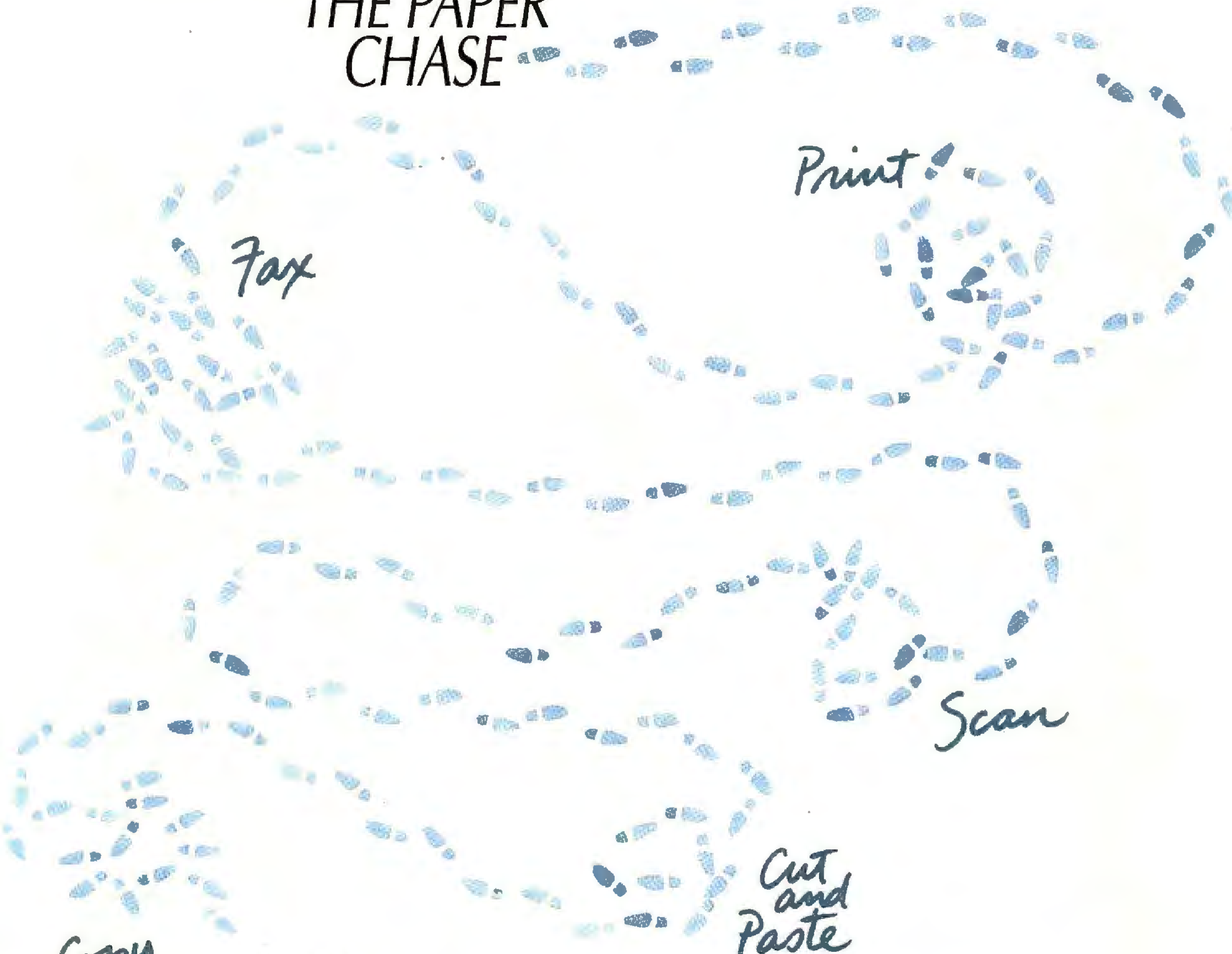

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The Wireless Factor

BOB RYAN

Before they can be more than just expensive electronic organizers, PDAs must let you communicate with other people and computers no matter where you are. Your PDA should let you send and receive E-mail messages, faxes, and even files and data from your desktop computer, network server, or other repository without having to be connected to a telephone jack. In fact, the lack of two-way wireless data communications ability is one of the biggest disappointments in the Apple Newton MessagePad and Tandy/Casio Zoomer.

At present, the most widespread, general-purpose two-way wireless communications network is the analog cellular phone network. You access this network with a PDA or a personal computer the same way that you access the wired analog phone system: by using a modem that translates between the digital world of your computer system and the analog signals used by the telephone system. Of course, using a cellular modem is not as simple as using a wired one. Modems today depend on carriers and other signals generated by central telephone switches. Using a standard modem with a cellular phone requires a special adapter that can supply these signals to the modem.

In addition, most modems today are not designed to work in a mobile environment. The slight interruption in your connection that occurs when you move from one cell to another is unimportant in terms of a voice connection, but it can wreak havoc with a modem connection. Also, wireless connections are subject to a greater amount of interference than wired ones, meaning that cellular modems require far more robust error detection than wired ones.

One company that's addressing these problems is Microcom, which has developed the MNP 10 protocol for cellular connections. MNP 10 supports smooth handoffs, has a lot of error checking, and can negotiate bit rates in real time as a cellular connection deteriorates or improves. Unfortunately, none of the currently available PDA devices use MNP 10.

Upgrading Cellular

Coming soon is CDPD (cellular digital-packet data), originally developed by IBM and backed by a formidable group of companies, including Ameritech Cellular, AT&T, McCaw Cellular Communications, Motorola, and Nynex Mobile Communications. CDPD is a specification that lets you send data over an enhanced cellular network. CDPD uses a full voice channel, but it can move your connection from one channel to another to avoid congesting voice communications. At 19 Kbps, it offers a lot of bandwidth.

The drawback to CDPD is that it requires that you have a CDPD modem and that your cellular supplier upgrades its base stations to CDPD. Thus far, only Ameritech, Bell Atlantic Mobile, and McCaw have announced plans to deploy CDPD throughout their networks. McCaw plans to have CDPD up and running in its 105 markets in the U.S. by mid-1994. On the end-user side, IBM and Eo are developing CDPD capability for their machines, while Motorola is developing a CDPD modem on a PCMCIA Type 2 card.

Competing directly with CDPD and analog cellular are the Ardis and RAM Mobile Data digital RF data networks. Unlike CDPD, Ardis and RAM are digital technologies from the ground up. They offer inherently better data transmission facilities than analog services. Ardis, jointly owned by Motorola and IBM, supplies dedicated radio communications networks to large corporate customers. RAM Mobile Data, with base stations in major metropolitan areas in the U.S., sells its services to anyone. It provides a wireless bridge to public data networks and services. Besides using digital technology, Ardis and RAM have one other advantage over CDPD: They're available today.

The User Experience

Whether you use digital RF or analog cellular, the connection you make over current wireless networks looks just like the wirebound connection you make with any terminal-based telecommunications program. Given that telecommunications remains the most arcane, unfriendly application in personal computing, this is a major problem for PDA vendors and service providers. If PDAs require their computer-ignorant target audience to learn the equivalent of even one of the easier-to-use packages, such as Procomm Plus, to communicate, then Apple, Eo, Tandy, and all the rest may as well fold their tents now. "Without ease of use," says Gerry Purdy, chief analyst for mobile computing at Dataquest, "[wireless providers] will always be selling to early adopters."

Luckily, both Newton Intelligence and Go Corp.'s PenPoint are built with communications in mind, as is Magic Cap, a software communications platform for PDAs under development by General Magic. In addition, General Magic has developed Telescript, a portable programming language designed to make it easy to develop communications applications. General Magic has revealed little technical information about Telescript, but both Apple and Eo have licensed it for use in future versions of their PDAs. In addition, AT&T is developing a network service that incorporates Telescript. General Magic hopes to make Telescript the lingua franca that spans and binds together applications, operating systems, and networks that support personal communications.

Today, the hardware and networks are in place to enable wireless mobile data communications, although the software and services that are needed to make such communications easy is not yet here. This imbalance is not very important now, as most early PDA adopters will likely be PC users. In the future, however, the success of PDAs will hinge on the success of technologies like Telescript.

Bob Ryan is a BYTE technical editor. You can reach him on BIX as "b.ryan" or on the Internet at b.ryan@bix.com.

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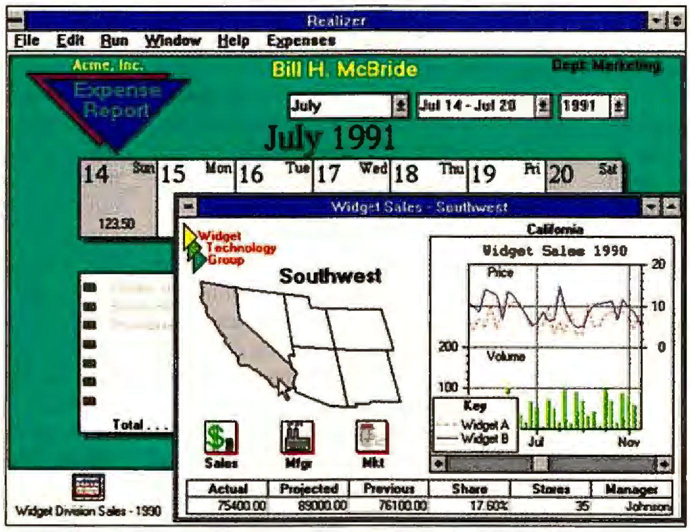

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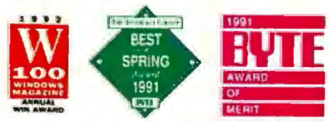

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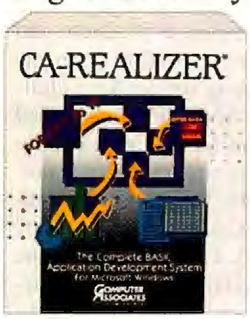

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messages. Although GEOS is not chained to the DOS file system, it maintains the link to DOS for file compatibility. Yet the Zoomer cannot run DOS programs; with the exception of Grid PenRight applications, the ability to run DOS executables was deliberately disabled because of limitations imposed by the 320- by 256-pixel screen.

Naturally, GeoWorks CEO Brian Dougherty doesn't view these differences as a handicap. The Newton architecture is unproven, he points out, and GEOS provides a rich operating environment for PDAs that is being widely licensed to several vendors (including Apple's Newton partner, Sharp). Programs written for the desktop version of GEOS can be ported to the Zoomer without recompiling, because GEOS decouples the user interface from the application code.

The PDA version of GEOS crams plenty into 1.5 MB of ROM: about 40 printer drivers, an imaging engine, IAC, multithreading, on-line help, PCMCIA support, high-level objects for programmers, and peer-to-peer networking via the serial and infrared ports. Approximately 1 MB of this ROM-based code must be bank-switched into RAM, because only the low-level kernel is XIP (executable in place). Dougherty says the next version of GEOS will keep more XIP code in ROM to minimize bank-switching, thus taking some load off the slow CPU.

If the Zoomer's 8088-class CPU wasn't limited to real mode, GEOS could run in protected mode, mapping the ROM into flat address space. With additional RAM, this could eliminate bank-switching altogether and speed up the machine considerably.

Dougherty would love to see this happen. In fact, from the very beginning he pushed Casio to build the Zoomer around a more powerful 80x86-compatible CPU, such as Chips & Technologies' PC/Chip, but he says Casio insisted on using a less powerful chip to maximize battery life. However, future versions of the Zoomer could escape that trade-off. Intel and VLSI Logic are developing a family of highly integrated chips that combine the logic cores of the 386SL and 486SL with other system components to make a two-chip solution for 80x86-compatible PDAs (see the text box "PDA CPUs: New Form Demands New Functions"). Neither Tandy nor Casio has announced plans to use the Intel/VLSI option, however.

Early Adopters or Suckers?

Although the MessagePad and the Zoomer fall short of some expectations and are relatively costly, from a purely technical standpoint they are both undeniably impressive. Compared to their distant ancestors that also broke new ground—the Apple I and the Tandy/Radio Shack TRS-80 Model I—they are remarkably mature products.

They also have bigger ambitions. With sub-$1000 prices, soon to drop below $500, there's not much profit in PDAs. To succeed as mass-market consumer items, PDAs ultimately must move in volumes measured in the millions.

Apple in particular has a lot riding on this gamble. Newton is one of Apple's answers to Microsoft's "Windows everywhere" strategy (see "Windows, Windows Everywhere?" in the June BYTE), and it's one of the two major projects on which Apple is betting its future. If Newton flops, and if the Mac doesn't make the transition to the PowerPC chip, Apple may not survive the 1990s. At the very least, it could lose its seminal position as a leading-edge computer company.

It may be years before PDAs match the sales volumes of desktop PCs, and whether Apple and others can wait that long depends partly on how many "early adopters" are willing to go out and purchase the first PDAs and fund the ongoing evolution. Nearly everyone agrees that those early adopters won't be the same people who are the eventual targets of PDAs. "We see the early adopters being PC users, but [sales] quickly moving to people who never considered buying a computer," says GeoWorks' Dougherty.

Dougherty envisions a not-too-distant future when PDAs are as ubiquitous as radios. "The average household has seven radios, and most people don't even realize they have seven radios until they start counting their clock radio, their Walkman, the stereo system, the car radio, and so on. We see the same thing happening with devices like the Zoomer as they get down to calculator prices. And that will happen sooner than you think," he predicts.

Dougherty estimates the bill of materials for a Zoomer-type device to be about $150, with the LCD being the most expensive component (about $30). Those costs will drop as volumes grow. Within two years, he says, a Zoomer could sell for as little as $300. That would put it in direct competition with personal organizers and pocket pagers. Dougherty points out that the current market for organizers is approximately 5 million units per year and that pagers are selling at a rate of approximately 2 million units a month. Dataquest projects that PDA unit sales in the U.S. will grow from 70,000 this year to 3.62 million in 1997.

Like the primitive personal computers of the 1970s, the MessagePad and the Zoomer have an air of future potential, of something young that's just on the verge of making it big. It's only a matter of time before their handwriting recognition improves and new applications are invented for them. They fit well into today's busy lifestyles, and they're perfectly positioned to ride the rising waves of wireless communications and data superhighways. In 10 years, these unassuming little devices could conceivably become the dominant personal computer platform. Desktop PCs will still be around, as mainframes and minicomputers are today, but most "personal computing" will probably happen on PDAs.

"There's a major intimidation factor with a computer," says Michael Reimer, chief operating officer of ParaGraph. "It has a scary-looking keyboard and a big monitor that stares back at you. The Newton is a very different kind of device: It's small, it's soft. It doesn't intimidate. It's like a Walkman."

However, there are some naysayers, too. Michael Homer, Go's vice president of marketing, predicts that consumers will find the MessagePad and the Zoomer too expensive and disappointing. "I don't think the Newton and the Zoomer are viable machines. There's no magic going on here," he says.

The future of PDAs isn't riding solely on the Newton MessagePad and the Zoomer. Both are promised to be only the first in wide-ranging families of products, and other contenders are poised to enter the race as well. Among the leading challengers will be the first PDAs to be based on Microsoft's WinPad and General Magic's Magic Cap. The millions of R&D dollars spent by Apple, Tandy, Casio, GeoWorks, Palm, Eo, Go, and other pioneers will not be wasted. Eventually someone will leverage the investment into a successful product.

Let's just hope we don't have to wait until the twenty-fourth century for that to happen. ■

ACKNOWLEDGMENTS

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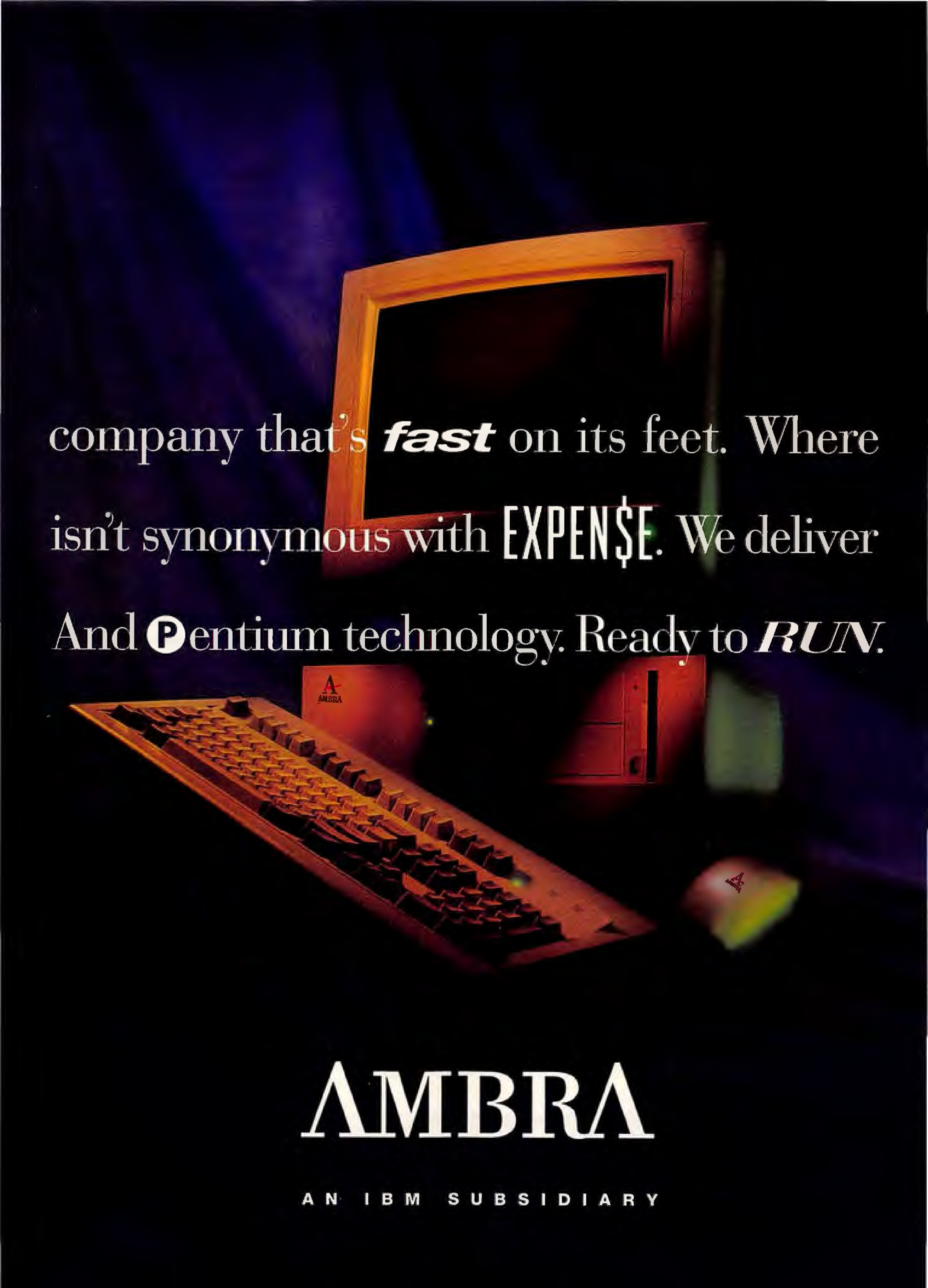
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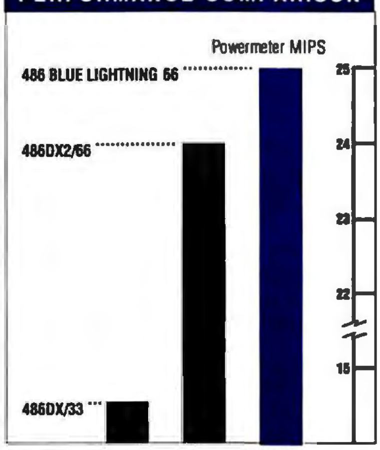

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RAM	8MB	8MB	8MB
Cache	**256KB**	128KB	—
Floppy	One	One	One
Hard disk	340MB	340MB	340MB
Onboard SCSI	✔	—	—
Local bus	✔VESA	✔VESA	✔
Video	Win accel w/1MB	Win accel w/1MB	Win accel w/512KB
Color monitor	15" FST*	15" FST	15" FST
Pentium-ready	✔	✔	✔
DOS 6.0, Windows 3.1, mouse	✔	✔MS Works for Windows	✔
Network-ready	**Ethernet (10BaseT)**	—	—
Tech support	24 hours, 7 days/week	Mon-Fri, 6am to midnight Sat, 9am-4pm	24 hours, 7 days/week
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Cache	256KB	256KB
Floppy	One	Two
Hard disk	**540MB SCSI**	500MB IDE
Onboard SCSI	**✔Dual 32-bit**	—
Local bus	✔VESA	✔
Video	**ATI™ Ultra Pro w/2MB DRAM**	Win accel w/512KB
Color monitor	15" FST*	15" FST
DOS 6.0, Windows 3.1, mouse	✔	✔
Tech support	24 hours, 7 days/week	24 hours, 7 days/week
Warranty/Service	1 year onsite	1 year onsite
Price	**$4,259**	$7,566

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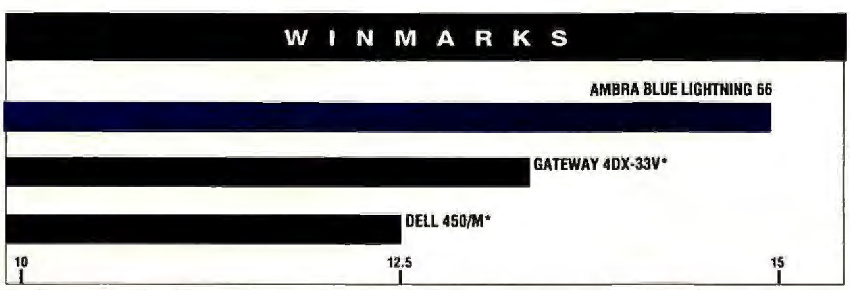

*Results measured in millions of Winmarks.™ Reported in *Window Sources* (Ziff Davis), June 1993. Call AMBRA for specifics of this graphics Winmarks test.

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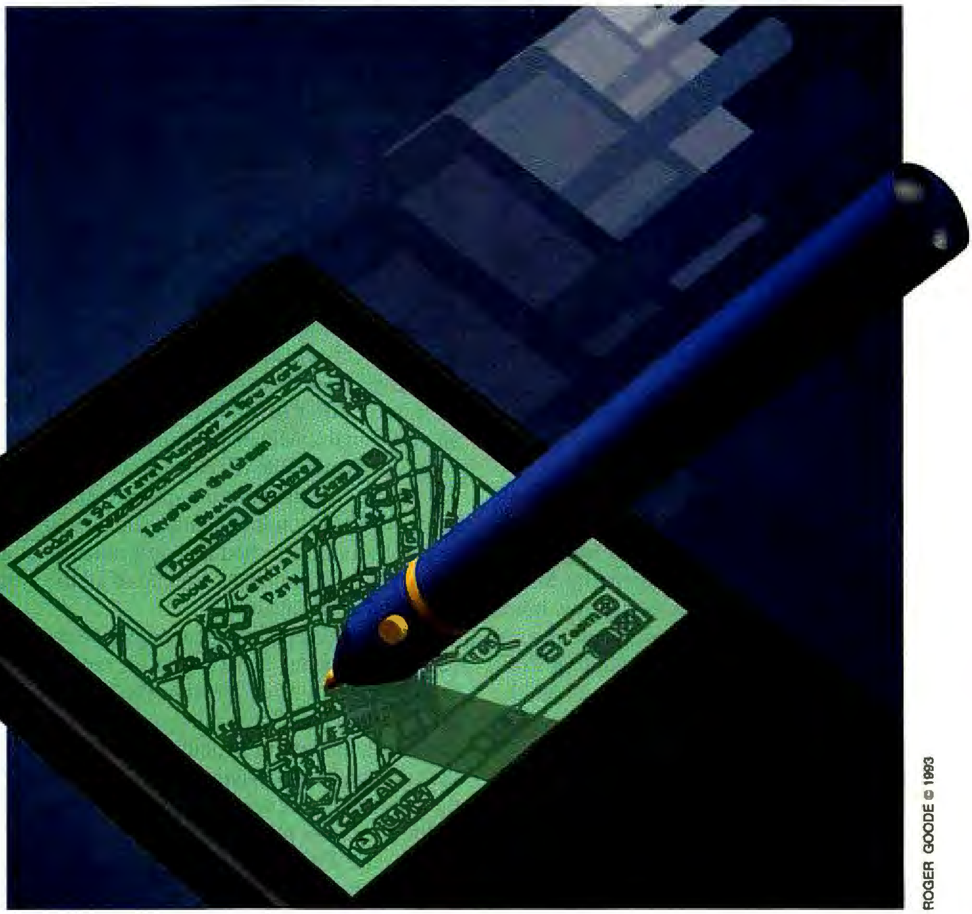

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TOM THOMPSON, TOM R. HALFHILL, AND MICHAEL NADEAU

Hands-on evaluations of the Apple Newton MessagePad, Tandy/Casio Zoomer, and the Eo 440 Personal Communicator

No matter what hardware is inside or how the operating system works, PDAs (Personal Digital Assistants) must provide valuable applications and be easy to use if they are to succeed. In general, the Apple Newton MessagePad and the Tandy/Casio Zoomer have accomplished both, but perhaps not well enough for their ultimate target audience, the computer-illiterate consumer.

The pen interface, with its finicky handwriting recognition, requires patience. The number of applications is limited for now. And communications capabilities are still incomplete; you can only send faxes, and the wireless infrastructure that will provide many of the promised information services is still being built.

The Eo Personal Communicator is not a true PDA, but it provides an example of how well a portable, wireless communications device can be built using the technology and services available today.

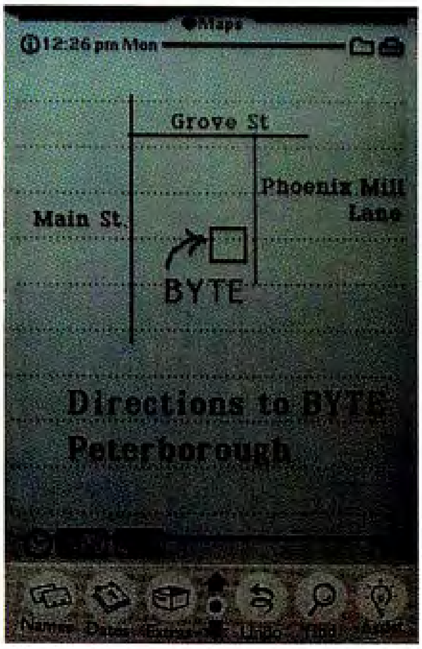
MessagePad Stretches to Fit

Using the MessagePad is like breaking in a new pair of shoes. You might experience a few pinches at first, but eventually they stretch to fit you.

The MessagePad fits snugly in the hand, measuring 7¼ by 4½ inches and three-quarters of an inch thick. The unit weighs nine-tenths of a pound. It's equipped with 4 MB of ROM that contains the Newton Intelligence and the following applications: Notepad, Date, and Name. The 640 KB of static RAM holds the Newton Intelligence's working data, and about 200 KB is free for your use. It's powered by a 20-MHz ARM610 (Advanced RISC machine) RISC processor.

The text interpreter works well. It recognized the first three words of the message "handwriting recognition fairly hit-and-miss," but it came up with gibberish for the last phrase. The reason for this error was the two hyphens. According to a draft copy of the MessagePad Handbook, punctuation must be placed close to the words to be recognized properly. Because the recognizer uses dictionaries and name lists (i.e., your own additions to the dictionary) for the recognition process, the results of its handwriting interpretation are frighteningly accurate or a hodgepodge of obscure words and numbers. Nevertheless, the recognizer is very adept at handling certain writing idiosyncrasies. For instance, we found that dotting all the *i*'s after writing a word didn't bother the recognizer a bit.

A Handwriting Practice section gives you practice words to write so that Newton Intelligence can adapt to your writing style. It takes about 150 words to train the text interpreter. When you use



The MessagePad *features a row of "hard icons" at the bottom of the screen that provide access to frequently used functions.*

a MessagePad for the first time, it pays off to spend a half-hour or more in this section giving the recognizer time to study your penmanship. In the Handwriting Styles section, a slider lets you specify how much of your writing is cursive, printed, or a mixture of the two. A Recognition Preferences section lets you fine-tune both the handwriting recognizer and graphics interpreter for certain situations (e.g., in text, to recognize numbers and punctuation; in graphics, whether to connect shapes in a drawing).

Once the MessagePad was trained to recognize an individual's handwriting, its text recognition was more impressive than that of the Zoomer or Eo 440. Still, be prepared to use Undo and practice the gestures you must use to make corrections.

Another nice feature of the MessagePad is that you can select an object (e.g., a chunk of text or a drawing), "park" it by dragging it to the screen's edge, flip to another Newton application, and drag the object into that application. It's a nice visual metaphor for a clipboard that should be easy for the noncomputer user to grasp. Also, programs can control what type of information gets placed in an object. For example, when you enter your phone number in the Personal area, the window you write in accepts only digits. This goes a long way toward reducing user errors.

To test printing capability, we first scribbled a note in Notepad and then plugged the MessagePad into a LocalTalk node on BYTE's AppleTalk network. From the Outbox, a printer-selection window showed the various network zones and PostScript printers. We tapped on a printer name, tapped on the Close box, and then tapped on a Print button. A minute later, a duplicate of the note appeared on a page coming out of a LaserWriter Pro 630.

An attempt at faxing the note didn't fare so well, however. Lacking a MessagePad fax modem, we plugged a Global Village TelePort/Gold fax modem into the MessagePad's serial port. According to the status window that appeared, the MessagePad was attempting to connect to the modem, but it never succeeded. So much for using third-party modems at the moment, but remember, we were looking at beta hardware and software.

For third-party hardware, we received a 2-MB PCMCIA RAM card from Epson. We put it into the card slot and switched the MessagePad on. Although this card was originally designed for PC notebooks, the MessagePad recognized it and asked us to erase it. After several seconds, we had an additional 2 MB of memory—a good show for Apple PIE (Personal Integrated Electronics), Epson, and hardware standards. The Newton Intelligence allows you to file individual schedules and notes to the RAM card or make a backup of all the MessagePad's data to it.

From the Notepad application, we wrote "See Rob Monday at 10"; after we tapped on the Assist button, Newton Assistance opened the Date Scheduling application, found the upcoming Monday's date, and then dropped a note saying "See Rob" into the 10:00 a.m. slot on the appropriate day.

Judging from just the built-in Notepad, Name, and Date applications, the MessagePad doesn't seem much of a win. After all, you can use a low-tech schedule book and business cards to arrange meetings and stay in touch. However, a MessagePad equipped with a fax modem and a Messaging Card changes the situation: You can fire off a diagram or a note to a contact's fax or E-mail address from nearly anywhere. The Messaging Card—actually a wireless pager that receives text messages—in turn lets your contacts get back to you immediately. For those folks who are on the road constantly but must still make quick business decisions, the MessagePad might be a solution.

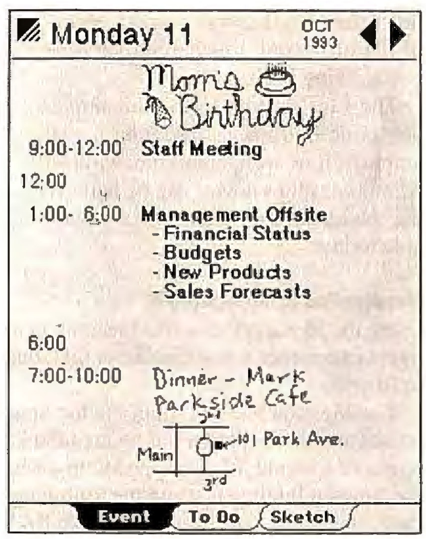
Third-party Newton applications may make a case for owning a MessagePad. Fodor's 1994 Travel Manager program from GeoSystems lets you call up maps of the eight largest cities in the U.S., locate hotels, and obtain their phone numbers (see the screen on page 92). Selecting a hotel in, say, Boston gets you a map of the city with a diamond icon pointing out where that hotel is located. Tapping on the diamond zooms you in on a map of the city block, complete with street names.

You can then summon a From/To window, where you can drop in the hotel's name and the name of a restaurant you've already located. You then get either street-by-street directions or a line on the map tracing the route from the hotel to the restaurant. The ability to navigate through a new city using the MessagePad shows its value as a general-purpose device, given the proper software.

For vertical markets, the MessagePad's light weight, combined with the ability of Newton Intelligence to restrict the types of data entry it will allow, makes it suitable for forms handling. For example, an insurance company's accident form might allow text entries in some sections and only numbers in other sections and provide an area where a field agent can sketch an accident scene using only ink.

The synergy of Newton's Intelligent Assistance together with the object database is what makes the MessagePad a winner. The ability of Newton Intelligence and applications to locate information within the system and then act on it in rational ways is a major improvement over desktop operating systems. Once a contact's relevant information (i.e., address, phone number, fax number, and E-mail address) is captured in a MessagePad loaded with communications options, you can call that person, fax him or her, schedule appointments, or send the person E-mail with a few stylus strokes.

Newton Intelligence eliminates the many redundant operations (i.e., launching



The Zoomer *emphasizes ink capture over handwriting recognition, which suffers from a slow, 8-bit processor.*

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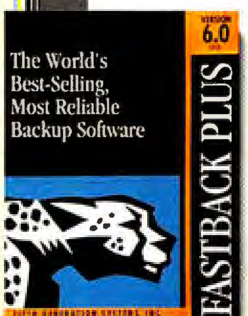

Then we invited 40 users – novices, propeller-heads, people who swear by Fastback, people who swear at it, and people who swear they've never seen it – to visit our offices and work with us personally.

During 30 days of interface design and usability testing, we ran up some hefty hotel bills. And learned some valuable lessons.

We learned, for example, that our installed base is nostalgic for the simple, straightforward, everything-available-at-a-glance interface we used way back in Version 2.0.

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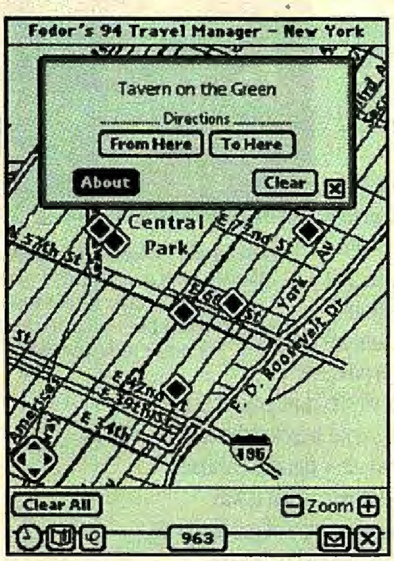
APPLICATIONS ON THE WAY

Although the MessagePad, Zoomer, and Eo Personal Communicator come bundled with several applications, you will most likely see more by the end of the year. Below is a representative sampling of what to expect.

Apple Newton MessagePad
(all application titles come from Apple's Starcore division)

- Fodor's 1994 Travel Manager: Top U.S. Cities: Contains detailed interactive maps highlighting destinations and routes in eight U.S. cities.



GeoSystems' MessagePad application, *Fodor's 1994 Travel Manager, in use. The diamond at the lower left is your current location. The other diamonds indicate the locations of restaurants, selected by search criteria such as distance, cost, ethnic cuisine, and other parameters.*

- Fortune 500 Guide to American Business: An expanded electronic version of the Fortune 500 and Service 500, with information on all aspects of America's largest companies.
- Money Magazine Financial Assistant: Includes calculation templates for evaluating a number of the most common financial decisions.
- Money Magazine Business Forms: Makes it easier to fill out the most commonly used financial forms, including expense reports, project plans, and loan calculations.

Eo Personal Communicator

- Gnosis, from Deskin Research Group, is a document retrieval and information management package.
- Pensil, from First Software, is a C development tool for PenPoint.
- Letter Express, from PenMagic Software, is a database of canned letters for use in business correspondence.
- SimCity, from Ink Development, is a PenPoint version of the popular simulation game.
- Pen Op, from Peripheral Vision, is a signature recognition and verification package.

an application, locating a file, opening the file, and then searching for the desired data within the file) that you have to do on a desktop computer to accomplish the same thing, and it's a model that desktop computers should adopt. The MessagePad's implementation of this intelligent assistant is by no means perfect, but it's a huge step in the right direction.

Zoomer: Hands-On

Tandy's version is called the Z-PDA, and Casio's model is known as the XL-7000, but the two are virtually identical PDAs known collectively as the Zoomer. Software, peripherals, and accessories bearing the Zoomer name are compatible with either device, and a pair of Zoomers can exchange information via their 9600-bps wireless infrared transceivers.

The Zoomer bears a strong resemblance to Apple's MessagePad, and indeed they have several features in common: a touch-sensitive LCD screen with a passive stylus; 4 MB of ROM, containing all the system software and built-in applications; a simplified pen-oriented user interface; a Type 2 PCMCIA slot for add-in cards; and an infrared transceiver for sharing data with compatible devices. The Zoomer measures $6\frac{3}{4}$ by $4\frac{1}{5}$ inches and is 1 inch thick. It weighs 1 pound. On the street, both PDAs sell for around $700.

Internally, however, the Zoomer and the MessagePad are different animals. The Zoomer has a 7.5-MHz 8088-compatible CPU made by Casio and runs a pen-based version of GEOS, a desktop operating system from GeoWorks. The Zoomer has a character-by-character handwriting recognizer that reads only block printing, not cursive writing, and it is not trainable. It has a little more RAM than the MessagePad (1 MB instead of 640 KB) and sets aside more of that RAM for storing user data (384 KB, versus about 200 KB for the MessagePad).

The Zoomer also has more built-in software—particularly content-oriented software. Standard applications (all written by Palm Computing) include a date book, an address book, a notebook, a to-do-list manager, a calculator, a dictionary with 60,000 definitions, a 100,000-word spelling checker, a 660,000-word thesaurus, translation dictionaries (1000 words in 26 languages), world clocks, a form calculator (including measurement and currency conversions), and an almanac listing U.S. holidays, area codes, information on cities around the world, and even the complete text of the U.S. Constitution and the Declaration of Independence.

Intuit contributed Pocket Quicken, a mobile version of its best-selling personal finance program, and America Online provided a terminal program that lets users send E-mail, access on-line information, and download software.

Of course, to get on-line you'll need a modem. A PCMCIA fax modem for the Zoomer is in the works, but you can connect just about any external modem via the RS-232 port. An optional adapter cable converts the subminiature 10-pin D-type connector into a standard DB-9 connector. With appropriate software, this will also allow the Zoomer to exchange files with desktop computers.

The Zoomer is powered by three AA batteries, and alkalines are rated for about 100 hours of use. Two CR2032 lithium cells preserve your RAM-based data if the main batteries go dead or need changing.

Flipping back a protective plastic cover reveals the Zoomer's 320- by 256-pixel passive-matrix LCD screen, which measures 80 by 100 millimeters. Contrast is rather low, but the screen is readable in normal light. There's no backlighting, so you can't use the Zoomer in the dark.

The screen, of course, doubles as your input device. Writing on the Zoomer is easy—almost too easy. Because the plastic stylus glides across the slick surface with less resistance than that of a pencil on paper, it feels a little strange at first. But you'll adjust quickly. If you lose the

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- **TOUCH:** Resets the DOS date/time on all files described to the current date and time (works great before DATECOPY for flexible backups).
- **MOVE:** Move subdirectory and contents to another directory.
- **DELDIR:** Delete an entire subdirectory and its contents in one command.
- **NUKE:** Delete and overwrite any file for security (cannot be un-deleted).
- **GETINI:** Reports any .INI files that match input variable.
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stylus, any implement that isn't too sharp will work just as well. (The programmers at Palm seem to favor wooden chopsticks.)

How good is the Zoomer's handwriting recognition? That's the gritty question everyone asks about pen-based devices, even though many PDAs (including the Zoomer) are designed to minimize free-hand translation. On the Zoomer, for example, you can navigate through most functions merely by tapping icons with the stylus, and you can switch off the recognizer to save your writing as digital ink.

But eventually you will want to write something and see it translated, because that's the only way to create information on the machine, unless you pop up the on-screen QWERTY keyboard. Some Zoomer proponents are enthusiastic about tapping letters on the keyboard; they say it's easy to learn and is often faster than relying on the recognizer.

Their first point may be true, but it raises the question of why you'd want to use a QWERTY keyboard on a pen-based PDA when the market is already crowded with similar devices that have real QWERTY keyboards. And the second point, unfortunately, also appears to be true: Handwriting recognition on the beta version of the Zoomer we tested was slow and not as reliable as we'd hoped.

It usually takes several seconds for the recognizer to convert a word into text. After you write a few words, the delay begins to add up, and you have to wait until it's finished converting, because there's no room on the screen to write anything more. Then you have to go back and correct the words it misinterprets.

The Zoomer's recognizer isn't trainable, but you are. Don't be surprised if you start bending to the Zoomer's demands. For example, one of us normally prints an uppercase *M* by drawing two vertical strokes joined with a *V*. The Zoomer got it wrong every time; it prefers to see an *M* drawn with a single zig-zag line. He soon began pleasing the Zoomer by changing his style, which has been burned into his ROM since the first grade.

Although the Zoomer's architecture can accommodate a different recognition engine, such as the ParaGraph recognizer on the MessagePad, that's not likely to happen until the hardware gets more powerful. The Zoomer's PalmPrint recognizer needs only about 48 KB of memory, and it's one of the few engines that runs on a CPU as slow as the Zoomer's 8088-class chip. A faster Zoomer would not only eliminate the annoying translation delays, but it would also enable Palm—or another company—to build a better recognizer.

Aside from the handwriting-recognition problems, we found the Zoomer a joy to use. The user interface is simple and straightforward. The date book and address book are logically organized, and we especially liked the ability to attach a hand-sketched map of directions to an address entry. The content-oriented material adds a lot to the Zoomer, although we wonder if there aren't better uses for the ROM than throwing in such things as birthstones, zodiac signs, and historical documents. We would vote for a generic terminal program that isn't dedicated to America Online, or even a chess game.

The Zoomer lends itself to games, of course. Its front panel has a directional pad and a pair of control buttons, just like a Nintendo Game Boy. The Zoomer will probably ship with a couple of simple games to get you started.

Considering their radically different hardware and software architectures, it's remarkable how closely the Zoomer compares with the higher-tech Newton. Their hidden differences will undoubtedly become more apparent as they evolve. And further evolution is mandatory before either platform is likely to reach its goal of bringing personal computing to the masses.

Eo: The Road Less Traveled

The smallest Eo, the 3-pound 440, dwarfs true PDAs. It's roughly the size of a sub-notebook PC, measuring 10⁴⁄₅ by 7¹⁄₁₀ inches and nine-tenths of an inch thick. Eo calls its systems Personal Communicators, which emphasizes their greatest strength. Portability and battery life (about an hour) were sacrificed to optimize the system for wireless communications.

For on-the-road communications, Eo's Personal Communicators are armed to the teeth. Both have a 14.4-Kbps cellular modem with 9.6-Kbps fax capability, along with Go Mail and Go Fax software. SunSelect's PenTops provides connectivity to your desktop and to LANs. Eo Sound allows you to voice-annotate a document. The unit's larger screen aids in creating and viewing faxed forms and documents. A detachable phone headset provides voice connections. To top it off, you get a free subscription to AT&T Mail. Of course, you'd *better* get extras like this: Prices for the Eo 440 start at $2800 with a hard drive and modem.

Go Corp.'s PenPoint operating system provides the pencentric interface. If you've used PenPoint on, say, a 386 system, be prepared for a surprise when you run it on the Eo 440—performance is dramatically better. That's because of the Eo 440's 20-MHz AT&T Hobbit CPU. With 13 MIPS to work with, PenPoint runs at a snappy pace. If you need even more speed, the Eo 880's 30-MHz Hobbit processor cranks out 20 MIPS, but the cost is a bigger unit that weighs 4 pounds.

Using the Eo's communications features is easy, but not completely foolproof. Even though we received a crash course in sending a fax via the Eo's cellular modem, we had trouble repeating the process later—without reading the documentation.

To fax a note from the Eo 440, you go to the Document menu item and select Send. Send gives you the option of choosing Go Fax or Go Mail (for selecting AT&T Mail). Selecting Go Fax brings up a cover sheet form on which you can write a note. After you fill in the name and number of the person you're sending the fax to—data you can either select with a few pen taps from a database or write in—Go Fax places the note in the Outbox.

From here, it becomes unclear what you need to do, as no prompt appears on the screen. To finish sending the fax, you go to the Outbox and tap on the Enabled box. A Dialing Location box then appears so that you can confirm or change information such as where you're dialing from, whether you wish to use a calling card, and so on. From this point, things are pretty automatic. Go Mail follows a similar process, but it has options such as selecting a file format for sending your fax.

This is not an onerous procedure for the Eo's target business user. But Apple and other PDA vendors cannot expect customers who have never used a cellular phone or a modem to embrace this kind of a ritual. Immediate gratification is key; PDA users should only have to make a couple of selections to make the connection they desire.

The PenPoint interface is easy to use, but a little less so than that of the MessagePad or the Zoomer. PenPoint has more menu and file layers. With its book-like table of contents, however, PenPoint could be easily adapted to provide a familiar interface metaphor for novice users. Our hands-on experience with these first PDAs shows that their ease of use is relative to the expectations of the user. Savvy computer users would say that the MessagePad, Zoomer, and Eo 440 are highly intuitive. Yet all have too many quirks and rough edges to make it in the mass consumer market. ■

Tom Thompson is a BYTE senior technical editor at large. Tom R. Halfhill is a BYTE senior news editor. Michael Nadeau is a BYTE senior editor. You can reach them on BIX as "tom_thompson," "thalfhill," and "miken," respectively.

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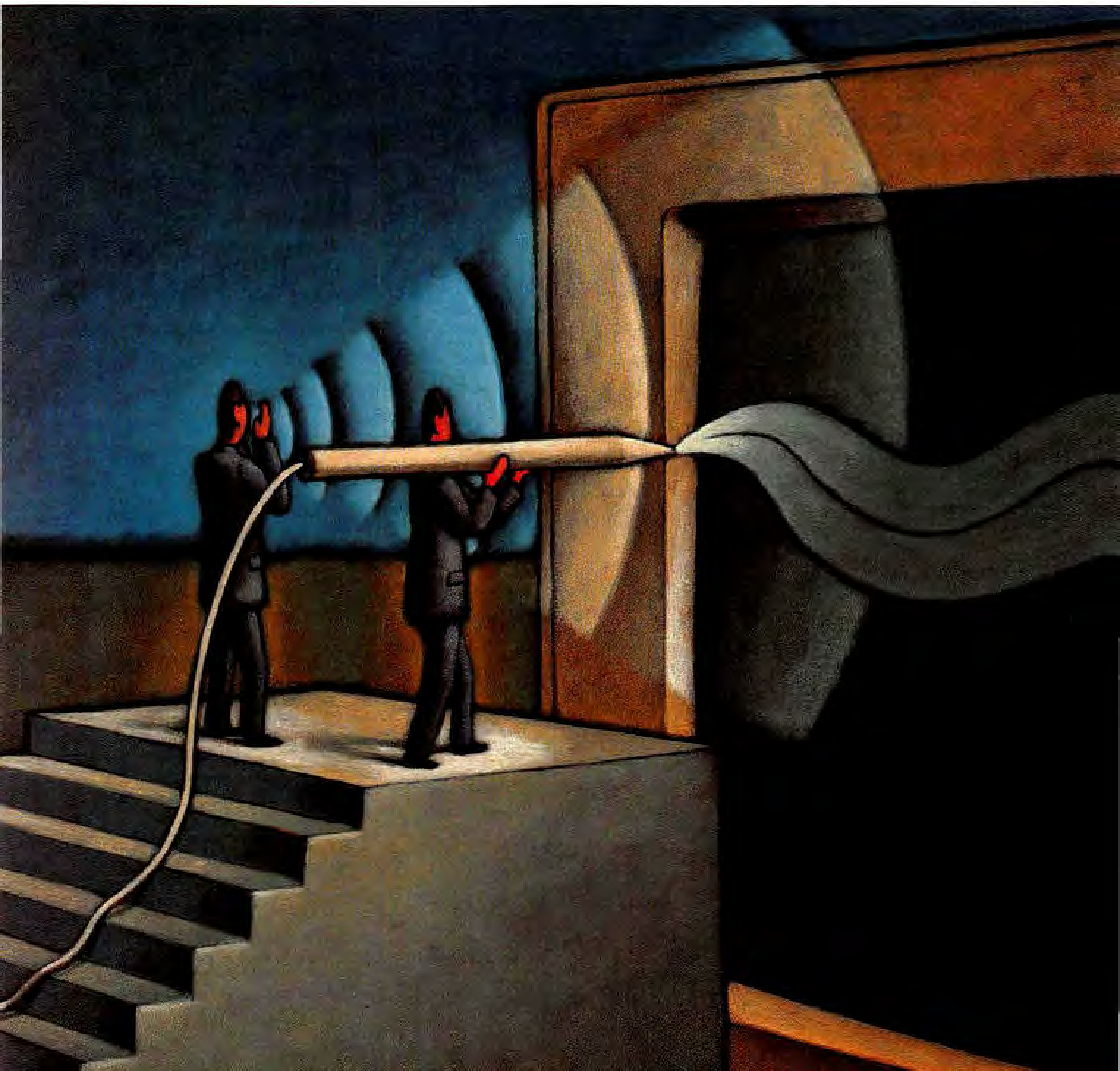
PEN AND VOICE UNITE

Adding pen and voice input to today's user interfaces opens the door for more natural communication with your computer

HEWITT D. CRANE AND DIMITRY RTISCHEV



The 1990s will be remembered as the decade in which large numbers of users began to communicate with computers through speech and writing. Held back in the past by immature technology and a lack of portable and desktop processing power, speech and handwriting recognition will break down the barriers that keyboards, mice, and GUIs present to natural communication with your computer.

"These input methods will be used in tandem, just like you use your fingers and your voice together," says Larry Dooling, president of Verbex Voice Systems (Edison, NJ), a manufacturer of desktop and portable speech systems (see the text box "Matching the Input Mode to the Task" on page 100). You can expect to see computers that combine some form of pen and voice input within a year, say several system manufacturers.

Raj Reddy, dean of the School of Computer Science at Carnegie Mellon University (Pittsburgh, PA) and a man with 30 years of speech research experience, predicts that about half the small, personal computers sold will use pen and voice input within five years. During that time, companies and research groups will be developing a wide range of joint pen and voice applications.

The underlying technologies of computing via pen and voice are more complementary than they might seem. Both perform what are basically pattern-recognition and matching tasks. Techniques such as Hidden Markov Modeling, neural networks, and template matching are used in both (see "Talk to Your Computer" on page 113).

Annotating Documents

One of the most obvious and easiest-to-implement applications of pen and voice input involves annotating documents on-line. For example, suppose you are reading someone's draft on your screen. If your computer and software could take input from both a pen and a microphone, you could write editing marks, sketch a drawing, and record your comments. Later, when the author looks over your suggestions, he or she can listen to you and see your markups.

Implementing such a capability is relatively low-tech: The computer simply captures and stores in digital form the raw "ink" and speech signal, associating each with a place in the document. Yet the benefits are substantial, since both you and the author can save time by using speech to communicate something like "this paragraph needs more details on the historical ramifications of philosophy" and using a drawn-in arrow to indicate two words or paragraphs that need switching. You may even want to sketch in a freehand graph to suggest adding another figure. Software packages that integrate such annotation capability are already coming on the market, such as Microsoft Word 5.0. Some of the latest videoconferencing systems offer "white boarding" features that provide similar functions.

Information Entry and Control

Consider a typical spreadsheet application. It is easy to imagine entering data either by speaking or by writing in the cells. For instance, to enter a long-digit string, you could voice it to avoid repeatedly shifting your eyes between the paper and the screen. To enter a name that is unknown to the speech recognizer, you could write it to avoid spelling aloud, since spoken letters easily confuse the speech recognizer because so many sound similar.

However, because it is as hard to point with voice as with a keyboard, speech input would have to be supplemented in some way to indicate where the spoken input should go. A good solution is to point with a pen to a particular cell while speaking its contents. Yet rather than letting the applications developer decide in advance where pen or voice input is better, the choice should be left to the user to be made on a case-by-case basis. Sometimes it will be easier to write or point to some input and other times easier to say; the choice might well change from one instance to another, even for the same user. In addition, you could use the pen not only for touching the tablet and pointing to the place of input but also for activating the microphone, thereby decreasing the risk of extraneous speech confusing the speech recognizer.

Pen/Voice Typewriter

An important, longer-range goal in speech research is to use voice to generate text documents without having to type. Building a widely acceptable voice dictation system will require efficient and flexible editing and control mechanisms. Pen input will provide the editing and control capability that is needed.

General dictation is a daunting speech-recognition task. Misrecognitions will be frequent in early speech-to-text systems not just because of algorithmic and modeling limitations but also due to other difficulties. For example, speech-to-text systems must deal with a wide range of homophones—words that sound the same but have different meanings. And spontaneous speech is unpredictable; it is often full of false starts, repetitions, and hesitation noises.

Using a pen to correct misrecognitions as they occur could make an otherwise tedious system acceptable. For instance, as you speak and notice a wrong word come up, you could simply cross it out; a short list of the computer's best alternative guesses appears and you circle one.

continued

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ILLUSTRATIONS: GARRY NICHOLS © 1993

Matching the Input Mode to the Task

ALEX RUDNICKY

While you perform a wide variety of tasks on a computer, the ways you can do them fall into a small number of classes. Different input modes support these activities to a greater or lesser degree. A well-designed interface will supply those input modes that best support the expected activities.

Most complex applications incorporate several distinct activities; for example, window-based applications combine both keyboard and pointer input. Word processing includes both text entry and editing and thus benefits from the availability of at least two input modes.

Newer input modes such as speech or stylus allow for a better fit between mode and activity. In addition, multiple input modes permit the use of parallel inputs using, for example, voice for mode switching in a graphics application while using a stylus to make changes on an image.

Spoken language is the best choice for queries, since natural language allows efficient specification of arbitrary constraints ("show all employees younger than 25 who have been employed less than a year"). As an input mode, speech is more efficient and easier to use than a keyboard.

Commands are more constrained than queries ("open file foo.bar"); they may need to follow a specific syntax and often can be made quite terse through the use of context. Choosing the best mode for item selection depends on the number of items from which to select. For small sets, such as yes/no choices or short menus, a pointing device might be best since a simple mechanical action (e.g., pressing a key or clicking a mouse) completes the transaction.

For larger sets, as might be found in a large vocabulary dictation task, speech may be best, since speaking a word is a simple one-step operation. Stylus devices appear to be best in situations that require a combination of positional and symbolic input, such as the markup of text or the entry of short notes or figures. Stylus entry is inefficient for the entry of extended text.

Pointing provides direct access to a location in space, which otherwise would have to be selected by coordinate specification (spoken or typed) or step-wise positioning (e.g., by arrow keys).

MATCHING INPUT MODE TO ACTIVITY

Some input modes suit particular activities better than others. A ● indicates that the input mode is a good choice for the activity; a • indicates that the input mode is merely adequate; and a ● indicates that the input mode is inappropriate for the activity.

ACTIVITY	SPEECH	STYLUS	KEYBOARD	POINTER/MOUSE
Editing (markup)	•	●	•	•
Note-taking, dictation, and annotation	●	•	•	•
User verification	●	●	•	•
Creating graphics	•	●	•	●
Form-filling	●	●	●	●
Check-off lists	•	●	•	●
Command and control, communications, and networking	●	•	•	•
Spreadsheet and financial computation	•	●	●	•
Scheduling, planning, and organization	●	●	•	•

Alex Rudnicky studies speech input and multimedia interaction at Carnegie-Mellon University (Pittsburg, PA). You can reach him on BIX c/o "editors" or on the Internet at air@cs.cmu.edu.

Or you could just repeat the word, and the speech recognizer places it in context and assumes that its original choice is wrong. It then quickly zeroes in on the word you want. To enter a term or acronym that is unfamiliar to the speech recognizer, you could write it; you could also then say it a number of times, and the speech recognizer would know it from then on.

Integrating Writing and Speech

In the examples above, the use of pen and voice alternates as you either speak or write to the system. Looking further ahead, more interesting possibilities arise that rely on *simultaneous* speech and writing, which better mimicks human interactions. For example, while editing on the screen, you might say the following: "Move this sentence [indicating what 'this sentence' refers to by simultaneously circling the sentence] to the beginning of this paragraph [simultaneously circling the paragraph]; then move the whole works [pointing to where the paragraph begins] and change the formula to read as follows [writing out the equation]." To execute such a mixed speech and writing instruction properly requires an intimate integration of spoken-language and written-language technologies.

Imagine someone with poor handwriting and a strong accent trying to communicate to you the spelling of some long foreign city name. The communication would be a lot easier if the person could both say it and write it.

This analogy carries over to computers struggling to understand our writing and speaking without the benefit of sharing our common-sense knowledge about the world and the context. Concurrent writing helps the computer to better transcribe the speech signal, and vice versa. For instance, saying "Move this sentence over here" concurrently with circling a sentence and then pointing elsewhere in the text can

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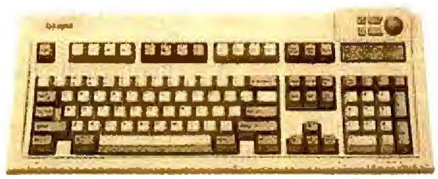

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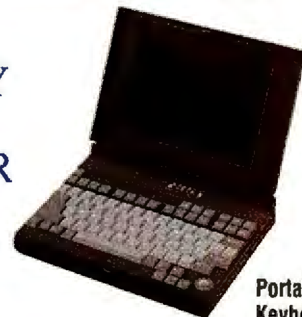

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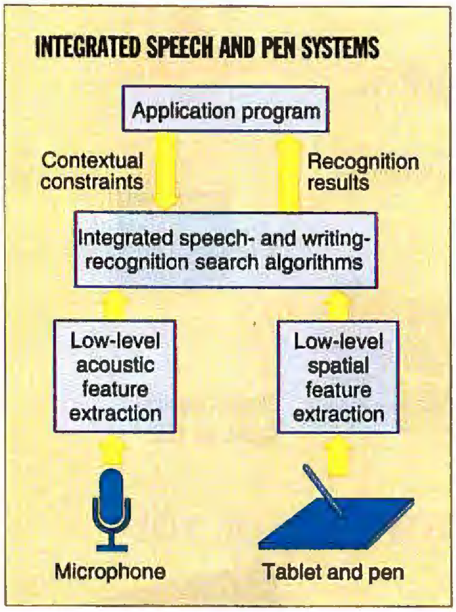

Speech and writing recognition *in computers of the future will be integrated above the low-level feature extraction stage, enabling both input signals to be jointly decoded into a single recognition result that is consistent with the current context set by the application program.*

alert the speech recognizer to expect a command that involves a sentence and a point in the text. The actual timing of pointing relative to speaking the words could alert the speech recognizer when you are talking about the sentence and when you are referring to a place in the text. The computer can use the constraints derived from one input signal to help decode the other input, making both inputs more reliable.

A technological challenge occurs in moving from an alternating use of pen and voice inputs to concurrently interpreting both as a single message. No longer can the handwriting recognizer and the speech recognizer operate as independent software processes, each concerned only with its own signal (writing or speech), each examining only its own search space for likely hypotheses, and each outputting the most probable string of characters and words.

To accommodate concurrent multimodal input in which one modality can affect the recognition of the other, the two recognition technologies will have to be fused at some yet-to-be-determined underlying linguistic/semantic level. These fused writing/speech-recognition algorithms will need to model and analyze the temporal sequencing and interleaving of writing and speaking events to determine the single message the end user wants to communicate.

Combining pen and voice technologies will enhance the communication between humans and computers by allowing the strengths of one input method to overcome the weaknesses of the other. The results will be obvious in products that are easier, and more natural, to use. ■

Hewitt D. Crane is a senior scientific advisor at SRI's Sensory Science and Technology Center. He is also codeveloper of handwriting-recognition technology at SRI.

Dimitry Rtischev is a computer scientist in SRI's Speech Research and Technology Program. He is currently working on how speech recognition and natural-language technologies can lower linguistic and cultural barriers. You can contact them on BIX c/o "editors" or on the Internet at crane @sri.com and dimitry@speech.sri.com, respectively.


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PEN COMPUTING CATCHES ON

After a slow start, pen computing is establishing itself in a number of businesses. Currently, it is on the verge of entering the mainstream.

DAN MEZICK

GARRY NICHOLS © 1993

Pen computing has experienced a rough childhood. Born to great expectations, the technology sputtered in 1992 as a lack of usable hardware and less-than-acceptable handwriting recognition left many people wondering if pen computing would survive infancy. But new and better pen-based hardware and software are starting to bring pen input into the mainstream.

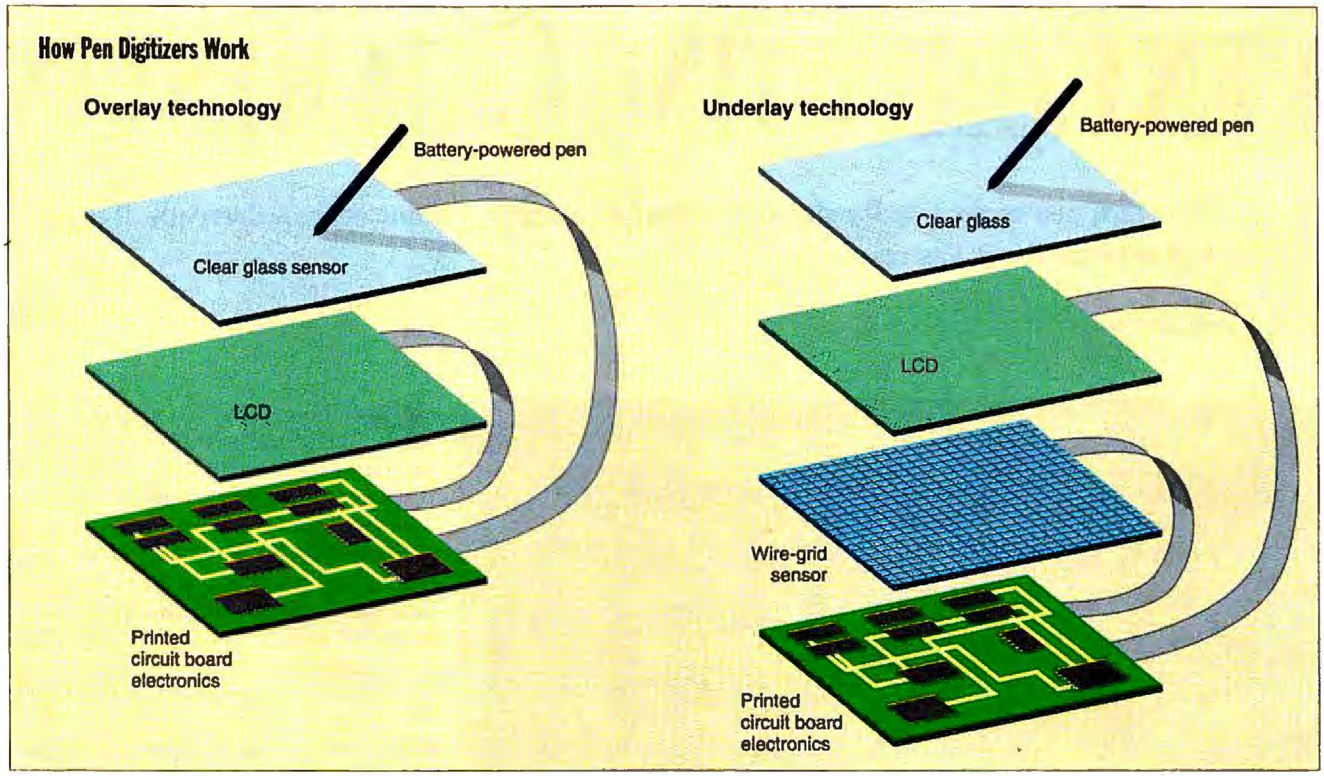
As little as one year ago, available pen PCs, such as the NCR 3125, were shipping with less-than-acceptable disk storage and poor display quality. This year, choices in pen hardware are plentiful, with over 30 different pen-based PCs available. Active-matrix color displays are now appearing in pen units (e.g., NEC's Versa) and drive capacities are exceeding 200 MB. Other hardware features (e.g., bridge batteries) make it easier to utilize a pen computer in the field by letting you swap a new battery without requiring a reboot.

Pens and digitizers are now supported in desktop operating systems (e.g., IBM's OS/2 2.1), laptops (e.g., Apple's PowerBook), and hybrids (e.g., Grid's Convertible). A new class of systems called PDAs (Personal Digital Assistants) (e.g., Apple's Newton series and the Tandy/Casio Zoomer) feature the pen as the sole input method.

The primary advantage of the pen is not the ability to write but the ability to point, to manipulate the user interface without requiring a surface to rest the device. The pen enables mobility, and mobility opens up vast untapped domains for automation by computer. Any worker who collects information while walking or standing is a candidate for pen-driven automation.

For example, data collection during, say, facility or vehicle inspections, requires long battery life and light weight. It is also forms-based, letting you simply check off boxes or enter a few characters. And pen-based sales automation software allows

Pen Computing Catches On



Both overlay and underlay digitizers work similarly. *First, the pen interrupts a sensor field, sending an analog signal of the x, y coordinates to the system. The system translates the signal from analog to digital and lights the appropriate pixel.*

for data entry and note-taking that is less intrusive than typing on a keyboard.

Pen technology is beginning to creep into mainstream applications. Bill Lempesis, publisher of the newsletter *PenVision News* (Pleasanton, CA), predicts that "pen, mouse, keyboard, and voice will coexist on the desktop of the future. No one input option will dominate. You'll select your input device based on applications and personal preferences."

Hardware Makes It Happen

Digitizer technology makes pen computing happen. A digitizer is a planar grid, capable of generating x, y coordinates when the pen is placed on or near it. A pen is said to be *in proximity* when you hold it close enough for the digitizer to detect it.

At interrupt time, digital ink may or may not appear. If you touch the pen in a region in which an application accepts writing, such as a data field, video display drivers handle the magic of making digital ink appear on the screen. If the pen touches a control such as a button, which does not expect writing or gestural commands, inking does not take place. In this case, the application recognizes the pen as a pointing device only.

Digitizer technology is varied. One type of technology uses direct-contact resistance (overlay) digitizers, which are mounted above a unit's display; physical contact from the pen generates the interrupt. In this technology, the pen is connected via an electrical cable to the unit itself. A second type of technology uses transparent-resistive (underlay) digitizers, which generate interrupts when the pen tip temporarily forces the two conductive layers together; Apple's Newton uses this technology. A third type uses electromagnetic digitizers, which are mounted beneath the unit's display; the pen in proximity of the tablet display generates a hardware interrupt.

Pen computers are characterized by the type of digitizer they use. For example, Grid's GridPad uses a tethered pen because of its overlay technology. On the other hand, the Newton's pen isn't tethered to a unit, and it contains no electronics since it only momentarily connects two conductive layers. Units such as the Grid 2260 use electromagnetic digitizers, which require a specialized pen containing batteries, resistors, or capacitors to interact with a unit's digitizer.

Digitizers have resolution granularity, like video displays, and the two (more often than not) don't map precisely to the same x, y location. For this reason, pen-input data that the digitizer reports must be calibrated to approximate the location of the video pixels that you view. This calibration often makes correct recognition more difficult than it would be if the digitizer and the video display coordinates were precisely the same.

How the pen "handles" also influences recognition rates: Recently, some pen systems have been equipped with etched display glass, which provides more paper-like drag on the pen. Users are more comfortable writing on glass, and characters are formed more precisely as a result.

Beyond the special hardware support for pen input, pen systems are nearly indistinguishable from conventional laptop computers. Hardware options—including PCMCIA slots, processors, rotating disks and CPUs—are virtually the same as those available in current laptop devices. While hard drives with capacities under 80 MB are common, many new pen models contain 200-MB or larger hard drives, making it possible to use one pen computer for all computing tasks, both desktop or nomadic.

User Interfaces

Pen computing is influencing the current state of the art in computer user-interface design. Norm Francis, president of pen

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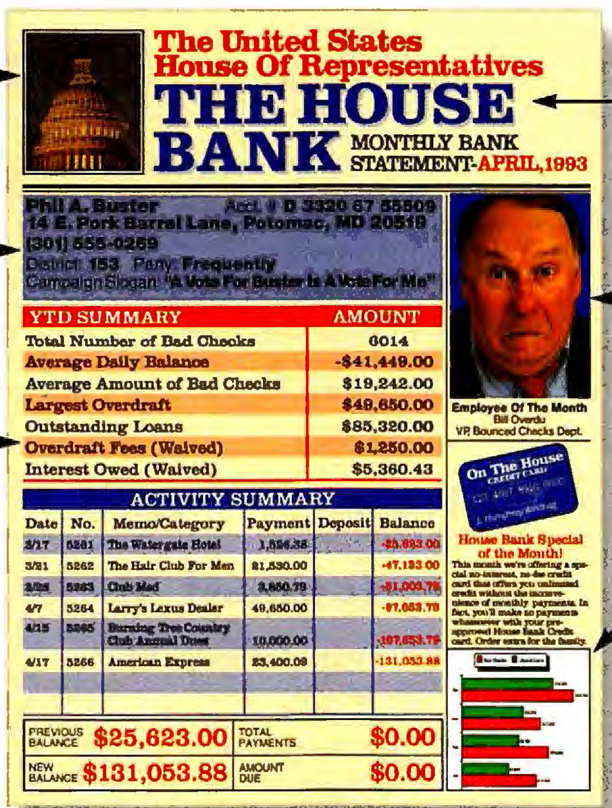

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Interest Owed (Waived)	$5,360.43

ACTIVITY SUMMARY

Date	No.	Memo/Category	Payment	Deposit	Balance
2/17	5261	The Watergate Hotel	1,526.38		-$5,823.00
3/21	5262	The Hair Club For Men	21,530.00		-47,153.00
3/25	5263	Club Med	3,650.79		-$1,003.78
4/7	5264	Larry's Lexus Dealer	49,650.00		-97,053.79
4/15	5265	Burning Tree Country Club Annual Dues	10,000.00		-107,653.79
4/17	5266	American Express	23,400.09		-131,053.88

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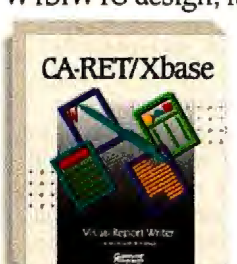

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software vendor PenMagic Software (Vancouver, British Columbia, Canada), credits Go Corp.'s PenPoint paper metaphor with furthering the evolution of user interfaces. Unlike the desktop, he says, "this new metaphor is more intuitive and simple: the document."

Novice computer users might not understand buttons, menus, and modal dialog boxes, but they do understand paper, forms, and notebooks. Microsoft's intention to implement a document model in future versions of Windows, says Francis, acknowledges that this metaphor eases the learning curve.

One largely undefined issue in pen applications design is the navigation from window to window. Microsoft's design guide included with its SDK (Software Development Kit) has little to say about navigation; Go's design guide is much the same. The reality is that developers are on their own until a market force or large vendor identifies acceptable alternatives to standard menu-command and command-button navigation.

For example, the Microsoft design guide doesn't discuss the use of a check box for navigating to a dialog box or other window: Menu commands or buttons are preferred for navigation. However, many pen applications automate paper forms. But often, forms have check boxes indicating that you must enter further information. On their way to standardizing pen applications, vendors must address problems such as this type of ambiguity.

Several interface issues are common to all pen applications. First, because forms on standard 8½- by 11-inch paper don't map directly to the smaller video displays, pen systems designers must segment the form into hidden and visible portions, with hidden windows accessible via a button or (perhaps) a check box. How to navigate gracefully from window to window and which windows to hide become issues for the pen user-interface designer.

Readability is another important component of navigation. The text and graphics must be easy to follow and view on the relatively low-contrast LCDs and where poor lighting conditions exist. Readability becomes even more important in face-to-face interaction with other people, when you must deftly navigate a pen device while maintaining eye contact with another person. Good user-interface design for pen applications mandates enlarged controls; bold and oversized fonts; and consistent use of navigation controls.

Digital Ink, Gestures, and Jot

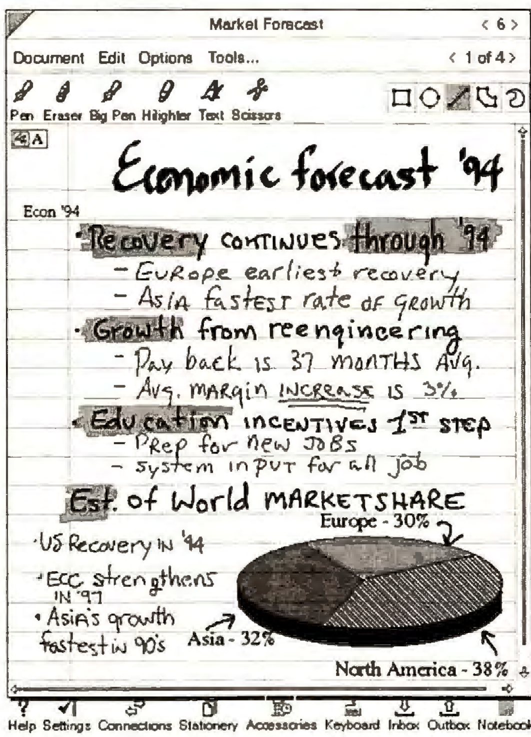
Pen input can include handwriting and gestures. *Digital ink* is written user input, which is saved in a data structure. *Gestures* are handwritten symbols that function as application commands. For example, writing and circling the letter *H* tells your application to hide the window on which it is drawn.

Gestures embody both the command (e.g., Hide) and the parameters (e.g., "Hide *this* form"). Where a gesture is written is important because command parameters are derived from the precise location of the gesture. For example, the circled *H* may be ignored if written in your application's data field but recognized if written elsewhere within a window.

> **BASIC GESTURES**
>
> **Pen input lets you perform tasks with simple gestures. Below is a sampling of gestures available with Go Corp.'s PenPoint operating system.**
>
> **Caret opens a writing pad in text or creates a document.**
>
> **Check displays options for whatever you draw it on.**
>
> **Circle opens an edit pad.**
>
> **Insert space adds a blank space in text or boxed pads.**
>
> **Cross out deletes whatever is beneath it.**

Gesturing capability provides you with a concise command interface. On the other hand, handwriting is typically used to enter characters in the absence of a keyboard. In this context, handwriting is immediately translated or saved in a digital-ink data structure for later recognition.

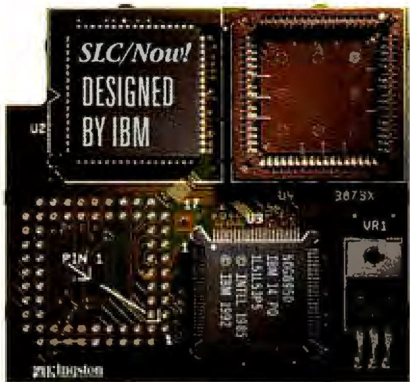
Support for digital ink requires a data structure to store the handwriting and an API for manipulating it. Digital ink is much more than a mere bit map. Stroke order and a time stamp, for example, are part of the data structure. In addition, optional information—if supported by hardware—includes tip pressure, tip angle, the state of buttons on the pen, and more. Recognizing the need for a standard data type for ink, industry leaders have partnered to create Jot. This standard will accelerate support for ink, even on platforms that don't currently support pen input (see the text box "Jot Defines Electronic Ink" on page 110).



Ink Development's Notetaker *captures, indexes, and manipulates digital ink. It can highlight or boldface handwritten text. You decide when to recognize handwritten text.*

The difficulty of implementing accurate handwriting recognition has caused vendors to promote digitized ink as a replacement for recognition. Project leader Ken Notestine codeveloped the first pen application, which automates loss-control representatives in the field, for insurer ITT Hartford Insurance Group (Hartford, CT). Field personnel collect risk data for analysis by property-casualty underwriters. "Our intention was to minimize the use of digitized ink," says Notestine. "It became, however, the only practical way to capture the required information. Support for digital ink ultimately became a subsystem within our application."

However, digitized ink has its own set of problems. Compared to ASCII text, digitized ink is bulky to store, and until Jot is widely implemented, digital ink doesn't port well across platforms. For example, attempting to render ink captured from a Windows application in the IBM 3090 mainframe environment will be an



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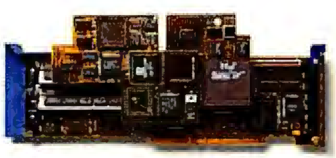

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MCMaster	PS/2 Model 55SX	With MCMaster SX 25	PS/2 Model 90-0H9	MCMaster
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Jot Defines Electronic Ink

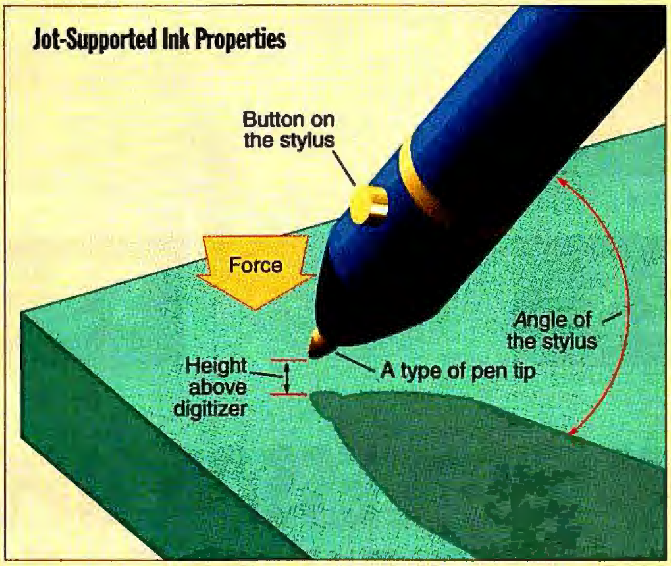
DAN BRICKLIN

Jot is a data-interchange standard with a difference: The data it defines is ink. Ink is not a traditional system data type, but it is an increasingly important one. Ink is the information your pen computer captures when you "write" on it.

Electronic ink is information you create when you use a stylus to draw strokes on the screen of a pen computer. The built-in digitizer captures the strokes and renders them to the screen, thus imitating how a pencil leaves marks on paper. The writing—whether it's words or shapes—may be kept as ink forever or later translated to ASCII text or graphics objects. Some obvious examples of ink are notes, signatures, sketches, and annotations on other documents. The ink data type lets you capture personal, unstructured data that your computer can store, manage, and communicate.

An important point is that ink is not just bit-map data. Although ink is represented as a bit map when it is rendered to the screen, the ink data type itself retains much more information than the *x*, *y* coordinates of "on" pixels. Ink stores how the information was created, as well as how it appears on the screen. Thus, ink data can include such components as the individual pen strokes, the timing of the strokes, the pressure used to create each stroke, the color of each stroke, and the relative scale and position of a stroke. Ink stores the direction and movements of the pen. In this regard, ink has much in common with MIDI data, which communicates information about what note to play and the pressure and duration used to play it as opposed to a straightforward recording of the sounds produced.

Jot-Supported Ink Properties



Jot captures a surprising number of ink properties, *in addition to the coordinates of the path the pen takes, and stores them in an application-specific record. Besides the properties shown in the figure, Jot supports multiple strokes of ink combined into single objects, bounds, scale, offset, numbered groupings of strokes, color and opacity, and timing information.*

The Jot ink standard is a joint effort of Slate, Microsoft, Go Corp., Apple, Lotus, and General Magic. It is a platform- and applications-independent format. It can be implemented on any platform whether or not the platform supports a pen device; thus, it solves the problem of sharing ink throughout an organization. Ink stored in the Jot format can be retrieved by any application that needs to display the ink, print it, translate it to ASCII text or some other format, or even to perform special functions such as signature verification.

The Jot standard is designed to meet the following goals:

Keep it simple. Jot makes it easy to handle the most common ink operations (e.g., reading stroke coordinates). You can ignore complex information if your application doesn't require it.

Compact. If optional information such as color specifications are absent, the data definition does not devote any storage space to it.

Storage saving. The standard supports optional compression for stroke data.

Inclusive. Jot supports every current property of ink.

Expandable and compatible. You can add new properties to the standard without affecting the operation of current applications.

Putting Ink to Work

Jot has many uses. For example, Jot lets you store and transmit signatures electronically. Many companies want to preserve a person's signature (e.g., a doctor's) by using the pen at the time of a transaction. This signature may be written on a tablet-style system but need to be sent back into a corporate database for storing, analyzing, or reporting. Jot makes it possible to gather the signature on one system and move it to another without any loss of data, all in a standard format.

Jot also plays a key role in letting people scrawl a handwritten E-mail message on their PDA (Personal Digital Assistant) device, send it to a colleague, and have it displayed on a desktop system that doesn't have a pen interface. It also lets you receive an E-mail message, mark it up with your handwritten response, and send it off again.

Jot is a rare example in the personal computer industry of companies establishing a standard in anticipation of customers' needs. The Jot specification is available to anyone, and any developer can incorporate and use the specification in its products. Developers can obtain a free copy of the specification from the Software Publisher's Association Mobile and Pen special-interest group by calling (202) 452-1600 ext. 336.

Dan Bricklin is vice president of new technology at Slate (Scottsdale, AZ). You can reach him on BIX c/o "editors."

effort, because functions equivalent to Microsoft's Windows for Pen Computing API functions must be created to manipulate the Windows data structure in the host environment.

Nevertheless, entire applications are built on the notion that digital ink is adequate for data capture, storage, and retrieval. NoteTaker from Ink Development (San Mateo, CA), for example, is best described as a digital ink manager: The application captures, indexes, and manipulates digital ink on your behalf. NoteTaker recognizes text only when necessary to index digital ink for storage or when you indicate recognition is desired.

All pen operating systems support digitized ink and gestural command recognition. They handle hardware interrupts by passing *x*, *y* axes data to video device drivers capable of rendering digital ink. In addition to ink, video drivers must support reorientable displays (i.e., portrait or landscape orientation based on the application). Systems like PenPoint support dynamic reorientation of the screen, while systems with historical ties to the desktop (like Windows) require a reboot to affect the reorientation.

As hardware evolves to support pen input, vendors are positioning operating system offerings. Several choices are available: GEOS from GeoWorks (Berkeley, CA), OS/2 from IBM (Armonk, NY), PenDOS from Communication Intelligence Corp. (CIC) (Redwood Shores, CA), PenPoint from Go (Foster City, CA), PenRight from PenRight (Westlake, TX), and Windows for Pen Computing from Microsoft (Redmond, WA).

Technology planners must consider a range of issues including effective battery life and the relative sophistication of users when selecting an operating environment to utilize. GEOS, PenDOS, and PenRight bring pen input to lower-powered 808x devices; this is a plus for applications that require long battery life. PenPoint is one of the easiest systems to adopt, with its intuitive easy-to-learn user-interface "notebook" metaphor. It is best for new users and new applications. Microsoft's Windows for Pens is most attractive to corporate technical planners considering pen input for selected applications. Developers working with familiar Windows tools can slipstream pen input into current applications with a minimum of effort.

PenMagic's Numero for PenPoint *might be called a "financial processor." Perhaps its most interesting feature, however, is its MagicScript visual scripting facility, which can automate both Numero documents and PenPoint tasks.*

Handwriting-Recognition Technology

The translation of ink to text has been a problem for the pen industry. Overhyped as almost magical, the current handwriting translation engines have left several people wondering if they will ever work. Users are demanding high recognition rates of both cursive and printed characters. Handwriting recognition is difficult to implement, and researchers and companies employ various strategies to effect recognition.

Generally speaking, handwriting technology uses one of several approaches—neural networks, HMM (Hidden Markov Modeling) (see "Talk to Your Computer" on page 113), or basic template-matching paradigms. Products available include Longhand from Lexicus (Palo Alto, CA), Handwriter from CIC, NestorWriter from Nestor (Providence, RI), and Calligrapher from Paragraph (Boulder, CO), which is licensed for use in Apple's Newton.

Handwriting is either *unconstrained*—meaning that you use a mixture of cursive and printed letters—or *discrete*—meaning that you neatly print a letter and then lift the pen before forming subsequent letters. Each type of writing mandates a different approach.

Lexicus refuses to discuss its recognition engine, but according to someone who has studied the product, it uses the Horabach mathematical model to recognize cursive unconstrained writing. The Horabach model defines a set of simulated hand motions based on circular movements. This approach is especially good at recognizing cursive text, but it isn't optimal when recognizing neatly printed uppercase characters, because this type of writing is not based on cyclic pen movements.

Paragraph, too, is playing its recognizer cards close to the chest. Its product reportedly uses a more intuitive approach involving templates of patterns. In this method, the recognizer tries to match one of eight basic patterns against the strokes to be recognized. These in turn are subdivided into 20 or 30 subalphabets, which are used to map the input to language-specific alphabets during the recognition process.

Regardless of the approach used, handwriting recognizers come in two forms: trainable and untrainable. A trainable recognizer is one that can be taught the nuances of a specific user's handwriting style. The algorithmic approach used in a recognizer is a factor in the recognizer's ability to be trained.

IBM is developing recognizers for unconstrained and discrete handwriting, as well as for signature verification. "IBM's solution to the handwriting recognition problem is optimized for training," says Tetsu Fujisaki, IBM's manager of handwriting systems. IBM's approach recognizes discrete handwritten input by a combination of elastic matching

CHOOSING THE APPROPRIATE PEN ENVIRONMENT

Needs of Application	Operating Environment
Battery life	GEOS, PenDOS, PenRight (808x)
Preemptive multitasking	PenPoint
Nonpreemptive multitasking	Windows
Compatibility with DOS	PenDOS, PenRight
Compatibility with Win3.1	Windows for Pen Computing
Virtual memory	PenPoint, Windows
GUI: existing users	Windows
GUI: new users	GEOS, PenPoint

and neural networks.

During recognition, elastic matching and neural networks work in parallel to obtain an output decision represented as a voting result. Because the technologies are complementary, the accuracy prior to training is substantially better than any known single-technology approach. User training further improves accuracy and can also reduce the number of computations necessary during the recognition process.

This hybrid approach allows user training to have a great impact on the recognition process. "Users want immediate increases in recognition rates after a short training session—no more than 15 minutes," says Fujisaki. A flexible, probabilistic algorithmic approach allows immediate responsiveness to a user's brief training session, he adds. But there is a price to pay: Robust support for training requires more computational power.

Pen systems designers recently discovered that electrical interference from the digitizer itself interfered with the "raw material" going to the recognizer. The latest systems compensate for this. This compensation combined with the use of etched-glass displays, which help you write more precise characters, is boosting overall recognition rates.

Tools

Selecting development tools is critical to successful pen applications. Like operating systems, development tool selection is highly dependent on the problem and on the issues of performance and maintainability. Not all tools run on all operating systems, making tool selection dependent on the operating-system platform.

You can program 808x devices with PenPal from PenPal Associates (Los Altos, CA) or with PenRight. PenPal supports a high-level language popular with non-technical users. PenRight includes a DOS run-time module and an SDK for C; the tool is popular with vertical developers. For applications designed for existing users, database applications, or applications developed to corporate specifications, Windows for Pens is an option. Tools under Windows include its SDK, as well as C language, PenApps for Windows, and Microsoft Visual Basic.

Databases must support digitized ink storage and seamless data exchange with existing systems. This means support for the binary large object and robust import/export facilities. Mobile databases must recover gracefully from sudden power disruptions and operate robustly on a resource-lean mobile device. Watcom SQL by Watcom (Waterloo, Ontario, Canada) and the relational database manager Quadbase-SQL from Quadbase Systems (Sunnyvale, CA) are especially suited for the mobile pen environment.

Slate's PenApps is the first to bridge Windows and PenPoint. Properly coded, PenApps applications port across platforms. One disadvantage here is that you must code to the lowest common denominator, forgoing features like PenPoint's EDA (Embedded Document Architecture) and Window's DDE, because these features aren't common to both platforms. PenApps generates applications rich in pen capabilities. Gesture support is fully integrated into the tool's design, along with many other innovative features.

> **The pen computer is a very personal device, and tailoring should be simple for everyone, not just programmers.**
>
> — **Norm Francis, president, PenMagic Software**

For example, Input targeting is a feature that recognizes where you intended to write, even if the input extends beyond the boundary of an input region. Markup mode is a feature that provides the ability to capture and store user annotations written on your application's windows.

Despite PenApp's pen-oriented features, corporate developers are gravitating toward Visual Basic. ITT Hartford's Notestine says, "Visual Basic's attractiveness is that it is extendable, and not just through custom controls. The availability of the Windows for Pens API functions gives the developer a great deal of flexibility."

Visual Basic 3.0, released earlier this year, is gaining momentum. Its new features are of interest to pen developers. Microsoft's Access 1.1 database engine, included with Visual Basic 3.0, supports digital-ink storage via the binary data type. Visual Basic's enhanced support for OLE 2.0 provides the ability to create applications with embedded instances of other executable files, such as spreadsheets and graphics applications. These new features, paired with Visual Basic's adequate support for pen input, are attractive to developers considering a Windows for Pens application.

Visual Basic supports pen computing primarily through two controls: the handwriting edit (Hedit) and the boxed edit (Bedit), included in its Professional Toolkit. Using Visual Basic for pen input, however, poses challenges. Programming gestural commands requires knowledge of the Windows API, Windows for Pens API, and the RCRESULT event unique to Hedit and Bedit. The RCRESULT event, specific to pen control, provides an opportunity to examine (and possibly alter) recognition results just before the application gains access to them.

In contrast, PenApps offers pencentric and cross-platform capabilities, but it is relatively immature (in release 1.0), doesn't support custom controls, and takes longer to master. Both tools use BASIC and support external function calls via DLLs.

Who's Buying What?

According to *PenVision News'* Lempesis, pen-based products are segmenting into four domains: deskbound devices, pen-only tablet machines, convertible (i.e., pen and keyboard) systems, and PDAs. Lempesis projects sales of all devices with pen input to hit $740 million this year and $8.7 billion in 1996. Lempesis expects that all laptops will support pens within four years.

Recently, the notion of "diagonal" applications has taken root. Diagonal applications are horizontal products that allow you to easily configure them to your specific needs. For example, PenMagic's Numero, a highly intelligent financial application, combines a rich features set with a visual scripting facility called MagicScript.

PenMagic's Francis notes that "the pen computer is a very personal device, and tailoring should be simple for everyone, not just programmers." MagicScript is not limited to automating Numero documents; it automates any routine task, providing a batch facility for PenPoint users.

Pen computing has finally left infancy behind. Hardware and software improvements have freed users and technical planners to make real the promise of pen technology. For mobile workers, pen-enabled computing has indeed arrived. ■

Dan Mezick is the president of New Technology Solutions (North Haven, CT). He has provided developer training and pen systems engineering to corporate clients since 1991. You can reach him on BIX c/o "editors," on the Internet at dmezick @world.std.com, or on CompuServe at 71773,3612.

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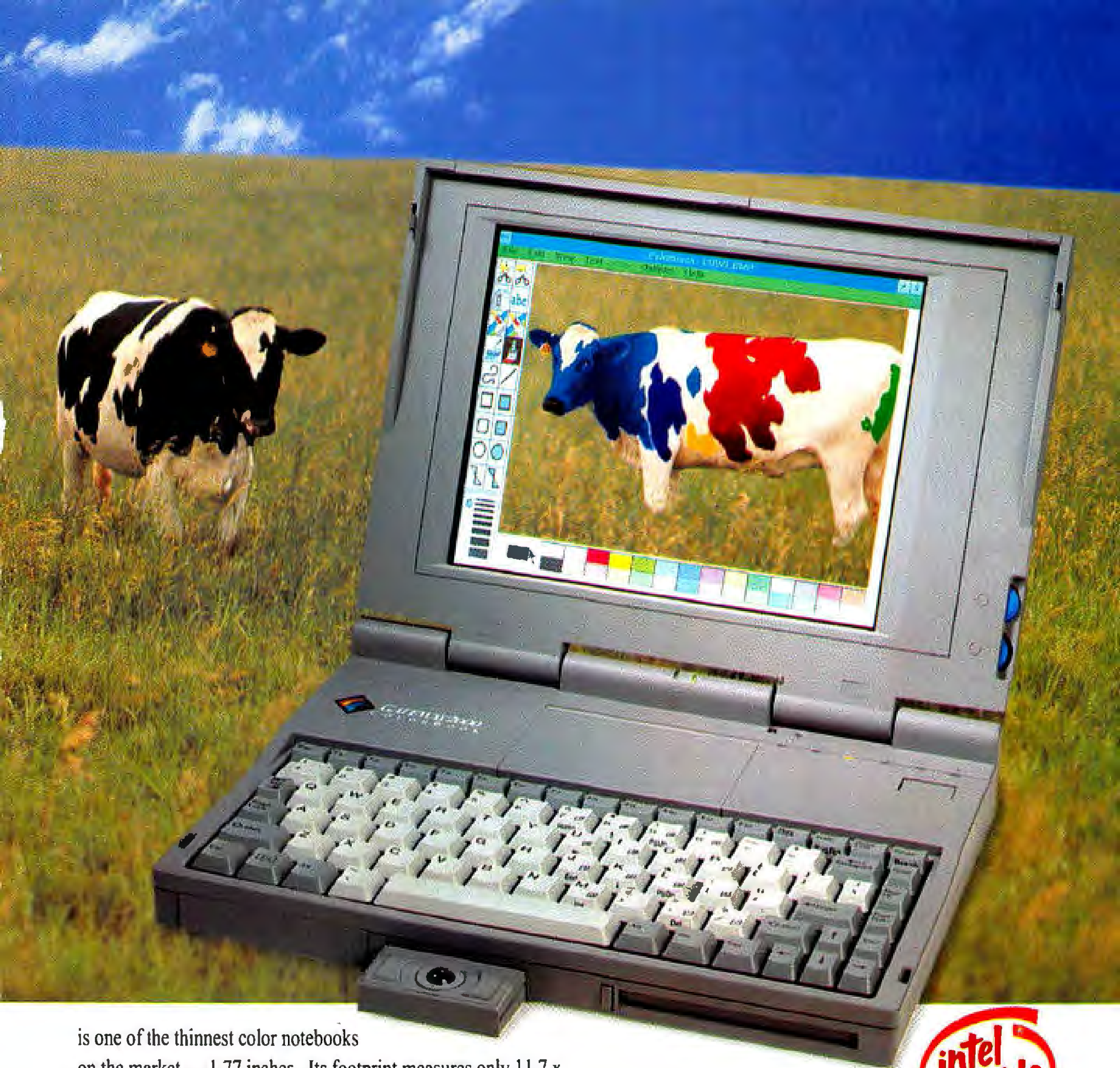

is one of the thinnest color notebooks on the market — 1.77 inches. Its footprint measures only 11.7 x 8.5 inches, and it weighs under 5.7 pounds.

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You don't have to sacrifice performance to have color, either. ColorBook models are based on SL Enhanced Intel486® CPUs. Both ColorBook models include a floppy drive, 4MB of RAM (upgradeable to 20MB), and a large, fast removable hard drive. These notebooks are powerful enough to become your only computer!

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The ColorBook includes a built-in track ball, which is much easier to use than a mouse in most portable situations. You also get two PCMCIA Type II card slots so you can plug in dozens of available PCMCIA peripherals.

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The grass *is* greener on the ColorBook side of the fence! It's an extraordinary value even by Gateway's standards — and we wrote the book on value! We have a reputation for offering the best prices on high-quality products with exceptional service from friendly folks in the Midwest. That's why the choice of a computer supplier is black-and-white, even when you're buying a color notebook! Give us a call.

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Exploding The Myth

Why do you expect to pay so much more for a color portable? Because other manufacturers always charge a plump premium for color. They've been milking the market, brainwashing you into thinking high-quality color costs a lot more to manufacture. It doesn't! We're selling the ColorBook for our usual cost-plus-small-margin. Now other companies will have a hard time perpetuating the color portable price myth. (Competitors absolutely *hate* us! Isn't it great?)

Experts' Reaction

We gave several PC trade publication editors a sneak preview of the ColorBook. Here's what they said about it: "Way cool!" "Dead on." "You won't be able to make enough of these."

Dazzling Color Display

The editors were impressed by the bright, crisp color graphics from the latest-technology, dual-scan STN display. It's a 9.4-inch VGA LCD, backlit for use in any lighting conditions. The editors said the ColorBook has the best STN color display they had ever seen! When they learned one model was priced *less than $2,000*, they were convinced the ColorBook will cause a stampede in the industry.

No Compromise On Size

Adding color to a portable usually means adding weight and bulk. Not so with the Gateway 2000 ColorBook. The ColorBook

Introducing The ColorBook!

The ColorBook is one of the thinnest color notebooks on the market — 1.77 inches. Its footprint measures only 11.7 x 8.5 inches, and it weighs under 5.7 pounds.

You'll appreciate the convenience of using PCMCIA cards. They're as easy to carry as credit cards, and they plug right into your ColorBook.

The integrated track ball slides out from a compartment by the space bar on the keyboard. You simply pull it out and go to work. Finished? Just slide the track ball back into the ColorBook.

Features

Size
With the ColorBook, you get great color at a great price while maintaining excellent portability.

SL Enhanced Intel 486® Processor
ColorBook notebooks are based on Intel's new SL technology 486 microprocessors, which makes them powerful enough to serve as your desktop PC with an external mouse, keyboard and monitor. Supports simultaneous video on an external monitor at 640 x 480 resolution.

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Dual-scan STN color is the latest technology in portable color displays, and it looks fabulous! You get 256 colors with the ColorBook running in VGA mode.

PCMCIA Type II Slots
Add a modem, network card or any of dozens of available PCMCIA-compatible peripherals. The ColorBook's two Type II slots can also be used for one Type III PCMCIA card.

ColorBook

- Weight: Under 5.7 Lbs.
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TALK TO YOUR COMPUTER

Voice technology lets you verbally command your computer or convert speech to text

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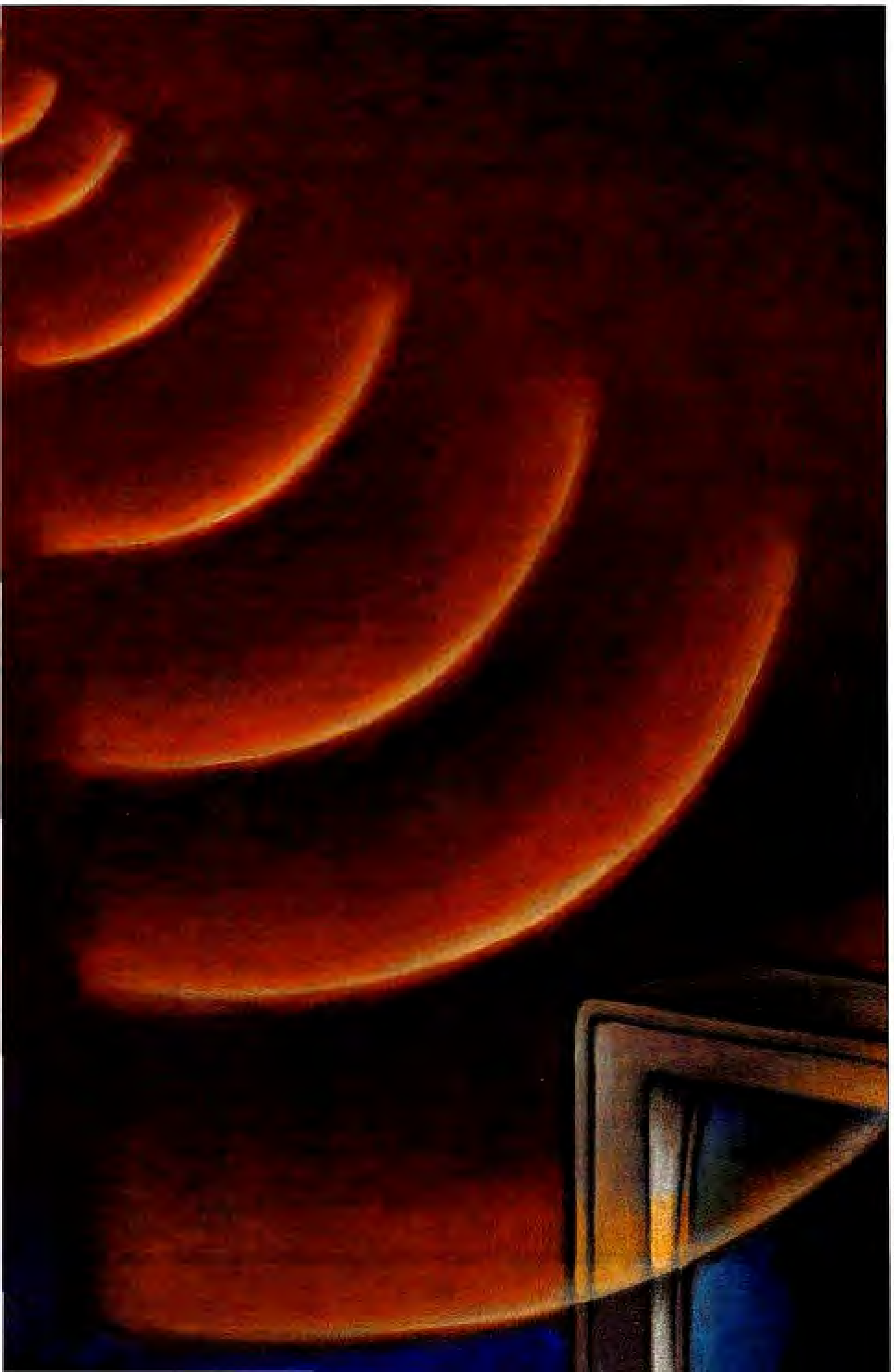


GARRY NICHOLS © 1993

Attach a microphone to a personal computer, and it has a whole new set of capabilities. It can store voice notes or act as a telephone. It can use the content of the speech to verify the speaker's identity for security purposes or to recognize the words in the speech. Of these functions, speech recognition has the greatest potential for fundamentally changing the way you interact with your computer. The technology is producing a new human-computer interface.

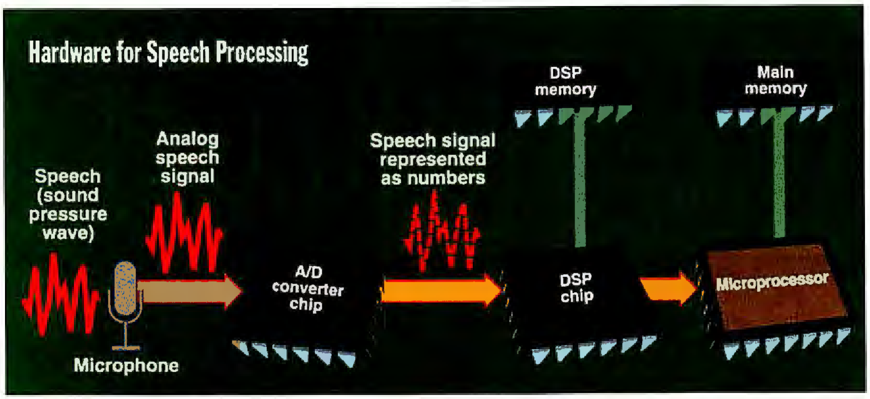
"Speech recognition is one of the business consumer's hot buttons," says Bob McBreen, product manager for Microsoft's Windows Sound System. He believes that speech recognition will be "an integral part of computing in the future."

To date, speech recognition has been largely confined to niche applications. But a new generation of powerful speech-recognition technology is becoming commercially available in software that's low cost and that runs on standard PC hardware. The focus now for developers is to move from basic technology to the development of good applications software.

Hardware and Software

The minimal hardware required to support speech is a microphone and an ADC (A/D converter) chip. A DSP (digital signal processor) is not strictly required, but if used, it at least doubles the processing power for speech recognition. Gene Frantz, applications manager for DSP at Texas Instruments (Houston, TX), points out that DSPs are better than general-purpose microprocessors for real-time signal processing.

Developers creating voice systems choose different types of DSPs depending on their specific needs. Some DSPs serve a number of purposes, acting as a fax or a modem, performing video data compression, or processing speech, while the CPU is free to do what it does best (see "Inside



The speech-recognition hardware *must convert the analog speech into digital form. Once in digital form, the speech is data that a DSP, a microprocessor, or both can process.*

Signal Computing," November 1992 BYTE). Apple chose AT&T's DSP for its new Macintosh AV series in part because it serves multiple purposes, according to Chester Anderson, technical marketing director for AT&T's Center of Excellence for Voice Processing (Middletown, NJ).

DSP manufacturer Analog Devices (Norwood, MA) has created a Personal Sound Architecture. Many firms such as Borland International, Lotus Development, and Microsoft have announced support for it. Analog Devices is trying to make it easy for systems developers to assemble a system by choosing modular hardware and software. Lernout & Hauspie Speech Products (Woburn, MA) and Dragon Systems supply speech-recognition software for the Personal Sound Architecture. AT&T is similarly using speech algorithms developed at Bell Labs to motivate use of its chips. IBM and Texas Instruments have teamed to create the MWave architecture with similar goals.

In any case, the minimal hardware for

Voice Recognition over the Telephone

DAVID B. ROE

Voice interactions with computers are often more practical than data connections, because there might be no visual display or keyboard available. Voice telecommunication is universally accessible to anyone, from anywhere, at any time. Speech-recognition technology offers a way to go beyond existing voice messaging and voice response services, to the concept of "voice information."

For example, if you were lost on the highway, you could telephone a "Directions Hot Line" and ask the computer questions about the simplest route. Or to keep track of that hot stock you are watching, you could call an up-to-the-minute stock price system and get a quote just by speaking the name of the stock. Not only will you be able to control your system by voice commands when you are physically present, but ultimately, you will be able to call and command your computer over the telephone.

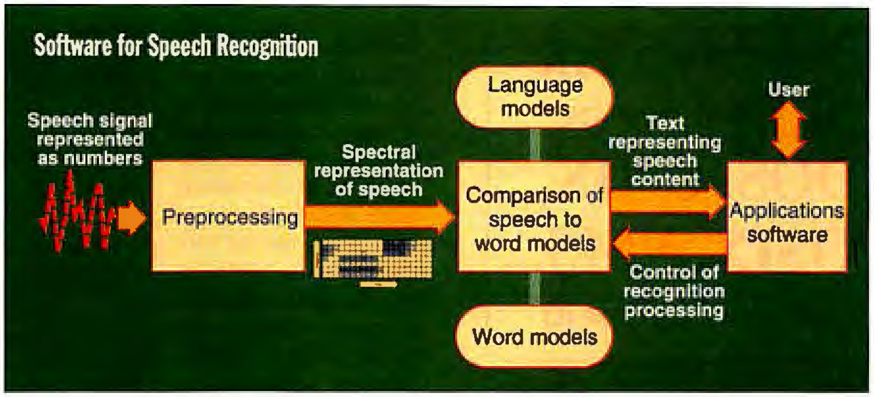
Speech recognition is still an imperfect technology, and the errors that speech recognizers inevitably make are magnified over the telephone network. Line quality varies considerably, especially in cellular or cordless telephones and with speakerphones. Telephone calls are often made from noisy places, and the background noise of other people talking can confuse a speech recognizer.

Most over-the-telephone applications must be speaker-independent, and recognizers must cope with a wide variety of voice types (e.g., male, female, or child), as well as regional dialects and foreign accents. These applications must also face practical difficulties of understanding speech. For instance, a voice-dialogue system has to recognize when people become confused and don't say the "right" thing, and a recognizer should start listening when people try to interrupt the machine.

Hidden Markov Modeling, or HMM, has been the most successful technique for speech recognition on the telephone because it is able to model a number of types of speech variability that are encountered. Starting with speech recorded from a wide variety of speakers and a number of types of telephone conditions, the HMM technique builds a statistical model of the speech sounds (or phonemes) and the expected variations of those sounds. Techniques like *word spotting* allow the recognizer to lock in on the keyword in a phrase, which can help deal with "ums" and "ahs." Another technique called *barge-in* uses echo cancellation, which removes spurious signal reflections over the telephone line, to eliminate the speech prompt from the machine when the caller interrupts.

Some systems already use speech recognition successfully. AT&T has deployed voice-recognition call-processing systems throughout much of the U.S. These systems recognize a vocabulary of seven phrases, including "collect," "operator," "person-to-person," "yes," and "no." Collect calls can now be fully automated, and the operator is involved only if the caller says "operator" or if the caller fails to speak one of the keywords. Word spotting and barge-in are important technologies in this application because a high percentage of the callers say phrases like "operator, please," or they speak before the end of the prompt. These systems have already handled over 1 billion long-distance calls.

A newer system is a stock-quotation prototype called StockTalk that Bell Northern Research built in conjunction with Northern Telecom. StockTalk provides current quotes on any stock traded on the New York, Toronto, or NASDAQ speech input is becoming ubiquitous on desktop computers. Sun Microsystems' workstations come with a microphone port and A/D conversion. Silicon Graphics also has a DSP in its workstations; in fact, its new Indy system comes standard with voice-recognition capability. The latest Macintoshes, the Centris 640AV and Quadra 840AV, also recognize speech out of the box (see "Apple, SGI Blaze Video Trail," September BYTE). Some Compaq PCs come with built-in speech hardware support and include Microsoft's Voice Pilot speech-recognition software as part of the Windows Sound System. For PCs without built-in speech input, audio boards are available for a few hundred dollars. Sierra Semiconductor, which supplies sound chips, estimates that 3 million sound boards will be sold this year. Several of these boards now ship with limited speech-recognition software.



Speech-recognition software *first converts the speech into its frequency components. It then uses stored models of expected word order to make a good guess as to what was said. The applications software can then display the text or take an action consistent with what was said.*

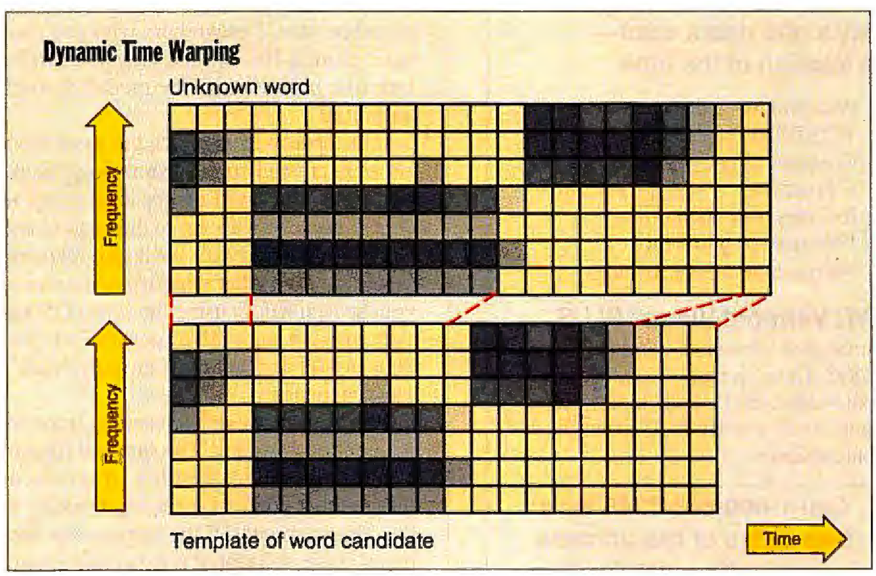
Speech-Recognition Software

Speech-recognition software operates on a digitized speech signal to perform one of two tasks: convert spoken words to text or perform a spoken command. First, a preprocessing step converts the speech signal into a form that exposes its spectral content. The spectral representation of each basic speech sound—each phoneme—has a characteristic form that shows up in the spectrum. Then, the spectrum of the incoming speech is compared to a library of word models—acoustic models of how the word sounds—to see which it matches best.

Acoustic models usually show how the spectrum of the speech varies over the duration of the word. The simplest acoustic model describes a single typical way in which a word is pronounced. This *template* represents a frequency time picture of the word. An unknown spoken word can then be identified by comparing it to templates of all the words in the vocabulary and finding the best match.

But a word varies slightly each time you pronounce it (e.g., you can say it quickly or slowly). In an attempt to handle this variation, the first generation of speech-recognition software mathematically distorted the time axis of each template until it best fit the unknown speech, a technique called Dynamic Time Warping, or DTW.

DTW proved too limited an approach



When an unknown word is spoken, *it is compared to stored templates (i.e., frequency time pictures) of each word to get the best match. Dynamic time warping allows a match to be made so that the best-matching parts of each word align, making the match less sensitive to the speed of speaking.*

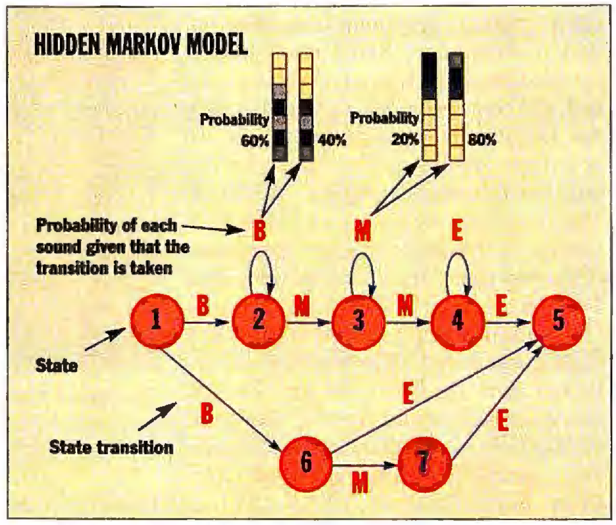
markets. You simply speak the name of the company, say "General Motors." This speaker-independent recognizer uses phoneme HMMs to build up the pronunciation models for over 5000 stock names. Because this system gives a response quickly, you can easily correct the occasional confusion between similar-sounding company names by repeating the name of the stock or saying "wrong stock" and hearing a list of alternatives.

As speech-understanding accuracy continues to improve, more sophisticated telephone applications will be deployed. Voice access to "yellow pages" information and voice directory assistance will only be the first steps. Ultimately, the challenges that face speech recognition over the telephone will be overcome, and people will converse with machines on the telephone just as fluently and easily as they talk with people.

David B. Roe is a supervisor in the speech-research department of AT&T Bell Laboratories (Murray Hill, NJ). His work includes the development of single-chip speech-recognition algorithms for cellular telephone and of speech recognition on massively parallel systems. You can reach him on BIX c/o "editors" or on the Internet at roe@hogpb.att.com.

for larger vocabularies, continuous speech, and speaker independence—a single template could not describe the full variability of pronunciations. A second generation of technology put the variability in the model instead of in the matching process, using a technique called Hidden Markov Modeling, or HMM.

An HMM is created from as much speech data as possible, statistically modeling the variation seen in that data. HMM methods have led to steady accuracy improvements, as measured in yearly workshops of the Speech and Spoken Language program of the U.S. Department of Defense's ARPA.



An HMM is a statistical model *that represents how a word's spectrum varies over time, essentially a flexible template of a word. An HMM has parameters that are estimated from spoken examples of a word to best model the observed variations. Once the parameters are estimated, any path through an HMM graph has a certain probability. In taking a path, each transition generates a spectral slice of speech that could have come from speaking the word. The most likely path through the graph and the most likely spectral slices generated taking that path create a likely spectrum-time picture of the word. An observed unknown word can be compared to the HMM of a known word to get the likelihood that the unknown word is modeled by the HMM. Likelihoods of HMMs for different words are compared to get the best match.*

An HMM can create word models from examples of full words, or it can create them by putting together models of the phonemes composing the word. In the latter case, to add new words without spoken examples, you enter a phonetic spelling. To complicate the matter, the "a" sound in *bake* looks quite different acoustically than the "a" sound in *rain*. Researchers who use phonetic models have found they can further improve performance by modeling such variation.

If the speech from which the word models were created comes from many speakers, the system will be speaker-independent—you can walk up to the system and use it immediately. A speaker-dependent system requires that you give examples of your speech before using the system. Some systems start out with a speaker-independent model and adapt to an individual's idiosyncrasies.

A language model is used to improve recognition accuracy. The simplest form of a language model is a list of words or phrases that you can speak legitimately in the current context. If the system asks how many copies to print, it is expecting a number. If the system asks for verification of a command to delete a file, it is expecting a "yes" or a "no."

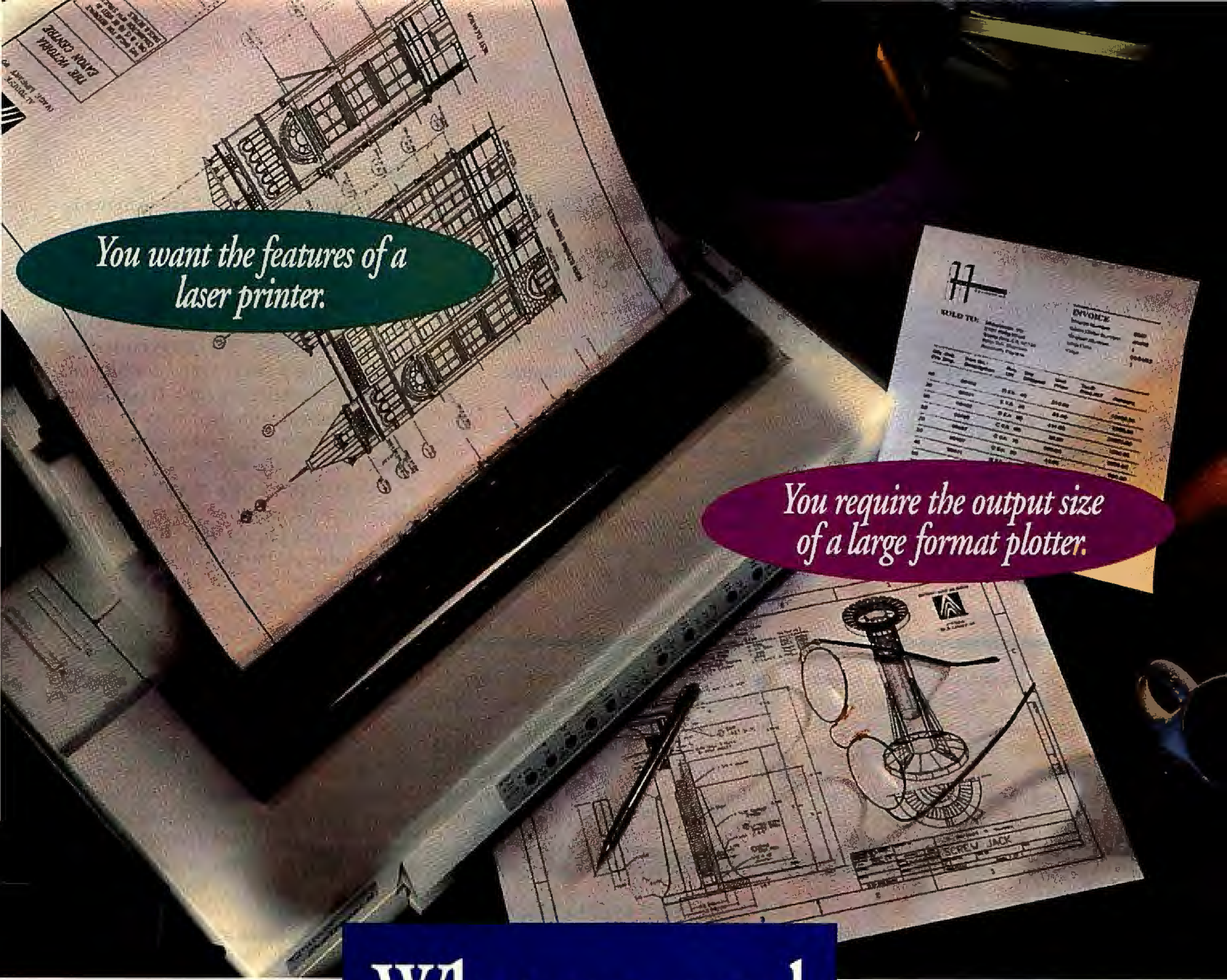
A more complex language model assigns a likelihood to word sequences. A language model can indicate that "they read" is more likely than "they red," allowing the speech-recognition algorithm to use word context to improve accuracy.

Speech into Text

You can use speech to create text. You say something and the computer types an exact transcription. Speech-to-text is often thought of as a keyboard alternative, particularly for those who have difficulty typing or for small systems without a full-size keyboard.

Dragon Systems (Newton, MA), IBM, and Kurzweil Applied Intelligence (Waltham, MA) offer general speech-to-text systems. Dragon's DragonDictate offers complete hands-free operation, making it particularly suitable for use by the physically disabled. In part for this reason, IBM sells a version of the Dragon system, as well as its own. These systems require that you speak one word at a time. No commercial systems can transcribe continuous speech for general dictation, although Dragon and other researchers have demonstrated limited prototypes.

The systems differ in vocabulary size, price, the platforms on which they run,



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PACIFIC DATA PRODUCTS

DISCRETE VOICE-CONTROL SYSTEMS

Simple discrete-command voice-control capability is offered on a number of sound boards and systems, each using one of several standard packages:

- **Microsoft, Media Vision, Articulate Systems, and IBM use a voice-control package with technology from Dragon Systems.**
- **Creative Labs uses technology from Voice Processing in some of its Sound Blaster boards.**
- **Several board manufacturers that use an audio processor from Sierra Semiconductor (e.g., Diamond Computer Systems) offer Aria Listener voice-control software from Scott Instruments.**
- **Silicon Graphics' Indy workstation also bundles a version of Scott Instruments' technology.**

and features. The vocabulary size ranges from 7000 words to 50,000 words; some of the words you add as you use the system. The Dragon and Kurzweil systems are speaker-adaptive; the IBM system requires that you spend about an hour of your time providing speech examples before you use the system. In return for the hour of time, the IBM system gives high accuracy immediately; it also improves over time by adjusting its language model as it learns how you use words.

DragonDictate and Kurzweil run under DOS on a PC. IBM's Speech Server Series, or ISSS, requires a Unix workstation, but IBM says a PC version will be available within a year. Elton Sherwin, IBM's manager of Speech Recognition Market Development, said that IBM had chosen to use an approach that required more computation to get more accuracy. According to Sherwin, ISSS uses more complex preprocessing and a more complex language model than the other commercial systems. He indicated that the IBM system gets better than 95 percent accuracy with an active 20,000-word vocabulary. IBM's research, he added, shows that only highly motivated people will use a system with less accuracy.

Prices range from $2000 for a single-user software package to $8000 for a complete system including hardware. Consequently, the installed base of such systems has only recently topped 1000. But prices will drop. "As DSP chips are built into computing platforms—be they palmtops, PCs, or workstations," says Janet Baker, president of Dragon Systems, "even the most sophisticated speech technologies will be available as simple software solutions."

Sherwin would like the 486 version of ISSS to ship bundled with PCs and be priced accordingly. The idea is intriguing. Dictating one word at a time is analogous to typing one letter at a time. If computers come standard with the ability to voice-type and touch-type, many people might prefer voice to the keyboard.

General speech-to-text systems usually come with a macro feature. For example, a trigger phrase like "finish letter" might print out the closing and signature line of a letter. Some of these systems are report generators; they extend the concept of macros to accelerating the preparation of a report. The defining characteristic of report generators is that you speak fewer words than appear as final text. Most speech-based report generators have been developed for medical dictation and cost $15,000 and up. Most of that price, according to Ray Kurzweil, chairman of Kurzweil, is for the applications design and embedded knowledge rather than the speech recognition.

AT YOUR COMMAND

The ability to use continuous speech allows a more flexible command language than using discrete commands. For example, you can do the following:

- **PC system control: "Change display to 24-bit color."**
- **PC application control: "Open spreadsheet, expand it to fill the screen."**
- **Word processing: "Make this paragraph Palatino font, 12-point italic."**
- **Graphics: "Change line width to two points."**
- **Calendar management: "Schedule an appointment on Friday at 10:00 a.m. with John Doe."**
- **Order execution: "Buy 400 ABC Corp. at 48½, good till canceled."**
- **Telecommunications control: "Send fax to George."**
- **Voice dialing: "Call home."**
- **Factory inspection: "Dent in right front fender."**
- **Data entry: "Nine of model 4A96."**

Continuous Speech-Command Systems

Apple's PlainTalk—standard on new Mac AV-series systems.

The IBM Continuous Speech Series—$299 per user for AIX, OS/2, and Windows.

Hark from BBN Systems and Technologies (Cambridge, MA)—$3000 per user, running on various workstations.

Decipher from SRI—price varies, runs on workstations.

PE400 from Speech Systems (Boulder, CO)—$3495 for Intel-based PCs.

Listen for Windows from Verbex Voice Systems (Edison, NJ)—$495 for Intel-based PCs.

Speech as a Command

The defining characteristic of general dictation systems is their broad scope, creating the need for huge vocabularies. If you specialize the application, however, you can use speech recognition effectively with smaller vocabularies.

Data entry is an application that sometimes allows for small vocabularies. If you fill out a form, each space on the form asks for different information. Although the entire form may require a large vocabulary, each space has a much smaller vocabulary than the whole. If the system knows which space is being filled in, it can constrain the grammar for that space. For example, it can limit an entry to only numeric or alphabetic data.

You can use speech to control a system, as well as to enter information. The simplest voice-control software uses

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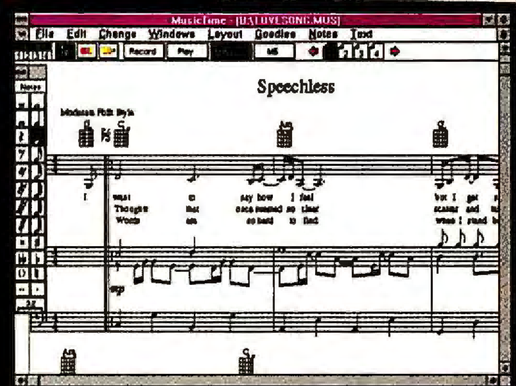

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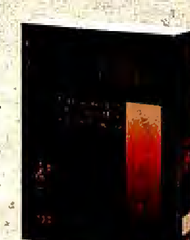

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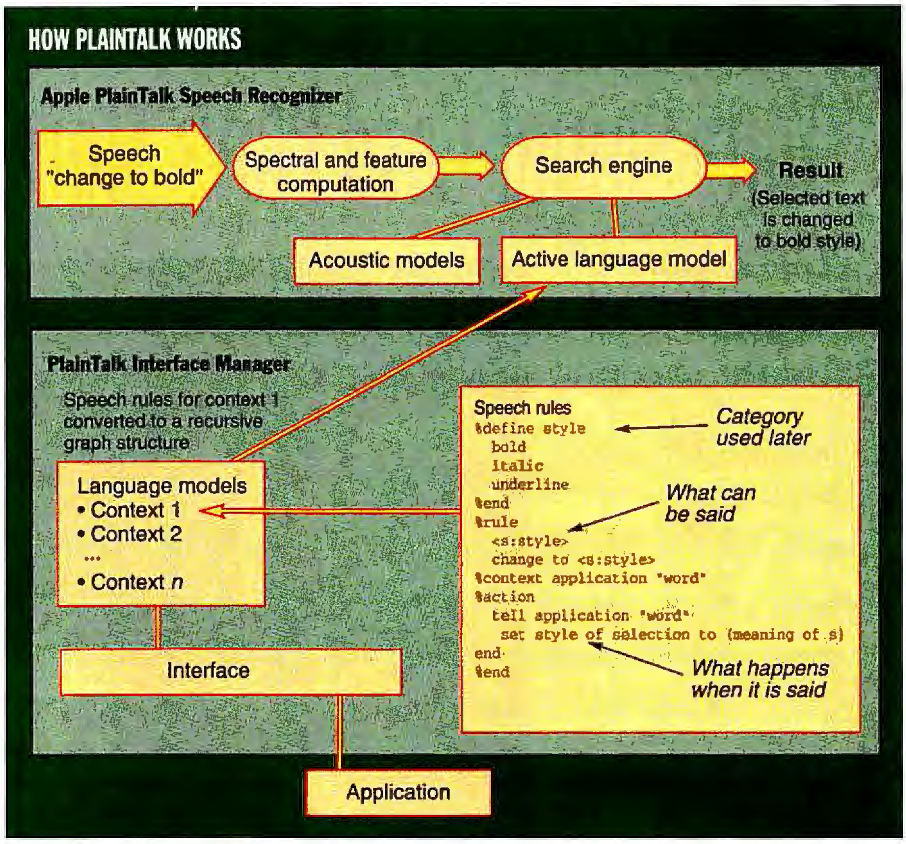

Apple's PlainTalk speech-recognition software *allows continuous speech for command and data entry. An applications developer can use data structures called "speech rules" to define what speech the systems will understand in specific contexts (e.g., within a specific application). The resulting action is also specified within the rule.*

isolated word or phrase recognition—discrete voice control. For example, you can voice the name of a menu in a Windows application and then voice an item from that menu. Speech allows a much longer list of active commands than it is feasible to put on a menu. Typically, discrete voice-control software can distinguish more than 60 words at one time, but it can handle over 1000 words by switching context (see "Discrete Voice-Control Systems" on page 118).

Continuous speech-command systems are more powerful and natural than discrete-control systems (see "At Your Command" on page 118). Typical continuous speech-command systems are speaker-independent, allow fluent speech, and let you spell or say each new word you want to add. These systems typically let you use several hundred words in each context.

Companies that sell continuous speech-command systems provide development software that lets you create vocabularies and language models to turn the raw recognition system into a useful product. Even with tools, developing a good speech-recognition application can be difficult. "If the software controlling the speech-recognition engine isn't highly tailored to the application, you will frustrate the user," says Adithya Padala, CEO of Umecorp (Novato, CA), a speech-recognition system developer. For example, in building workstations for Wall Street traders, developers must be aware of how a broker voices stock names and prices.

Customers and developers are just beginning to understand where speech recognition will really pay off. The creativity of applications developers will determine whether a microphone on a computer is just a novelty or whether it fundamentally changes the way we use our machines. ■

William S. Meisel, Ph.D., of Encino, California, wrote the first textbook on computer pattern recognition and ran a speech-recognition company for 10 years. He publishes Speech Recognition Update, *a newsletter on the speech-recognition industry. You can reach him on BIX c/o "editors" or on the Internet at 72162.3175@compuserve.com.*

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Personal Databases

For many applications, an inexpensive Windows database will get the job done more easily than traditional solutions

MATT TRASK AND DON SORENSEN

Personal databases form one of the hottest product categories on the market today. The term *personal* does not denote recipe files or other home uses; it simply means that the products in this category usually reside on a local hard disk and track information that is not used corporatewide.

Databases can be intimidating things: They're big, complex, expensive, and programmable. Complex databases can hold megabytes of the most mission-critical data in an organization; such an organization needs to have a database administrator to keep track of it all. When something goes wrong, you call the database administrator to straighten it out.

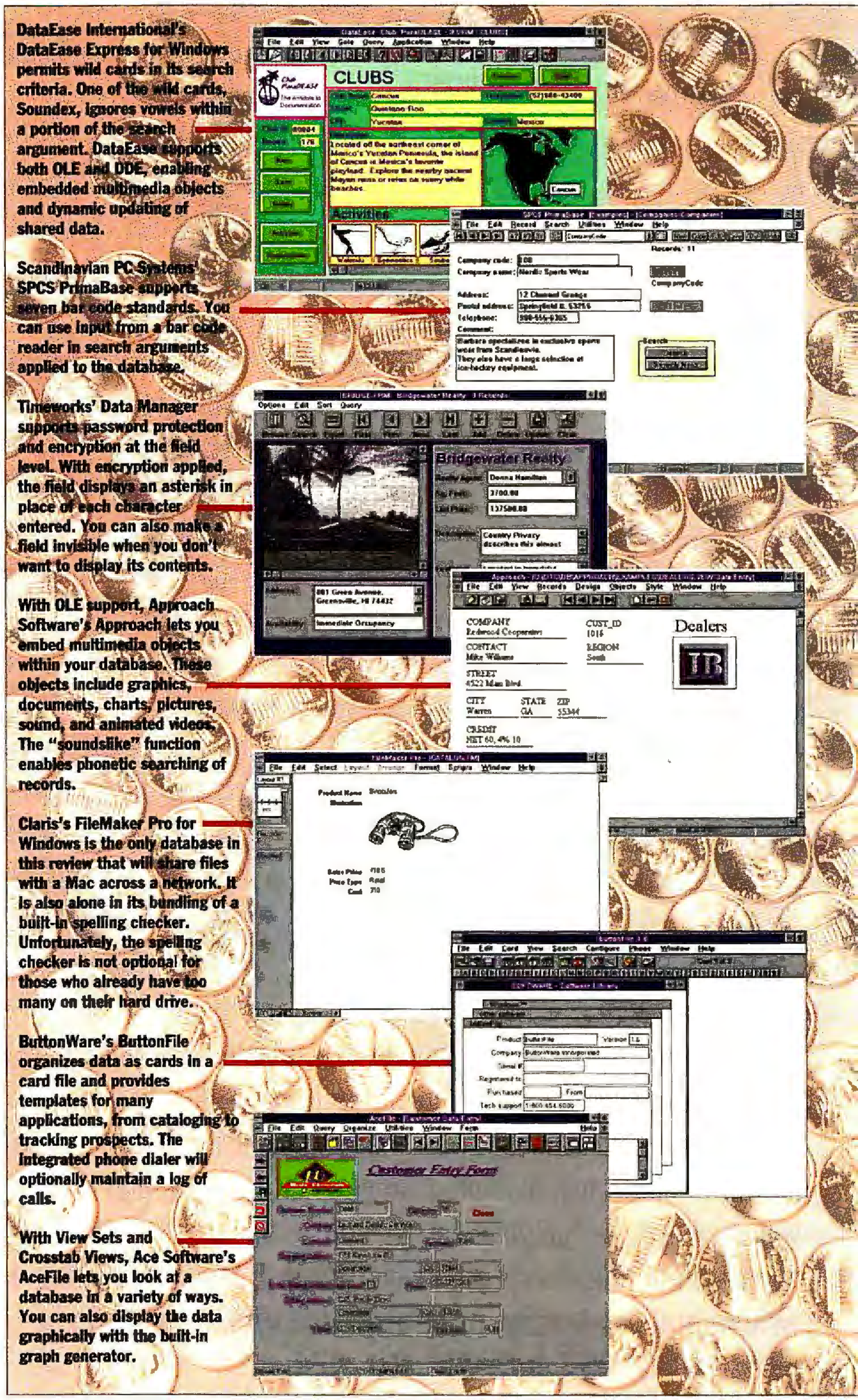
Personal databases can take some of the burden off the database administrator and return control of the data to a department or workgroup. Personal databases work well for an individual who must track information that the entire organization does not need to access regularly, or for a department or workgroup that needs to access interdepartmental data and doesn't require a customized application.

For the purposes of this review, we define a personal database as one that is useful for a workgroup, department, or small business; has no programming language (macros are permitted); and carries a retail price of under $400. All the databases we reviewed run under Windows 3.1.

What to Look For

So you think you've got an application that's suitable for a personal database. You want to get a package that's easy to use, but you don't want to sacrifice any of the features you'll need. Once you've determined the application, you need to ask some questions about the database you're considering.

Is the package relational? Arguments persist over what constitutes a true relational database. In general terms, a *relational* database can join two or more database tables using a common field. For example, a personnel file could contain ZIP codes for each record, and a different file could hold the city and state informa-



DataEase International's DataEase Express for Windows permits wild cards in its search criteria. One of the wild cards, Soundex, ignores vowels within a portion of the search argument. DataEase supports both OLE and DDE, enabling embedded multimedia objects and dynamic updating of shared data.

Scandinavian PC Systems' SPCS PrimaBase supports seven bar code standards. You can use input from a bar code reader in search arguments applied to the database.

Timeworks' Data Manager supports password protection and encryption at the field level. With encryption applied, the field displays an asterisk in place of each character entered. You can also make a field invisible when you don't want to display its contents.

With OLE support, Approach Software's Approach lets you embed multimedia objects within your database. These objects include graphics, documents, charts, pictures, sound, and animated videos. The "soundslike" function enables phonetic searching of records.

Claris's FileMaker Pro for Windows is the only database in this review that will share files with a Mac across a network. It is also alone in its bundling of a built-in spelling checker. Unfortunately, the spelling checker is not optional for those who already have too many on their hard drive.

ButtonWare's ButtonFile organizes data as cards in a card file and provides templates for many applications, from cataloging to tracking prospects. The integrated phone dialer will optionally maintain a log of calls.

With View Sets and Crosstab Views, Ace Software's AceFile lets you look at a database in a variety of ways. You can also display the data graphically with the built-in graph generator.

tion for each ZIP code. When city and state information is required, the database could perform a join of the two tables using the ZIP code field as a key. Relational capabilities are particularly useful when you need to reuse your database in many different ways—reentering the data multiple times requires much more disk space than is otherwise necessary.

Does the personal database you're considering provide ready-to-use templates for forms and reports? Such templates make it easier to set up a database and to produce good-looking reports. The template should be easy to modify to match your particular requirements.

Is mail merge available to combine names and addresses with letters? Sometimes a database exports names and addresses to a word processor for this purpose. Can labels be formatted and printed? These features eliminate the need for reentering data for mailing and shipping applications. Is auto-dial available? For applications requiring a lot of phone activity, automatic dialing can add up to a meaningful savings of time and energy.

How well does the database work over a network? When multiple users access the same database, data integrity becomes an important issue. If two people change the same field at the same time, integrity is lost. Features such as read-only fields and record locking prevent such problems and guarantee the integrity of the database. And you may need password and encryption features if you're tracking sensitive information, such as your personal stock portfolio or employee salary records.

Group Overview

All the personal databases reviewed here have much in common—database programs are all expected to do certain things. For example, every package can apply filters, sort entries, and search for a match to a supplied argument. And all of them can import and export data to and from common file formats (see the table "Personal Database Features").

All are also easy to use. They share a common form-building orientation, which focuses on letting you quickly build forms for data entry or browsing.

You'll find that most of what differentiates these packages is around the periphery: a card stack metaphor, unusual data types, or bar code support.

As a result, our individual reviews will concentrate only on the aspects of each database that make it stand out from the rest of the pack.

AceFile 2.0

AceFile features two views in addition to the typical list and form views. The View Set consists of one or more views from one or more databases that have been saved together. For instance, you could use a View Set of an appointment schedule, a phone book, and a to-do list as a PIM (personal information manager). If your monitor has a large enough screen, you can simultaneously open up to 20 views from up to 10 databases with up to 10 index files each.

A Crosstab View is a matrix displaying the relationship between two fields. The relationship may consist of summarized data or calculated minimized, maximized, or averaged values portraying trends or patterns in the data. You can display or print Crosstab information in 16 styles of graphs, including variations on column, area, bar, line, and pie graphs (many in either two or three dimensions).

AceFile, like all these personal databases, reads .DBF files directly, and .DBF files are AceFile's native format. However, you can't create a form to connect fields from several databases.

You can record repetitive sequences of keystrokes and mouse movements as macros and play the sequences back at any time. The main toolbar has icons for recording, stopping, and playing macros. Macros can simulate virtually any repetitive task.

AceFile provides a large number of operators and functions that you can use, along with wild-card characters, in expressions. Expressions combine one or more fields in a formula for defining index keys and filters. Add a number of provided field macros (not to be confused with the recorded macros described above), and you have all the tools you need to format displays and reports.

This feature, along with mail merge, label printing, the auto-dialer, and DDE support, make AceFile a fairly comprehensive package. Its $199 price puts it in direct competition with less fully featured systems such as Data Manager and PrimaBase. We do wish AceFile used the standard Open dialog box from Microsoft's Common Dialog library, however. If databases are maintained in different directories, it's sometimes difficult to reach the database desired. Use of the standard Open dialog box would have made this task much easier.

Approach 2.0 for Windows

Approach's support for OLE permits a database to contain not only graphics but also documents, charts, pictures, sound, and animated videos. A special PicturePlus field contains these multimedia elements.

Networks are supported with file and record locking, password protection, and read-only fields. Record locking can be full or optimistic (which is the default setting) when dealing with either Paradox or dBase databases. Full record locking prevents all other users from updating a record for as long as the record is "out" for modification. Optimistic record locking allows two users to modify the same record simultaneously, locking the record when one person writes it back to the network and giving the other person an error message with an override option.

Using the many provided operators and functions, you can write formulas to analyze fields and display the results in a calculated field. These calculations can summarize data in a group of records, an entire database, or several databases. We particularly liked the "soundslike" function: When you're unsure of a word's correct spelling, you can search for the record phonetically.

The package supports mail merge, label printing, and macros. Buttons on a form or a report can launch user-defined macros. One small complaint: We found the tiny font used on the status bar nearly unreadable, even at 640- by 480-pixel resolution, and the font is not configurable.

ButtonFile 1.0

This package is the definitive easy-to-use information manager. ButtonFile's database is called a Deck; a record is called a Card; and a field is known as a Data Box. For a work space, ButtonFile uses the Microsoft MDI (Multiple Document Interface). Cards are displayed in a traditional list view, or in a continuous loop like a Rolodex. Just below the menu bar is an optional Index Button row (consisting of A through Z and 0 through 9). Clicking on an Index Button quickly positions you at the point in the Deck where the index starts with that character. A ButtonFile Deck is compatible

PERSONAL DATABASE FEATURES

Personal databases are very affordable and surprisingly powerful. These databases support a wide range of file formats and networks. (● = yes; ○ = no.)

	ACEFILE 2.0	APPROACH 2.0 FOR WINDOWS	BUTTONFILE 1.0	DATAEASE EXPRESS FOR WINDOWS 1.1
Company	Ace Software	Approach Software	ButtonWare	DataEase International
Price	$199	$399	$89	$395
Minimum requirements				
Processor	286 or higher	286 or higher	286 or higher	286 or higher
Memory	2 MB	2 MB or higher	1 MB or higher	2 MB or higher
Hard disk	3 MB	2 MB	2 MB	6 MB or higher
Mouse/pointing device	Required	Required	Optional	Required
Maximums				
Records per file	1 billion	1 to 2 billion*	Limited by disk space	2 billion
Fields per record	254	255	40	255
Characters or notes per field	5120	4,294,967,295	8192	4000
Indexes per database	10	255	1	Unlimited
Files open at once	60	30 to 60*	Limited by memory	100
Database features				
Operators	●	●	○	●
Relational	○	●	○	●
Password protection	○	●	●	●
Encryption	○	○	●	●
Read-only fields	●	●	○	●
Automatic record locking	●	●	● (network version)	●
DDE support	●	○	○	●
OLE support	○	●	○	●
Mail-merge letters	●	●	Export to word processor	○
Print labels	Avery predefined	Avery predefined, custom	●	●
Templates provided	●	●	●	●
Auto-dial phone	●	○	●	○
Functions	●	●	○	●
Create new macros	●	●	○	○
Report generation	●	●	●	●
Graphs	●	○	○	○
Store pictures/graphics	●	●	○	●
Store sound	○	●	○	●
Other databases supported				
DB2	○	●	○	Optional
dBase	III Plus import/export	●	III import/export	File access via ODBC
DRDA Access	○	○	○	●
EDA/SQL Access	○	○	○	●
FoxPro	○	●	○	○
Microsoft SQL	○	●	○	Optional
ODBC Access	○	●	○	●
OS/2 Database Manager	○	○	○	Optional
Oracle SQL	○	● (versions 6.0 and 7.0)	○	Optional
Paradox	○	●	○	File access via ODBC
Rapid	○	○	○	○
AS/400	○	○	○	Optional
Sybase	○	○	○	Optional
ASCII text files	●	Import/export	Import/export	●
Lotus 1-2-3	Import/export	Import/export	○	●
Microsoft Excel	Import/export	Import/export	○	○
Symphony	Import/export	Import/export	○	○
Image formats				
BMP	●	●	○	●
CGM	○	○	○	○
DIB	○	○	○	○
DRW	○	○	○	○
EPS	○	●	○	●
GIF	○	●	○	●
PCT	○	○	○	○
PCX	●	●	○	●
PIC	○	○	○	○
TIF	●	●	○	●
WMF	○	●	○	●
Networks supported				
3Com 3+Open	●	●	○	●
Banyan Vines	●	●	○	●
IBM PC LAN Program	●	●	○	●
LANtastic	●	●	○	●
Microsoft LAN Manager	●	●	○	●
Novell NetWare	●	●	○	●
Novell NetWare Lite	●	●	○	●

*Lower limit = dBase/FoxPro; upper limit = Paradox.

DATA MANAGER FOR WINDOWS	FILEMAKER PRO 2.1 FOR WINDOWS	SPCS PRIMABASE 3.1
Timeworks	Claris Corp.	Scandinavian PC Systems
$59	$129	$199
286 or higher	286 or higher	286 or higher
2 MB	3 MB or higher	1 MB or higher
3.5 MB	4 MB	2 MB
Required	Required for design	Optional
50 million	Limited by disk space	300 million
Unlimited	Limited by disk space	200
30,000	Limited by disk space	32,000+
200	All fields indexed	15 (five levels deep)
100	16	100
●	●	●
●	Via ScriptMaker lookups	●
●	●	●
●	○	●
○	●	●
○	●	●
●	●	●
○	○	○
Export to word processor	● (export to word processor)	Import letter from Write or internal report generator
●	Avery predefined, custom	Export to word processor via report generator
●	●	● (upon registration)
○	○	○
○	●	●
○	Scripts, not macros	○
●	●	●
○	○	○
●	●	○
○	●	○
○	○	○
III and IV import	Import/export	Import/export
○	○	○
○	○	○
○	Import/export DBF	○
○	○	○
○	○	○
○	○	○
○	○	○
○	○	○
Import	○	○
○	○	○
○	○	○
Import/export	Import/export	Import/export
○	Import/export	○
○	Import/export	○
○	○	○
●	●	○
○	●	○
●	○	○
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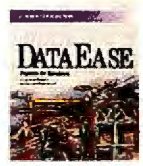
○	●	○
○	●	○
○	●	○
○	●	○
○	●	○
○	●	○
○	○	●
○	●	●
○	●	●
○	●	●
○	●	●
○	2.15 or higher	●
○	●	●

with the Windows Cardfile.

ButtonFile provides many templates for Decks. You can use a template as is, design your own Deck based on a template, or design your own template from scratch. You can assign password protection and encryption on a per-Deck basis, print labels, and use the phone dialer to not only dial the phone but also maintain a log of outgoing calls.

Although mail merge cannot be performed directly from within ButtonFile, you can export data needed for that purpose to an external word processor.

DataEase Express for Windows 1.1



DataEase uses OLE to include all the usual multimedia objects in a database. Support for DDE makes it possible for two active programs to interact and not only share data but also affect each other's data. When you change data in a database field, a DDE link can then update related fields in an active spreadsheet such as Excel. An Excel graph based on that data and embedded in the original database file is also refreshed for display in a report.

DataEase enhances searches with wild cards and Soundex references in the search criteria. Soundex performs a search on the consonant content of the search key, ignoring all vowels. For example, entering an argument of "bt" would find such words as *bat*, *beat*, *boat*, and *but*.

DataEase Query Language is defined with a large list of operators, functions, and symbols. In addition to those provided, C programmers can create CDFs (Custom-Defined Functions) and install them in a DLL file. The DLL is then linked to DataEase.

Data Manager for Windows

Data Manager's support for DDE permits real-time transfers of database information with other active programs. An example of this is a Microsoft Word macro that searches a Data Manager database and reads data for use in a document or report. Additionally, you can add bit-mapped graphics from the Windows Clipboard to image fields in the database.

Data Manager supports password protection and encryption at the field level. With encryption applied, the field displays an asterisk in place of each character entered. You can also make a field invisible if you don't want to display its contents.

There were two things we didn't like about this product. One is that the oversize icons on the menu bar left less room on the screen and required frequent use of the vertical scroll bars to access the entire database form. We also disliked the message that appears every time you tell Data Manager that you wish to exit. The message tells you how long the program has been active and asks if you *really* want to exit. After a while, this becomes irritating. Worse, if you have an unsaved modified database loaded and answer "yes" to this question, you lose all your changes. We'd much prefer to receive a warning that the modified database had not been saved and otherwise be able to exit with no questions asked.

FileMaker Pro 2.1 for Windows

FileMaker Pro has two features that are unique among this group of products: a spelling checker and cross-platform file sharing. The program's spelling checker can check a selected word or passage, all the text in the current record or a set of records, or field names on the current layout. When it finds a questionable spelling, it provides a list of possible replacements. You can replace the word with a selection from the list, add the word to the dictionary, skip the word without adding it to the dictionary, or cancel.

While this feature may be very desirable if you're a particularly bad speller, the installation routine should give you the option of refusing to load it. With hard disks already littered with the huge spelling checkers included with word processors and other programs, the last thing many people need is another spelling checker.

Cross-platform file sharing can take place between FileMaker Pro for Windows and its Mac version running on a Mac on the same network. For network security, password protection is available, and fields within records can be defined as read-only or hidden.

FileMaker Pro understands an unusually large list of file formats, making it possible to import and export files with Microsoft Word and Excel, BASIC programs, VisiCalc, Lotus 1-2-3, dBase III and IV, and many other programs accepting tab- or comma-delimited text files. This makes it possible to perform a mail merge by exporting necessary fields from your database to a word processor.

The package's ScriptMaker feature enables you to write scripts that perform a series of actions. Scripts can execute subscripts (which are like subroutines) or external scripts (from other database files).

Although OLE is not directly supported, similar functionality permits graphics, pictures, or sounds to be stored in a picture/sound field. You can use the bundled form templates as is or modify them to suit your own requirements.

SPCS PrimaBase 3.1

SPCS PrimaBase supports seven bar code standards: the full ASCII Code 39, the numeric Interleaved 2/5, three U.S. standards (UPC/A, UPC/E, and U.S. Postnet), and two European standards (EAN/13 and EAN/8). You can print bar codes, and if your hardware includes a bar code reader, you can use bar codes as input to search for records in a database.

You can use the instant-search feature at any time in either form or list mode. You just type in a character, and the current record pointer goes to the record whose key begins with that letter. Enter a second character, and the pointer again moves to the key beginning with the two typed characters, and so on. This feature gives you fast access to a desired record.

Network support includes passwords with various levels of protection. You can set access rights to read/write or read-only, and you can determine whether a user can authorize exclusive access or modify forms and reports. PrimaBase can also encrypt files.

PrimaBase's mail-merge support is unique—other database managers have simple word processors or export formatted data for use by other programs. PrimaBase can perform merges with letters created by Windows Write or within PrimaBase's report generator. Expressions are supported for calculated fields with provided operators and functions.

A Personal Preference

These database packages have many interesting features, ranging from bar code support to custom-defined functions to an integrated spelling checker. If you have specific requirements, your choices may be limited. For a rich feature set and both DDE and OLE support, the only choice is DataEase. FileMaker Pro is the way to go if you require a spelling checker or Mac file sharing. And SPCS PrimaBase is the only database package in the group with bar code support.

If ease of use is important to you, ButtonFile is a good choice. Predefined templates make it ideal for tracking and cross-referencing simple lists such as business contacts or small inventories. For the best mix of features and ease of use, we like FileMaker Pro. ■

Matt Trask is president of Communica, Inc., a Cape Cod–based consulting firm that specializes in system software for PCs. Don Sorensen is a senior software engineer at Communica and has done independent database contract programming for over 10 years. You can contact them on BIX as "matt.trask" and c/o "editors," respectively.

Company Information

Ace Software Corp.
(AceFile 2.0)
1740 Technology Dr.,
Suite 680
San Jose, CA 95110
(408) 451-0100
fax: (408) 437-1018
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Approach Software Corp.
(a subsidiary of Lotus Development Corp.)
(Approach 2.0 for Windows)
311 Penobscott Dr.
Redwood City, CA 94063
(415) 306-7890
fax: (415) 368-5182
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ButtonWare, Inc.
(ButtonFile 1.0)
P.O. Box 96058
Bellevue, WA 98009
(206) 454-0479
fax: (206) 454-1838
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Claris Corp.
(FileMaker Pro 2.1 for Windows)
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P.O. Box 58168
Santa Clara, CA 95052
(408) 987-7000
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DataEase International, Inc.
(DataEase Express for Windows 1.1)
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Scandinavian PC Systems, Inc.
(SPCS PrimaBase 3.1)
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fax: (504) 338-9670
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Timeworks, Inc.
(Data Manager for Windows)
625 Academy Dr.
Northbrook, IL 60062
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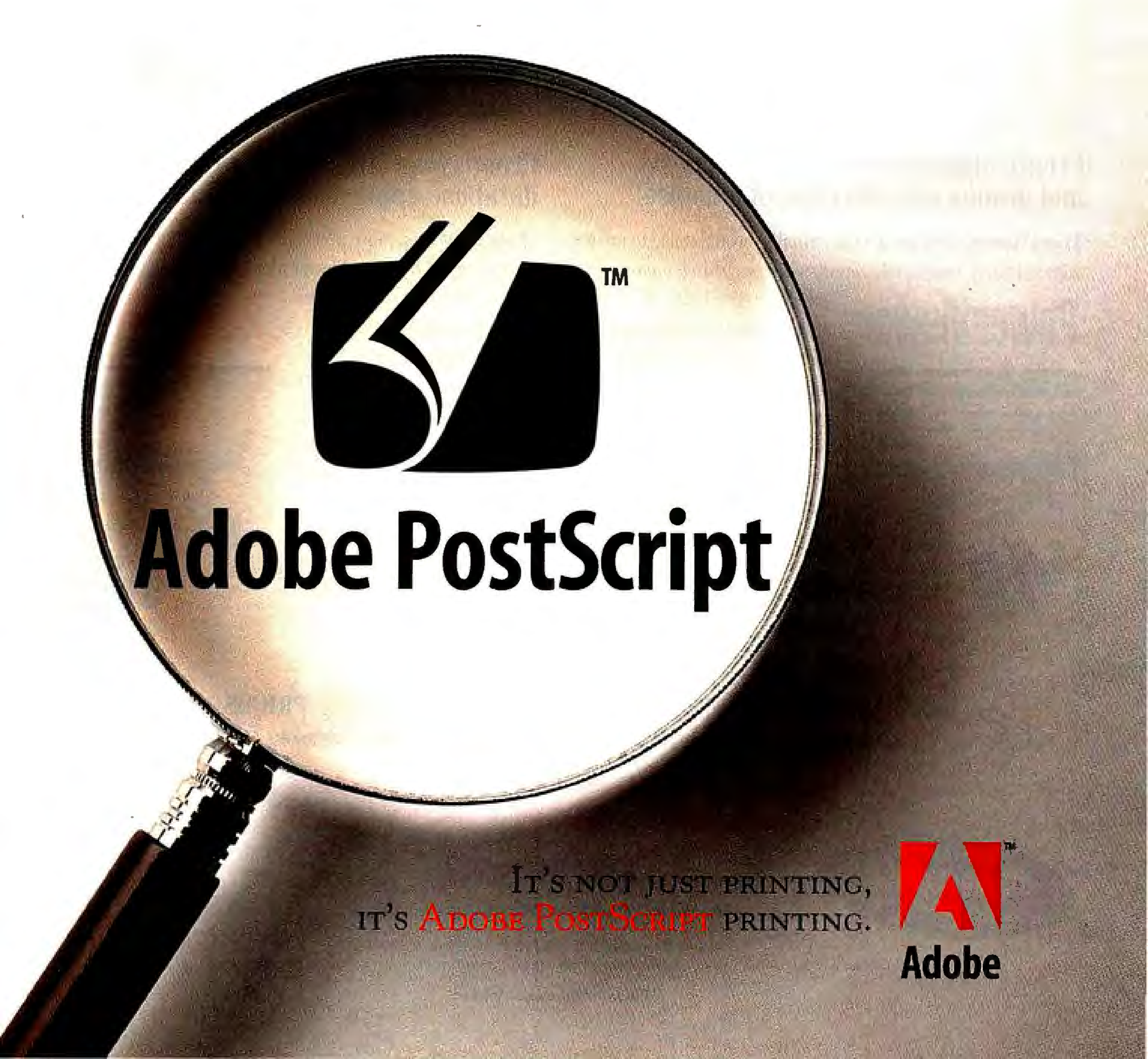
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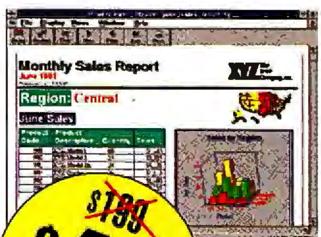

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Acrobat vs. Common Ground

Adobe Systems and No Hands Software offer two different ways to distribute electronic documents

STANFORD DIEHL

Consider it a pothole in the digital highway. Amid the promise of electronic-information delivery, we still don't have a reliable and efficient medium for communicating via formatted electronic documents.

We could continue to send unformatted ASCII text back and forth, but the style and layout of a document offers more than just a distinctive look. A document's design helps a reader better understand the information. But unless the document's recipient shares the same platform, the same applications, and the identical fonts as the document's creator, a meticulously designed report can fall apart, dropping its page formatting and, more important, some of its information content. In some cases, the recipient may not be able to access the document at all.

Enter Adobe's Acrobat and No Hands Software's Common Ground, two competing technologies for creating cross-platform, application-independent documents. Both technologies are compelling and workable. Each has clear advantages and disadvantages. Both show the potential power of a cross-platform document format. And both need some work.

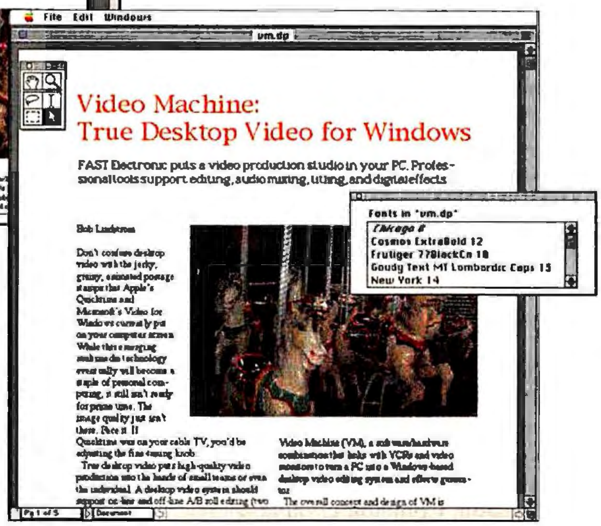
Applications for document distribution are vast. With portable documents, corporations can electronically distribute telephone lists, manuals, or company newsletters throughout the organization.

The PostScript Solution

To provide a format for electronic-document distribution, a technology must retain the layout, the graphics, and the distinctive look of the original document. The digital document must be compatible with a wide range of output devices and, ideally, available to the widest possible audience. Acrobat and Common Ground take different approaches to this same end.

Adobe Systems has leveraged its experience on two fronts, PostScript and fonts, to devise a portable-document strategy. As the creator of PostScript and an industry leader in font technology, Adobe has impressive credentials in both areas.

◀ **Acrobat delivers** *a strong set of navigation features. Double-clicking on the thumbnails sends you to the selected page, or you can go to a specific page number. The controls on the tool ribbon let you step through a document, or you can go directly to the first or last page.*



▶ **Common Ground's tools** *are available from a floating palette. The information box lets you know which fonts were used in the original document.*

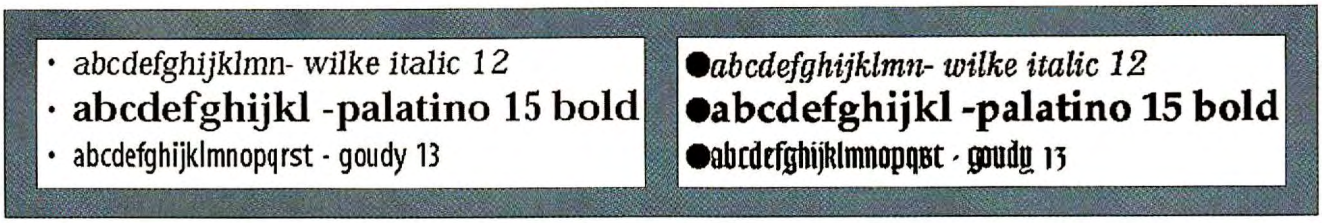
Acrobat is actually a family of products, three of which are shipping. Acrobat Exchange ($195) creates electronic documents through the printer-driver mechanism on a Mac or on a Windows-based PC. You can then view the document, search it for individual words, print it, or embellish it with annotations and hypertext links. Acrobat Reader sells in bundles of 50 ($50 per user), 100 ($40 per user), or 500 ($35 per user). Acrobat Reader lets you view, navigate, or print Acrobat documents, but you can't create them. Acrobat Distiller ($695) takes raw EPS (Encapsulated PostScript) files and converts them to portable documents.

Acrobat's PDF (Portable Document Format) uses PostScript to describe the text, graphics, and images in a file. Because it uses PostScript, a PDF file is device- and resolution-independent, so it will reproduce at the highest resolution that your output device supports. You can view a page on a high-resolution display system at multiple magnification levels, and you can print to any device, from a 300-dpi laser printer to a Linotronic image setter. Adobe has published PDF as an open standard, allowing developers to support the format in third-party applications.

To reproduce a document's fonts, Acrobat comes bundled with ATM (Adobe Type Manager) and its font-substitution technology. If a font is missing from a document, ATM substitutes one of two multiple-master fonts (serif or sans serif) to match the general style of the missing font. The substituted font will also duplicate the missing font's metrics. For basic fonts, this technology works well. The substituted font retains the weight and width of the original font. However, the distinctiveness of ornate fonts is lost, because ATM substitutes only a basic serif or sans serif outline and cannot replicate the actual font design. But by retaining the metrics of fonts on the page, ATM ensures that all lines break properly and that the page layout is duplicated exactly, even when complex fonts are unavailable.

Building DigitalPaper

Common Ground from No Hands Software sells for $189.95 and creates documents via the printer-driver mechanism on the Mac. A Windows version should be available by the time you read this. Instead of PostScript, Common Ground uses a proprietary format called DigitalPaper



To retain the distinctive look of a page, *a portable document technology must handle fonts that are not available on a recipient's system. Acrobat's font-substitution method retains the metrics of a font and thus retains proper page layout, but it often loses the decorative design of more ornate fonts such as Goudy. Common Ground's proprietary technology precisely mimics the font's appearance (right).*

for creating and displaying its electronic documents. Embedded graphics are rendered by using the host-imaging system (QuickDraw on the Mac, and the Windows Graphical Device Interface, or GDI, when the Windows version ships) to build a scalable image. Using the host-imaging system saves memory overhead, because it does not require an additional imaging component.

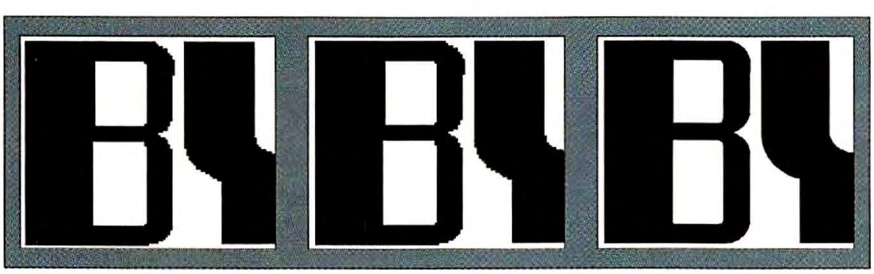
Acrobat Exchange requires 2 MB of application RAM on the Mac; Adobe recommends 4 MB. Common Ground requires only 700 KB, but the company recommends about 1.2 MB.

Common Ground's font description is the proprietary part of DigitalPaper. The characters are not embedded outlines or bit maps (a common misunderstanding about Common Ground). To a first approximation, Common Ground sprays rectangles across the page and describes the contents of each rectangle in vector format. The first time a unique character is encountered, it is described and stored. When the same character occurs again, only location information is stored, with a reference to the original description of the character. The vector information tells Common Ground how to rebuild characters at fixed resolutions (72 and 100 dpi for screen display, 200 dpi for faxing, and 300 dpi for printing) with pixel-for-pixel fidelity. Although No Hands Software plans to increase the available resolutions in future versions, Common Ground will always be less flexible than the resolution-independent technology of Acrobat.

Perhaps Common Ground's greatest asset (in addition to small memory requirements) is its ability to attach a mini-viewer to an electronic document. With this run-time viewer attached, the recipient requires no additional software to view the document. The mini-viewer offers no searching and only basic navigation features, but it is freely distributable (up to 100 copies for each document).

Acrobat's lack of a run-time viewer could be a serious pitfall. If you want to establish a universal format for document transfer, you shouldn't expect everyone to buy a $50 reader program. On the other hand, Adobe may be more effective in establishing a standard than No Hands Software because of its preeminent presence in the market. If Adobe can attract licensees in the same way it did for ATM—in effect, letting vendors evangelize the product by shipping an Acrobat reader with shrink-wrapped software—or if it really gets aggressive and ships an Acrobat viewer with ATM, the company could establish Acrobat by brute marketing strength.

ACROBAT	COMMON GROUND
• resolution independence	• lower resource requirements
• hypertext linking	• distributable viewer
• bookmarks (index creation)	• password security
• higher-quality EPS files	• phrase searching
• smaller electronic documents	• cut-and-paste graphics
• text annotations	• faster performance



Common Ground (left) and Acrobat Exchange (middle) *create electronic documents by servicing print calls from the application. Using this method, both technologies process the low-resolution preview image of an embedded EPS graphic. Acrobat Distiller converts EPS files directly, resulting in much higher-quality output (right).*

The Feature Set

When it comes to current features, a general theme comes clear: If you could somehow combine the functionality of Acrobat and Common Ground into a single application, you would end up with a well-rounded solution.

Common Ground includes security features (e.g., password protection for a document) that Acrobat should have. In addition, Common Ground lets you search for phrases, expanding on Acrobat's limit of single-word searches. However, Common Ground lacks Acrobat's hypertext linking, which lets you link to a specific view or magnification level. It also lacks any annotation features, while Acrobat lets you annotate a document with "sticky" notes. All told, Acrobat's interface is more fully featured.

The two products support thumbnail views of a document. Acrobat places the thumbnails to the left of the current page view, so you can conveniently turn to a specific page by double-clicking on the thumbnail. You can create bookmarks in an Acrobat document to quickly build a table of contents or an index of a document. Common Ground does not support a bookmarking facility. Acrobat supports magnification levels of from 12 percent to 800 percent in 1 percent increments; Common Ground's magnification levels are preset to 25 percent, 50 percent, 100 percent, 200 percent, and 400 percent.

Common Ground uses an I-beam for text selection, the standard method for selecting text in a graphical document, and captures graphics in bit-map or PICT format. With Acrobat, you draw a rectangle around text to select it. This method is a bit more cumbersome, and you can select only complete lines, not selected phrases within a line. In addition, you can't cut and paste graphics with Acrobat.

Testing the Technologies

To test out these two technologies, I generated an assortment of documents with a wide range of Mac software (e.g., Adobe Il-

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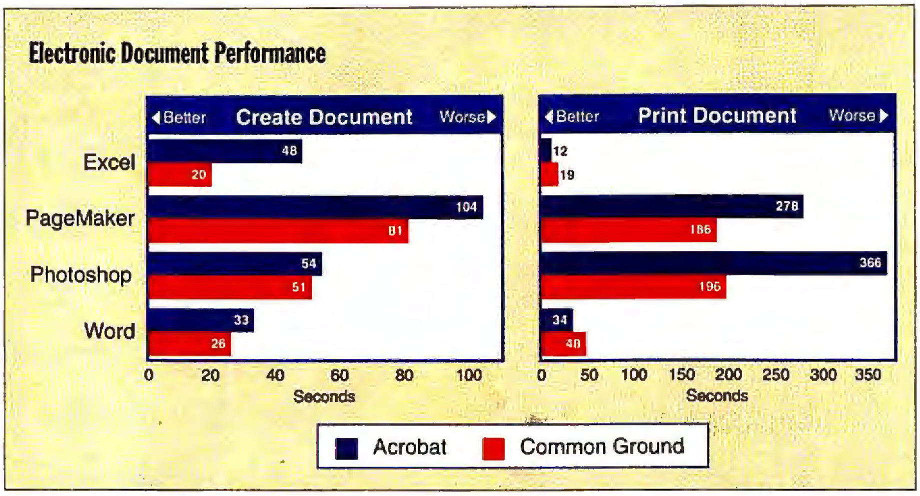

Common Ground *consistently outperformed Acrobat on the Macintosh. Acrobat's on-the-fly file compression slows performance but results in significantly smaller electronic documents.*

lustrator, Adobe Photoshop, Aldus PageMaker, Claris FileMaker Pro, Claris MacWrite, Informix Software Wingz, Microsoft Excel, Microsoft Word, and QuarkXPress). I transported the Acrobat files back and forth between a Mac and a PC running Windows.

On Windows, I tested Acrobat with PageMaker 4.2 and 5.0, Word for Windows, WordPerfect for Windows, Lotus 1-2-3 release 4, Excel, Photoshop, Picture Publisher, and CorelDraw. I used a system with a minimum configuration (a 16-MHz Mac SE/30 with 5 MB of RAM or a 25-MHz Dell 486SX with 4 MB of RAM), as well as a higher-end system (a 25-MHz Mac Quadra 800 with 8 MB of RAM or a 66-MHz Gateway 2000 486DX2 with 16 MB of RAM).

I ended up with electronic documents incorporating elements from all this software, but not without running into quirks. I created some PostScript files under Windows that the Mac version of Acrobat Distiller couldn't handle. An image embedded in a Word document displayed fine from the Mac version of Acrobat Exchange but didn't display on the Windows version. Adobe acknowledges some problems in its release notes, but a problem such as "canceling printing from PageMaker may cause a crash" is no less disconcerting just because it's documented.

Both products have some basic limitations. On low-end machines, I could process only simple documents, and graphics performance was slow. In general, lack of available memory was a persistent problem. And if your original document includes hyphenated words, neither product will be able to find the hyphenated occurrence of the word, an understandable limitation but still a problematic one.

As you might expect, the Acrobat technology handles EPS files more efficiently than Common Ground does. Both products create documents by accepting application calls to the printer driver, so the low-resolution preview image of the EPS file is processed. Acrobat Distiller converts EPS files directly, resulting in higher-quality images. In fact, in its release notes for Acrobat, Adobe suggests using Acrobat Distiller if you run into problems with the PDF Writer.

Common Ground was faster than Acrobat at creating a portable document and printing it. The Acrobat files are smaller, though, thanks to various compression schemes, including LZW (Lempel-Ziv-Welch), RLE, CCITT Group 3 and 4, and JPEG.

Common Ground documents are approximately the same size as the original file. For simple documents, this is sufficient, but when I put together a PageMaker document with multiple 24-bit images, file sizes became a significant factor. The Acrobat file was about 4 MB in size, while the Common Ground file ballooned to over 20 MB. You can control the size of a DigitalPaper file by reducing the bit depth of your monitor to match the intended output. If you need only black-and-white output, you can set your monitor to 1 bit and decrease file sizes significantly. Once again, Common Ground's approach is less flexible than Acrobat's.

A Portable Format for the Future

Clearly, the time has come for a cross-platform standard for electronic documents. Now that the Acrobat and Common Ground technologies are in place, we can expect that future software releases will improve the performance and address some of the shortcomings of the current offerings.

If you're looking for today's best solution for corporatewide document distribution (e.g., memos, telephone lists, reports, and simple manuals), Common Ground is it. Your low-end machines will not be left out of the mix, and with the distributable viewer, you can send electronic documents off-site. It's a solution for simple correspondence and communication. Documents with large 24-bit images will be too big until DigitalPaper incorporates a good compression scheme.

Adobe is going to have trouble migrating Acrobat down to low-end systems. Based on PostScript and ATM font substitution, the Acrobat technology will require resources above and beyond the capacity of today's low-end systems. You'll have to decide if the requirement of a 4-MB or, preferably, an 8-MB system is too high for your organization.

I think the resource requirements will keep Acrobat from becoming a wide-spread standard in the short run. But as mainstream systems become more substantial, Adobe has what it takes to build a long-term standard: a proven technology, strong partnerships, an open standard, and a formidable market presence. The company has already announced technology partnerships to make future versions of Acrobat compatible with popular style sheets and style codes such as SGML (Standard Generalized Markup Language). The current proliferation of ATM also helps. In the long run, Acrobat will be the standard to beat. ■

About the Products

Acrobat Distiller $695
Acrobat Exchange $195
Acrobat Reader $50
Unlimited users $2495
(volume discounts available for Exchange and Reader)

Adobe Systems, Inc.
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P.O. Box 7900
Mountain View, CA 94039
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Common Ground $189.95
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1301 Shoreway Rd., Suite 220
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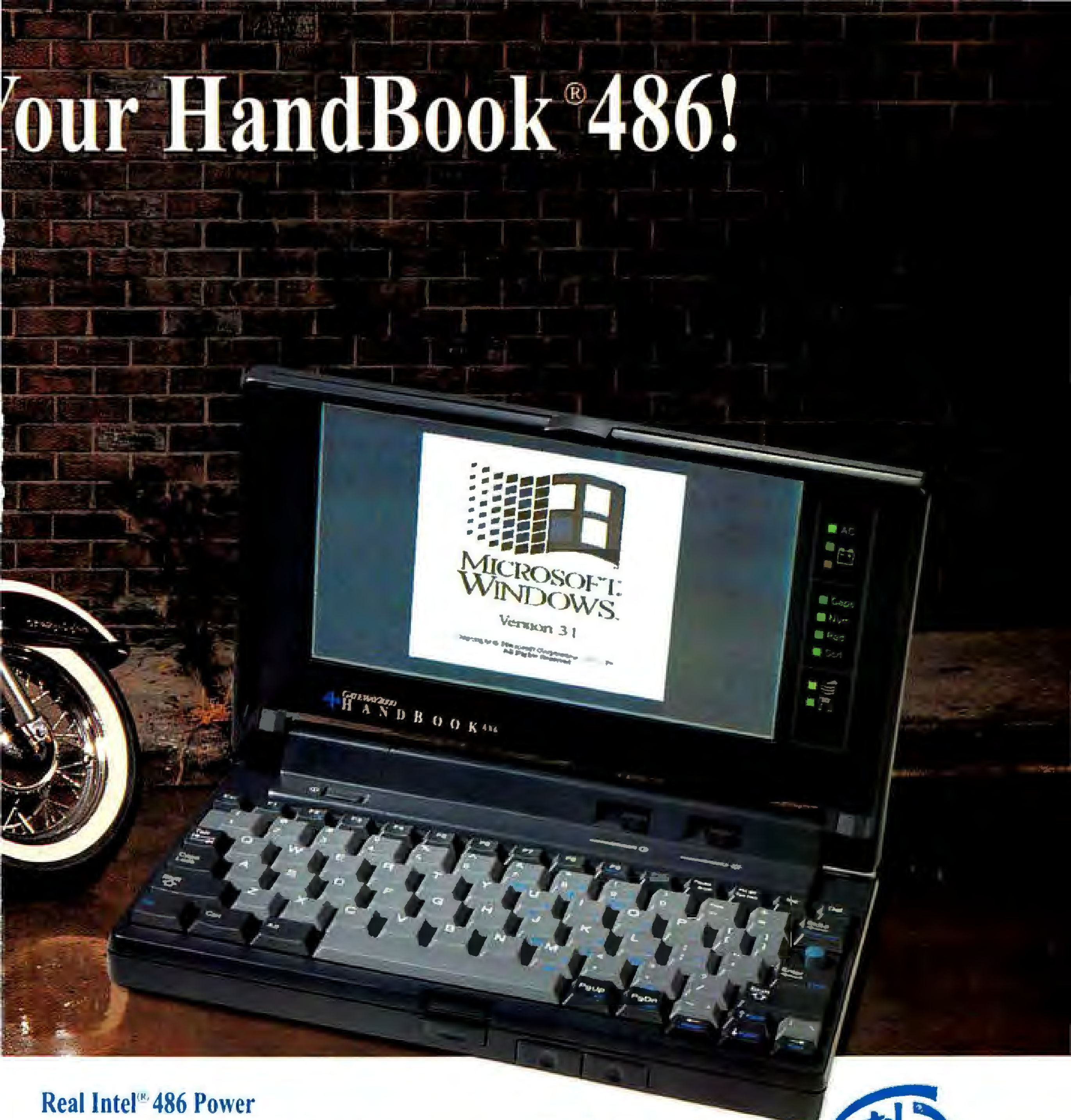
Stanford Diehl is a technical editor for the BYTE Lab. Formerly, he worked for a large defense contractor, creating database applications and electronic training programs for a wide range of customers, including the United Arab Emirates and the Canadian Air Force. You can reach him on BIX as "sdiehl."



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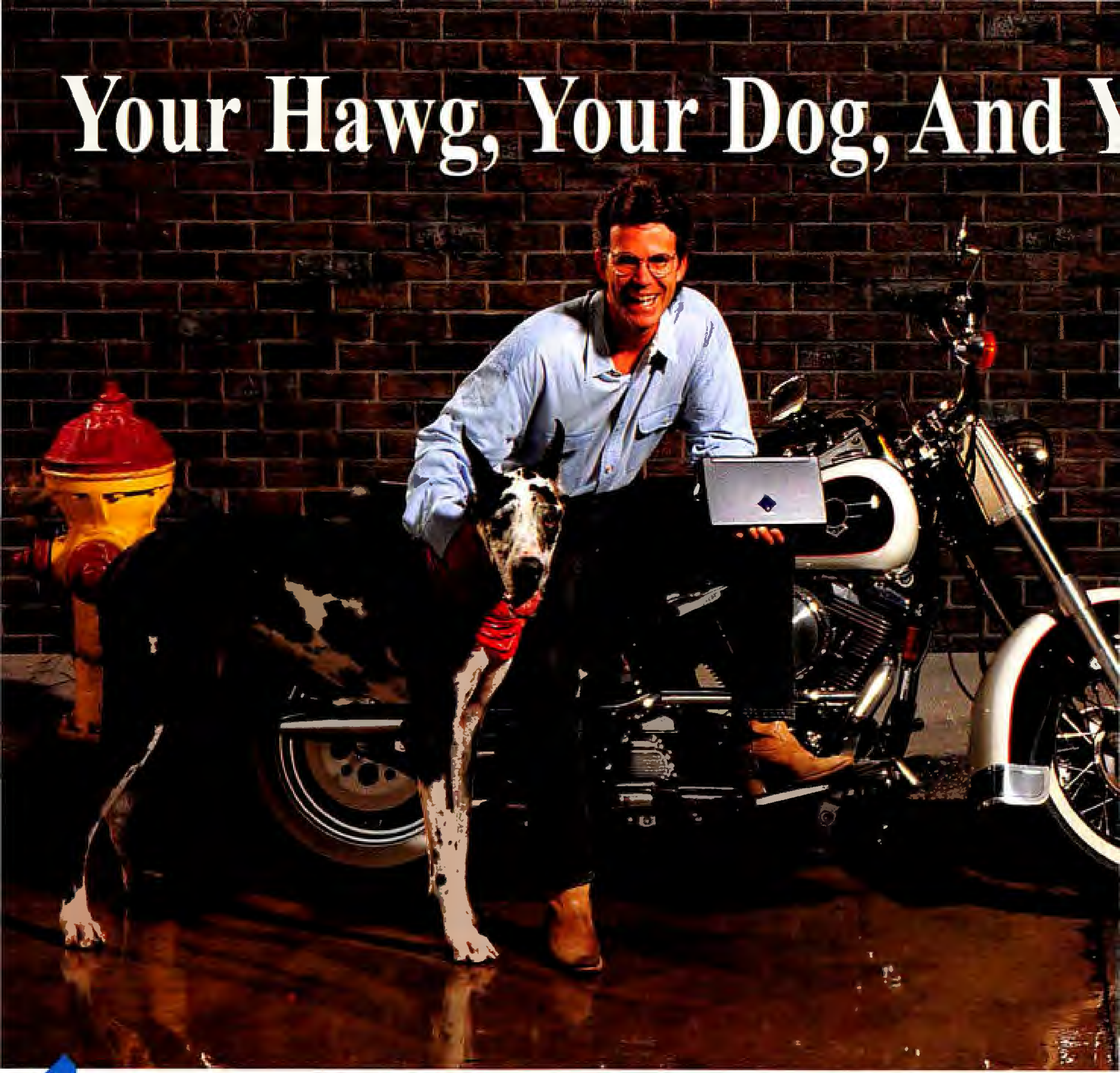

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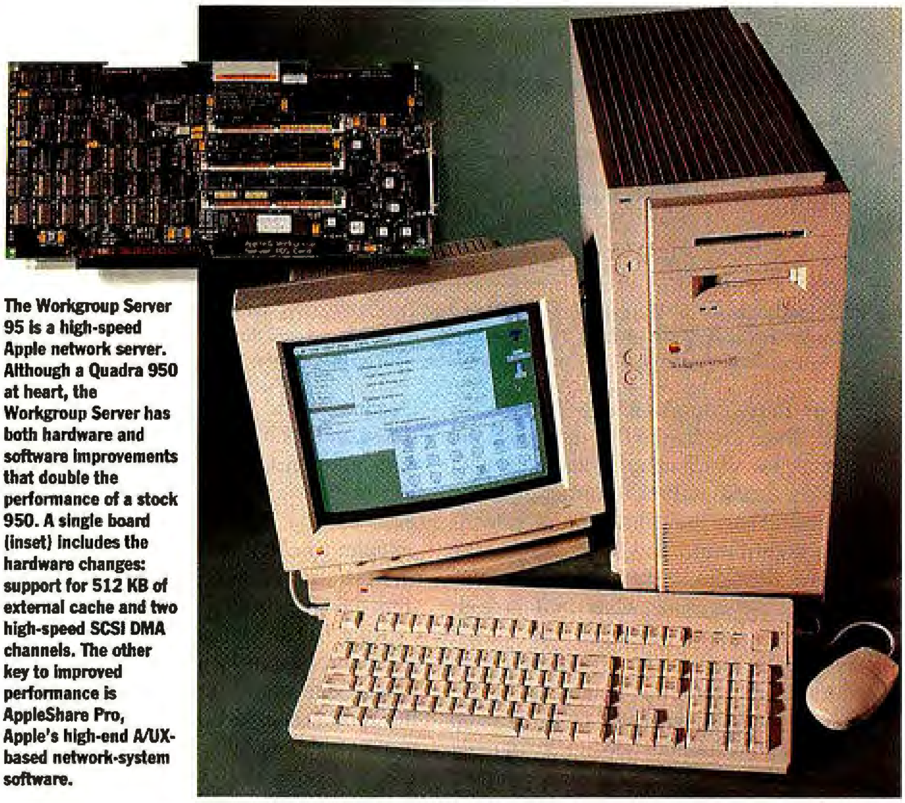
Mac for Workgroups

Apple's Workgroup Server 95 combines high-speed SCSI and larger cache with faster AppleShare software to make a killer Mac server

RAYMOND GA CÔTÉ

Very little is constant in today's computer domain. The title of *fastest* or *best performer* is perhaps the most fleeting. It seems like just the other day I was enthralled by the speed and throughput of a Mac Quadra 950, an ideal server or workstation system. Today, it's a second-rate machine.

The Apple Workgroup Server 95 is the latest record setter and the newest high-performance Mac. Essentially a Quadra 950 with some minor, but important, modifications such as high-speed SCSI with DMA support and 512 KB of secondary cache, the Workgroup Server is an excellent server platform. These two hardware modifications, along with AppleShare Pro, combine to create a system that runs file I/O tests typically twice as fast and sometimes nine times as fast as a Quadra 950.



The Workgroup Server 95 is a high-speed Apple network server. Although a Quadra 950 at heart, the Workgroup Server has both hardware and software improvements that double the performance of a stock 950. A single board (inset) includes the hardware changes: support for 512 KB of external cache and two high-speed SCSI DMA channels. The other key to improved performance is AppleShare Pro, Apple's high-end A/UX-based network-system software.

The Basics

The Workgroup Server 95 is built on a Quadra 950 base: It has a 33-MHz 68040 microprocessor, 16 MB of RAM, and 128 to 512 KB of secondary cache. You can expand on-board RAM to 256 MB.

System software consists of Apple's A/UX Unix system, Retrospect Remote backup software, and AppleShare Pro 1.0 for file and print sharing. This new Unix-based version of AppleShare, which can have up to 5000 open files, is rated for use by 200 simultaneous users. Up to 50 of these users can be what Apple calls "highly active" users. Although *highly active* is not defined, you can assume it to mean heavy file I/O use. To put this in perspective, AppleShare 3.0 running on System 7 can handle only 120 simultaneous users, approximately 350 open files, and only 15 highly active users.

The Workgroup Server's performance as a file server is optimized by its four SCSI channels, which provide support for up to 20 devices. Two of the SCSI channels are available at the back of the box for external connections and the other two are only available internally. The SCSI connections are also divided by speed: One high-speed DMA channel is available externally, and one internally; the other two are standard Quadra-style SCSI connections. This arrangement lets you place your inherently slower devices (e.g., tape drives and CD-ROMs) on your non-DMA interface and reserve your high-speed interface for your hard drives.

Of course, having multiple high-speed SCSI interfaces would not provide much extra speed if your system software could not keep up with them. This is where the next level of server efficiency becomes critical—A/UX.

Speedy System Software

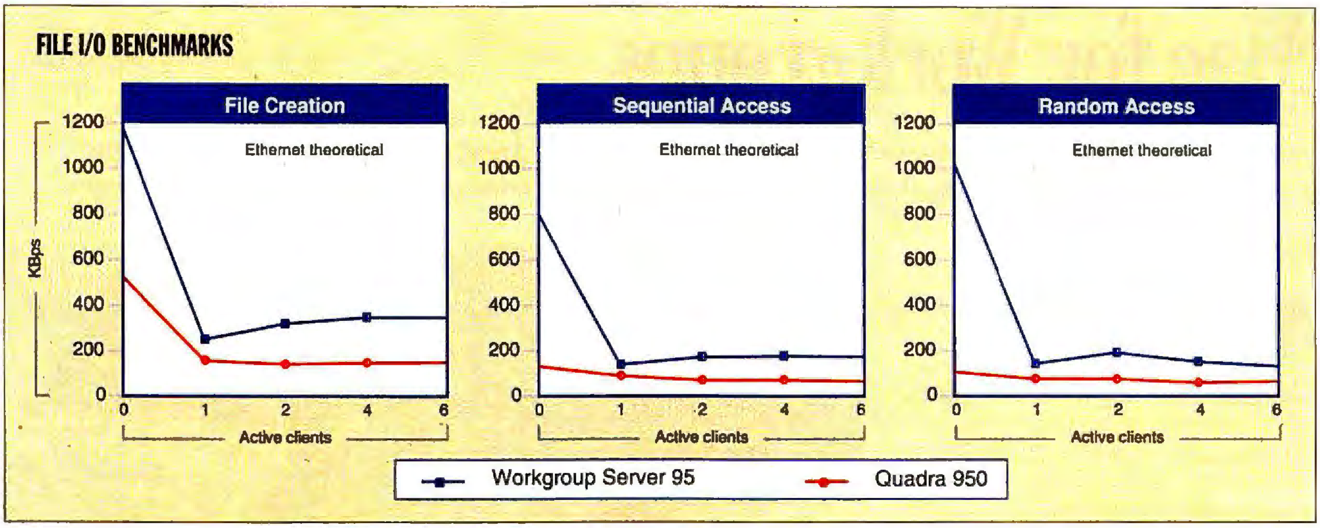
For maximum performance when communicating with multiple devices and clients, you need a true multitasking operating system. As wonderful as Apple's System 7 is, it is simply not a preemptive multitasking environment.

The Workgroup Server comes with A/UX, on top of which runs Mac System 7.0.1. This combination provides not only the preemptive multitasking needed to provide higher throughput but also the ability to run all your standard Macintosh software.

A/UX also provides support for asynchronous SCSI I/O transfer. This allows the system to start multiple-transfer operations (e.g., seeks, reads, and writes) on different SCSI devices and then accept them in the order in which they appear. At no point does the software need to wait around for a response.

On top of all this sits AppleShare Pro 1.0, the successor to AppleShare 3.0. If you've been using AppleShare 3.0, you'll immediately be familiar with AppleShare Pro, as very little of the interface has changed. In fact, you may not realize you're actually running Unix; you can configure the system so it boots you directly into the AppleShare Administration shell, and you can comfortably administer the system from there. If you really feel the need to delve into the Unix portions, a command-line interface is provided for full access to the A/UX environment.

continued



File I/O benchmarks *for the Workgroup Server 95 and the Quadra 950. The Workgroup Server had a 500-MB hard drive and 16 MB of RAM to the Quadra's 230-MB hard drive and 12 MB of RAM. The figure shows aggregate network throughput while creating files and during sequential and random access. The Workgroup Server maintains a high network throughput at up to six highly active clients, although, of course, still well below theoretical Ethernet bandwidth.*

The most important new features in AppleShare Pro are the file, directory, and icon caches, which increase the speed with which a system returns information to the network. These logical caches are provided in addition to a low-level disk cache for overall speed improvements.

Unlike a disk cache, which buffers reads and writes on a track and sector basis, AppleShare caches store frequently used entities. For example, the icon cache can store all the icons presented on the desktop so the system does not need to continually read these from disk each time the Finder opens a shared volume. Also, frequently accessed directories are kept in memory to reduce the amount of time needed to open a folder. A separate file cache maintains complete copies of frequently accessed files.

Workgroup Server Workout

The tests I ran for this evaluation were a variant of the file I/O tests BYTE has used in the past to test network file servers. Each client workstation first creates 10 2-MB files by writing multiple 1-KB chunks. The sequential test consists of walking through each of the 10 files by reading three 1-KB chunks and then writing one. The random file I/O test builds a random array of file offsets that are identical for each client. The test then reads 1 KB of data from the first three offsets and writes 1 KB of data to the fourth. My test network consisted of six identically configured Mac Centris 650s running System 7.1.

The Workgroup Server 95 is an impressive performer when stacked up against a Quadra 950 (the Quadra 950 had 12 MB of RAM and a 230-MB hard drive). A comparison of the two servers running the file I/O tests is shown above in "File I/O Benchmarks." Note that these numbers are an aggregate of all clients on the network and that "zero clients" is the result of running the tests locally.

"File I/O Benchmarks" also calls out the theoretical maximum through an Ethernet connection. You can quickly see that the Workgroup Server was able to use approximately twice the available bandwidth that the Quadra 950 could use. Although it is difficult to tell how frequently our test environment was causing network collisions (and thereby slowing the overall test environment) the Workgroup Server was able to maintain a much higher bandwidth than the Quadra 950. And, in this case, increased network loading is the key to productivity. Only on the random-access test is any saturation noticeable as performance degrades between two and four clients. On the file creation and sequential access tests, the Workgroup Server does not saturate with up to six active test clients.

For file creation at zero clients, the Workgroup Server is over twice as fast as the Quadra 950. The sequential read/write test shows a fivefold improvement, and the random I/O test demonstrates a speed improvement of nearly 10 times due to the use of a large disk cache.

The Workgroup Server running A/UX makes excellent use of a disk cache. This is a big improvement over a Quadra running System 7.0.1. Under System 7, a larger disk cache can produce horrendous speed penalties. At one point during my testing, I had set the Quadra 950's cache to 3 MB to approach the 5 MB of cache reserved in the Workgroup Server. At this setting, the file-creation test times went from 38 seconds to several minutes. I found that a minimal cache setting of 32 KB was ideal for a Quadra running System 7.

Right for the Workgroup?

The Apple Workgroup Server 95 is Apple's speediest system yet. The high-speed SCSI DMA and secondary processor cache aid in the overall excellent performance, and network testing shows the Workgroup Server is a big improvement over a standard Quadra 950.

The system I tested goes for $8838, including 512 KB of cache and a 2-GB 4-mm DAT (digital audiotape) drive for system backup. That makes this machine not only a reasonably priced server but also a good choice for a high-end development system or workstation. ■

About the Product

Apple Workgroup Server 95 .... $8838

AppleShare Pro 1.0 .... $2399

System configuration:
a 500-MB hard drive with 16 MB of RAM, a 2-GB 4-mm DAT drive, and 512 KB of secondary processor cache.

Apple Computer, Inc.
20525 Mariani Ave.
Cupertino, CA 95014
(800) 776-2333
(408) 996-1010
fax: (408) 974-6412
Circle 978 on Inquiry Card.

Raymond GA Côté is a BYTE contributing editor and is the publisher of The Robot Explorer *newsletter. He has extensive experience in Macintosh program development. You can reach him on BIX as "rgacote" and on the Internet at rgacote@world.std.com.*

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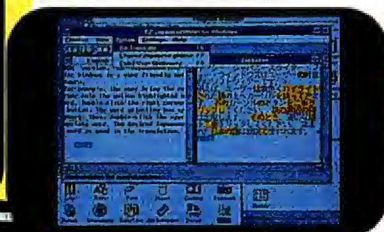
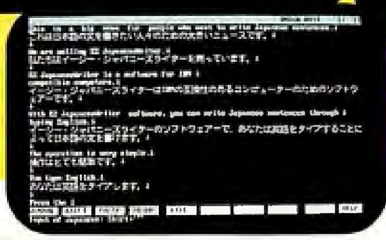


Windows Version

Windows Version	$795
DOS Version	$495
Trial Version	$ 95



DOS Version

Combined English / Japanese window

IBM Compatible Software

Q1. How does the software work?
A1. Type an English sentence in the English window and the translated Japanese sentence is displayed. Then, in the Translation-Fine-Tuning mode, you can select the appropriate Japanese word relying on the given English definitions, rephrase sentences, and add new words into User Dictionary etc.

Q2 Is it a translation software?
A2 Although EZ JapaneseWriter has a basic capability of translation from English to Japanese it is not enough to translate your English as it is since it is made without consideration for computer translation. In order to achieve a good translation, the user should follow the rules required by EZ JapaneseWriter. Basically, the English sentence should be relatively short, grammatically structured and use carefully chosen vocabularies.

Q3. Is the translation word-for-word, or sentence-to-sentence?
A3. Sentence-to-sentence.

Q4. How accurate is the translation?
A4. It could be 60% to 100% depending on the structure and vocabulary of your sentence.

Q5. How can I make sure that the translated Japanese correctly relays the message to my receiving party?
A5. EZ JapaneseWriter® displays/prints in the combined English and Japanese format in which an English sentence is immediately followed by the corresponding Japanese sentence, one by one. When you send your fax/letter in this format, it will allow the Japanese to grasp the essential points by scanning the Japanese version and then reviewing the English, if required, in more detail. As a result, you can get a quicker response from Japan.

Q6. Japanese uses Kanji, Hiragana and Katakana. Which characters does EZ JapaneseWriter® use?
A6. All of the three different characters are properly mixed.

Q7. I understand that Japanese uses thousands of Kanji. How can a computer handle Kanji?
A7. EZ JapaneseWriter® software includes Japanese font files or KanjiBoard™ in which the Kanji fonts are stored.

Q8. How about terminology and names?
A8. In addition to 60,000 vocabularies in the system dictionary, you can add up to 30,000 words into the User Dictionary. You can create as many User Dictionaries as you want and choose one for translation.

Q9. Can I import the files made by a word-processing software?
A9. Yes. You can load any ASCII text file into the English window. Similarly, the translated Japanese sentences are saved on Japanese industry standard text files which are compatible with most Japanese softwares.

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KanjiBoard version	DOS 3.3 or higher, 640K RAM, 3MB Hard disk, one AT Bus expansion slot

BASIC Windows Programming

CA-Realizer 2.0 and Visual Basic 3.0 make it easy to build interactive Windows applications

MICHAEL C. WIGGINS

What's the fastest way to write a professional-looking Windows application without driving yourself crazy? How about BASIC? Specifically, how about Computer Associates' CA-Realizer 2.0 or Microsoft's Visual Basic 3.0?

Both programming systems have been updated and vastly improved, especially VB. Realizer and VB have much in common, such as complete access to the Windows API and to external DLLs, an integrated database engine, and DDE links to share data with other Windows applications. Best of all, if you know even a little BASIC, they'll give you the means to create professional-looking, interactive Windows programs in no time—without learning C or the SDK (Software Development Kit), and without headaches.

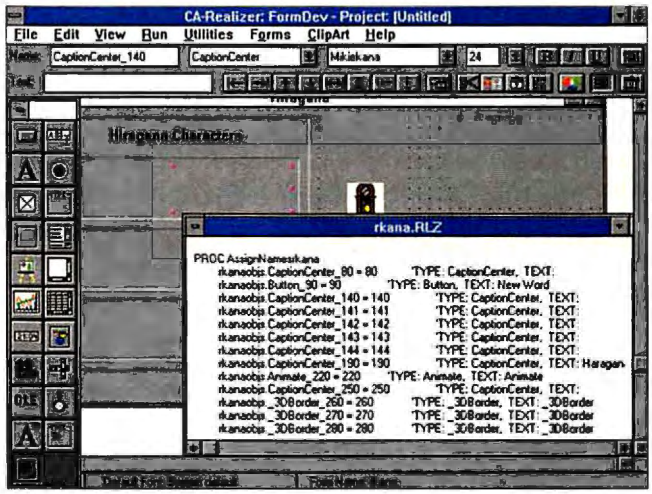
Two to Savor

Realizer 2.0 offers a complete set of multiplatform development tools. It comes with a visual report generator, the ability to import and export Xbase (.DBF) files, access to ODBC (Open Database Connectivity) drivers, and OLE 1.0 support. It ships in Windows and OS/2 versions. I tested the Windows version.

VB comes in Standard and Professional Editions. Both ship with the Access 1.1 database engine, OLE 2.0 support, and Setup Wizard, an application for making distribution disks. I reviewed the Professional Edition, which has custom controls, a visual report generator, and full ODBC support, with drivers for Microsoft SQL Server, Sybase SQL Server, and Oracle.

At the heart of each system is a screen designer that helps you build interactive GUIs quickly. You select control objects from a toolbox and place them wherever you want on the screen. (If you need to, you can build custom control objects; in VB, you have to write custom controls in C.) Once you've painted your screens, you simply add a few BASIC statements to do the real work, and your program is ready.

Realizer and VB differ in one big way: programming approach. VB relies on an event-driven programming model. Each control element—a button, for example—has code attached to it. When you click on a button, the attached code runs. Realizer, however, lets you write out your application's core as a procedural program, complete with subprograms and functions. Clicking on a Realizer control object queues up the event. Your program sees the queued event and dispatches a handler through SWITCH or CASE statements.



CA-Realizer 2.0's application screen and the underlying code generated by FormDev. This code is called from the main project program to display the screen at run time. The form code is a procedure function written in Realizer BASIC.

Konnichiwa

I used Realizer and VB to develop a Japanese-language vocabulary aid called Kana Workbook. Kana Workbook is a flash card–style program that displays one English word or phrase and five words in hiragana, one of which matches the English word. The goal is to pick the right match; for example, you'd match *konnichiwa* with *good afternoon.* I created my own hiragana character set, converted it to a Type 1 PostScript font, and installed it into Adobe Type Manager. I designed Kana Workbook so that any answer will change the background color and cause an animated sequence to run.

Kana Workbook makes good use of animation, event trapping, menu creation, the MDI (Multiple Document Interface), and object controls. I stored the vocabulary words in each programming environment's native database format.

CA-Realizer 2.0

The first step in building a Realizer application is to create your screen, known as a *form* in Realizer parlance. FormDev is Realizer's visual design tool, and it's easy to use. For example, to paint the display screen, you select control objects from the Object Palette and position them. For a more professional appearance, you can use an optional grid to snap the objects into alignment.

Your form can be anything from the main application window, a dialog box, or an About box. You can move or resize items until you get the desired effect.

Kana Workbook uses the Label object for both English and Japanese vocabulary words. Each label is surrounded by a 3-D border, creating a chiseled look. A New Word button moves you to the next word in the lesson. To animate objects, you supply a series of bit maps as .BMP files and set their frame-per-second rate. The `AnimateFrame` command starts the action.

FormDev provides the usual assortment of control objects for most applications. Its toolbar gives you a quick way to change an object's characteristics—an improvement on version 1.0's endless barrage of dialog boxes. Computer Associates has also added a bunch of new objects to Realizer 2.0, most notably scroll bars and a graphics tablet region that can display lines and circles. Also new is the ability to add custom controls to the Object Palette, multilevel menus, and database forms.

Once you've drawn a form, FormDev generates a Realizer BASIC file. You have the option of generating code for the form, for your entire project, or for a stand-alone program. Computer Associates claims that

CA-REALIZER 2.0 VERSUS VISUAL BASIC 3.0

	CA-Realizer 2.0	Visual Basic 3.0	
		Standard	Professional
Database engine support	Xbase, text, Lotus 1-2-3, Excel, CA-SuperCalc	Access 1.1, dBase, FoxPro, Paradox, Btrieve	Access 1.1, dBase, FoxPro, Paradox, Btrieve
ODBC?	Yes	No	Yes
Server drivers provided	None	N/A	Microsoft SQL Server, Sybase SQL Server, Oracle
Report generator	CA-RET	None	Crystal Reports
Direct database access?	Yes	N/A	Yes
OLE?	1.0	2.0	2.0
API, DLL, DDE support?	Yes	Yes	Yes
MDI?	Yes	Yes	Yes
Communications (serial)?	Yes	No	Yes
Develops OS/2 applications?	Yes	No	No
Custom controls?	Yes	Yes	Yes

N/A = not applicable.

Realizer BASIC has better compatibility with Microsoft QuickBasic than VB does. I don't know if that's true or not, but I do know that it's a rich dialect with more than 350 commands.

Realizer's built-in debugger lets you step through your program, add watch expressions, and view data structures. I wish it were easier to set breakpoints, and when single-stepping, I'd like to see source lines on both sides of the current line. Otherwise, the debugger worked well and is a vast improvement over the debugger supplied with Realizer 1.0.

Realizer's visual report generator, CA-RET, is as easy to use as FormDev. It gives you the tools to create sophisticated reports from dBase files, entirely on-screen, without writing any code. Its Report Definition holds all the essential elements to produce a report, such as telling CA-RET how to access database tables and where to place the fields in the report.

You define your query with Realizer's Query Builder. After declaring the database table, you select the fields and any necessary conditions. Query Builder automatically generates the necessary SQL statements to retrieve the data. You can create a report query that uses information from multiple database tables.

After defining the query, you use the report editor to design your layout. Besides a do-it-yourself, freestyle layout, you can choose one of the report editor's standard layouts: tabular, form, or label. Reports are divided into header-/body-/footer-type sections, making layouts easier to define.

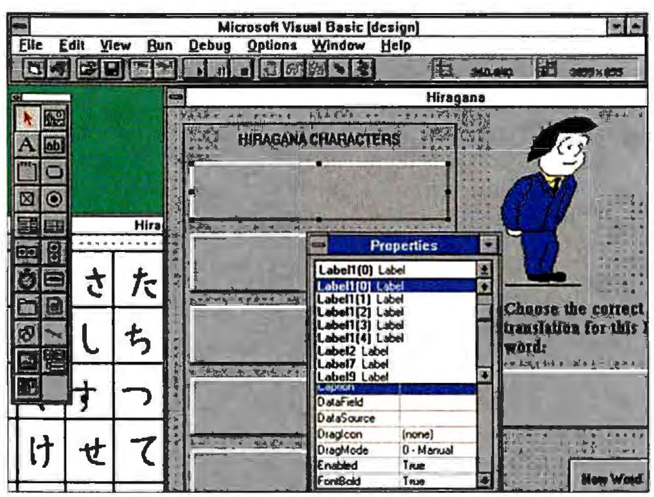
CA-RET is chock full of functions for everything from doing simple math to printing the current date. Altogether, it took a good evening's work to get my Kana Workbook application up and running. I consider that a success.

Visual Basic 3.0

Inspired by my success with Realizer, I rewrote Kana Workbook using VB 3.0. The process was virtually the same as with Realizer: Design the screens, place the objects, set their attributes, and write the underlying code to do the fancy things.

VB presents four independent windows: the main menu/toolbar, the Toolbox, the Project, and a blank form/grid. These disjointed windows can be confusing at first, especially if the Program Manager is running underneath or if you have busy wallpaper, but the tools work together smoothly. At times, I found it useful to maximize the form window, but that obscures the Toolbox and menus. A function key brings up the main menu from which you can retrieve the other tools. It would be helpful if future versions of VB tied these windows closely or provided hot keys to switch between them.

Kana Workbook uses VB's MDI capability to display multiple lesson plans simultaneously. New MDIForm, from the File menu, creates a parent form, but parent forms accept only picture box objects for creating the tool or status bars—I wanted a Common Dialog object on the parent form. So I created a toolbar out of a picture box, made it zero length (i.e., invisible), and placed the Common Dialog object on it. Kludgy, but it worked. To create a child window, just open a new form and set its MDIChild property.



The development of the hiragana screen using Visual Basic 3.0. The five label objects, used to display the Japanese words, are set up in a control array for easier program handling. VB will ask if you want an array when you copy and paste multiple objects or give two similar objects the same name.

Earlier versions of VB saved programs, forms, and projects as binary files, readable by VB only. VB 3.0 provides a default that you can set to text. It's convenient to edit your files outside of BASIC or to generate forms programmatically.

Database Access

VB's hottest new feature is the Access 1.1 database engine. Access gives you native support for such popular database formats as Btrieve, dBase, and FoxPro. The Professional edition adds full ODBC support for client/server applications, which gives you unprecedented control over enterprise-wide data.

Access is a good addition to VB. If it worked completely, it would be a great addition. For example, it's supposed to support Paradox files. But after trying the suggestions in the manual and tinkering with every setup file I could find, my attempts to use Paradox files only got me "Cannot find installable ISAM" messages.

My Kana Workbook didn't take full advantage of Access, but I was able to write a program to display and move through an Access database that I generated for another project. From within VB, you can use a Data Manager tool to handle database tables and fields.

Writing a database front end is easier with VB 3.0 than with earlier versions. Its

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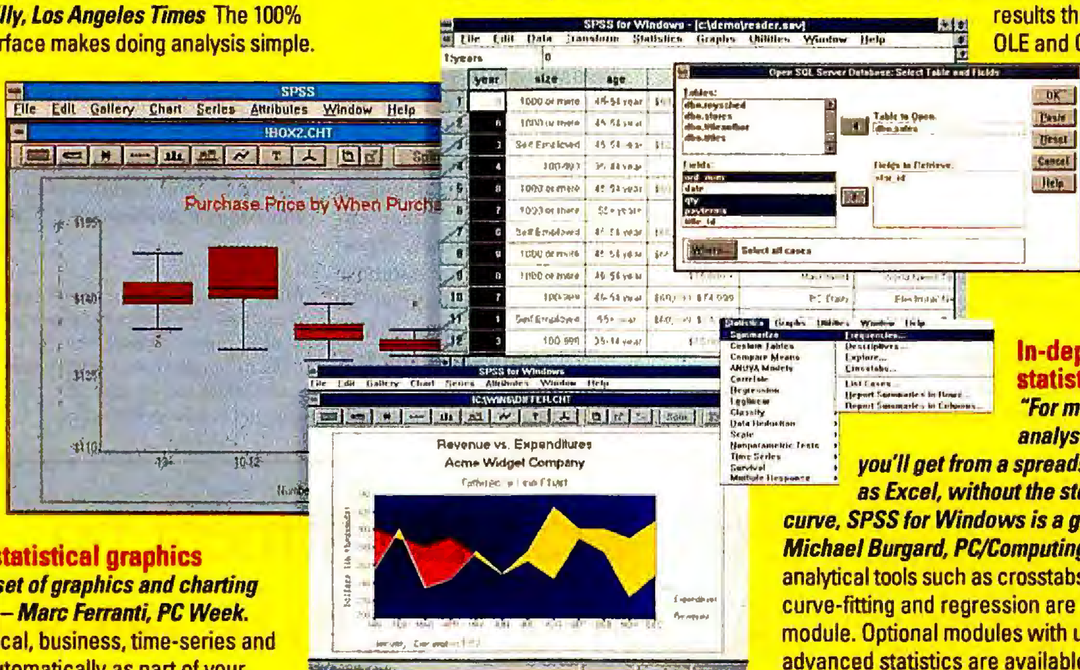

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new data-aware controls can be drawn on the screen and used programmatically from within the code. This means you can link controls directly to the database query by setting properties. Most of VB's standard form objects are now data-aware.

OLE 2.0 automation is yet another avenue for data sharing among Windows applications. Incorporating OLE support in your program is no different from using any other toolbox object: You click and place the OLE object on the form and then set up the link with the properties window.

VB comes with the Crystal Reports 2.0 report generator, which uses Access to produce professional-looking reports. Similar to CA-RET, Crystal Reports lets you use a visual design environment to create the report layout.

VB's most intriguing new feature is Setup Wizard, an application delivery system for creating distribution disks. Rather than manually copying all the font and DLL files onto a floppy disk for distribution, I ran Setup Wizard and generated an installation disk with all the DLLs and supporting files.

However, Setup Wizard may take a bit of tweaking to work. It bashed heads with SHARE.EXE when I tried to compress some DLL files. Rebooting my system without SHARE.EXE got Setup Wizard to work correctly.

About the Products

CA-Realizer 2.0 ....$247
($99 until 11/30/93)
Computer Associates International, Inc.
1 Computer Associates Plaza
Islandia, NY 11788
(800) 225-5224
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C You Later

Realizer 2.0 is a significant improvement over version 1.0. For example, FormDev has more capable layout functions, and the debugger is much better. These enhancements, the new report generator, and its database functions make Realizer 2.0 a capable challenger of VB.

If I could fix just a few things, I'd add a Delete key to FormDev's editor, simple graphics such as lines and circles to the Object Palette, and OLE 2.0 support. I'd also like to see more details in the help files. Mind you, I'm not complaining—Realizer 2.0 should make any Windows programmer take another look at BASIC and reconsider working in C.

VB 3.0 is a real improvement over version 2.0—and if you're using VB 1.0, the 3.0 upgrade is mandatory, in my opinion. If nothing else, the Access engine is worth the price of admission. My VB wish list includes fixing Setup Wizard, adding hot-key access to the editing windows, and cleaning up those loose threads in Access.

If you're under the gun to get a Windows application out right away and don't know how, try Visual Basic 3.0. It offers more control and greater flexibility for databases and client/server architectures than does CA-Realizer 2.0. ■

Michael C. Wiggins, a founder of MultiMate International, owns a programming consultancy in South Windsor, Connecticut. He's been programming PC applications for more than 12 years. You can contact him on BIX c/o "editors" or on the Internet at editors@bix.com.

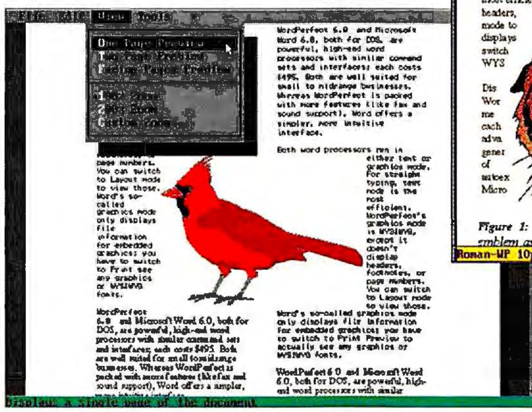
DOS Dilemma: Word or WordPerfect?

High-end word processors bypass Windows in the quest for the perfect balance of powerful features and ease of use

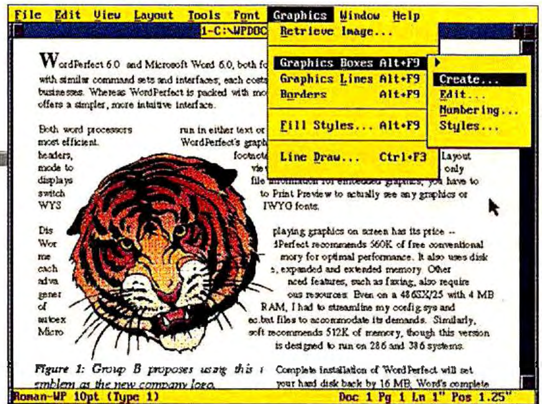
SELINDA CHIQUOINE

WordPerfect 6.0 and Microsoft Word 6.0, both for DOS, are powerful, full-featured word processors with similar command sets and interfaces. Windows may be all the rage for PC applications, but if generating good-looking documents is your primary concern and you can live without multitasking, it will pay to buck the trend with one of these packages. A foundation in DOS means you can use these applications on systems with fewer resources and get much better performance than you can reasonably expect running through Windows' graphical interface.

These aren't toy packages, and they don't represent a step backward to mandatory keyboard templates or Byzantine command sets. Besides the familiar keystroke sequences and command lines that long-time users will find natural, each presents a Windows-type editing interface that new users may adapt to quickly. Both packages are quite similar in form and function, although WordPerfect is packed with more features (e.g., fax and sound support), and Word offers a simpler interface.



WordPerfect's graphics mode ▶ *displays 24-bit WYSIWYG graphics and is capable of irregular text wrap and drag-and-drop image manipulation.*



◀ Word's print preview mode *displays 16-color graphics and rectangular word wrap. However, you must return to the non-WYSIWYG graphics mode to edit text or to move or size graphics.*

Resource Requirements

Both word processors run in either text or graphics mode. Text mode is, of course, more responsive when writing or editing flat-out. Both packages easily kept up with my typing in text mode, but Word's graphics mode is more responsive than WordPerfect's. However, WordPerfect's graphics mode is WYSIWYG, except it doesn't display headers, footnotes, or page numbers; you have to switch to a page mode to view those details. Word's graphics mode is less complete: It only displays file information for embedded graphics. You have to switch to the print preview mode to see images, line graphics, or WYSIWYG fonts.

Graphics gobbles memory, and because WordPerfect has greater graphics capability than Word, it has more stringent requirements. WordPerfect recommends 520 KB of free conventional memory for optimal performance. Microsoft recommends 512 KB for Word. However, you can get each to work with considerably less if you need to run them on an IBM AT–class machine.

Complete installation of WordPerfect takes 16 MB of hard disk space; Word's complete installation fills 5.5 MB. You can trim those numbers down as far as 7 and 1.5 MB, respectively, again by sacrificing some utilities.

WordPerfect is filled with features that require more resources. It can use expanded and extended memory, but on my 4-MB 25-MHz 486DX (networked and running DOS 6.0), I still had to streamline my configuration to satisfy its demands for conventional memory. Even after loading every driver high that could be loaded high, I still had to swap out the sound-card driver and fax-board driver, depending on which device I was planning to use for each session.

Interface Issues

By adding pull-down menus in version 6.0, WordPerfect lessened the grade of its learning curve immensely. In previous versions, I had to reference the Help menu two times just to accomplish a single command that might require three or more keystrokes. WordPerfect gurus who mastered version 5.1 will be happy to find that version 6.0 supports the same keyboard command sequences and lets you hide those pesky pull-down menus. Microsoft, ahead in the GUI field, already offered pull-down menus in Word 5.5.

Now, the new versions of Word and WordPerfect have customizable menu bars and drag-and-drop editing. You can turn on or off status bars, style ribbons, and horizontal and vertical scroll bars. Both packages allow you to split the screen in various dimensions, with nine windows open at a time. Each has a screen setup utility letting you control the timing of automatic saves. The basic data-entry and editing

Best New Features in Versions 6.0

Microsoft Word 6.0 for DOS
- One-step table creation
- Drag-and-drop text editing
- TrueType fonts
- Automatic numbering or bulleting of text
- Style ribbon for quick formatting changes
- Grammatik grammar checker
- Help menu for WordPerfect users

WordPerfect 6.0 for DOS
- Fax and sound support
- TrueType, Bitstream, Type 1, and Intellifont font support
- WYSIWYG graphics and page modes
- Document compare
- Grammatik grammar checker
- Spreadsheet capability in tables
- Drag-and-drop graphics

DOS Dilemma: Word or WordPerfect?

WORD 6.0 VS. WORDPERFECT 6.0

WordPerfect offers more high-end features, but Word is somewhat simpler.

	MICROSOFT WORD 6.0 FOR DOS	WORDPERFECT 6.0 FOR DOS
Memory (recommended RAM)	512 KB	520 KB
Storage (max./min. installation)	5.5 MB/1.5 MB	16 MB/7 MB
Typefaces	11	13
Font formats	TrueType, Word	TrueType, Bitstream Speedo, Agfa Intellifont, Adobe Type I
Number of printers supported	About 300	About 900
Label/envelope support	Mail merge, macro support	Mail merge, automatic address insertion, bar-code support, and label printer support
Fax support	No	Yes
Import formats	Word 4.0 and higher, Word for Windows, DCA/RFT, RTF	Fax, Lotus 1-2-3, Word, WordPerfect (all previous versions), DisplayWrite, MultiMate, DIF, WordStar
Export formats	Word 4.0 and higher, Word for Windows, DCA/RFT	Fax, Word, WordPerfect (all previous versions), DisplayWrite, MultiMate, RTF, DIF, WordStar
Graphics file support	HPGL, EPS, PIC, PCX, TIFF	BMP, CGM, DXF, EPS, HPGL, PIC, PICT, PCX, TGA, TIFF, WMF, WPG, WPG 2.0
Close and save all files	Yes	No, but it can exit and "mark all"
Merge files	Uses main document and data files, conditional fields	Form file template, data files for merging, includes 81 merge programming commands
Password security	Document level	Document and macro levels, file encryption
E-mail links	No	WordPerfect Office, MS-Mail, cc:Mail, MCI Mail
Import from Windows Clipboard	Text and bit maps	No
Indexing/TOC generation	From outline or tagged text	Concordance file or tagged text
Leaders	Dots, hyphens, underscores	Any symbol
Mark revisions	Insertions, deletions, replaced and moved text	Marks deltas
Tables	One-step formatting, but WYSIWYG only in Print Preview	WYSIWYG table editing, 98 math functions, can link cells to text
Drag-and-drop editing	Text only	Text and graphics
Bookmark	Cross-referencing and automatic numbering	QuickMark and named bookmarks
Graphics tools	Screen-capture utility	Rotate, crop, control contrast and brightness, distort, and flip

menus for both packages conform to CUA (Common User Access).

Word and WordPerfect have improved automatic table of contents and index generation, as well as new bookmark and outline features. In Word, outlines are integrated as structural views of text documents that you can expand and collapse; you can toggle back and forth between the document or the outline view. In WordPerfect, outlines are also collapsible, and you can convert them to text, but the integration is not as complete as Word's.

Although I've used WordPerfect for years, I still don't like its file management system. It's powerful, but as is common in WordPerfect, simple operations require twice the keystrokes they should. You can develop elaborate document summaries for file queries or devise your own "QuickIndex" cataloging scheme. If you're working with numerous versions of files, you can compare documents by words, phrases, sentences, or paragraphs, and mark all the revisions. The Master Document feature expands and collapses linked sections of long documents at your command.

Word's file management is refreshingly simple. Its document summary information doesn't offer all the hooks of WordPerfect's, but you don't need intensive training to master it.

Fonts and Printing

DOS word processors don't share fonts with other applications as do Windows applications, so the fonts each supplies is an important consideration. However, both Word and WordPerfect support scalable (and shareable) TrueType fonts.

As with the font selection, printer support is a critical issue for DOS applications, since you can't share printer drivers as you can under Windows or on the Mac. Both Word and WordPerfect support color and network printing. From both packages' print menus, you can also select resolution and any printer drivers you've installed. Word supports approximately 300 printers, and WordPerfect supports around 900.

The main difference in print capability is WordPerfect's faxing module; WordPerfect can print directly to any FaxBIOS, Type I, Type II, or CAS-compliant (Communications Applications Specification) fax card. Many fax boards qualify; I had an Intel Satisfaxtion Modem/200 that fit the bill. As long as you feed your system the recommended 520 KB of free conventional RAM, faxing works like a charm. When I tried to fax a graphics file with less, WordPerfect hung up the system.

Tables and Spreadsheets

WordPerfect excels at tables. Its graphics mode makes creating tables a quick drag-and-drop affair. Contrast that with Word, where you need to imagine how cell borders will look, since dotted grid lines appear where real borders should be. In Word, you must manipulate cells by changing coordinates rather than directly with a mouse.

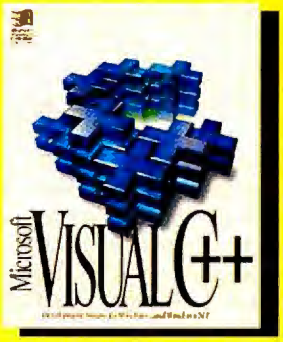
WordPerfect tables handle many spreadsheet functions including cell formatting, naming and linking ranges, and calculations on ranges. The Floating Cell feature lets you link a section or value of a table to any other area in your document. For instance, you could reference a sales figure in your text and rather than type in a static number, insert its cell address. Your document would always reflect an updatable value. You could use the same technique to embed a larger portion of a table.

Word includes math functions, even though you have to select text that includes an operator and then go to a pull-down menu to activate the command. Alternatively, you could write a macro to perform the math. WordPerfect has similar math features. In addition to the basic math commands also supported by Word, WordPerfect's math command calculates subtotals, grand totals, and averages across rows or columns.

Graphics

In these versions, WordPerfect's support for graphics is a league beyond Microsoft's. But you pay for this luxury with a resource load that slows performance considerably. WordPerfect has various graphics editing

Microsoft



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tools like cropping, flipping, sizing, and adjusting brightness and aspect ratio. You can also drag and drop your graphics and view them in up to 16 million colors (assuming you have a 24-bit graphics card). Word supports only 16 colors.

WordPerfect allows you to zoom in on text while editing in graphics or page mode. In Word, zooming is only possible in print preview mode. The two packages support word wrap. With Word, however, you can wrap text around rectangles only, not around irregularly shaped pictures as with WordPerfect. Both applications will print over graphics, even though WordPerfect has a Watermark dialog box specifically for printing over shaded graphics. For simple graphics work, WordPerfect supplies most of the tools you need. In contrast, with Word, you need to handle image manipulation before importing.

About the Products

Microsoft Word 6.0 for DOS...$495
Upgrade...$99
Microsoft Corp.
1 Microsoft Way
Redmond, WA 98052
(800) 426-9400
(206) 882-8080
fax: (206) 936-7329
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WordPerfect 6.0 for DOS...$495
Upgrade...$129
WordPerfect Corp.
1555 North Technology Way
Orem, UT 84057
(801) 225-5000
fax: (801) 222-5077
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Frills

No word processor would be complete without a spelling checker; both packages offer one. Amazingly, WordPerfect's spelling checker is simpler than Word's. Word and WordPerfect also sport a decent thesaurus and bundle the sometimes helpful Grammatik grammar checker.

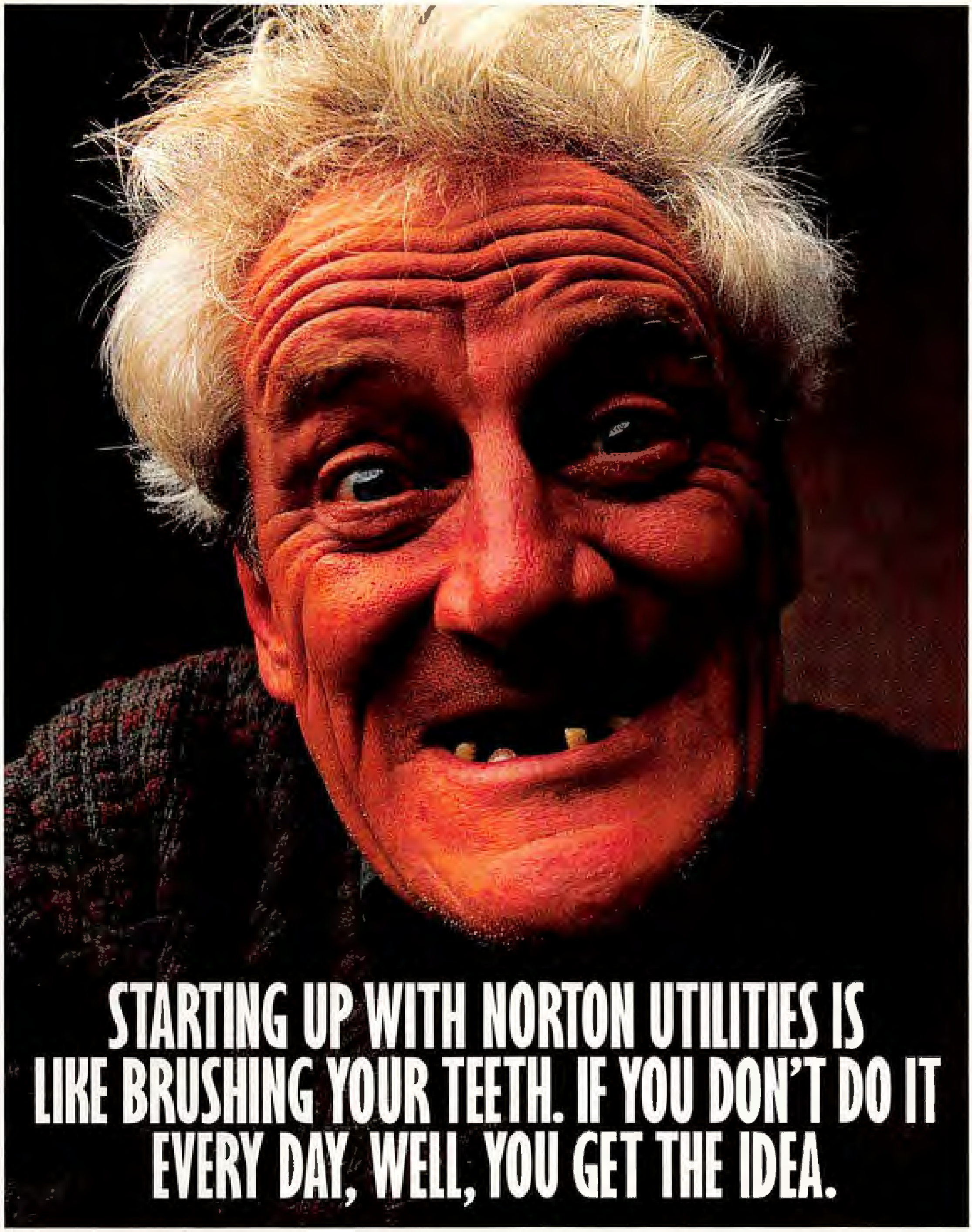
WordPerfect includes some impressive—although exclusive—frills. Hypertext lets you link parts of your document to one another or to a macro. Once you create a link, you click on a highlighted section in your document to activate the link. The cursor then jumps to the linked text or executes a macro. Word lets you link tables to external spreadsheets, and it lets you import live sections of other Word documents, but it does not support executable hypertext. If you're planning to capitalize on hypertext, remember whoever's receiving your files must also have WordPerfect to use the links.

WordPerfect can embed and play MIDI or WAV sound clips in your documents. Although this is an interesting feature, as with hypertext, you benefit from it only if your target audience has WordPerfect 6.0 or 5.2 for Windows and the same sound drivers you do.

Brand Loyalty

How do you choose between these two? Unless you need WYSIWYG graphics (in which case, you should choose WordPerfect), familiarity has to come first. But if you can make an unencumbered choice, you should choose on the basis of features versus resources and complexity. WordPerfect delivers more features for the money. But if your hardware is modest, you might be happier with Word's more intuitive command set and simpler interface. ■

Selinda Chiquoine is a BYTE Lab staffer. She has worked as a typesetter and desktop publisher. You can contact her on BIX as "schiquoine" or on the Internet at selinda@bytepb.byte.com.



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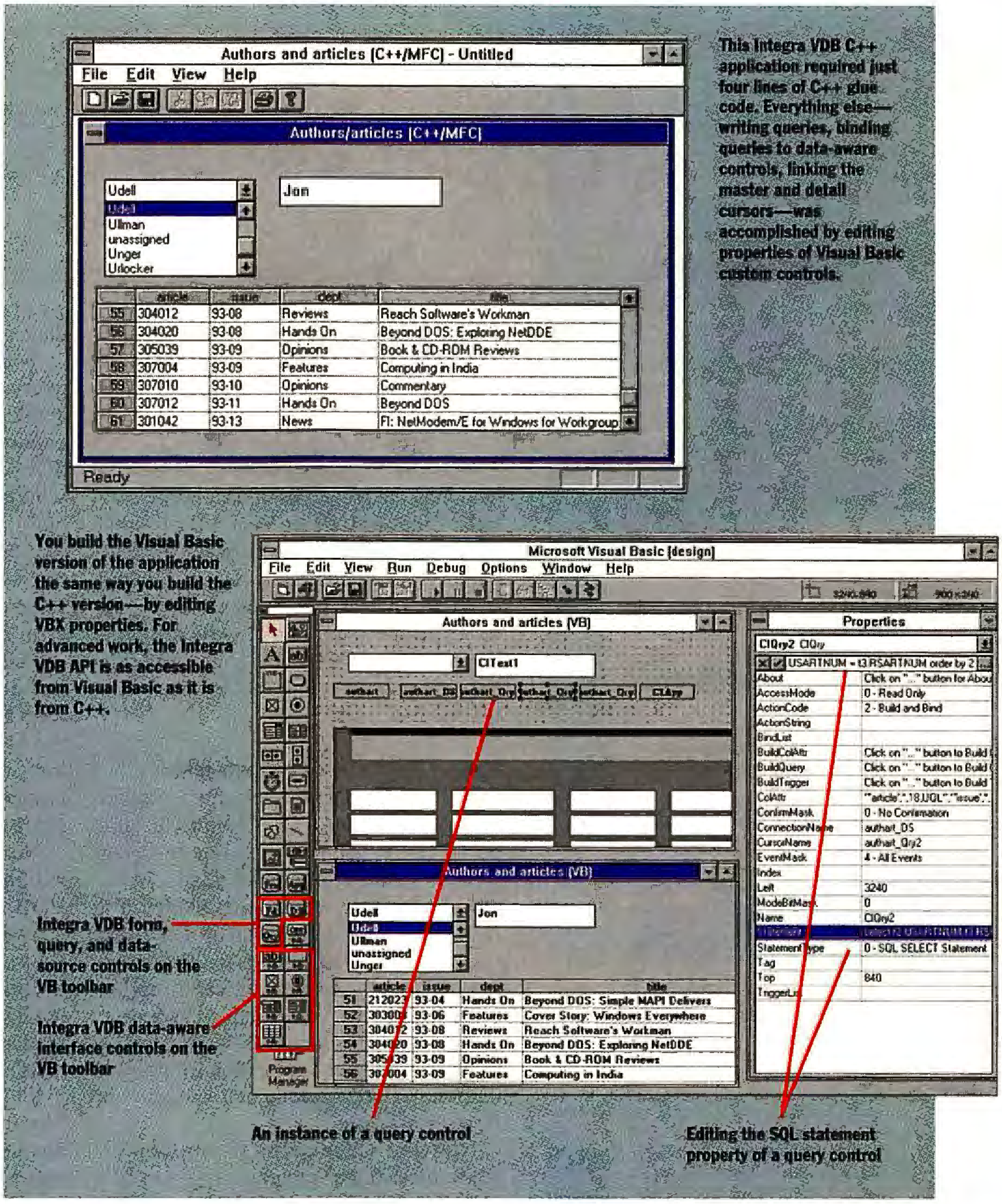
Integra VDB

You can use Coromandel's Visual Database Builder with C++ or Visual Basic to write programs that work with any ODBC data source

JON UDELL



This Integra VDB C++ application required just four lines of C++ glue code. Everything else—writing queries, binding queries to data-aware controls, linking the master and detail cursors—was accomplished by editing properties of Visual Basic custom controls.

Not to brag, but I can build the C++ and Visual Basic applications you see on this page from scratch in 5 minutes. They're not too fancy, but they're not trivial, either. Each uses a master query bound to a combo box (for author names) to trigger a detail query bound to a two-table join (for article information). The data can come from any ODBC (Open Database Connectivity) source. I've run these programs with identical results against FoxPro, dBase, and Access files and against two servers—SQL Server and Coromandel's Integra.

The secret to this rapid development of flexible applications is Coromandel's Integra Visual Database Builder, or VDB, a set of tools for creating database-oriented Windows applications with Visual C++ and Visual Basic. Each kit includes Integra, a single-user SQL engine that natively supports ODBC. Integra's ODBC driver is the most advanced that I've seen yet, offering level 1 API conformance and extended SQL grammar. You also get a data management tool, a query builder, a set of Visual Basic custom controls for interactive database development, and a library whose functions marry the data controls to the ODBC interface.

You can do quite a lot with the custom controls alone. I built my test programs exclusively in what Coromandel calls *automatic mode*. That means you simply drop data-aware controls onto a form and edit their properties in order to bind them to data.

Like Visual Basic 3.0, Integra VDB provides simple data-aware controls, like checkboxes and text boxes, that can bind to individual database fields. Unlike VB 3.0, it also gives you data-aware versions of the controls that are most crucial for working with columns and entire tables of data—the listbox, the combo box, and the all-important grid. Another control performs operations on a SQL cursor, including fetch (next, previous, first, or last), insert, delete, update, and query by form. Still other controls name data sources, define queries, and bind result sets to user-interface controls.

For more advanced work, you can code directly to the Integra API using either C++ or Visual Basic. The boundary between VBX (Visual Basic custom controls) property-editing and coding is fluid, though, and the ability to combine both styles in a single application makes Integra VDB extremely potent. Coromandel's showpiece sample application, for example, features a master-detail view that is

You write just four lines of C++ *code for a simple Integra VDB application like the one shown on page 151. In this example, the* `OnFileNew` *handler generated by ClassWizard starts the database application by passing the ID of a database dialog box to Coromandel's* `SQcStartApp()` *API function. Lines in black were generated by ClassWizard; lines in red were added.*

```
#include "sqcform.h"        // Include the Integra VDB API definitions.

void CByteView::OnFileNew()  // Handler for the File New menu
                             // selection.
{
  static UINT dlgid[] = {IDD_DIALOG1,0}; // Declare array of database
                                          // forms.
  SQcStartApp(this,dlgid,1);              // Activate the database forms.
}

void CByteView::OnFileSave() // Handler for the File Save menu.
{
  SQcEndApp();              // Deactivate the database forms.
}
```

completely dynamic. The user can pick which table to bind to a master listbox and which to bind to a detail grid. This multipurpose form efficiently displays a half-dozen different data relationships.

You can't achieve such effects just by twiddling the properties of data-aware controls. Lines of C++ or Visual Basic code have to be written to prepare and execute queries, bind their results to controls, and dynamically connect master and detail tables. But those lines of code are relatively few, and they integrate smoothly into an application that is otherwise mostly codeless.

VDB for the Visual C++ Programmer

Coromandel's C++ implementation relies on Microsoft Visual C++'s ability to support VBXs. You begin an Integra VDB project by checking AppWizard's VBX option, so the new program skeleton it writes will contain the function call that initializes VBX support, as well as declarations for VBX event notification codes. Then you add the VBX itself to the project, along with Coromandel's supporting library and a simple application framework that knows how to load and activate the forms you create.

Now the scene shifts to AppStudio, where most of the "programming" can take place. In version 1.0 of VDB, you had to create form, data-source, and query controls, and then manually synchronize various properties of these controls. Version 1.1, which I received while working on this review, adds a form builder that simplifies things even more. Now, when you create a new dialog box and drop a VDB form control onto it, the form builder automatically pulls in supporting data-source, data, and query controls.

You can define the SQL property of a query control using an interactive query builder or (if, like me, you find that tool to be less than intuitive) by just writing the SQL code yourself. The form builder asks which data control you'll use for each query and binds the control to the query. For a master-detail view, it helps you define a trigger that connects the detail cursor to the master. These triggers are a powerful feature of Integra VDB. They can cascade and can synchronize cursors both within and across forms. Complex multiform applications are beyond the scope of the form builder, however. You create these by manually editing form and query properties that define bindings, SQL statements, and queries.

Next, you launch ClassWizard from within AppStudio to wire in the Integra VDB function calls that activate and deactivate your database forms. Coromandel's application framework reduces this to a trivial exercise for applications (like mine) that don't handle VBX events (see the listing). Real applications, of course, must respond not only to application events like File New but also to database events like insert, update, and delete. But the model is the same. You tell ClassWizard which events you want to handle; it generates handler skeletons; you flesh them out.

Finally, you build and run your C++ application and then, of course, immediately begin to tweak it. If you haven't worked with VBXs in C++ before, you may be shocked to discover how quickly you can modify and test your application. All the properties of the database custom controls live in the application's resource file. When

you add forms, modify SQL queries, rewrite triggers, switch data controls, and tinker with database operations, you can test your changes almost immediately. If you haven't touched any event handlers, the compiler sits idle and a rebuild boils down to the few seconds AppStudio takes to update the resource file and bind it to an otherwise unmodified program.

The Visual Basic Option

I also tested the Visual Basic version of Integra VDB 1.1, using Visual Basic 3.0. Having used the C++ version, I already knew how to proceed: Add the VBX to a new project, load a file of API declarations, create a new form control, and use the form builder to orchestrate the form's data controls, queries, and triggers. A Visual Basic handler for the form's Load event, installed automatically by Coromandel, makes the API call that activates the database controls on the form.

Queries run as fast in Visual Basic as they do in C++, because the work gets done either by an ODBC driver (in the case of single-tier drivers like those for FoxPro, dBase, and Access) or by a server (in the case of multitier drivers like those for Integra and SQL Server). And while Coromandel says C++ programs that manage lots of database forms can process those forms faster than the Visual Basic equivalents, I found no noticeable difference in speed between the two environments. That's because in both cases the VBX, not your code, does the work. The Visual Basic version also gives you full access to the Integra VDB API, and Coromandel reproduces the dynamic master-detail example to prove that Visual Basic can wield that API as flexibly as C++ can.

Why, then, would you ever want to use C++ to develop Integra VDB applications, or indeed any VBX-intensive application? What you want from C++, presumably, is the ability not just to reuse but also to extend software components. VBXs are reusable but not extensible. While Visual C++ emulates Visual Basic to give you access to a rich selection of useful VBX components, it can't magically transform these into true C++ classes.

What the C++ programmer really needs, Coromandel admits, are database-aware document and view classes. The company is now designing such classes, and until they're available, I'd incline toward the Visual Basic version of Integra VDB. It's a bit simpler to use, and it's almost equally flexible and powerful. Nevertheless, I'm glad the C++ version is available. If

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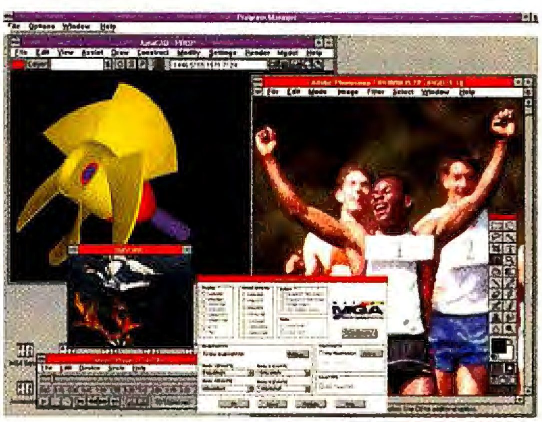
Peter Coffee
PC Week Magazine
June 14, '93



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PC User, U.K.
August '93 (Issue 217)

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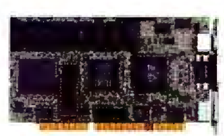

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your project happens to rely on homegrown or commercial C++ class libraries and needs an injection of database support, you'll find Integra VDB to be a welcome ally.

Managing Data

Central to Integra VDB's database model is a scrollable, updatable cursor. ODBC level 2 drivers have the same capability, but currently they're hard to come by. Coromandel's API implements forward- and backward-scrolling cursors on top of the much more common level 1 drivers that I used for this review. Insert and delete operations logically renumber a cursor's record set, but invariant physical record numbers are also available for the life of a cursor. Specialized cursors support SQL-driven import and export operations to and from dBase III, delimited ASCII, or Lotus 1-2-3 files. For high-performance lookup, you can stash data temporarily in a memory cursor.

To create, load, and query databases interactively, you use the Visual Data Manager. It gives a common visual interface to CREATE TABLE and ALTER TABLE commands for any ODBC data source, supports ad hoc queries (you either type these or invoke the visual query builder to construct them), and performs import/export operations. It's a Swiss Army knife for ODBC data sources, but I found it most useful for creating, altering, and querying databases. As a database loader, its performance lagged behind that of Microsoft Access, and it won't build database schemata automatically, the way Access will. Coromandel acknowledges both problems and says they'll be fixed.

About the Product

Integra VDB 1.1
for Visual C++ $499
for Visual Basic $499
Coromandel Industries, Inc.
70-15 Austin St., Third Floor
Forest Hills, NY 11375
(718) 793-7963
fax: (718) 793-9710
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Betting on ODBC

Coromandel has bet the farm on ODBC—wisely, I think. This summer marks the arrival of the first two boatloads of ODBC drivers. One set of drivers comes from Microsoft; the other is from Pioneer Software, whose Q+E Database Library and drivers delivered ODBC-like benefits long before ODBC became a hot topic. (A spokesperson says that Pioneer will soon offer its own ODBC-aware application toolkit.)

Common data access, long a dream of database developers, is fast becoming a reality. I maintain a hefty FoxPro application that wants to become a client/server application, and making part of that application run against five different data sources was a real thrill.

Integra VDB adds value to raw ODBC in two key areas. The API library layers much-needed abstractions onto ODBC, notably scrollable cursors and triggers, and the visual controls connect users to data quickly and easily. Coromandel is moving fast—the 1.1 release arrived a scant three months after the 1.0 version—and I expect that this already-excellent toolkit will keep improving, as will the ODBC driver foundation on which it rests. ■

Jon Udell is a BYTE senior technical editor at large. You can contact him on BIX as "judell" or on the Internet at judell@bytepb.byte.com.

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Bounds Checker for Windows

Nu-Mega's Bounds Checker catches Windows programming errors that other tools miss

STEVE APIKI

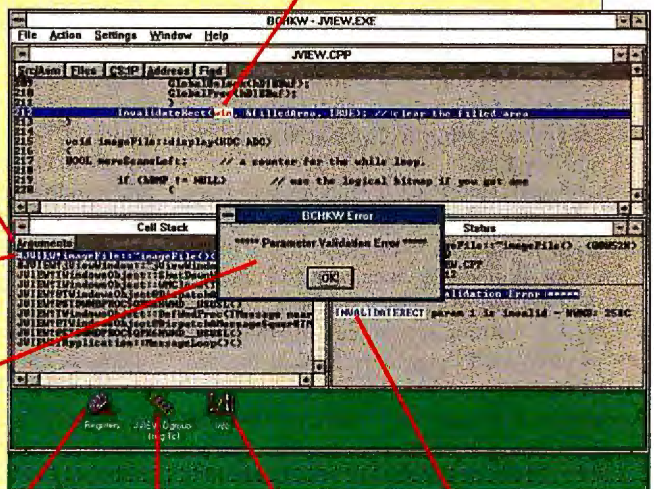
Bounds Checker for Windows 1.0, in the words of one especially enthusiastic developer I spoke to, is "a gift from the gods." While maybe not worthy of praise usually reserved for discoveries of the significance of fire, Bounds Checker deserves serious consideration by C developers plagued by the mysterious, hard-to-repeat, and almost impossible-to-catch bugs symptomatic of memory violations under Windows.

Bounds Checker for Windows *waits in the background as your program runs—when it encounters an error, it pops up a dialog box and freezes execution.*

Bounds Checker is a debugging tool that does what no other Windows debugging tool can do: It tracks down errors like NULL pointer dereferencing, array boundary overruns, memory leaks, and bad parameters passed to Windows API functions. It runs on Windows 3.1 only and requires a 386-class processor.

I ran Bounds Checker against two Windows programs. As this review went to press, Nu-Mega was finishing up version 2.0 of Bounds Checker for Windows; I tested version 1.0 but also worked a little with a beta release of version 2.0. My primary test program was JView, an image-file viewer that I'd written using ObjectWindows Library, or OWL, and Borland C++ almost a year ago and that has been mostly working fine ever since. JView is a 250-KB program built under the medium memory model. As a test using large applications, I also ran a huge, commercial application coded straight to the Windows API; this is a program at the beta-test stage that's just over 4.5 MB, including debugging information, and it's built using the large memory model. Bounds Checker did an outstanding job on JView, finding some real problems that may never have otherwise been caught. It also unraveled lots of hard-to-find errors on the larger executable file but had some problems of its own with an odd-size custom stack used in the program.

After your program terminates, *Bounds Checker gives you a diagnostic log that lists memory use and memory and resource leaks. The log includes memory that is allocated but not freed by your program and by Windows DLLs on behalf of your program.*



The Code window shows the source line where the error occurred—you must have symbolic debugging information available.

The Call Stack Arguments button toggles between showing function arguments as addresses or values.

Call Stack shows a stack trace of calls leading up to the errant routine.

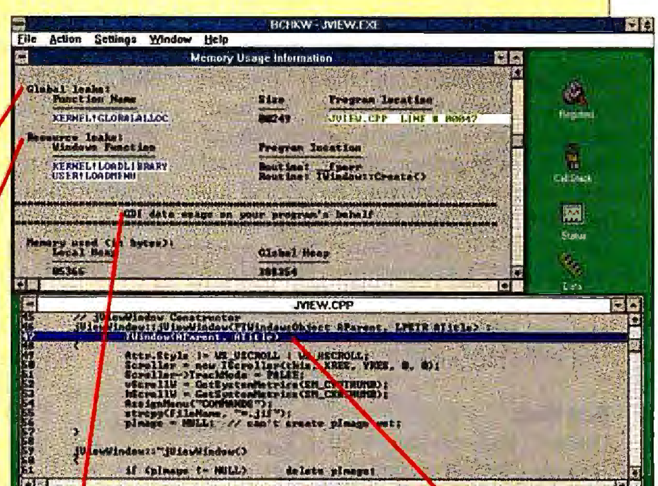
Bounds Checker for Windows pops up on invalid memory accesses, writes to NULL pointers, and several other events. In this case, the error is an invalid parameter passed to a Windows API function.

The Registers window shows 386 register information.

The Data window shows the state of memory when Bounds Checker pops up.

The Info window lets you track Windows heap and resource information.

The Status window shows a detailed description of the problem: a bad parameter passed to InvalidateRect().



On program exit, Bounds Checker shows memory that has been allocated and not freed.

Allocated resources that haven't been freed. On this screen, Borland C++ and OWL load these resources.

Bounds Checker also reports GDI and USER allocations.

The line of code where the global memory leak occurred.

What It Can Tell You

Bounds Checker provides a nice Windows user interface, although the guts of the interface require a virtual device driver. You launch Bounds Checker under Windows and then use it to load the program you want to check. Once your program is loaded, Bounds Checker minimizes itself and waits in the background, monitoring your program's use of memory and other resources. Bounds Checker can also check the activities of DLLs that your program loads.

When the program under test does something wrong—and believe me, if you haven't run it under Bounds Checker already, it will—Bounds Checker pops up an error message, a description of the problem, and the offending code. Once Bounds Checker pops up, you can choose to log the error and continue, to terminate the program, or choose from among a few other options.

Bounds Checker 1.0 validates Windows API calls; in version 2.0, Bounds Checker flags actual API failures, which is more useful. Bounds Checker 1.0 also monitors the first part of the data segment to catch NULL pointer references in small- or medium-model programs. It tracks the size of structures and arrays to ensure that writes to these data items don't exceed their boundaries. It watches attempts to free unallocated pointers, and it monitors allocated memory to check for writes that go beyond allocated limits. Finally, it catches actual processor faults and handles them gracefully.

But Bounds Checker can't pop up on memory leaks. Instead, it monitors memory and resource usage to ensure that all calls to `malloc()` are paired with a call to `free()`, that all `LoadResource()` calls have a corresponding `FreeResource()`, and so on with all memory and resource allocation functions. Since problems in this class can't be found until the test program is done, Bounds Checker pops up a memory usage report on test program termination. The memory usage report shows stack use, memory used from the global and local heaps, global leaks (memory allocated but not freed), resource leaks, and GDI (Graphical Device Interface) and USER memory allocated on behalf of the test program.

Real Work

Once I had played with Bounds Checker to find out what it could do, I was anxious to try it out on a few programs. I first used it to check errors in JView, a relatively simple program; it ran fine.

Because of its simplicity, JView had few problems. Keep in mind, however, that this is a program that has been stable for quite some time without causing noticeable crashes—and it had bugs. It had a few minor resource and memory leaks, but these were mostly in code generated by OWL and the C compiler itself. JView's only serious problem was a parameter violation on a call made with an invalid window handle made from the destructor for one of my classes. Although Nu-Mega understandably touts Bounds Checker's unique ability to track out-of-range references ahead of the rest of its functions, I actually found some serious problems in JView and the large test program through Bounds Checker's Windows API validation. You could find these errors through the Windows debug kernel, but the collection of functions in Bounds Checker and its full-code and status displays makes finding these errors a more natural part of the debugging process.

Bounds Checker adds a lot of overhead, of course, but the slowdown during testing wasn't noticeable for JView. For example, it took about 2.5 seconds to open a dialog box under Bounds Checker versus half a second without Bounds Checker, and this was while using the most stringent checking options; certainly overhead I could live with. The large program was also slower under Bounds Checker (about 9.5 seconds versus 5 seconds to open a file), but eliminating some of the most time-consuming checks (e.g., checking all allocated blocks on every call to an allocation routine) reduced delays a tiny bit.

On the large test program, Bounds Checker caught many bad parameters sent to APIs, more than one attempt to use a NULL window handle, and a raft of memory leaks. Since the test program was built with the large data model, NULL pointer checks weren't as useful as they'd be in a small or medium model, as large-model NULL pointers tend to throw general-protection faults as soon as you touch them anyway.

Bounds Checker 1.0 had a few problems with the large file. It was subject to inexplicable system crashes sometime during each debugging session. After a few rounds of phone calls and after seeing a copy of some of the source code, Nu-Mega traced the problem to a bug in Bounds Checker 1.0. The large program used the Windows `SwitchStackTo()` API to set up its own custom stack; however, it requested a stack size that was somewhat smaller than a full segment. Bounds Checker 1.0 expected, and assumed, that stacks set up in this manner would be a full 64 KB in length; thus, it failed on this program. The problem is exorcised from the latest beta of version 2.0.

The good news is that these were the only problems I had with Bounds Checker. Considering that the large test program was almost pathologically large for a single executable file—about 18 MB of symbol information before CVPACK—and that CodeView itself sometimes failed on this file, I was more than happy with Bounds Checker's stability.

Naturally, Bounds Checker will tell you only about errors in functions that you exercise, so if you have a large and complex program, it's best to use Bounds Checker while running whatever validation script or set of actions you use to test the complete functionality of your program.

Working with Soft-Ice/W 1.3

Even with Bounds Checker's complete reporting, you'll want to run a debugger alongside Bounds Checker to get the most secure handle on errors as they occur. Bounds Checker supports direct coordination with Soft-Ice/W 1.3, Nu-Mega's low-level Windows debugger. Getting the two to work together took some fiddling with configuration files, but it was well worth the effort.

Bounds Checker doesn't offer real debugging services to help you explore the source of errors. You can't single-step, trace, or view variables without looking at a memory dump. Bounds Checker works extremely well in concert with Soft-Ice/W as a "breakpoint generator," popping you directly into Soft-Ice/W whenever memory errors occur. With Soft-Ice/W, you can, of course, set breakpoints, and trace through your Windows code.

With or without Soft-Ice/W, Bounds Checker is a valuable tool, one that can help you find bugs that will elude even the best debuggers, bugs that could even go unnoticed through a good quality-assurance check. Unless you write perfect C code for Windows on the first try, Bounds Checker is an outstanding investment. ■

Steve Apiki is the director of the BYTE Lab. He has worked as a programmer and engineer and has a B.S.E.E. from Rensselaer Polytechnic Institute. You can reach him on BIX as "apiki" or on the Internet at apiki@bytepb.byte.com.

About the Product

Bounds Checker for Windows 1.0..............$199

Bounds Checker for Windows 2.0..............$249

Bounds Checker and Soft-Ice/W 1.3..........$499

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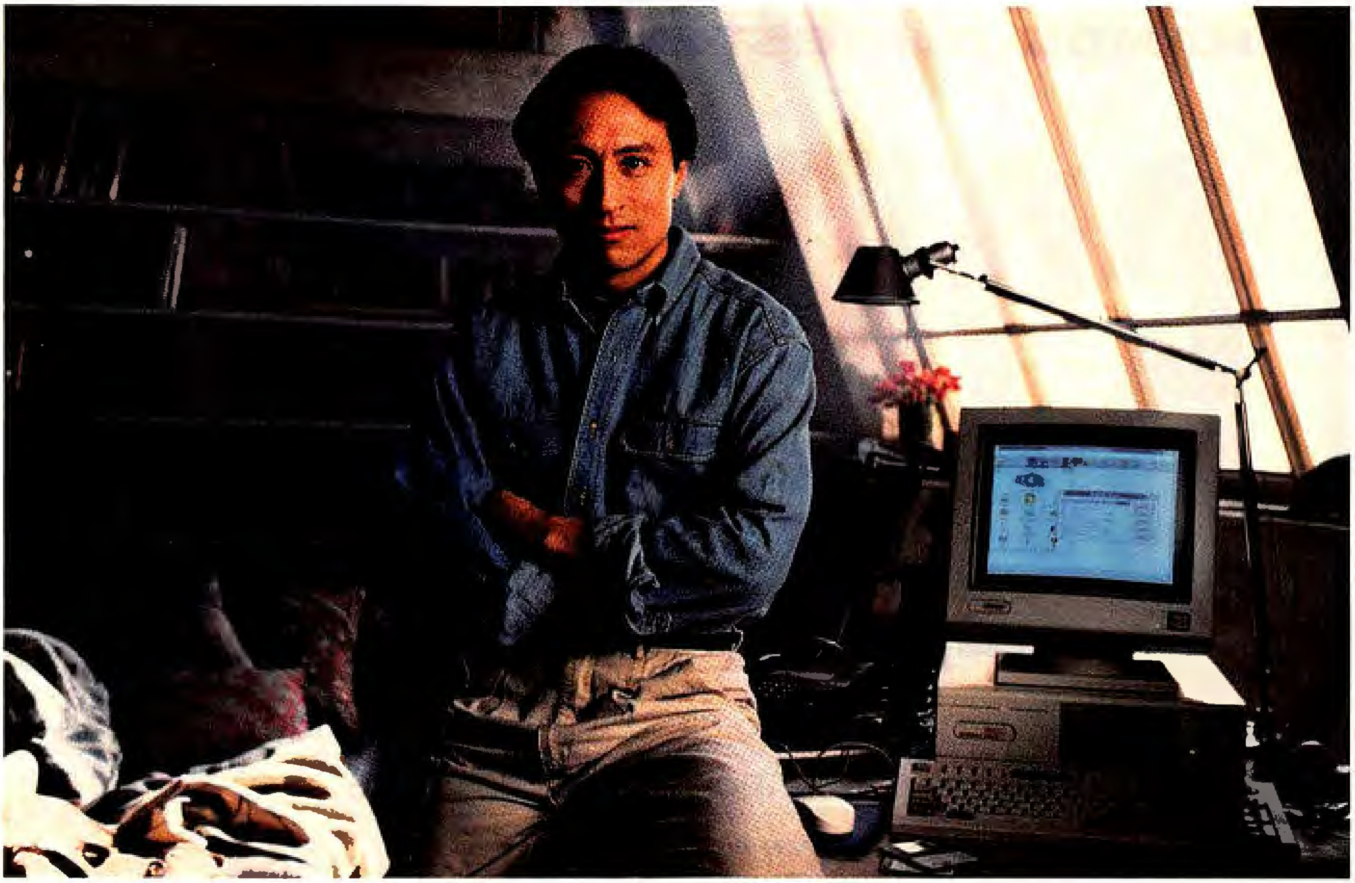


62 HIGH-POWER NOTEBOOKS

We choose the best 486-class notebooks and Macintosh PowerBooks for four important applications

RICHARD FOX AND STEPHEN PLATT

If you view travel time as wasted time, read on. We tested 62 of today's fastest PC and Macintosh notebooks and found a multitude of performance capabilities, color options, and price points to keep you working at full speed when you're away from your desk.

We put 486-class notebooks and 68030-based Mac PowerBooks through their paces with nine DOS/Windows and 13 Macintosh performance tests. We also evaluated the systems for screen quality, battery life, price, and ease of use.

Our test sample included color and monochrome DOS/Windows notebooks with CPUs from Cyrix, IBM, and Intel. Clock speeds ranged from 20 MHz to clock-doubled 66 MHz. The PowerBooks ran at 33 MHz. We chose this performance class because we believe it offers the best in price and speed.

We limited our scope to notebooks weighing 7 pounds or less, excluding battery and AC adapter. We required an internal floppy drive (this criterion excluded the Mac Duo line and the CompUSA 4SL/25.) Dell, DEC, Gateway 2000, and Packard-Bell were revamping their 486 notebook lines as we prepared this report and couldn't send new systems in time. All but Dell should announce new lines by the time you read this.

The fastest notebook was the DX2/66-based Amrel 486DX2/66 AC, which ran more than four times faster than our baseline 20-MHz 386SX notebook and performed on a par with high-end desktop systems. At the other end of the scale was the SLC/25-based KingTech KS-486C, with speed roughly equivalent to that of a slow 386SX machine. But top performance is expensive: The Amrel notebook lists for $5249—over three times the $1695 price of the KingTech system. Overall, we found that systems with Cyrix processors were consistently slower than Intel-based units, although the Cyrix-based systems were often less expensive.

How to use this guide

We selected notebooks by choosing the ones with the best mix of performance, screen quality, battery life, price, features, and ease of use.

Scores are calculated from appropriate Windows and DOS tests. Higher numbers mean better performance.

Rating based on quality of keyboard design, pointing device, status lights, other considerations.


BEST OVERALL Compaq LTE Lite 4/25E

This notebook lasts more than 7 hours—90 minutes longer than its nearest competitor. Further, its active-matrix monochrome screen's gray-scale quality, clarity, and range of viewing angles made it the best monochrome screen we saw; its quality even rivaled that of some active-matrix color displays. A good screen like this is important for Windows: It avoids the muddy grays that can easily obscure visual details in a windowing environment. The trackball placement is unusual; it sits next to the screen rather than near the keyboard. The pointer is easy to use, although the small ball sometimes wobbled during use. Numerous security features, such as power-on and setup-utility password protection and a pop-up battery gauge on the LCD, round out the Compaq LTE Lite 4/25E's capabilities.

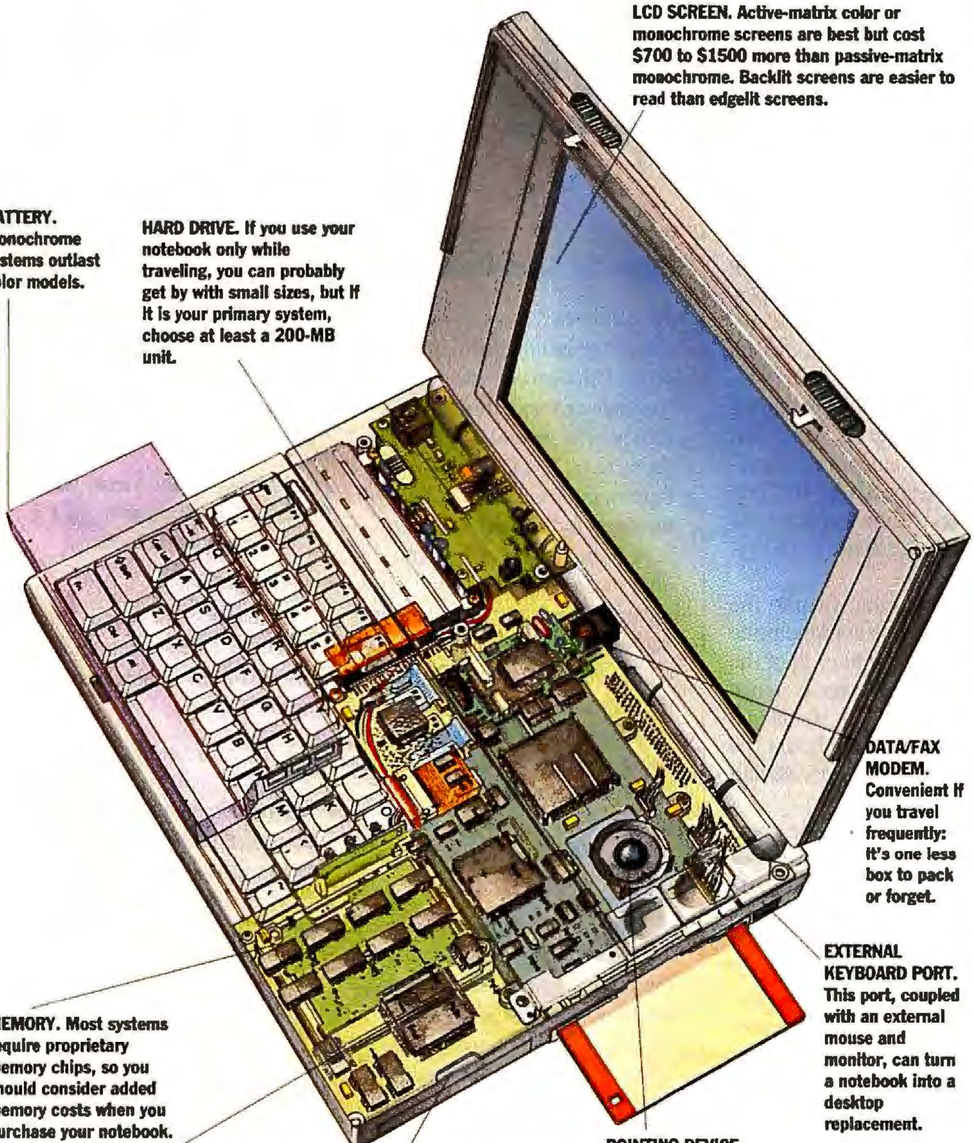
		PRICE	CPU	WINDOWS SPEED	EASE OF USE	BATTERY LIFE (HOURS:MIN)	SCREEN QUALITY	SCREEN SIZE (IN.)
BEST	Compaq LTE Lite 4/25E	$4339	SL/25	2.61	Good	7:06	Excellent	8.4
RUNNER-UP	ZDS Z-Note 425Ln Model 120	$2599	SL/25	2.89	Good	6:27	Fair	9.5

Rating clarity, reproduction of gray scales or color, and range of viewing angles.

Battery discharge under real-world conditions.

PHOTOGRAPHY: STEVE BELKOWITZ © 1993

Anatomy of a Notebook



LCD SCREEN. Active-matrix color or monochrome screens are best but cost $700 to $1500 more than passive-matrix monochrome. Backlit screens are easier to read than edgelit screens.

BATTERY. Monochrome systems outlast color models.

HARD DRIVE. If you use your notebook only while traveling, you can probably get by with small sizes, but if it is your primary system, choose at least a 200-MB unit.

DATA/FAX MODEM. Convenient if you travel frequently: it's one less box to pack or forget.

EXTERNAL KEYBOARD PORT. This port, coupled with an external mouse and monitor, can turn a notebook into a desktop replacement.

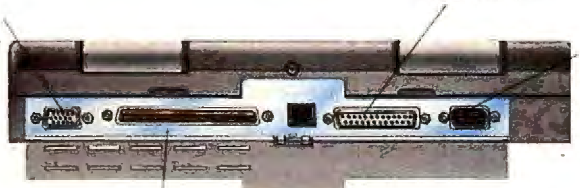
MEMORY. Most systems require proprietary memory chips, so you should consider added memory costs when you purchase your notebook.

VIDEO CONTROLLER. Almost all notebook vendors use a Cirrus Logic or Chips & Technologies VGA controller. (We experienced no difficulty with systems using other controllers.) If you plan to use an external monitor at high resolutions, buy a notebook with 1 MB of VRAM (video RAM).

PCMCIA I/O SLOT. Allows simple expansion if you need a modem or need to connect to a network.

POINTING DEVICE. Trackballs at the far right side of the unit can be trouble for left-handed users. Centered trackballs may be a better choice for lefties.

Back View



EXTERNAL VIDEO CONNECTOR. Most notebook LCD screens handle a resolution of only 640 by 480 pixels. Make sure your notebook's VGA controller can handle up to 1024 by 768 pixels on the external port if you want to use an external monitor.

PARALLEL PORT

SERIAL PORT. You should get at least one COM port—two if your system doesn't have an internal modem or an external mouse port.

EXPANSION SLOT. For connecting to a docking station, which lets you add peripherals on expansion cards.

OCTOBER 1993 BYTE BEST NOTEBOOKS

BEST

WINDOWS

Compaq LTE Lite 4/25E

This isn't the flat-out fastest notebook for Windows applications. However, the LTE Lite 4/25E's active-matrix display was the best monochrome display we evaluated. The notebook also placed first in our battery-life tests, running 90 minutes longer than its nearest competitor. **PAGE 165.**

COLOR

Sager NP843T

The NP843T's 10-inch, active-matrix color screen displayed colors, text, and graphics with a brilliance unsurpassed by any other notebook. The NP843T was also among the fastest notebooks we tested: It outperformed all but one of the 12 33-MHz color notebooks we tested for Windows and DOS speed, and it even outran one system with a higher clock rate. **PAGE 167.**

DOS

Compaq LTE Lite 4/25E

As in the Windows performance tests, the LTE Lite 4/25E didn't set the standard for DOS speed; its performance scores were in the middle of the pack. But its active-matrix monochrome screen had the highest quality of those we tested, and its 7-hour battery life was outstanding. **Page 181.**

DESKTOP REPLACEMENT

NEC UltraLite Versa 33C

If you want one system to serve at the office and on the road, this is it. For travel, the Versa 33C's active-matrix color screen was among the best we tested. PCMCIA slots accommodate portable modems and network adapters, and a unique bay lets you plug in a floppy drive or a second battery. At the office, the Versa can drive a Super VGA monitor and achieves desktop-class video performance. The built-in keyboard has such a wonderful feel, you may not want an external keyboard. **PAGE 189.**

THE BEST

WINDOWS NOTEBOOKS

If Windows on the road is a necessity and you don't require a color display, the following 486 notebooks offer the best mix of price, performance, and features. (If you must have color, see our rankings for best color notebooks on page 167.)

We chose our Best Overall winners from among notebooks with processors rated at 33 MHz and slower. Our High-Performance category considered notebooks that had clock speeds of 40 MHz or faster. We made this separation because the faster systems fill a specific niche in the notebook market.

We received only 15 systems that fit into the high-performance category, and the average price of these machines is about $1000 higher than the $3100 average of the 33-MHz and slower systems. Furthermore, 80 percent of the faster systems had below-average battery runs—less than 3 hours. To be considered for Low Cost status, a notebook had to be priced at $2750 or less.

Once we had made our initial cuts, we compared systems for performance when running our Windows performance test suite. This test suite consists of popular Windows business applications that provide real-world measurements of notebook performance. The suite also includes low-level tests that compare how well video subsystems execute Windows graphics calls. The resulting scores counted for 30 percent in our evaluation. Next, we factored in display quality (which was weighted at 20 percent), battery life (20 percent), ease of use (10 percent), features (5 percent), and price (15 percent).

Steps to Save Battery Power

1 Avoid excessive spinning up and spinning down of the hard drive. Once power management has been enabled, this can be achieved in several ways. A disk cache (e.g., SMARTDRV) buffers information in system memory, reducing the need to read from the hard drive. Storing your data on a RAM disk when operating on battery power eliminates the need for disk access at all. Be careful with this approach, however, because your data is not secure on the RAM disk and is lost once power is shut off. Finally, experiment with different time-out settings for the hard drive to find the one that works best for you.

2 Set the LCD shutdown interval to a short time. Backlighting can eat up a great deal of battery power, and when off, it simply requires a tap of a key when you are ready to resume working.

3 Most notebooks have controls for reducing the intensity of the LCD lighting. Backlighting requires less power at lower intensities.

4 Minimize the use of floppy drives, which also place a great strain on the battery.

5 Many systems let you adjust the processor speed. Set your system for the slowest speed that gives you reasonable performance.

6 If you are going to leave the notebook for a substantial length of time, place the notebook in its sleep mode. This shuts off most of the system's components but saves the contents of its memory so that you can pick up where you left off.

7 Choose a low-voltage CPU. Nine of the 14 longest battery times were produced by systems with 3.3-V processors.

The Compaq LTE Lite 4/25E won out as the Best Overall Windows system, even though its Windows performance was only average. Its display quality and battery-life scores were unsurpassed among monochrome Windows systems. For the best in Windows speed among the Best Overall finalists, the TI TravelMate 4000 WinDX/25 ranked first, running more than three times faster than the baseline 386SX notebook. The TravelMate 4000 WinDX/25 even out-scored the Twinhead Slimnote 4DX/33M, which runs at a faster clock speed.

For pure Windows performance, nothing matched the Micro-International HCP Model 65681M, which ran more than five times faster than the baseline notebook and became our High Performance winner. The HCP Model 65681M was the fastest monochrome system on the BYTE Windows low-level tests. In the Windows application tests, it was the fastest monochrome notebook to run the Excel test and placed second (behind the TI TravelMate 4000 WinDX2/50) in the Word for Windows and Lotus 1-2-3 for Windows tests. The CompUSA 486DX2/66 Slimnote placed second overall, with a higher price tag and slower performance but 35 minutes more battery life.

All but two of the top-ranked Windows systems turned in above-average battery-life numbers, with half of the times topping 4 hours. Only the Twinhead Slimnote 4DX/33M and the HyperData HB 2300 DLC/40 had below-average battery endurance of under 3 hours. The HyperData system, which is based on a Cyrix 486DLC processor, was also the only ranked Windows system to employ a non-Intel CPU. Overall performance of this 40-MHz unit was comparable to Intel 33-MHz–based notebooks (except in the integer-math portion of the BYTE CPU test, where results placed it squarely between the 50-MHz and 66-MHz systems). Its $2295 price also makes it the only notebook that qualified for both Low Cost and High Performance consideration.

A pointing device is crucial for Windows use. While most of today's notebooks include an integrated trackball with two buttons, the location and design vary greatly from model to model. Micro-International's design is easy to use if you are right-handed: The trackball sits between the keyboard and the display on the far right side of the system, with the two input buttons on the right side of the case. Lefties may not be as pleased with the placement. By contrast, CompUSA places the trackball above the keyboard and slightly to the left of center, which makes it convenient for either left- or right-handers. The downside is that you're forced to hold your arm unnaturally elevated above the keyboard.

We found some keyboard designs to be unsuitable for long typing sessions. For example, the HyperData HB 2300 DLC/40's keyboard stands a full 1½ inches above the work surface; it's best to use an external keyboard or separate wrist rest when you're using this notebook for long typing periods. The Low Cost–winning Zenith Data Systems (ZDS) Z-Note had a much more comfortable keyboard that approximated the spaciousness and response of a desktop keyboard.

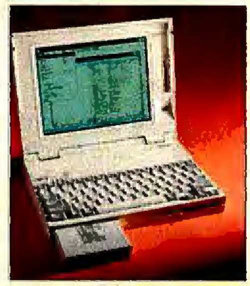
The $1948 AST Bravo provided several unique hot-key features. You can use keys to toggle through several different gray-scale schemes to find the best color mapping for a particular application. This is especially helpful in determining the quick keys listed in an application menu or viewing the highlight bar. To conserve power on the Bravo, you can use keys to quickly enable or disable the LCD backlighting or enter a low-power mode that reduces both CPU speed and backlight intensity. The Bravo (as well as the Compaq LTE Lite) also includes a pop-up battery gauge that predicts the amount of remaining battery time based on the current usage pattern.

The Texas Instruments TravelMate 4000 WinDX/25 and WinDX2/50 map PageUp, PageDown, Home, and End keys via function-key/arrow-key combinations.

BYTE BEST | WINDOWS

For the sharpest display and best battery...

BEST OVERALL — **Compaq LTE Lite 4/25E**



This notebook lasts more than 7 hours—90 minutes longer than its nearest competitor. Further, its active-matrix monochrome screen's gray-scale quality, clarity, and range of viewing angles made it the best monochrome screen we saw; its quality even rivaled that of some active-matrix color displays. A good screen like this is important for Windows: It avoids the muddy grays that can easily obscure visual details in a windowing environment. The trackball placement is unusual; it sits next to the screen rather than near the keyboard. The pointer is easy to use, although the small ball sometimes wobbled during use. Numerous security features, such as power-on and setup-utility password protection and a pop-up battery gauge on the LCD, round out the Compaq LTE Lite 4/25E's capabilities.

		PRICE	CPU	WINDOWS SPEED[1]	EASE OF USE	BATTERY LIFE (HOURS:MIN)	SCREEN QUALITY	SCREEN SIZE (IN.)
BEST	Compaq LTE Lite 4/25E	$4339	SL/25	2.61	Good	7:06	Excellent	8.4
RUNNER-UP	ZDS Z-Note 425Ln Model 120	$2599	SL/25	2.89	Good	5:27	Fair	9.5
RUNNER-UP	TI TravelMate 4000 WinDX/25	$2678	DX/25	3.13	Good	4:46	Fair	10
RUNNER-UP	AST Bravo NB 4/25s	$1948	SX/25	2.41	Good	3:16	Good	9.5
RUNNER-UP	Twinhead Slimnote 4DX/33M	$2195	DX/33	2.96	Fair	2:51	Fair	10

Need the fastest Windows performer?

HIGH PERFORMANCE — **Micro-International HCP Model 65681M**

If you need a notebook with processing power for massive spreadsheets and databases, to perform gray-scale imaging, or for other demanding tasks, the HPC 65681M is for you. It ran our Windows performance tests twice as fast as the Compaq LTE Lite 4/25E, our Best Overall winner. In fact, this was the fastest monochrome notebook in our entire test sample. The HCP 65681M's monochrome screen quality is the best we saw from passive-matrix monochrome displays. In addition, it offers a reasonable battery life (3 hours, 32 minutes), two PCMCIA Type II slots, readable LED status indicators, and an excellent keyboard.

		PRICE	CPU	WINDOWS SPEED[1]	EASE OF USE	BATTERY LIFE (HOURS:MIN)	SCREEN QUALITY	SCREEN SIZE (IN.)
BEST	Micro-International HCP Model 65681M	$2805	DX2/66	5.28	Good	3:32	Good	9.5
RUNNER-UP	CompUSA 486DX2/66 Slimnote	$3228	DX2/66	4.40	Excellent	4:07	Fair	9.5
RUNNER-UP	TI TravelMate 4000 WinDX2/50	$3499	DX2/50	4.75	Good	4:01	Fair	10
RUNNER-UP	HyperData HB 2300 DLC/40	$2295	DLC/40	3.52	Excellent	2:52	Fair	8.8

Budget conscious?

LOW COST — **Zenith Data Systems (ZDS) Z-Note 425Ln Model 120**

This $2599 notebook ran slightly faster than our Best Overall system. The Z-Note's display quality isn't in the same league as the Compaq LTE's, but the edgelit passive screen was visually pleasing and well above average in our screen-quality tests; it beat the screens of numerous more expensive systems. The screen's wide viewing angle means you can move around while using the notebook and still see what you are doing. The keyboard is a pleasure to use. A built-in Ethernet adapter is standard.

		PRICE	CPU	WINDOWS SPEED[1]	EASE OF USE	BATTERY LIFE (HOURS:MIN)	SCREEN QUALITY	SCREEN SIZE (IN.)
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RUNNER-UP	AST Bravo NB 4/25s	$1948	SX/25	2.41	Good	3:16	Good	9.5
RUNNER-UP	Twinhead Slimnote 4DX/33M	$2195	DX/33	2.96	Fair	2:51	Fair	10

[1] Higher numbers indicate better performance (a 20-MHz 386SX Toshiba T2200SX = 1.0).

THE BEST

COLOR NOTEBOOKS

Color 486 notebooks are the easiest notebooks to use if you are running a GUI. But exceptional screen quality comes with a hefty price premium. Generally, an active-matrix color notebook will cost $500 to $1000 more than a similarly configured passive-matrix color system, and a passive-color product will cost $500 to $700 more than a passive-monochrome model. Micro-International's notebooks illustrate this: A monochrome unit lists for $2805, an equivalent passive-matrix color notebook lists for $3535, and the active-matrix color version lists for $4305.

Screen quality counted for 20 percent in our evaluation when we chose the best color notebooks. We also factored in performance (30 percent). For all the categories, performance was an average of DOS and Windows test scores. We also considered battery life (20 percent), ease of use (10 percent), features (5 percent), and price (15 percent).

We chose our Best Overall winners from among notebooks with processors rated at 33 MHz and slower. Our High Performance choices considered notebooks with clock speeds of 40 MHz or faster.

To qualify for Low Cost status, a notebook had to be priced at $2750 or less. Thus, it is not surprising that all the Low Cost systems came with passive-matrix displays. Moreover, 20 of the 21 most expensive notebooks that we tested contained active-matrix color displays. Active-matrix technology adds weight as well as cost—13 of the 20 heaviest models in our sample were active-matrix units.

All the systems considered for the Best Overall category had active-matrix screens; active matrix remains a clearly superior technology. These displays use three transistors to control each pixel's red, green, and blue values. By contrast, passive-matrix screens use three transistors to control an entire row or column of pixels.

Active-matrix displays deliver brilliant, fully saturated colors; deep contrasts; and wide viewing angles. Passive-matrix displays have slower refresh rates and narrower viewing angles, and they are prone to color streaking and pointer *submarining* (where the cursor seems to disappear when you are moving it across the screen). In our screen-quality testing, all the passive-matrix displays posted scores that were well below those achieved by the active-matrix products.

The $3750 Sager NP843T ranked first among the Best Overall systems, in part for its winning performance in the Excel 4.0a portion of our applications tests. This benchmark, which displays many different multicolored bar, column, line, and pie charts, provides a good basis for comparing video performance, and the Sager NP843T repeatedly placed within the top five in several of these tasks. Runner-up NEC UltraLite Versa 33C outclassed the Sager NP843T in every aspect of our testing, but its steep list price of $5538 was almost $1800 higher than the Sager NP843T's—and the

Key Notebook Terms

Active matrix
Each pixel of an active-matrix display uses three transistors to control the red, green, and blue signals. This produces vibrant, fully saturated colors; deep contrasts; and wide viewing angles. However, due to manufacturing complexity, users must pay a price premium for active-matrix technology.

Docking station
An external expansion chassis that attaches to a notebook. A docking station can provide adapter slots, drive bays, and ports for attaching an external monitor, keyboard, and mouse. It provides the means for using the notebook as a desktop unit when you're not traveling.

Dual scan
An enhanced passive-matrix screen technology that divides the screen into two portions. Dual scan improves the refresh rate of the screen by updating two lines simultaneously. This technology is twice as fast as standard passive screens that update one line at a time.

Hot swap
The ability to swap batteries while using the notebook, without shutting off the power.

LCD
Liquid crystal display; a common display technology used in portable computers that uses a liquid between two transparent electrodes. When an electric current passes through the electrodes, the molecules in the liquid form a crystalline pattern that polarizes the light passing through it.

Nickel cadmium, NiMH
Two battery chemistries prevalent in mobile computers. Nickel-cadmium batteries are prone to the *memory effect*: When they are recharged before they are completely drained, subsequent charges tend to run out at about the point where they were last recharged. Nickel-cadmium batteries are being replaced by more expensive NiMH (nickel-metal-hydride) batteries, which offer more power per pound than nickel-cadmium batteries and do not exhibit the memory effect.

Passive-matrix
Each column or row of pixels in a passive-matrix display uses three transistors to control the red, green, and blue signals. Passive-matrix units produce slower refresh rates and narrower viewing angles than active-matrix displays (see Active matrix, above). This technology is also subject to color streaking and pointer submarining (where the cursor seems to disappear when being moved across the screen).

PCMCIA
An acronym for Personal Computer Memory Card International Association, as well as the name of the standard established by that association. PCMCIA is a hardware and software specification for memory, I/O, storage, and communications (e.g., fax, modem, and network adapter) devices. All these devices can be inserted into a credit-card-size slot (the slots range from 3.3 millimeters to 10.5 mm in height) in the notebook without any need for configuration by the user. The standard has yet to achieve plug-and-play compatibility, however.

Power management
A common feature in portable computers that conserves battery life by shutting down system components such as the hard drive and the display. Some systems slow down the CPU's clock speed as well.

second highest among all 62 tested notebooks. (The price of the Versa 33C is partly owing to this unit's having 12 MB of RAM; most of the reviewed notebooks included only 8 MB.)

Most color notebooks require more power to operate than monochrome units do. Monochrome notebooks averaged 3 hours, 19 minutes of battery life, while the average battery life of the color models was only 2 hours, 48 minutes. Eight out of the 10 best battery times were produced by monochrome products.

However, this is merely an overall trend in our testing; there are plenty of exceptions. Six color notebooks achieved battery-life numbers that were higher than the monochrome average. The Acer Note 750C, the winning Best DOS Color notebook, lasted 4.5 hours, which places it within the top five models for battery endurance.

The median battery life for an active-matrix color system was 2.9 hours, outlasting the median time of 2.5 hours for the passive-matrix models. Once again, we saw exceptions. Our low-cost leader, the Toshiba Satellite T1900C, outlasted more than two-thirds of all the notebooks tested, with 3 hours, 17 minutes of staying time.

All the notebooks in this review offer a maximum internal resolution of 640 by 480 pixels. However, nearly all support higher resolutions, either 800 by 600 or 1024 by 768 pixels, on external monitors. This is especially important if you want your notebook to serve as your desktop system. Among top color systems, only the Toshiba Satellite does not support 1024 by 768 pixels externally: It supports only 640 by 480 pixels.

Simulscan support, which is the ability to simultaneously display on both the internal LCD and the external monitor, is another important consideration. Only nine of the tested notebooks—including the Toshiba Satellite—did not support this feature.

BYTE BEST — COLOR

Need the best color at an affordable price?

BEST OVERALL — Sager NP843T

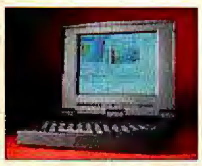
OCTOBER 1993 BYTE BEST COLOR NOTEBOOK

The Sager NP843T's 10-inch, backlit, active-matrix display scored top honors for quality in the color purity section of our screen-quality test. Overall, this screen was in the top three for clarity and brilliance in displaying color text and graphics. The NP843T's speed score was the second fastest of the 12 33-MHz color notebooks we tested and was faster than one system with a higher clock rate. The keyboard is well built, with a nice, crisp response; most of the keys are full-size, making it easy to use. The Sager's trackball is located on the upper right edge of the keyboard.

		PRICE	CPU	OVERALL SPEED[1]	EASE OF USE	BATTERY LIFE (HOURS:MIN)	SCREEN QUALITY	SCREEN SIZE (IN.)	SCREEN TECHNOLOGY
BEST	Sager NP843T	$3750	DX/33	2.99	Good	2:52	Excellent	10	Active
RUNNER-UP	NEC UltraLite Versa 33C	$5538	SL/33	3.06	Excellent	2:55	Excellent	9.5	Active
RUNNER-UP	AST Power Exec 4/25SL ColorPlus	$4758	SL/25	2.18	Excellent	3:49	Excellent	9.5	Active
RUNNER-UP	Acer Note 750C	$3988	SL/25	2.22	Excellent	4:28	Good	9.5	Active
RUNNER-UP	NEC UltraLite Versa 25C	$4888	SL/25	2.52	Excellent	2:40	Excellent	9.5	Active

Need speed and color?

HIGH PERFORMANCE — Micro-International HCP Model 65681C



This passive-matrix color notebook was the third-fastest system in our entire sample. It repeatedly placed within the top three slots in our video-intensive application tests and flew through tests like our WordPerfect 5.1 for DOS print preview, charting portions of the 1-2-3 for DOS and Windows benchmarks, and the font-change section of the Word 2.0 for Windows test. Color detail was good, with crisply defined text in all modes. The display's viewing angle was above average, but the colors themselves were washed out. The keyboard was well arranged and had an excellent feel: All the keys were large, were placed where a touch-typist would expect to find them, and had nice travel.

		PRICE	CPU	OVERALL SPEED[1]	EASE OF USE	BATTERY LIFE (HOURS:MIN)	SCREEN QUALITY	SCREEN SIZE (IN.)	SCREEN TECHNOLOGY
BEST	Micro-International HCP Model 65681C	$3535	DX2/66	3.92	Good	2:33	Fair	9.5	Passive
RUNNER-UP	AMS TravelPro 5366A	$3895	DX2/66	3.39	Good	2:52	Good	9.5	Active
RUNNER-UP	TI TravelMate 4000 E WinDX2/50	$5278	DX2/50	3.62	Good	2:36	Excellent	8.5	Active
RUNNER-UP	Twinhead Slimnote 4DX2/66T	$4399	DX2/66	3.41	Fair	2:38	Good	8.5	Active
RUNNER-UP	Amrel 486DX2/66 AC	$5249	DX2/66	4.13	Fair	1:30	Good	8.5	Active

Need economical color?

LOW COST — Toshiba Satellite T1900C

Toshiba's new Satellite presents a good set of features in a low-cost package. The passive-color screen did well on our quality tests, providing crisp text and good graphics, but it offered limited left/right visibility. This means that you'll be able to read the screen easily, but only from head on. The notebook is based on the SXA/20 chip and provides more than enough performance for day-to-day activities: its performance was faster than that of 19 of the 27 systems with clock speeds less than 33 MHz, and faster than two 33-MHz systems. It uses a QuickPort mouse, which simplifies the process of attaching and detaching the external mouse. Sliding port-covers slip inside the case so they won't easily break or get lost. A Type III PCMCIA slot further distinguishes the Satellite: Only nine other systems support the larger Type III slots.

		PRICE	CPU	OVERALL SPEED[1]	EASE OF USE	BATTERY LIFE (HOURS:MIN)	SCREEN QUALITY	SCREEN SIZE (IN.)	SCREEN TECHNOLOGY
BEST	Toshiba Satellite T1900C	$2700	SXA/20	2.03	Excellent	3:17	Fair	9.5	Passive
RUNNER-UP	AST Bravo 4/25s Color Model	$2748	SX/25	2.14	Good	2:15	Fair	9.5	Passive
RUNNER-UP	AMS TravelPro 4533 PAS	$2495	DX/33	2.66	Good	2:11	Poor	7.75	Passive

[1] Higher numbers indicate better performance (a 20-MHz 386SX Toshiba T2200SX = 1).

The ZEOS® Conte
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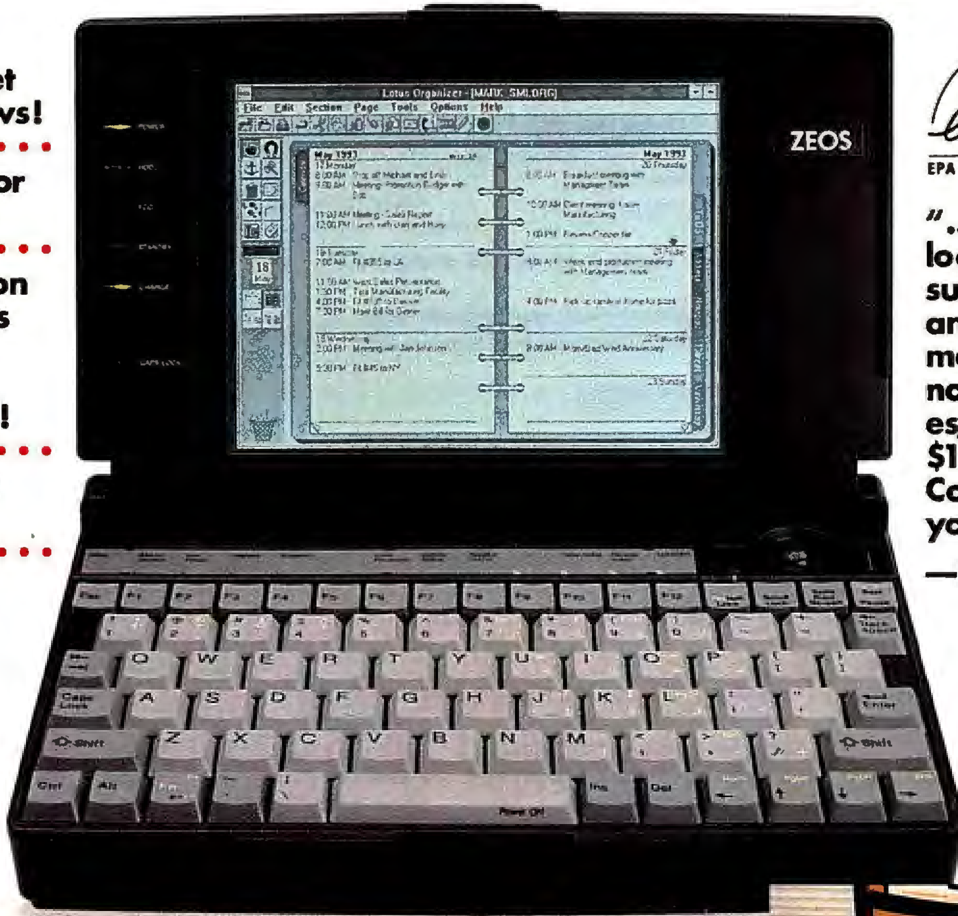
Less than 4 pounds, yet runs Windows!

Intel 386SL or 486SL CPU

486SL version has local bus video for Windows acceleration!

VGA backlit screen

Built-in trackball



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"...if you're looking for a subnotebook and want to make next to no compromises, then the $1295 ZEOS Contenda is your best bet."

—PC Week

Smaller than a notebook. Lighter than your briefcase. The ZEOS Contenda subnotebook is proof that great things come in small packages...including plenty of power to run Windows wherever you go!

We start with a smart Intel SL processor—your choice of either a 386SL-25 or new 486SL-25. You'll find that the Contenda's processor extends your battery life significantly—because it's intelligent enough to power-down the memory, disks, modem and more when they're not in use.

What's more, the Contenda's features make it a pleasure to use. Features such as a high-resolution backlit screen that's crisp and vibrant. A built-in trackball so you won't have to tote a mouse around. And with a standard 80MB hard drive, memory up to 10MB and weight of less than four pounds, it's one powerful, portable Windows workhorse!

How We Tested

PERFORMANCE

We tested each 486-class notebook with a performance suite of combined BYTE low-level DOS and Windows benchmarks, along with Windows application tests developed by NSTL. Mac PowerBooks ran BYTE's Macintosh Performance Benchmarks version 2.0.

The BYTE DOS low-level tests measure performance of specific system components, including CPU, FPU, memory, video, and hard drive. The Windows low-level tests exercise the Windows GDI (Graphical Device Interface). These determine how well a system can execute basic graphics calls within Windows, including calls that display pixels, lines, rectangles, polygons, and ellipses. Text and BitBlt operations are also executed. Windows-based performance tests (both low-level and application) were executed in 640- by 480-pixel resolution at 16 colors.

The NSTL application tests use popular business applications that give a real-world representation of notebook performance. For DOS tests, we use WordPerfect 5.1, Lotus 1-2-3 release 2.4, FoxPro 2.0, and Autodesk Animator Pro 1.0. Our Windows application tests include Microsoft Excel 4.0a, Microsoft Word 2.0b, and Lotus 1-2-3 for Windows 1.1.

All applications execute macros that exercise common areas of each application. For instance, the Word for Windows test includes many subtests that measure a variety of activities, including common file I/O, search and replace functions, changing fonts, page and line scrolling, spelling checking, print preview, and print to file.

For comparisons, we scaled all test scores against a 20-MHz 386SX Toshiba T2200SX, whose performance equaled 1.0 in our index. Thus, a system with an overall performance index of 3.0 executed our tests three times faster than the baseline T2200SX.

The Macintosh performance suite is a sequence of 13 tests. Four are low-level performance tests, concentrating on the CPU, FPU, disk, and video. Two others are the industry-standard LINPACK and Dhrystone tests. Finally, the suite includes seven application tests, including word processing, desktop publishing, database, program development, graphics, mathematical, and spreadsheet. All test scores are scaled relative to the baseline Mac Classic II.

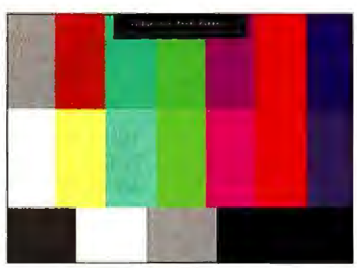
Testing team (clockwise): Richard Fox, Siva Kumar, Stephen Platt, Alan Joch, and Anthony Lennon

EASE OF USE

To gauge usability, we evaluated several factors. Keyboard quality was important, and we considered whether noncharacter keys were located in more-or-less standard positions, how comfortable the typing angle was, and the crispness of key response.

We judged pointing devices by considering whether the design accommodated both left- and right-handed users and whether the pointer's location was within convenient reach from the keyboard. We considered status indicators: Were the common conditions (e.g., battery low and hard disk access) represented? Was the indicator's meaning obvious or obscure? Were indicators easy to see?

We also looked at the less-frequently-used areas of battery installation, setup utility, memory expansion, ports, and overall construction. Finally, we considered the completeness and clarity of the technical documentation.



Color bars helped our panel of testers rate displays for color purity and depth.

SCREEN QUALITY

We evaluated three aspects of display quality: crispness, intensity/color range, and viewing-angle range. Crispness measures how detailed the line- and character-drawing abilities of the screen are. We ran numerous tests to examine text clarity in both color and monochrome environments; horizontal and vertical line placement; color and gray-scale displays; LCD streaking; and solid color and black, gray, and white regions.

We used DisplayMate Professional 1.0 from Sonera Technologies, which provides a wide range of monitor tests. All the tests were run in a darkened room and examined by a panel of testers. Many of the tests were rerun at different times to ensure that our results remained consistent throughout the testing cycle.

To determine color quality, we displayed a color bar on each of the color systems and segregated displays into five categories, ranging from those with bleached and barely distinguishable colors up through the best

Windows at Your Fingertips

"Scoring high in overall value and design, the Micro Electronics WinBook gives you a lot for your money, including an outstanding integral trackball."

PC MAGAZINE, August 1993, Cover Story: Portable Computing

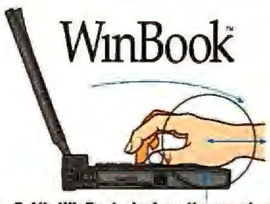
The WinBook by Micro Electronics™ gives you all the power to run Windows, and a unique, ergonomic design to make it easier to use.

It features a built-in, centered trackball which allows you to control cursor movements effortlessly with either thumb without having to lift a single finger off the keyboard. Full-size keys and the WinBook's exclusive sloping hand rest let you work in total comfort.

The WinBook comes with the power and speed needed to run Windows effectively. You get 4MB memory, the new ultrafast 486 SLC/E processor and the Motorola chipset which provides eight power-saving features, even while running Windows. Plus, we have fine-tuned the WinBook's screen. In monochrome and now in dual-scan STN color—you get sharper and clearer images with less cursor loss.

The WinBook was engineered for Micro Electronics, a division of MEI/Micro Center, Inc. MEI is America's leading direct source for computer accessories. Micro Center has been selling PCs for more than 14 years—longer than IBM or Compaq—with over 736,000 units sold. With over 2.2 million satisfied customers nationwide, we have developed a superior support staff, including top engineers and technical specialists. So you always get the highest quality product at the lowest possible price.

Before you choose a notebook computer, look at the WinBook—the first notebook computer designed specifically for Windows.



The 5.4 lb. WinBook, designed by award-winning Palo Alto Design

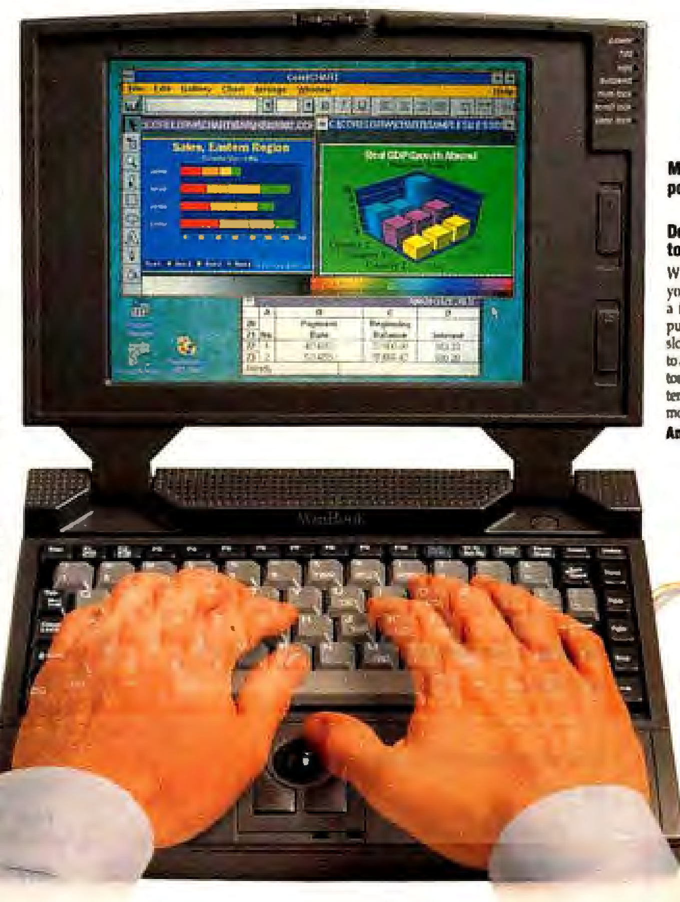
- Includes a 9600 baud send/4800 baud receive fax/2400 baud modem.
- Fast-acting, LCD screen for less cursor loss.
- Industry-standard PCMCIA 2.0 slot for future expandability.
- 512k video RAM.

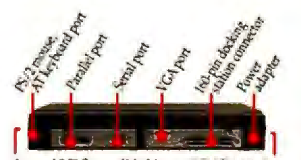
Longer battery life

The WinBook features NiMH 2200 MA batteries with gold-plated contacts. This allows it to run much longer than units with traditional NiCAD batteries—and there's no memory effect.

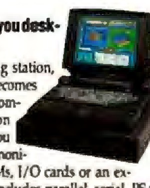
Clean, sharp color display

The WinBook's advanced, dual-scan color display gives you 99% shadow-free performance compared to other single-scan passive matrix displays. You get near active matrix quality at a passive matrix price!





Mouse/keyboard, parallel, serial and VGA ports plus PCMCIA expansion



Docking station gives you desktop power

With the available docking station, your WinBook instantly becomes a full-function desktop computer. The two expansion slots and drive bays allow you to add peripherals such as monitors, hard drives, CD ROMs, I/O cards or an extended keyboard. It also includes parallel, serial, PS/2 mouse, external keyboard and VGA ports.

And it's just $399!

Service, warranty and support

- 72-hour service turnaround guarantee.
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- One-year limited warranty on parts and labor.
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Your satisfaction is unconditionally guaranteed for 30 days from date of purchase. If for any reason whatsoever you are not satisfied with your purchase from us, we want you to return it. We will be glad to repair the product or give you your money back.

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Team your new WinBook with the Hewlett Packard DeskJet Portable printer and you get quality and value in portable printing and computing! The Hewlett Packard DeskJet Portable printer weighs only 4.7 pounds and uses the same inkjet technology as other DeskJet models. At only $299*, you can't afford to miss this offer!

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*$299 after $75 mail-in rebate. For more information, call 1-800-468-0366.

Specifications

Size/Weight
- 11" X 8 3/4" X 1 3/4"
- 5.4 lbs. with battery (monochrome)
- 5.9 lbs. with battery (dual-scan color)

Pointing Device
- 16mm Alps dual-action, Microsoft-compatible trackball

Battery
- Up to 3 hours with power management (less 30 minutes for color)
- NiMH (no memory effect)
- 2200 MA with gold-plated contacts
- Worldwide auto-sensing AC adapter
- Quick 2-hour recharge

Power Management
- Eight power-saving features

Processor and Memory
- 486 SLC/E-25MHz CPU
- 4MB RAM
- 1MB ROM for AMI BIOS
- Motorola chipset
- 1k internal cache

Drives
- One built-in 1.44MB 3.5" floppy drive
- Monochrome: Internal 120MB (15ms) hard drive
- Color: Internal 250MB (16ms) hard drive

Software
- Comes loaded with MS-DOS 6.0 and Microsoft Windows 3.1

Display
- Super-twisted 64 grayscale, 10" LCD and 1024 x 768 for external monitor with 512k video RAM
- Optional dual-scan STN color display
- Adjustable contrast and brightness
- Visible LED indicator on cover-down

Keyboard
- Full-function keyboard with 85 keys and 4 inverted-T cursor control keys, 3.0mm keyboard spacing

Modem
- Fax-9600 baud send/4800 baud receive/2400 baud modem

I/O Ports
- PS/2 mouse interface/AT keyboard interface
- PCMCIA 2.0 slot
- Serial: 9-pin connector
- Parallel port
- Video: 15-pin connector for CRT
- 160-pin docking station

Options
- Coprocessor
- Docking station

No-risk, 30-day unconditional money-back guarantee

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Use your VISA, MasterCard, Discover Card, personal check or P.O. with credit approval

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How We Tested *(continued)*

screens with solid, pure colors. A similar test was performed for monochrome systems using a 16-level gray scale. For monochrome systems, we looked for level gradation, evidence of *banding* (i.e., groupings of gray levels in the middle of the display), and the intensity of the white and black bands.

We measured the viewing-angle range of each display using a rotating platform that allowed us to move the test unit left and right until we detected visible distortion in the display. Distortion includes loss of text, color changes, or glare caused by the design of the backlighting or edgelighting. After testing the left/right range, we tilted the screen to measure the vertical viewing range.

After we computed a display's viewing range, we compared it to the range of the best system we tested; in this way, we determined ratings for each screen. Screens tended to cluster at viewing ranges of 55 to 60 degrees, 35 degrees, 20 degrees, and 10 degrees, providing four categories: excellent, good, fair, and poor.


Thumper 2 rates notebook battery life by mimicking a word processing session and working with each notebook's power management capabilities.

Our final screen evaluation combined all three factors—clarity, quality, and range. Monochrome systems were evaluated separately from color displays; however, we grouped active and passive screens together.

We measured PowerBook screen quality using a modified version of our notebook screen methodology that included our viewing-angle measurements. DisplayMate doesn't run on the PowerBooks, so we substituted similar Mac screens on a test-by-test basis.

BATTERY LIFE

We measured battery performance using BYTE's Thumper 2 battery-life tester. Thumper mimics real-world use by running a program that replicates a typical word processing session. It uses robotic arms and an optical sensor to detect and control each notebook's power management functions.

We configured each notebook's power management features to let the hard drive spin down and the screen's backlighting shut off after a set period of inactivity. The notebook is also allowed to enter a standby mode during the test cycle. Each notebook is put through the test cycle repeatedly until the battery is dead. Note that results from any battery-life test, including Thumper 2, are meant as a guideline. Your usage patterns will affect your system's battery life.

CONFIGURATION

Our testing was open to all 486-class notebooks. We specified that the system must have a minimum of 8 MB of RAM and at least a 120-MB hard drive (the AMS TravelPro 4533 PAS and TravelPro 5366A that we received contained only 80-MB hard drives and so were evaluated with that configuration). Each notebook had to have an internal floppy drive and a VGA display. The products all weighed less than 7 pounds without a battery or AC adapter.

KEY NOTEBOOK FEATURES

We considered the following features most important for 486 notebooks:

FLASH ROM BIOS	Allows you to upgrade the BIOS without taking the notebook apart to replace chips
SUPER VGA SUPPORT	Important for connecting to an external monitor when you're not traveling
ENHANCED OR BIDIRECTIONAL PARALLEL PORTS	Improved performance with network adapters and printers
INTEGRATED POINTING DEVICE	Eliminates extraneous parts and cables
PCMCIA SLOTS	Needed for future generations of modems, network adapters, and storage devices
PASSWORD PROTECTION	For added data security on the road
REMOVABLE HARD DRIVE	For added data security, notebook sharing, or efficient data transfer to another unit

OUR TEST TEAM

Richard Fox, *Senior Testing Engineer/NSTL, has spent the last two years testing compatibility and performance of notebooks, systems, and applications software.*

Alan Joch, *Senior Editor/BYTE, coordinates the combined testing between the BYTE Lab and NSTL.*

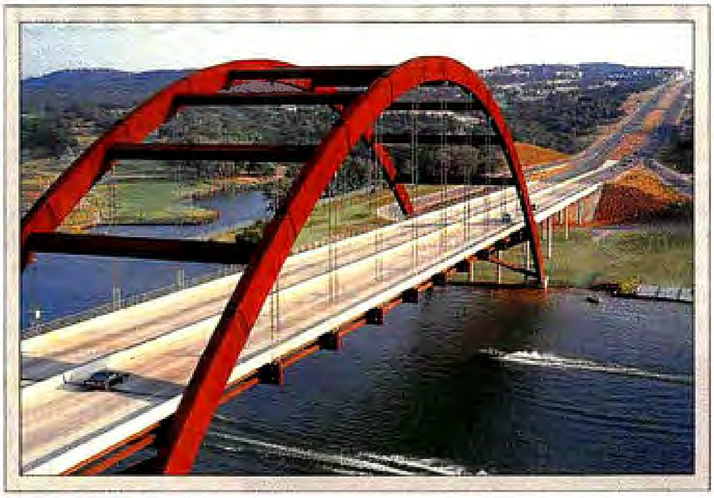
Siva Kumar, *Technical Analyst/NSTL, specializes in hardware and network operating-system testing.*

Anthony Lennon, *Technical Editor/NSTL, conducts evaluations of notebooks, systems, and peripherals.*

Stephen Platt, *Manager of Unix Development/NSTL, directs testing of Unix hardware and software, Windows NT, and network operating systems.*

The Lab Report is an ongoing collaborative project between BYTE Magazine and National Software Testing Laboratories (NSTL). BYTE Magazine and NSTL are both operating units of McGraw-Hill, Inc.

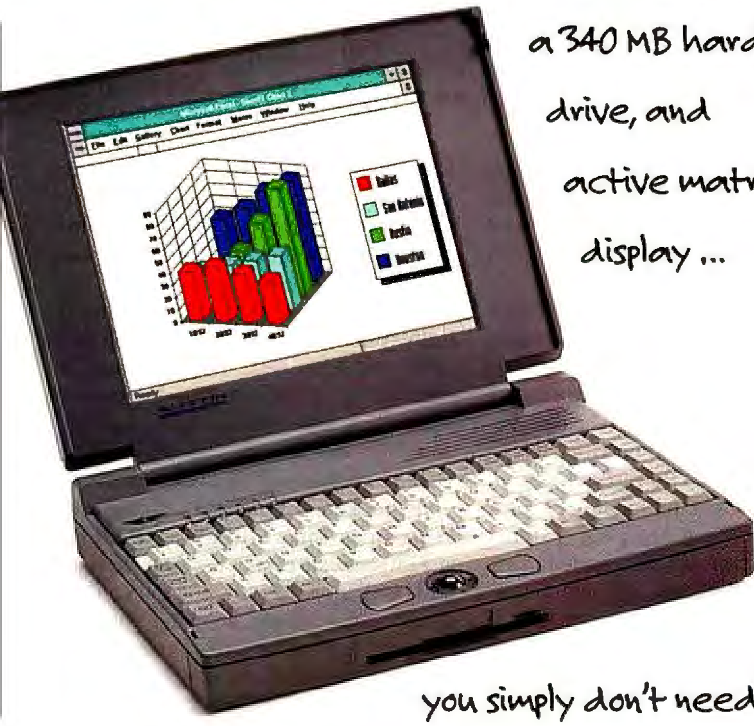
CALL FOR INFORMATION OR OTHER CONFIGURATIONS 1-800-331-1701



AUSTIN'S LOOP 360 BRIDGE

Austin has it all!

With Austin's powerhouse 486DX2-66,



a 340 MB hard drive, and active matrix display ...

you simply don't need a desktop computer anymore!

Austin 486 Notebooks

The freedom of fully portable, fully powered computing!

Discover the freedom to go anywhere the road takes you. Do anything. Anytime. Our compact, high-performance notebook computers prove it! The active-matrix color models provide crisp, clear screens with the advantage of simultaneous CRT and LCD display—a must for impressive, portable presentations.

The full-size keyboard is easy to use whether you're at your desk, in a plane, or on the road. The large 16mm trackball is located front and center for optimal comfort and control. The PCMCIA slots accept two Type II devices or one Type III device for communications and future multimedia options.

Powerful Portable!

The state-of-the-art Intel 486DX2-66 model packs all the speed and power of the best desktop workstation into a compact, lightweight case. A 32-bit local bus Windows accelerator provides the best notebook video performance available.

486DX2-66 **$4,499**

340 MB Hard Drive,
9.5" TFT Active-Matrix
Color LCD Display

Affordable Portable!

486SX-25 **$1,899**

130 MB Hard Drive,
9.5" Mono Display

Austin 486 Notebooks

Intel 486SX, DX, or DX2 Processors • 4 MB RAM Expandable to 32 MB • 130, 213, or 340 MB Hard Drive • 3.5" Floppy Drive • 32-Bit Local Bus Windows Accelerator Video • Monochrome Display or TFT Active-Matrix Color Monitor with Simultaneous Display • 85-Key Keyboard with 16mm Front-and-Center Trackball • Two Serial Ports, One Parallel Port • Two- to Five-Hour Battery Life • 11.1" x 8.58" x 2", 6.3 lbs. • Preinstalled MS-DOS 6.0, Windows 3.1 • One-Year Warranty

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Macintosh PowerBooks

Apple has come a long way since the days of the PowerBook 100. The current PowerBook line boasts performance levels and features that rival those of many leading PC notebooks. We focused our evaluations on the PowerBook 165c, 180, and 180c, all of which use the Motorola 68030 CPU. We omitted DuoDocks because they don't contain internal floppy drives. The three tested PowerBooks are virtually identical except for their displays: 9-inch passive-matrix color in the 165c, 10-inch active-matrix monochrome in the 180, and 8.4-inch active-matrix color in the 180c.

All the PowerBooks have the same physical keyboard: a standard chassis topped with a set of full-size keys in the standard Mac layout. All have the same trackball, which is large and comfortable to use, with buttons both above and below the ball. It's the best mouse replacement we've seen for right-handed, left-handed, and ambidextrous people. The wrist rest is large, with no obstructing features.

SCSI, LocalTalk, external monitor, sound I/O, and two serial ports are all standard. The PowerBook external video monitor can either mirror the display (showing the same information) or act as a dual display (providing a second desktop, giving you more surface area for applications).

Internally, the three PowerBooks are all based on the same 68030 CPU and 68882 FPU (both at 33 MHz), with the same memory expansion capabilities (4 to 14 MB). The 165c and 180 come with either 80-MB or 120-MB hard drives, while the 180c offers 160-MB drives.

Since they are based on the same processor technology, you would expect the PowerBooks to provide the same level of performance (see the table). In processor-intensive tasks, we found this to be true. However, we saw wide differences in video-processing tests, such as the spreadsheet (charts and diagrams) and database (full-screen redraw of displayed data). The monochrome 180 showed a 4-to-1 advantage in screen speed over its two color cousins.

From left to right: The PowerBook 180c, with an active-matrix color display; the monochrome-version 180; and the 165c, a passive-matrix color PowerBook.

Battery life for all the PowerBooks was similar to that of comparably equipped PCs. PowerBook screen quality was generally better than that of DOS/Windows notebooks. The passive-color screen of the PowerBook 165c, which was the worst PowerBook screen, was equivalent to a mid-quality PC passive-color screen. It had clear text and one of the widest viewing-angle ranges among passive-matrix color displays, but its colors were washed out.

The active-monochrome PowerBook 180 has only one rival in the PC group—the Compaq LTE Lite 4/25E. Both had excellent screens. We found that the Compaq's smaller screen (8.4 by 10 inches) produced slightly better gray scales and had a wider viewing angle. Both had left/right viewing angles of approximately 55 to 60 degrees in each direction, but the Compaq's screen could be tilted back twice as far (30 degrees versus 15 degrees) before it became difficult to read.

The active-matrix color screen of the PowerBook 180c was beautiful. Clear, crisp, and with good saturated colors, it was equivalent to the best of the PC color screens in both quality and viewing angle. It had a viewing angle equivalent to the NEC UltraLite Versa 33C's—you could twist it left, right, and back until it was practically flat and still read text. Likewise, the colors were as solid as those of the AST Power Exec 4/25SL ColorPlus, which had the best PC screen. In some senses, the 180's was the best color screen we saw; our only complaint was that it was small (8.4 inches versus the Power Exec's 9.5 inches).

In the end, we can recommend two PowerBooks: the PowerBook 165c and the PowerBook 180c. If your budget is limited, the $2339 PowerBook 165c is a solid choice. Its screen quality is acceptable, and the price compares well with PC passive-matrix color systems. If your pockets are deeper, choose the PowerBook 180c. For only an additional $330 over the cost of the monochrome 180 ($4079 vs. $3749), you gain a top-quality color screen. Denying yourself one of the best active-matrix color screens for a savings of less than 10 percent is a decision you may regret later.

RESULTS OF THE BYTE MACINTOSH BENCHMARKS VERSION 2.0

Figures shown are summary index figures and represent how many times faster the notebook is than a Mac Classic II, with an index of 1. The exception is the Overall App Index (the sum of all the application indexes, for which the Mac Classic II scores 7.0).

	LOW-LEVEL				APPLICATION							
	CPU Index	FPU Index	Disk Index	Video Index	Word Processing Index	DTP Index	Database Index	Development Index	Graph App Index	Scientific Index	Spreadsheet Index	Overall App Index
PowerBook 165c	2.59	10.49	1.71	0.57	2.73	1.72	1.98	1.89	1.98	4.16	4.92	19.39
PowerBook 180	2.60	10.68	1.72	2.00	2.76	1.81	2.50	2.19	2.63	4.46	5.54	21.91
PowerBook 180c	2.59	10.64	1.70	0.55	2.74	1.68	2.10	2.13	1.44	4.16	5.10	19.35

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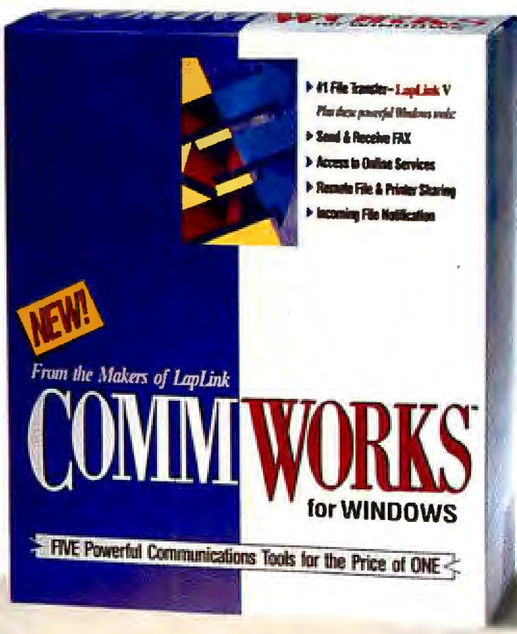

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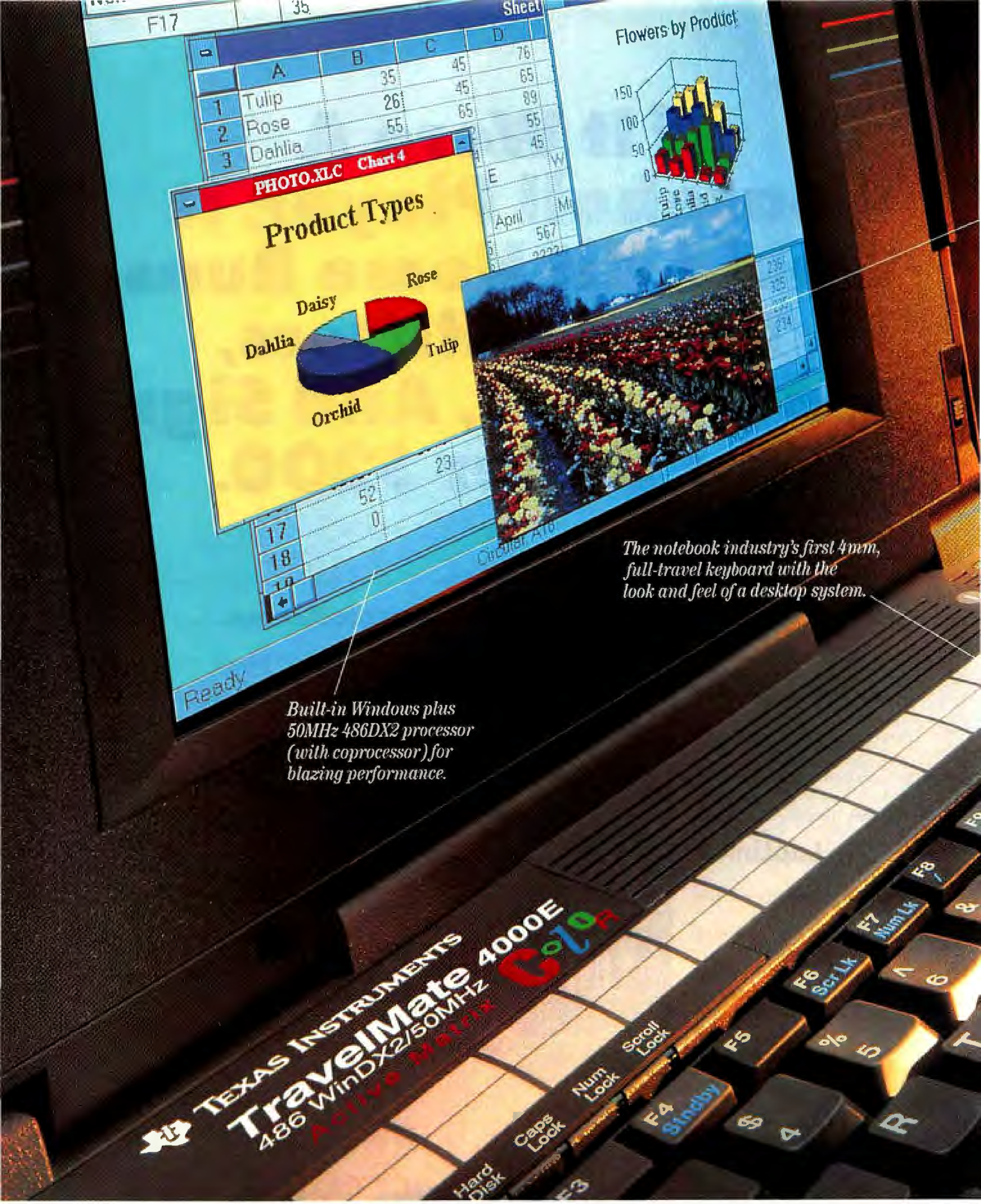


The notebook industry's first 4mm, full-travel keyboard with the look and feel of a desktop system.
Built-in Windows plus 50MHz 486DX2 processor (with coprocessor) for blazing performance.
Flowers by Product
Product Types
PHOTO.XLC Chart 4
Rose
Daisy
Dahlia
Tulip
Orchid
Ready
TEXAS INSTRUMENTS
TravelMate 4000E
486 WinDX2/50MHz
Active Matrix Color

ACTIVE COLOR. 486DX2 50MHZ POWER. WINDOWS IN 15 SECONDS. HEY, WHAT ARE YOU WAITING FOR?

New TI TravelMate™ 4000E WinDX2™/50 Active Matrix Color

If you've been waiting for an active matrix color notebook with true desktop power, your wait is over. Thanks to the new TravelMate 4000E WinDX2/50 Active Matrix Color notebook from Texas Instruments.

With 256 brilliant, simultaneous colors and a 50MHz 486DX2 processor, this powerhouse doesn't just whisper color, it screams it.

And yet the TravelMate 4000E weighs a mere 6.2 pounds, including battery. This convenient size and weight gives you more performance* than the leading 486 notebooks.

New, desktop-like keyboard with separate function keys.

Thanks to the built-in Windows 3.1 and useful TI utilities, you can power up to Windows in just 15 seconds. And the TravelMate 4000E is Windows NT-compatible. With 4MB of main memory, expandable to 20MB, you're ready for today's and tomorrow's software.

Using the mouse on the TravelMate 4000E is a snap. The Microsoft BallPoint™ mouse with QuickPort™ connection snaps on and off and needs no cable, giving you more flexibility and better ergonomics than a built-in mouse. With the industry's first 4mm, full-travel keyboard, the TravelMate 4000E gives you the feel of a desktop.

If you work on the go, you'll also go for the rugged 200MB hard disk drive, the high-speed video bus and 1MB of video RAM, as well as the full range of connectivity options – snap-on modules for Ethernet® LANs, SCSI-compatible devices and an internal 14,400 bps V.32 bis modem with 9,600 bps send/receive fax capability.

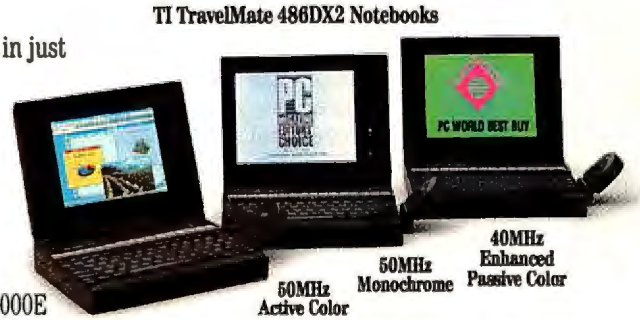
50MHz DX2 processor with coprocessor provides desktop performance in a notebook.

Of the leading active matrix color notebook manufacturers, only TI offers the desktop performance of a 50MHz DX2 processor.

Active Color Notebook	*Weight (lbs.)*	*486 Processor*	*Speed*	*Coprocessor*
TravelMate 4000E	**6.2**	**DX2**	**50MHz**	**Yes**
Toshiba T4600C	6.9	SL	33MHz	Yes
Compaq LTE Lite 4/33c	6.5	SL	33MHz	Yes
IBM ThinkPad 720C	7.6	SLC2	50MHz	No

Texas Instruments offers over 10 models of 486 notebooks for you to choose from.

TI TravelMate 486DX2 Notebooks



For more information about the only 486 notebook family that won five Editor's Choice awards in PC Magazine's August issue, call *1-800-527-3500*.

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TEXAS INSTRUMENTS

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Notebook CPUs

Many chips now carry the 486 label, making the user's choice of CPU even more difficult. We received notebooks with 486 processors from Intel, IBM, and Cyrix. The table lists the important attributes of each CPU.

	CYRIX	CYRIX	INTEL	INTEL	INTEL	INTEL	IBM
Model	486SLC	486DLC	486SX	486DX	486SL	486DX2	486SLC2
External data path (bits)	16	32	32	32	32	32	16
Internal cache (KB)	1	1	8	8	8	8	16
FPU	No	Yes	No	Yes	Yes	Yes	No

The graphs compare the overall system performance of each CPU class at each clock speed. Manufacturers typically design a system around comparable components; that is, a low-cost unit will be constructed with inexpensive components, like a lower-quality screen, a slower hard drive, and a less expensive CPU. Look at the total notebook performance (including video, hard drive, and memory subsystems) for insight into typical notebook designs for each CPU. All ratings in the figures are indexed; a Toshiba T2200SX, a 20-MHz 386SX notebook, equals 1.0.

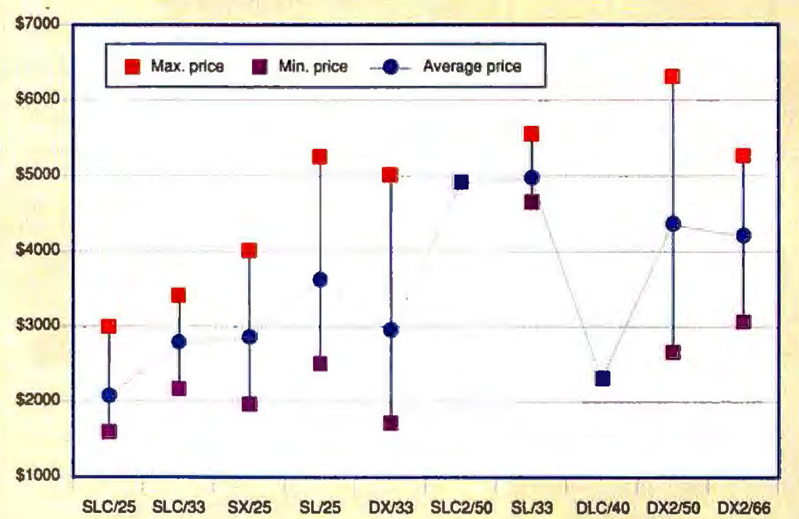
At the low end of the performance scale are the Cyrix 486SLC chips at 25 and 33 MHz. Units running at 25 MHz were only 41 percent better than the baseline Toshiba T2200SX; however, these notebooks were also the cheapest, averaging little more than $2000. The $1580 Xinetron X/LAN Book was the lowest-priced notebook tested and the second-fastest SLC/25 unit. All the 486SLC/25 units employed passive-matrix monochrome displays that were ranked "fair" in our screen-quality tests. Many of the 486SLC notebooks supported a maximum of only 8 MB of RAM. On average, notebooks with the 33-MHz Cyrix 486SLC—with an index score of 1.82—outperformed those with the 25-MHz Cyrix model but still lagged behind the slowest Intel-based notebook.

Although IBM's 486SLC2/50 chip (used in the ThinkPad 720C) operates internally at 50 MHz, its overall performance was comparable to that of notebooks containing Intel 486DX/33 and 486SL/33 chips. The 486SLC2/50 has only a 16-bit external data path, as opposed to the Intel's 32-bit path, and it does not contain a math coprocessor.

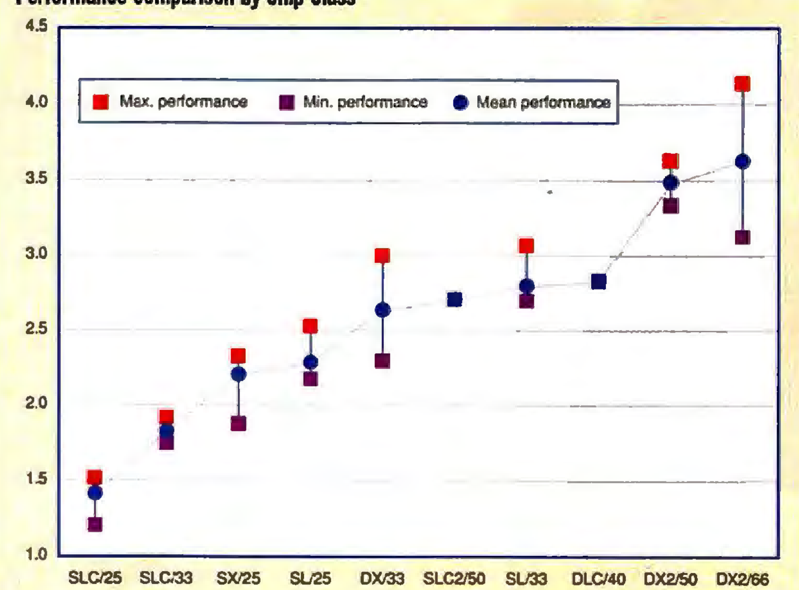
Generally, more powerful CPUs are used in more expensive systems. At the left of the graph (the low end), SLC/25 systems are exclusively monochrome. At the SX/25 level, there is an even mix of screen technologies. By the time you reach the DX2/66 class, six of the nine units are active-matrix color notebooks. You pay a pretty penny for DX2/66 notebooks: Average cost is $3737, while the most expensive model, the Amrel 486DX2/66 AC, is $5249.

A good deal of this trend analysis uses averages, so there are exceptions: The fastest SX/25-based notebook, the CompuAdd 425TXT, had an better index than the CAF AquaLite-486DX3/C, the slowest DX/33 notebook.

System Price Comparison by Chip Class



Performance Comparison by Chip Class



Toshiba T2200SX = 1.0.

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Perk up your presentations. Make training more effective. And, put some guts into your gaming pastimes. Anytime. Anywhere. In fact, if you are not a card carrying member of the computer set, you have to hear PORT·ABLE Sound Plus from DSP Solutions. You know, those real smart people who make simple sound solutions.

PORT·ABLE Sound Plus is the first portable external sound peripheral to deliver 16 Bit CD quality music with stereo audio capabilities. And, since you just plug into your IBM PC or compatible, desktop or laptop parallel port, you do not need an engineering degree or even a screwdriver.

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As a bonus, you will get all the software you need to communicate. Like Lotus Sound™ an OLE server for Windows 3.1. WinReader for Windows 3.1, a handy text-to-speech utility. DSP Solution's DOSTalk and DOSReader text-tc-speech applications. Show & Tell For Kids™ for Windows – an easy to use MultiMedia Authoring program. It is also Sound Blaster and AdLib compatible.

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To order or obtain more information about PORT·ABLE Sound Plus, write or call DSP Solutions, or, contact your local dealer.

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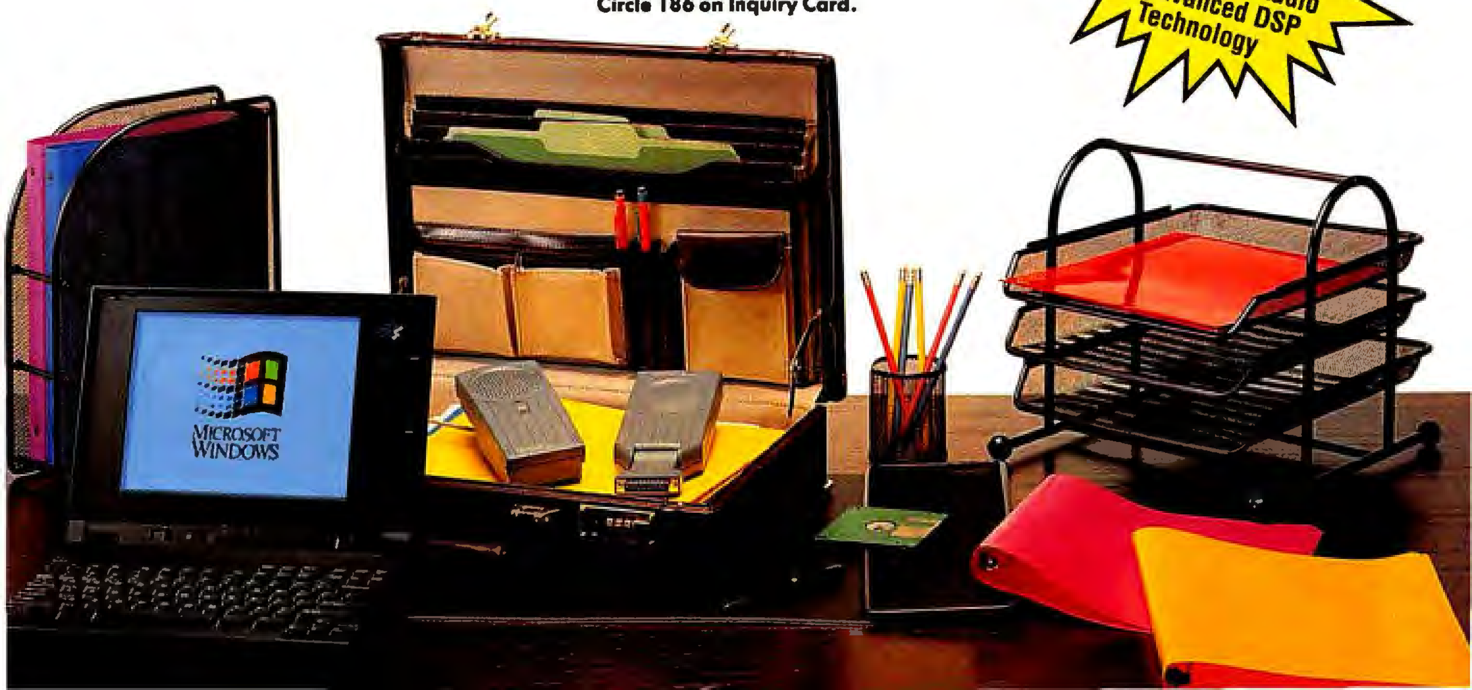
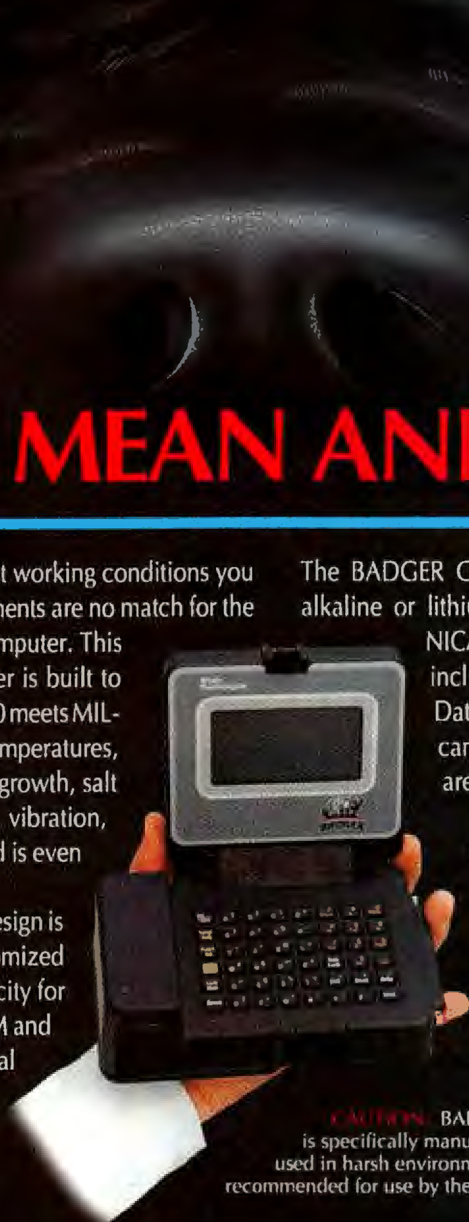


TOUGH, MEAN AND VICIOUS

Nothing can stop it! No matter what working conditions you are up against, the harshest of environments are no match for the rugged BADGER GT-110 handheld computer. This lightweight DOS compatible computer is built to operate outdoors. The BADGER GT-110 meets MIL-SPEC standards including extreme temperatures, solar radiation, rain, humidity, fungus growth, salt fog, blowing sand, water immersion, vibration, drop shock, explosive atmospheres and is even resistant to most chemicals.

Unique to the BADGER GT-110's design is a removable keypad which can be customized for special applications. Memory capacity for the BADGER GT-110 is 1 MB of PSRAM and 512 KB of EPROM, with up to an additional 8 MB memory available through the use of PCMCIA memory cards.



The BADGER GT-110 can be powered by a standard 9-volt alkaline or lithium battery, three 2/3A lithium batteries or a NICAD rechargeable battery pack. Built-in utilities include GT Shell, Communications, Text Editor, Data Base and Forms Manager. Application software can be downloaded from any DOS PC and data files are easily exchanged.

BADGER GT-110 is setting a new standard in outdoor computing. This tough, combat ready computer is now available at commercial prices below $2,000. For more information call 1-(800)-3-BADGER.

CAUTION: BADGER GT-110 is specifically manufactured to be used in harsh environments. It is not recommended for use by the faint-hearted.

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BYTE BEST

DOS

Is screen quality important?

BEST OVERALL **Compaq LTE Lite 4/25E**

An excellent active-monochrome screen and a long battery life (over 7 hours) make the Compaq LTE Lite 4/25E our choice for the best monochrome DOS notebook. The spectacular screen was far above and beyond that of any other monochrome system we tested in both viewing angle and quality. Further recommending it are small details like the well-constructed port covers and clear, comprehensive, and complete manuals.

		PRICE	CPU	DOS SPEED[1]	EASE OF USE	BATTERY LIFE (HOURS:MIN)	SCREEN QUALITY	SCREEN SIZE (IN.)
BEST	Compaq LTE Lite 4/25E	$4339	SL/25	2.15	Good	7:06	Excellent	8.4
RUNNER-UP	ZDS Z-Note 425Ln Model 120	$2599	SL/25	2.22	Good	5:27	Fair	9.5
RUNNER-UP	TI TravelMate 4000 WinDX/25	$2678	DX/25	2.32	Good	4:46	Fair	10
RUNNER-UP	CompuAdd 425TX	$2090	SX/25	2.22	Excellent	4:10	Fair	9.5
RUNNER-UP	AST Bravo NB 4/25s	$1948	SX/25	2.19	Good	3:16	Good	9.5

Tired of waiting for recalculations?

HIGH PERFORMANCE **CompUSA 486DX2/66 Slimnote**

If you need the fastest notebook for DOS applications, consider the CompUSA 486DX2/66 Slimnote. Internal niceties such as a 128-KB hard disk cache (most systems have from 0 to 32 KB) helped it achieve the second-best monochrome DOS performance score. A battery life of 3½ hours was longer than the average. The trackball is nearly centered above the keyboard, making it easy to use with either hand.

		PRICE	CPU	DOS SPEED[1]	EASE OF USE	BATTERY LIFE (HOURS:MIN)	SCREEN QUALITY	SCREEN SIZE (IN.)
BEST	CompUSA 486DX2/66 Slimnote	$3228	DX2/66	3.14	Excellent	4:07	Fair	9.5
RUNNER-UP	Micro-International HCP Model 65681M	$2805	DX2/66	3.66	Good	3:32	Good	9.5
RUNNER-UP	TI TravelMate 4000 WinDX2/50	$3478	DX2/50	3.27	Good	4:04	Fair	10
RUNNER-UP	HyperData HB 2300 DLC/40	$2295	DLC/40	2.74	Excellent	2:52	Fair	8.8

Want the best for DOS on a budget?

LOW COST **Zenith Data Systems (ZDS) Z-Note 425Ln Model 120**

For simple DOS computing on a budget, the Z-Note 425Ln Model 120 is the best system we tested. The edgelit passive screen was easy to read from a wide range of angles. Its 3.3-V processor (this was one of the 15 systems with low-voltage processors) gave the Z-Note a long battery life of almost 5½ hours. Nine manuals detailed DOS, networking, start-up, the trackball, and other topics. Like the Compaq LTE, the Z-Note uses a processor with middle-of-the-road speed. At a price of $2599, that's an acceptable trade-off.

	MODEL	PRICE	CPU	DOS SPEED[1]	EASE OF USE	BATTERY LIFE (HOURS:MIN)	SCREEN QUALITY	SCREEN SIZE (IN.)
BEST	ZDS Z-Note 425Ln Model 120	$2599	SL/25	2.22	Good	5:27	Fair	9.5
RUNNER-UP	TI TravelMate 4000 WinDX/25	$2678	DX/25	2.32	Good	4:46	Fair	10
RUNNER-UP	CompuAdd 425TX	$2090	SX/25	2.22	Excellent	4:10	Fair	9.5
RUNNER-UP	AST Bravo NB 4/25s	$1948	SX/25	2.19	Good	3:16	Good	9.5

[1] Higher numbers indicate better performance (a 20-MHz 386SX Toshiba T2200SX = 1).

Today's DOS applications are increasingly robust, and a 486-class processor can eliminate the time that you need to spend waiting for screens to redraw or for sales projections to recalculate. All the notebooks ranked in this section offer performance that is more than double the speed of the baseline Toshiba 386SX system.

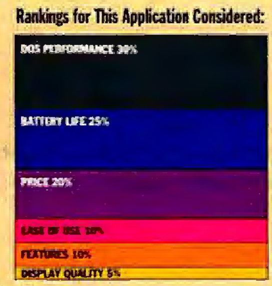
For all the DOS categories, we compared systems for performance in running our DOS test suite. Within the DOS application tests, we placed the most emphasis on the WordPerfect 5.1 and Lotus 1-2-3 release 2.4 results. The combined performance score accounted for 30 percent of our evaluation. Next, we factored in display quality (weighted at 5 percent), battery life (25 percent), ease of use (10 percent), features (10 percent), and price (20 percent).

For the Best Overall category, we ranked only systems rated at 33 MHz or slower. The High Performance category considered systems with internal clock speeds of 40 MHz or faster. To be considered for Low Cost status, a notebook had to be priced at $2750 or less.

All the notebooks rated for DOS Best Overall or Low Cost used 25-MHz Intel CPUs. Two of these five systems used Intel 486SL chips that combine the performance of a 486DX/33 with power-saving features that prolong battery life.

The $2678 Texas Instruments TravelMate 4000 WinDX/25 turned in the best performance of all the 25-MHz systems for the DOS WordPerfect and 1-2-3 application tests, with scores that averaged more than three times faster than those of the baseline Toshiba system. Although we tested several 33-MHz monochrome systems that produced better performance results than the 25-MHz units, each of these notebooks had shorter battery-life times and inferior ease-of-use ratings.

Rankings for This Application Considered:



How to Buy a Notebook

1 Do you really need a cordless machine, or just a portable? If you plan to work while traveling, battery life is a high priority. If you plan to take your keyboard from site to site and expect to always have a power outlet handy, other features may be more important.

2 Are you left-handed? Many of the pointing devices are designed for right-handed use. Look for a system with a centered mouse or one that's mountable on the left side.

3 Are you concerned about stress-related injuries? A notebook with a wrist rest may be easier and healthier to use.

4 Are you using your notebook as your primary system? If so, you will need external ports for keyboard, video, and mouse. Additionally, you may need a docking station to access network interface cards, CD-ROM, and sound cards. Some systems, such as the Mac PowerBooks and Zenith Data Systems' notebooks, have many of these features built in.

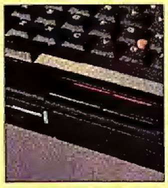
5 How important is color? If your system is used primarily for document preparation, you probably don't need color. If you do extensive chart preparation on the road, however, color may be a must.

6 Are you using a windowing operating environment? The Mac OS, Microsoft Windows, and X Window System all use more processor power and place greater emphasis on screen quality. Plan to buy a 33-MHz or faster system.

7 What's your comfort level? Make sure that the notebook you buy has acceptable keyboard and pointing-device designs. If you are purchasing from a mail-order company, make sure you can return the notebook without incurring any restocking fees.

8 Do you plan to do extensive traveling? Monochrome notebooks lasted longer on our battery-life tests than color notebooks.

Portable Pointers



KEYBOARD-BASED
IBM's TrackPoint II places a small, pressure-sensitive, eraser-like protrusion between the G and H keys. Its two buttons are located just below the space bar, within easy reach of thumbs. This design makes it extremely easy to use and does not require your hands to leave the keyboard. However, damp or sweaty fingers slide right off the smooth rubber tip, which has no grooves or raised portions for extra grip.

RETRACTABLE
The slide-out trackball on the Amrel 486DX2/66 AC makes for easy storage when traveling. Due to the trackball's central placement on the front of the unit, it can be used by either left- or right-handed users.

FRONT AND CENTER
This trackball is located on the front of the Noteable N425. It's designed for thumb movement, with buttons located on each side. The range of thumb movement is greatly limited, however, because the trackball is so close to your work surface. Moreover, its left mouse button is dangerously close to the suspend/resume switch, and the buttons are unresponsive.

WRIST-REST TRACKBALL
A very large trackball is located on the PowerBook's wrist rest below the keyboard, with two surrounding oversize buttons. It's an extremely good design that several PC vendors have tried to imitate.

SIDE-MOUNT
Several vendors have begun using a QuickPort implementation that is an altered Microsoft BallPoint Mouse that attaches to the unit via pins, eliminating the need for a dangling cable. This mouse connects to a specialized port on the right side, prohibiting left-handed operation. Since the mouse is not integrated into the unit, you have to carry it separately when you're traveling.

CLIP-ON
Usually a Microsoft BallPoint Mouse or Logitech TrackMan Portable that provides more flexibility than the QuickPort interface, since this model can be attached to either side of the unit. On some notebook designs, the clip-on mouse can obstruct the floppy drive when attached to the right side of the case.

UPPER-RIGHT
Many pointing-device implementations arrange the trackball and buttons above the keyboard. This design offers a compromise between comfort and convenience. It usually offers left- or right-handed operation that is not too far from the keyboard, and there are extra parts to carry while on the road.

YOU CAN'T CONTROL YOUR BOSS, YOUR WORKLOAD, YOUR WEIGHT, YOUR BACKHAND, YOUR WEEDS, YOUR DOG, YOUR LIFE. AT LEAST NOW YOU CAN CONTROL YOUR CURSOR.

At Microsoft, we feel there are enough things in the world that follow their own unpredictable path.

So we redesigned just about every aspect of the new Microsoft® BallPoint® mouse to let you regain control of your portable computer.

We started by changing the weight of the ball. We improved the smoothness of the tracking mechanism. We reshaped our mouse to fit your hand better. We even added software features that make it easier to find and control your cursor.

All of which means, in simple terms, that the cursor will now do what you want it to do.

And which is why, in independent tests, people worked 35% faster with the BallPoint mouse than with other leading portable and built-in pointing devices.

Of course, you should try it yourself. So pick up a BallPoint mouse at a computer store today.

And have one aspect of your life firmly, and comfortably, in the palm of your hand.

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Making it easier

Unix on a Notebook

What does it take to run Unix on the road? To find out, we installed The Santa Cruz Operation's Unix System V release 3 version 2.4 on five notebooks. This version of SCO Unix is a full, non-graphical Unix, a multitasking operating system that is capable of supporting networking and compilers. We also installed SCO's Open Desktop 2.0. ODT 2.0 is a full-blown system based on SCO's System V product. It includes the X Window System (a fully networked windowing system), network software, a shared file system, and a DOS subsystem (which allows you to run DOS and Windows in an X window).

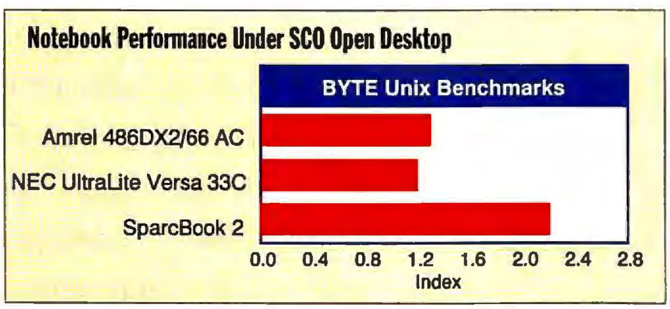
Unix on the road: The SparcBook 2 (left), a RISC-based notebook; and Amrel's 486DX2/66 AC, the fastest 486-class system.

For comparison, we looked at a SparcBook 2 from Tadpole Technology. The SparcBook is based on Sun Microsystems' SPARC processor and came with X, the OpenWindows display manager, networking software, and a development system. A DOS emulator capable of running Microsoft Windows is also available for the SparcBook.

The SparcBook 2 is the only RISC-based Unix system that we tested. The test system had an active-matrix color screen; 32 MB of RAM; a 250-MB drive; an external monitor port; a SCSI port; an Ethernet port; and microphone, mouse, serial, keyboard, and fax modem connections; but it had no floppy drive. The test configuration, including software, costs $13,350. Using an Ethernet transceiver, it took us less than 5 minutes to connect to our in-house TCP/IP network.

Although the display is only 640 by 480 pixels and 256 colors, the video system supports a virtual screen with six times the total area of the visible portion. You can slide windows from section to section and choose which of the six virtual pieces of the desktop you want displayed.

The SparcBook has a true sleep state: The system is turned off, and all memory is written to disk, to be automatically restored at start-up. But this nifty feature is not without cost: Of the 250 MB on the hard disk, 32 MB is used for a swap space, and another 32 MB is used for a resume partition to hold the saved memory image.



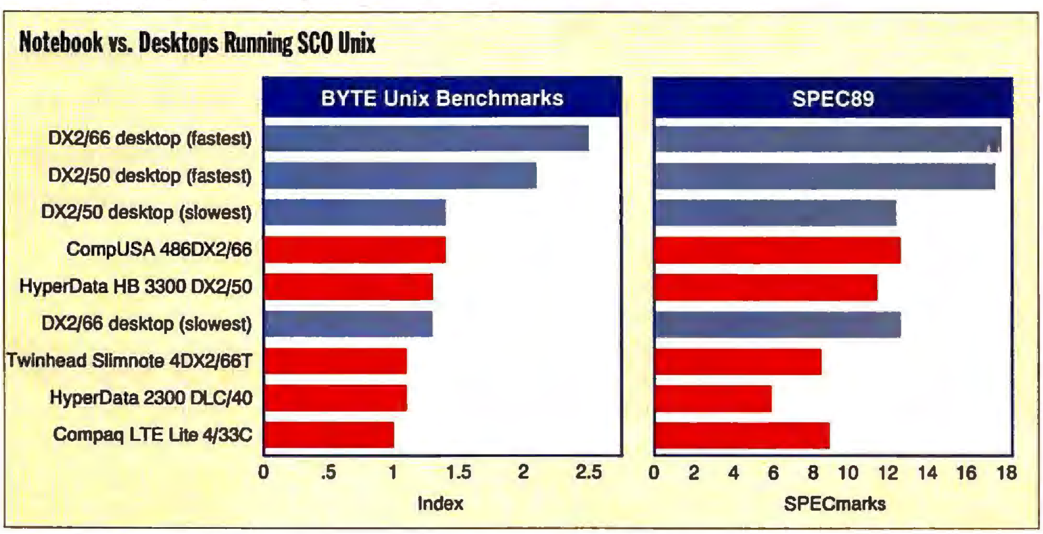
The SPARC-based SparcBook 2 had performance nearly double that of two Intel 486-based notebooks.

PERFORMANCE

We ran the SPEC89 suite of application-level benchmarks on the five notebooks running SCO Unix SVR3 2.4. This implementation of SPEC is an unaudited implementation; as such, it should be used only to compare these notebooks with other systems running our implementation. We also ran the BYTE Unix Benchmarks version 3.0. The results are summarized in the graph.

The graph shows the fastest and slowest in each of the DX2/50 and DX2/66 categories for the June Lab Report on systems. Note that SPEC89 figures are indexed with respect to a DEC VAX 11/780 and that the BYTE Unix Benchmarks are indexed with respect to a Sun 3/50.

These results can be summarized in three words: Notebooks are slow. They are built with power conservation in mind, not raw performance. For example, practically every desktop system will have a secondary processor cache, but of the Unix notebooks we tested, only the HyperDatas had one.



Although adequate for some Unix applications, 486-based notebooks lag in Unix performance compared to desktop 486-based systems.

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BYTE BEST

DESKTOP REPLACEMENT

The processing power of 486-class notebooks means many people can justify buying a single system for use on the road or at the office rather than a separate system for each environment. A single system ends the hassle of transferring data between two different computers to keep duplicate sets of data files current. And depending on your hardware choices, the cost of a single 486 notebook may be far less than the combined price of a notebook and a desktop system.

To qualify as a desktop replacement, a notebook had to support an external Super VGA monitor at a minimum of 1024 by 768 pixels, an external keyboard and external PS/2-style mouse, and a docking unit. The latter is essential for expansion options for network or SCSI adapters, and bays for a second hard drive or tape or CD-ROM drives. Only 14 of the reviewed notebooks met these requirements. Because the prices for this subset of notebooks were so similar, we were unable to choose low-cost winners for this category.

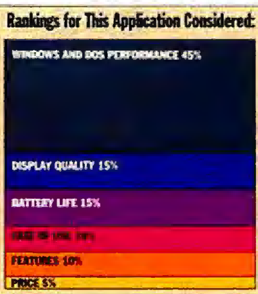
We ranked these systems based on their performance in our DOS and Windows tests (weighted at 45 percent), screen quality (15 percent), battery life (15 percent), ease of use (10 percent), features (10 percent), and price (5 percent).

As in our other application categories, the Best Overall notebooks here are those with clock speeds of 33 MHz or slower, while the High Performance models had CPUs ranging from 40 MHz up to the clock doublers.

The top notebooks in our Best Overall, High Performance, and Best Monochrome categories were among the fastest systems in our entire test sample. The NEC UltraLite Versa 33C performed especially well in our graphics tests, thanks to its implementation of local-bus video. The Versa 33C even outperformed some of the clock-doubled systems on some of the tests.

Texas Instruments swept the remaining categories with the TravelMate 4000 E WinDX2/50 and the TravelMate 4000 WinDX2/50. These two systems turned in the top two results in our hard disk–intensive FoxPro 2.0 application test, as well as the best scores for three of the five memory-move tests in the low-level benchmarks.

Rankings for This Application Considered:



Need one system for office and travel?

BEST OVERALL — NEC UltraLite Versa 33C

OCTOBER 1993 BYTE BEST DESKTOP REPLACEMENT NOTEBOOK

The UltraLite Versa 33C was the fastest mainstream notebook in this category. In addition, this notebook's 9½-inch screen received the second-best quality score in our entire sample (AST's PowerExec ranked first). A special bay lets you slide in a floppy drive or an additional battery, which can extend battery life to almost 6 hours. The $5538 test model came with 12 MB of RAM, two Type II PCMCIA slots, a removable hard drive, and a clip-on mouse.

		PRICE	CPU	OVERALL SPEED[1]	EASE OF USE	BATTERY LIFE (HOURS:MIN)	SCREEN QUALITY	SCREEN TYPE	DOCKING STATION
BEST	NEC UltraLite Versa 33C	$5538	SL/33	3.06	Excellent	2:55	Excellent	Color	$699
RUNNER-UP	NEC UltraLite Versa 25C	$4888	SL/25	2.52	Excellent	2:40	Excellent	Color	$699
RUNNER-UP	Toshiba T4600C	$4699	SL/33	2.69	Excellent	3:52	Fair	Color	$849
RUNNER-UP	Twinhead Slimnote 4DX/33T	$3895	DX/33	2.74	Fair	2:54	Good	Color	$499

Do you need portability without compromise?

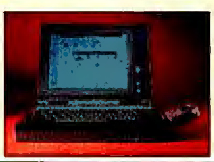
HIGH PERFORMANCE — TI TravelMate 4000 E WinDX2/50

The TravelMate 4000 E was the fastest notebook in this class, and within the top five notebooks in our entire sample. In addition, its active-matrix color screen is crisp and clear, with a very good viewing angle. The keyboard has a nice feel and can be used for hours without hand or wrist exhaustion.

		PRICE	CPU	OVERALL SPEED[1]	EASE OF USE	BATTERY LIFE (HOURS:MIN)	SCREEN QUALITY	SCREEN TYPE	DOCKING STATION
BEST	TI TravelMate 4000 E WinDX2/50	$5278	DX2/50	3.62	Good	2:36	Excellent	Color	$929
RUNNER-UP	TI TravelMate 4000 WinDX2/50	$3499	DX2/50	3.50	Good	4:01	Fair	Mono	$929
RUNNER-UP	Twinhead Slimnote 4DX2/66T	$4399	DX2/66	3.41	Fair	2:38	Good	Color	$499

When color isn't required...

MONOCHROME — TI TravelMate 4000 WinDX2/50



The TI TravelMate 4000 WinDX2/50 is the fraternal twin of the 4000 E color notebook and, as such, the top monochrome system for both office and travel. This monochrome version may offer the best of both worlds. You get 4 hours of battery life for work on the road (the color 4000 E is limited to 2½ hours), and when you're back at the office, the notebook can drive a full-color Super VGA monitor.

		PRICE	CPU	OVERALL SPEED[1]	EASE OF USE	BATTERY LIFE (HOURS:MIN)	SCREEN QUALITY	SCREEN TYPE	DOCKING STATION
BEST	TI TravelMate 4000 WinDX2/50	$3478	DX2/50	3.50	Good	4:01	Fair	Mono	$929
RUNNER-UP	TI TravelMate 4000 WinDX/25	$2678	DX/25	2.48	Good	4:46	Fair	Mono	$929

[1] Higher numbers indicate better performance (a 20-MHz 386SX Toshiba T2200SX = 1).

HONORABLE MENTIONS

You can extend battery life by removing the floppy drive from the NEC UltraLite Versa notebooks. After you pull out the floppy drive, you pop in a second battery, doubling the effective battery life to more than 6 hours.

External ports on the Toshiba Satellite T1900C are covered with sliding doors. Most other systems use hinged panels, which are subject to snapped hinge pins.

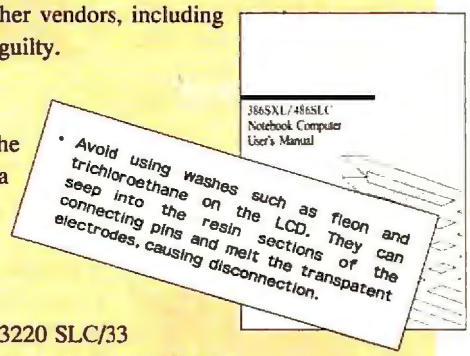
The Toshiba T4600C status indicators consist of clever battery and water-faucet icons that make it easy to see how much battery power remains (either in percentage of full power or in time remaining) and what level of power management you've set. Other icons show typical items such as Caps-Lock, floppy drive and hard drive access, and whether the power is on or off.

The AST Bravo 4/25s Color Model supported an extensive collection of well-labeled hot keys. These keys (activated by pressing Fn-F1 through Fn-F10) allow you to quickly adjust a variety of system management functions, such as system setup, gray-scale schemes, external monitor control, and checking the expected battery life. Other systems had similar hot-key features, but none were as extensive, convenient, or well labeled as the AST Bravo's.

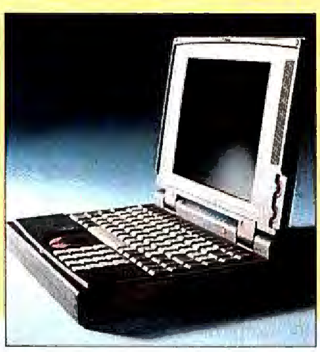
Dubious Achievements

Snap! Flimsy hinge pins on the Compaq Contura's port-cover plate break off with the slightest provocation. Thicker pins proved sturdier, but the best solution was the Toshiba Satellite's, with sliding doors covering its ports. Note that this problem is not restricted to Compaq; other vendors, including Twinhead and Texas Instruments, are equally guilty.

We expect occasional typographical errors, but the manual of the KingTech KS-486C went far beyond the norm. We had trouble finding a page without spelling or grammatical errors. Worse, some pages, like this one, contained incomprehensible crucial warnings.


386SXL/486SLC
Notebook Computer
User's Manual

• Avoid using washes such as fleon and trichloroethane on the LCD. They can seep into the resin sections of the connecting pins and melt the transpatent electrodes, causing disconnection.



Better keep your HyperData HB 3220 SLC/33 plugged in. Once its battery gets low, it starts playing Beethoven's *Für Elise*. Over and over. Until the system finally dies, leaving you (and whoever is sitting in the plane seat next to you) in blessed silence once again.

Two Thumbs Up For ALR's EVOLUTION V

BEST OF BYTE COMDEX Spring '93 Winner

"Best of Show, Spring Comdex, 1993"
BYTE Magazine - May, 1993

"ALR has built a screamer."
Computer Shopper - May, 1993

"Expect to hear a lot more about the EVOLUTION V... ALR did its homework when it came to optimization."
Computer Shopper - May, 1993

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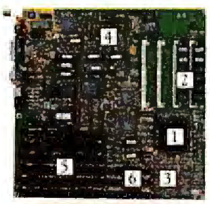
intel inside pentium



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System Also Includes: Six DriveBays & 200Watt Power Supply

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MODEL 170DWM
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includes above features plus: 170-MB IDE Hard Disk high-performance local bus video adapter14" SVGA monitor MS-DOS 6.0, MS-Windows 3.1 and Mouse
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includes above features plus: 16-MB RAM total480-MB (Dual 240-MB) IDE Hard Disk ALR MULTUS™ multiseeking disk interfaceWD 90C31-based Local Bus Video Adapter
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with 66-MHz Processor ... $6295

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includes Model 8CM features plus 16-MB RAM total1.2-GB SCSI Hard Disk with 32-bit SCSI Local Bus master controller WD 90C31-based Local Bus Video Adapter
$7595
with 66-MHz Processor ...$7895

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ROLL CALL OF NOTEBOOKS

VENDOR	MODEL	CPU	DISPLAY		OVERALL SPEED²	BATTERY LIFE (HOURS:MIN)
DOS/PC						
Acer America Corp.	Note 750C	SL/25	Color	Active	2.22	4:28
Aero Computers	486DX/33 NB	DX/33	Mono	Passive	2.45	2:32
Amrel Technology, Inc.	486DX2/66 AC	DX2/66	Color	Active	4.13	1:30
AMS, Inc.	TravelPro 4533 PAS	DX/33	Color	Passive	2.66	2:11
AMS, Inc.	TravelPro 5366A	DX2/66	Color	Active	3.39	2:52
AMS, Inc.	TravelPro 7525A	SL/25	Color	Active	2.20	2:58
Aspen Computer, Inc.	Aura 33	DX/33	Color	Passive	2.88	1:39
AST Research, Inc.	Bravo 4/25s Color Model 123W	SX/25	Color	Passive	2.14	2:15
AST Research, Inc.	Bravo NB 4/25s Model 123W	SX/25	Mono	Passive	2.15	3:16
AST Research, Inc.	Power Exec 4/25SL ColorPlus	SL/25	Color	Active	2.18	3:49
CAF Technology, Inc.	AquaLite-486DX3	DX/33	Mono	Passive	2.80	4:34
CAF Technology, Inc.	AquaLite-486DX3/C	DX/33	Color	Passive	2.29	3:04
CAF Technology, Inc.	AquaLite-486DX3/T	DX/33	Color	Active	2.80	3:16
CAF Technology, Inc.	AquaLite-486SLC	SLC/33	Mono	Passive	1.74	2:47
Chaplet Systems, Inc.	NBD 486SX-25	SX/25	Mono	Passive	2.30	2:39
Chaplet Systems, Inc.	NBD 486SX-25TFT	SX/25	Color	Active	2.29	1:55
Compaq Computer Corp.	Contura 4/25	SL/25	Mono	Passive	2.21	3:55
Compaq Computer Corp.	**LTE Lite 4/25E**	**SL/25**	**Mono**	**Active**	**2.21**	**7:06**
Compaq Computer Corp.	LTE Lite 4/33C	SL/33	Color	Active	2.71	2:20
CompuAdd Computer Corp.	425TX	SX/25	Mono	Passive	2.29	4:10
CompuAdd Computer Corp.	425TXT	SX/25	Color	Active	2.32	3:24
CompUSA Direct	486DX/33 Slimnote	DX/33	Mono	Passive	2.51	2:30
CompUSA Direct	486DX2/66 Active TFT Color	DX2/66	Color	Active	3.50	2:17
CompUSA Direct	486DX2/66 Slimnote	DX2/66	Mono	Passive	3.31	4:07
Epson America, Inc.	ActionNote 4SLC/25	SLC/25	Mono	Passive	1.40	2:32
Ergo Computing, Inc.	486 Marathon NoteBrick	SL/25	Mono	Passive	2.17	3:16
Ergo Computing, Inc.	PowerBrick 66	DX2/66	Color	Active	3.12	2:39
HyperData Tech Corp.	HB 2300 DLC/40	DLC/40	Mono	Passive	2.82	2:52
HyperData Tech Corp.	HB 3220 SLC/33	SLC/33	Color	Passive	1.83	2:04
HyperData Tech Corp.	HB 3300 DX2/50	DX2/50	Color	Active	3.33	1:19
IBM Corp.	ThinkPad 350C	SL/25	Color	Passive	2.41	3:07
IBM Corp.	ThinkPad 720C	SLC2/50	Color	Active	2.70	4:00
Jetta International, Inc.	JetBook 486DX-33	DX/33	Mono	Passive	2.34	2:55
KingTech USA Corp.	KS-486C	SLC/25	Mono	Passive	1.20	1:30
Micro Electronics	WinBook 486 SLC/E	SLC/E/25	Mono	Passive	1.91	2:20
Micro-International, Inc.	HCP Model 65681C	DX2/66	Color	Passive	3.92	2:33
Micro-International, Inc.	HCP Model 65681M	DX2/66	Mono	Passive	3.84	3:32
Micro-International, Inc.	HCP Model 65681T	DX2/66	Color	Active	3.96	2:38
Mitsuba Corp.	486SX-AC	SX/25	Color	Active	1.87	2:33
NEC Technologies, Inc.	UltraLite Versa 25C	SL/25	Color	Active	2.52	2:40
NEC Technologies, Inc.	**UltraLite Versa 33C**	**SL/33**	**Color**	**Active**	**3.06**	**2:55**
Noteable Computers, Inc.	N425	SLC/25	Mono	Passive	1.47	2:16
Panasonic Communications & Systems Co.	CF-580¹	SLC/25	Mono	Passive	N/A	N/A
Primax Data Products	MediaNote 450V	DX2/50	Mono	Passive	2.15	2:01
Sager Midern Computer, Inc.	**NP843T**	**DX/33**	**Color**	**Active**	**2.99**	**2:52**
Samsung Electronics America, Inc.	S3800	SLC/25	Mono	Passive	1.48	2:30
Texas Instruments	TravelMate 4000 E WinDX2/50	DX2/50	Color	Active	3.62	2:36
Texas Instruments	TravelMate 4000 WinDX/25	DX/25	Mono	Passive	2.48	4:46
Texas Instruments	TravelMate 4000 WinDX2/50	DX2/50	Mono	Passive	3.50	4:01
Texas Instruments	TravelMate 4000 WinSX/25	SX/25	Color	Passive	2.28	2:23
Toshiba America Information Systems, Inc.	T4600C	SL/33	Color	Active	2.69	3:52
Toshiba America Information Systems, Inc.	Satellite T1900C	SXA/20	Color	Passive	2.03	3:17
Twinhead Corp.	Slimnote 4DX/33M	DX/33	Mono	Passive	2.51	2:52
Twinhead Corp.	Slimnote 4DX/33T	DX/33	Color	Active	2.74	2:54
Twinhead Corp.	Slimnote 4DX2/66T	DX2/66	Color	Active	3.41	2:38
Xinetron, Inc.	X/LAN Book 486SLC-25	SLC/25	Mono	Passive	1.51	2:32
Zenith Data Systems	Z-Note 425Ln Model 120	SL/25	Mono	Passive	2.34	5:27
Zenith Data Systems	Z-Note 425Lnc Model 200	SL/25	Color	Active	2.34	3:14
Zenith Data Systems	Z-Note 425Lnp Model 120	SL/25	Color	Passive	2.34	3:37
MAC						
Apple Computer, Inc.	PowerBook 165c	68030/33	Color	Passive	2.77	2:40
Apple Computer, Inc.	PowerBook 180	68030/33	Mono	Active	3.13	3:02
Apple Computer, Inc.	PowerBook 180c	68030/33	Color	Active	2.76	2:19

= BYTE Best *Estimated selling price, not list price. N/A = Not applicable. ¹ Didn't arrive in time for testing. ² Higher numbers mean better performance.

EASE OF USE	PRICE AS TESTED	SCREEN QUALITY	POINTING DEVICE	DOCKING STATION	MAX. RAM (MB)	PHONE	TOLL-FREE PHONE	INQUIRY NUMBER
Excellent	$3988	Good	Integrated trackball	None	20	(408) 432-6200	(800) 733-2237	1346
Fair	$1699	Fair	None	$200	16	(212) 971-0285	(800) 232-1050	1347
Fair	$5249	Good	Integrated trackball	$699	52	(818) 575-5110	(800) 882-6735	1348
Good	$2495	Poor	Integrated trackball	None	20	(818) 814-8851	(800) 886-2671	1349
Good	$3895	Good	Integrated trackball	$345	32	(818) 814-8851	(800) 886-2671	1350
Excellent	$3290	Fair	Integrated trackball	None	20	(818) 814-8851	(800) 886-2671	1351
Fair	$2595	Fair	Integrated trackball	$495	20	(716) 626-0315	(800) 472-3273	1355
Good	$2748	Fair	Integrated trackball	None	20	(714) 727-4141	(800) 876-4278	1356
Good	$1948	Good	Integrated trackball	None	20	(714) 727-4141	(800) 876-4278	1357
Excellent	$4758	Excellent	Integrated trackball	$488	32	(714) 727-4141	(800) 876-4278	1358
Fair	$2559	Poor	Integrated trackball	None	20	(818) 369-3690	N/A	1359
Fair	$3259	Poor	Integrated trackball	None	20	(818) 369-3690	N/A	1360
Fair	$4650	Good	Integrated trackball	None	20	(818) 369-3690	N/A	1361
Fair	$2099	Poor	Integrated trackball	None	20	(818) 369-3690	N/A	1362
Excellent	$1999	Fair	Integrated trackball	$325	20	(408) 732-7950	N/A	1363
Excellent	$3399	Fair	Integrated trackball	$325	20	(408) 732-7950	N/A	1364
Fair	$2949*	Fair	Cabled trackball	None	20	(713) 370-0670	(800) 345-1518	1365
Good	$4339*	Excellent	Integrated trackball	$579*	20	(713) 370-0670	(800) 345-1518	1366
Good	$5419*	Good	Integrated trackball	$579*	20	(713) 370-0670	(800) 345-1518	1367
Excellent	$2090	Fair	Integrated trackball	None	20	(512) 250-1489	(800) 627-1967	1368
Excellent	$3890	Fair	Integrated trackball	None	20	(512) 250-1489	(800) 627-1967	1369
Excellent	$2728	Poor	Integrated trackball	None	20	(214) 702-0055	(800) 862-3082	1370
Fair	$4728	Good	Integrated trackball	None	20	(214) 702-0055	(800) 862-3082	1371
Excellent	$3228	Fair	Integrated trackball	None	20	(214) 702-0055	(800) 862-3082	1372
Good	$1699	Fair	Cabled trackball	None	8	(310) 782-0770	(800) 289-3776	1373
Excellent	$3795	Good	Integrated trackball	None	20	(508) 535-7510	(800) 633-1925	1374
Good	$4295	Good	Integrated trackball	$395	32	(508) 535-7510	(800) 633-1925	1375
Excellent	$2295	Fair	Cabled mouse	None	20	(909) 468-2955	N/A	1378
Excellent	$3395	Fair	Integrated trackball	None	8	(909) 468-2955	N/A	1376
Excellent	$5495	Fair	Integrated trackball	None	20	(909) 468-2955	N/A	1377
Excellent	$2800	Fair	Integrated TrackPoint II	None	20	(914) 766-1900	(800) 772-2227	1379
Excellent	$4900	Fair	Integrated TrackPoint II	$859	16	(914) 766-1900	(800) 772-2227	1380
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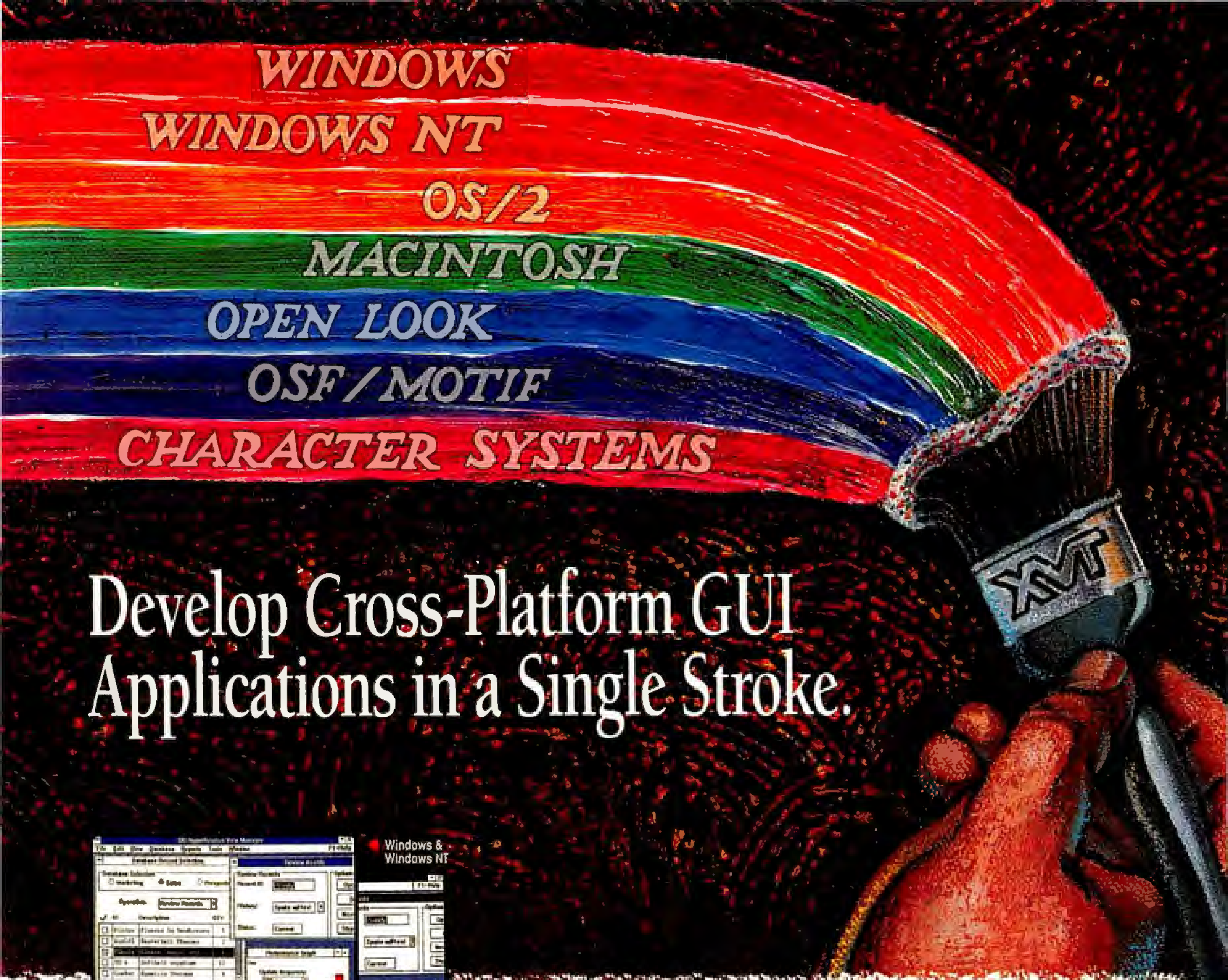

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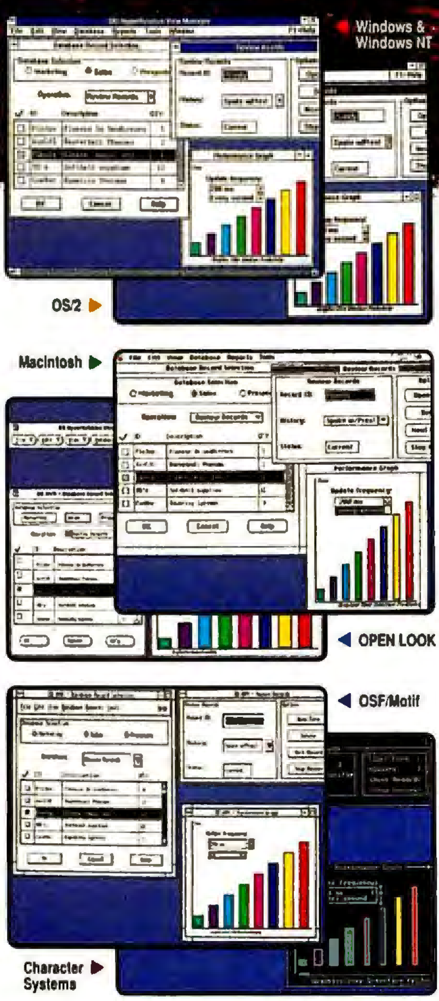

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Fractal Image Compression

Fractal-based compression techniques offer distinct advantages over JPEG image-compression techniques

LOUISA F. ANSON

For several years, many people in the personal computing world have been chasing the Holy Grail of mass-market computing: multimedia. Two obstacles to reaching that goal have been overcome: 16- and 24-bit color printers and scanners are now readily available, and true-color graphics adapters display stunning pictures. But the large size of the image files required for these beautiful images is a huge problem. A single 800- by 600-pixel true-color image requires 1.44 MB of disk space; an uncompressed 10-second video clip with 30 frames per second at 320 by 200 pixels in true color requires an enormous 57.6 MB of disk space.

Clearly, compression is necessary. JPEG is one commonly used compression technique. But you may not be aware of fractal image compression, which combines high compression ratios with fast decompression times.

Compression technologies can be divided into *lossless* and *lossy* methods. A lossless method always produces a decompressed image that is identical, pixel-for-pixel, to the original image. The problem with lossless methods, such as the one used in PKWare's PKZip, is that the attainable compression ratios on images are very small—typically 2 to 1. Lossy compression methods designed for image data can achieve much higher compression ratios. Both the DCT (Discrete Cosine Transform) and fractal-transform image-compression methods are lossy, but in other respects they are very different.

JPEG Compression

To understand the value of fractal image compression, you must first understand the status quo. In the world of image compression, that means JPEG. This standard, defined by the Joint Photographic Experts Group, describes ways of taking bit-mapped data for color or gray-scale continuous-tone images and storing it in a smaller number of bytes.

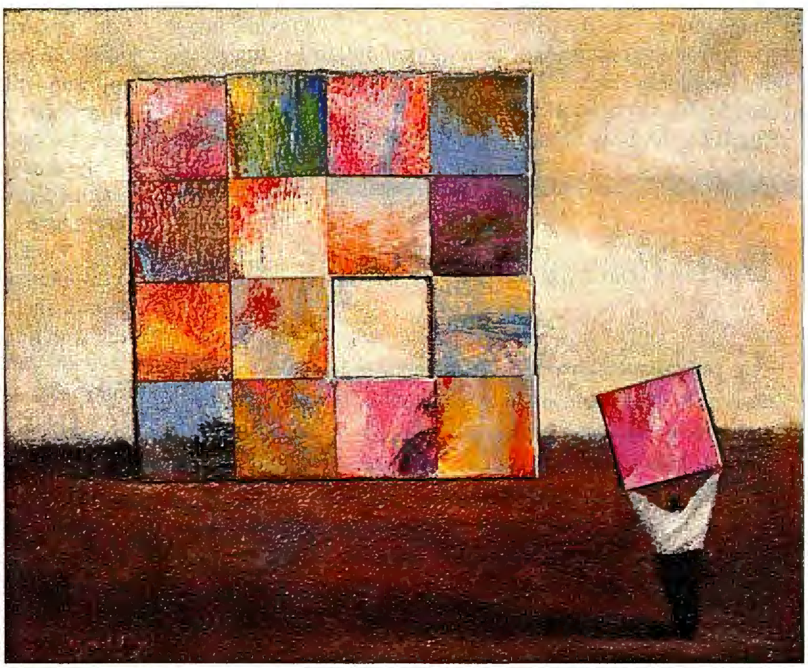
The JPEG assembly was first convened in 1986. Its goal was to find the best method for image compression and to get it adopted as an international standard. At press time, many worker-years had resulted in the JPEG recommendations' being formally adopted by the CCITT; acceptance by the ISO was expected shortly.

The image-compression technology at the heart of the JPEG standard is DCT. Numerous publications provide an in-depth explanation of DCT and how it is used within the JPEG standard. Here I will provide just enough description to highlight the significant differences between DCT and fractal image compression.

DCT Explained

DCT breaks an image into 8- by 8-pixel blocks and then uses mathematical tricks to decide what image information can be thrown away without damaging the appearance of the image too much. DCT transforms the image data in the 8-by-8 block mathematically from *x*, *y* space into frequency space. Instead of viewing the data as an array of 64 values arranged in an 8-by-8 grid, DCT views it as a varying signal that can be approximated by a collection of 64 cosine functions with appropriate amplitudes. Each cosine that DCT uses as a basis function is associated with a value called its *DCT coefficient*, which determines each cosine function's amplitude.

Most of the important visual information for typical continuous-tone images is concentrated in the cosine functions with lower frequencies. Thus, by giving less weight to higher-frequency cosines and approximating



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Compare the difference: *The left image is from a 640- by 400-pixel, 24-bit color scan that resulted in a 768-KB file. Compressing this image at a ratio of 100 to 1 using JPEG/DCT creates a 7365-byte file (center), versus a 7316-byte file for the fractal transform compression (right). Both fractal and JPEG/DCT compression are lossy, but notice how the JPEG/DCT image exhibits distinct blockiness at this relatively high compression ratio.*

small DCT coefficients to zero, compression can be achieved without too much image degradation. Further space savings are possible if you quantize the remaining DCT coefficients to a predefined set of values. With JPEG/DCT, the algorithm is symmetrical: Compression and decompression take roughly the same amount of time.

JPEG/DCT Limitations

Although the DCT method in the JPEG standard is effective at low compression ratios—up to about 25 to 1—it suffers from serious problems at higher compression ratios. Since the first step in JPEG/DCT is to break the image into 8- by 8-pixel blocks, the compressed file size is roughly proportional to the number of these blocks. Hence, as uncompressed files increase in resolution, JPEG/DCT compressed files either increase in size or decrease in image quality (see the parrot images above). The middle image of the parrot was compressed by a ratio of 100 to 1 using JPEG/DCT. The blocky nature of the image is typical of JPEG/DCT images at high compression ratios.

The JPEG/DCT assumption that higher frequencies are unimportant does not hold if you have sharp edges in your picture. Attenuating the higher-frequency DCT-basis functions results in artifacts that look like ripples spreading out from the edges. This effect, called *Gibb's phenomenon*, is most noticeable around edges and textures, and it is an unavoidable aspect of DCT.

The most serious problem caused by the long-term use of JPEG/DCT compressed images is that they are resolution dependent. Any attempt to display the decompressed image at a higher resolution than the original will result in the blockiness that results from pixel replication. Since graphics cards and printers have increased in resolution every year, resolution dependence results in this year's images needing to be rescanned and recompressed next year to take full advantage of the latest technology.

Fractals Defined

For the purposes of this article, a *fractal* is an infinitely magnifiable picture that can be produced by a small set of instructions and data. With a fractal, the more you zoom in on an image, the more detail you see. If you zoom in on a bit-mapped image, however, eventually all you will see is big blocks of the same color.

The word *fractal* was coined by Benoit Mandelbrot to mean a fractured structure possessing similar-looking forms at many different sizes. For example, a tree in winter has large branches, small branches, and tiny twigs, all branching off in the same way at different scales. Traditional, abstract fractals, such as the Mandelbrot set, have become very popular. They tend to be harmonious, delicate, balanced, and pleasing to the eye because they have low information content (in the mathematical sense), which follows from the fact that the program that produces them is finite, even though the picture appears to be infinite. The eye is drawn toward them, and the mind senses their hidden order. Mandelbrot created some of the first pictures of abstract fractals, and he observed that similar mathematical structures lay behind the geometry of such things as clouds, mountains, and forests.

Affine Transformations

The concept of an affine transformation is central to fractal image compression. An *affine transformation* is a mathematical function made up from some combination of a rotation, a scaling, a skew, and a translation in n-dimensional space. A simple example in two dimensions would be

$$W(x,y) = (ax + by + e, cx + dy + f).$$

This can be written in matrix notation as the following:

$$W\begin{pmatrix} x \\ y \end{pmatrix} = \begin{pmatrix} a & b \\ c & d \end{pmatrix}\begin{pmatrix} x \\ y \end{pmatrix} + \begin{pmatrix} e \\ f \end{pmatrix} = \begin{pmatrix} ax + by + e \\ cx + dy + f \end{pmatrix}$$

Do-It-Yourself Fractal Compression

The fundamental mathematics behind the fractal transform are very deep and can be implemented in various ways. To help you better understand the material in this article, I've made the source and executable code for a simple version of the gray-scale fractal transform available on-line as the file fractal.zip (see editor's note).

In these sample programs, various choices have already been made: The domain regions are simple 4- by 4-pixel squares, and the only affine transformations considered are simple translations, rotations, and flips. This program was written for clarity rather than speed or image quality, but it can achieve quite good results. Enclosed in fractal.zip you'll find compress.exe, decompress.exe, and two sample image files on which to run the program. See the readme file for details on using the program.

Note that computer implementations of the fractal transform are covered by various U.S. and worldwide patents and that the demonstration code is for sample purposes only. Use of this code for other purposes requires a licensing agreement from Iterated Systems.

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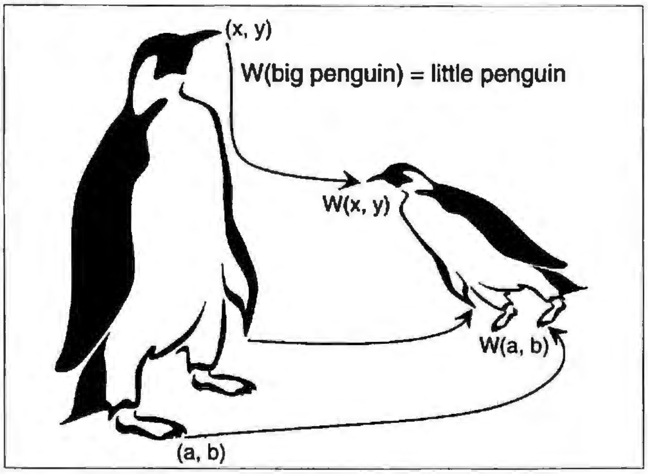


A contractive affine transformation *has a distinct effect on this penguin. The transformed big penguin (right) is smaller, and its feet are closer together. Such affine transformations are central to fractal image compression.*

The matrix

$$\begin{pmatrix} a & b \\ c & d \end{pmatrix}$$

determines the rotation, skew, and scaling, and

$$\begin{pmatrix} e \\ f \end{pmatrix}$$

determines the translation. This transformation moves the point (0,0) to (e,f), the point (1,0) to $(a + e, c + f)$, the point (0,1) to $(b + e, d + f)$, and the point (1,1) to $(a + b + e, c + d + f)$. The values a, b, c, d, e, and f are the affine coefficients for this transformation.

Consider the effect of an affine transformation W on a picture of a penguin in the x, y plane (see the figure above). Notice how applying W to the big penguin on the left results in the smaller penguin on the right. An affine transformation with this property is said to be *contractive*. Such affine transformations are important to the theory and practice of fractal image compression.

Given a two-dimensional image such as the penguin and its affine transformation W, you can solve the six simultaneous equations determined by the x, y location of three points on the big penguin and the corresponding three points on W(big penguin) to find the values of the six coefficients (a, b, c, d, e, and f) that define the affine transformation W.

Affine transformations are not restricted to two dimensions. A gray-scale image can be considered to be a 3-D entity with two spatial dimensions and one intensity dimension (see the figure below). If you apply a 3-D contractive affine transformation to a gray-scale image, then it will become smaller spatially, the brightness will change, and the contrast will decrease.

A collage of an image S is a finite set of N contractive affine transformations W_i with the property that

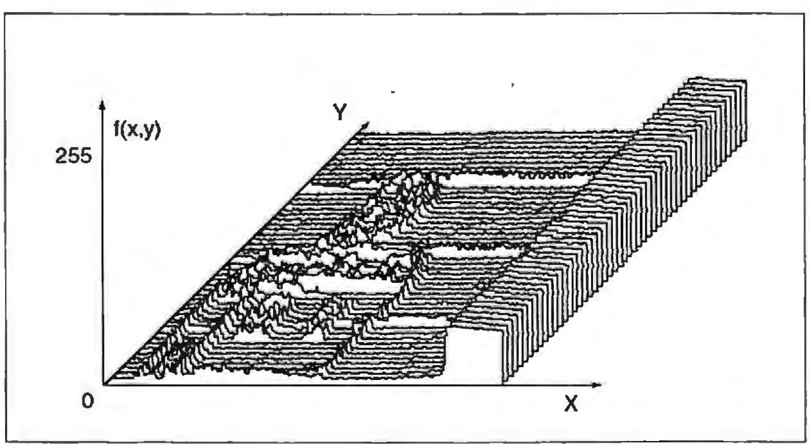
$$W_1(S) \cup W_2(S) \cup \ldots\ldots \cup W_N(S)$$

is approximately the same as S, where $\cup$ denotes the union of the images.

Study the series of images on page 202, and you will see that image A can be constructed from a combination of the two affine transformations of the leaf. To visualize these transformations, consider the three points labeled O, X, and Y, which make up three of the four corners of the rectangle in image A.

The affine transformation W_1 takes the origin O to W_1(O), the point X to W_1(X), and the point Y to W_1(Y). The result appears as image B. Rectangle A has been shrunk, rotated, slightly twisted, and translated. The affine transformation W_2 takes origin O to W_2(O), X to W_2(X), and Y to W_2(Y). The result appears as image C. Note that W_2 not only shrinks, rotates, and translates rectangle A, it also flips it relative to the y axis.

You can re-create the leaf by combining images B and C, so these images and their affine transformations form a perfect collage for the leaf. In "A Better Way to Compress Images" (January 1988 BYTE), Iterated Systems' founder Michael F. Barnsley and Alan D. Sloan show in detail how a collection of affine transformations can be used to re-create a fractal replica of a leaf by using an algorithm called the Chaos Game. In this way, the 12 numbers that define the two transformations can generate an intricate picture of a leaf with infinite detail. The Collage Theorem states that "the more accurately the union of the transformed images approximates the target image, the more accurately the set of transformations provides an encoding of that target image."



A 2-D gray-scale image *actually has three dimensions: height, width, and intensity. This is evident in the above graph.*

Fractal Image Compression

The Collage Theorem and the Chaos Game were breakthroughs for pictures of ferns, but arbitrary real-world images could still be encoded only by the tedious process of modeling the image as a collection of fractal segments and finding the right set of affine transformations for each. Before fractal image compression could be used commercially, a method was needed that could be carried out automatically by a computer in a reasonable amount of time and with predictable and accurate results.

While considering this problem, Barnsley made the observation that all real-world images are rich in *affine redundancy*; that is, under suitable affine transformations, large bits of real-world images look like smaller bits of the same real-world image. This observation, together with the mathematics of the Collage Theorem, led him to the invention of

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the fractal-transform process for automatic image compression.

The first step in the fractal-transform compression process is to partition the image into nonoverlapping domain regions (see the figure "The Fractal Image Compression Process"). Taken together, the set of domain regions must cover the entire image, but they can be any size or shape. Next, the program defines a collection of possible range regions, which must be larger than the domain regions, can overlap, and need not cover the entire image.

For each domain region, the program must choose the range region that, after an appropriate 3-D affine transformation is applied, most closely matches the domain region. The affine transformations not only shrink and deform the image within the range region, they also decrease contrast and change brightness in the intensity dimension. Each 3-D affine transformation can be described by its affine coefficients.

A FIF (Fractal Image Format) file is then written. It consists of a header with information about the specific choice of domain regions, followed by the packed list of affine coefficients chosen for each domain region. This process generates a file that is independent of the resolution of the original image; you have found an equation for the picture. Consider a straight line: It can be represented by the equation $y = ax + b$. If you know the values of the coefficients a and b, then you can draw the line at any resolution. In an analogous way, given the affine coefficients in the FIF file, the decompression process can create a fractal replica that looks like the original at any resolution.

Commercial implementations of the fractal transform face some complex trade-offs when choosing domain regions, range regions, and allowed transformations. The larger the domain regions, the fewer the number of transformations that are needed to model the image, and the smaller the fractal file. However, if a reasonably close match is not found between each of the domain regions and a transformed range region, the quality of the decompressed image is reduced.

The compressor considers domain regions of various sizes, finds the best range region for each in the time available, and uses a mathematical procedure to assess the optimim set of domain regions for the desired file size. On a region of blue sky, for example, it may be possible to use a large domain region that matches well with an even larger patch of sky. But in another part of the picture, you might have to use a smaller domain region to find a good-enough range region within the available search time.

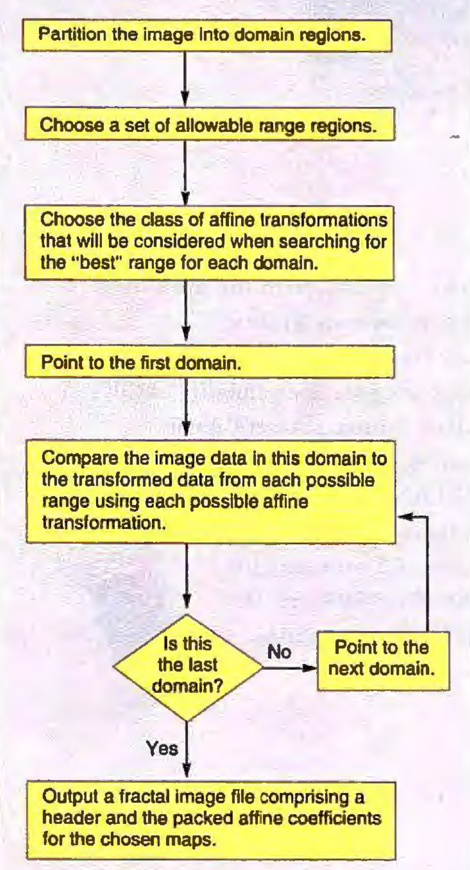
To keep compression time reasonable, practical limits must be put on the collection of possible range regions and the allowed transformations. In Iterated Systems' Poem ColorBox, for example, the compressor has four possible modes that control the time allowed for searching out the best range region for each domain. In the higher-quality modes, which take the most time, it is possible to extend the class of transformations and the set of possible range regions to achieve better image quality in the same compressed file size.

Fractal-Transform Decompression

The decompression process starts when you assign memory for two equal-size images A and B. The size of these images can be smaller or larger than that of the original image before compression, and the initial content is unimportant. It can be data, a picture of your dog—anything.

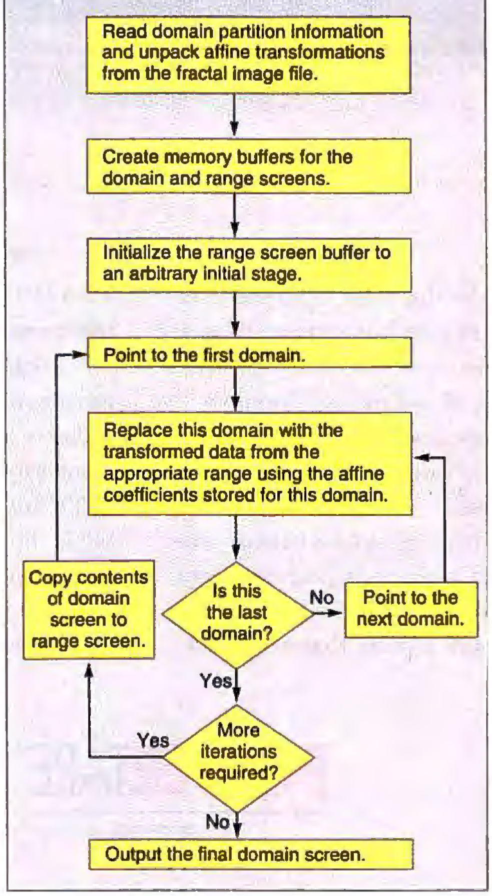
For the first iteration of the decompression process, I refer to image A as the *range image* and image B as the *domain image* (see the figure "The Fractal Image Decompression Process"). I partition the domain image into domain regions specified in the FIF file header. For each domain region in the domain image, I read the affine coefficients for this domain from the FIF file, locate the range region specified by this affine transformation in the range image, and map the contents of this range region from the range image

The Fractal Image Compression Process

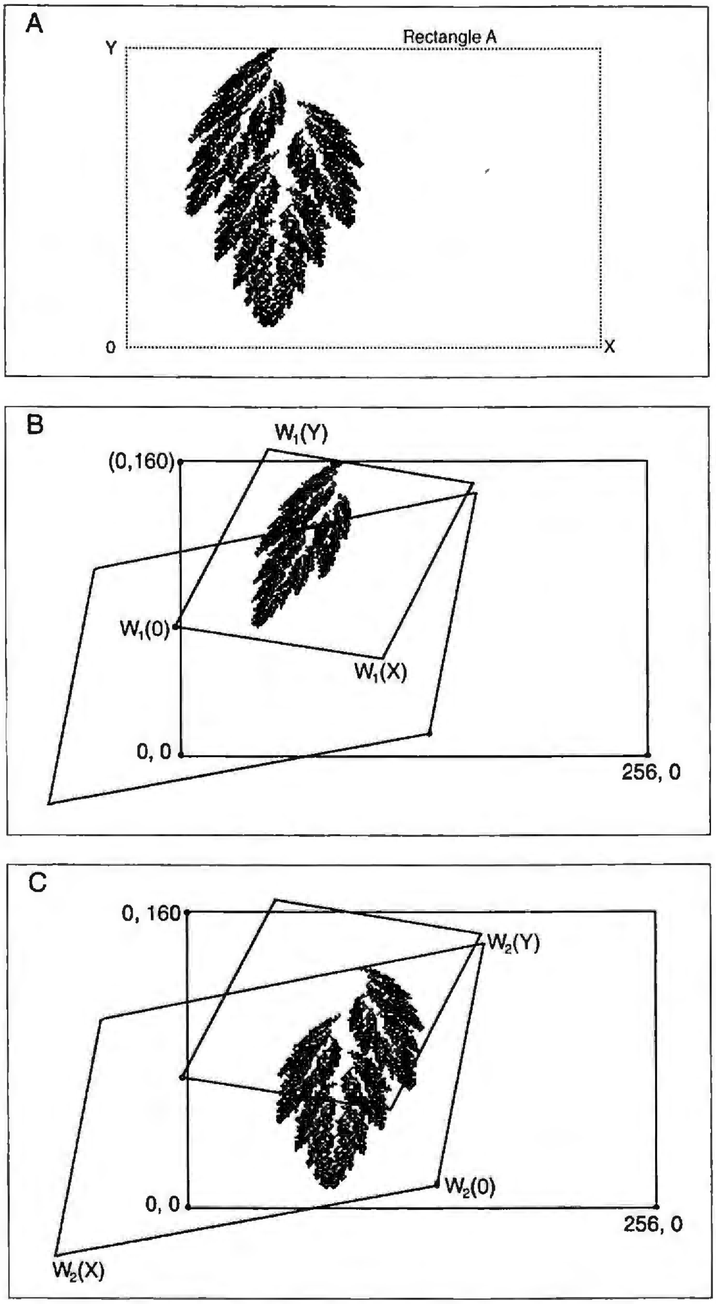


The algorithm *for fractal-transform compression of image data.*

The Fractal Image Decompression Process



The algorithm *to decompress an image stored as fractal-transform data.*



The leaf in A has been transformed *by affine transformation W_1 to get leaf B, and by affine transformation W_2 to get leaf C. If you combine the transformed images in B and C, the resulting image looks like the leaf in image A.*

to the appropriate domain region in the domain image.

Note that the transformation from the range to the domain is contractive, since I require the range regions to be larger than the domain regions. When this is done for each domain region, a new image B is created from transformed bits of image A.

For the second iteration, I make the new image B the range image and image A the domain image, and I repeat the process for each domain region. After two iterations, the arbitrary starting data has been mapped from A to B and then from B to A. I repeat this process until the differences between images A and B are indiscernible, and I then display image A.

This simple process creates an image. How closely the decompressed image matches the original depends on how accurately the chosen range regions match the domain regions during the compression process. For a mathematical explanation of why the fractal transform works, see the book *Fractal Image Compression* (see bibliography).

Fractal vs. JPEG/DCT

Fractal-transform image compression overcomes many of JPEG/DCT's problems. The fractal-transform process can use much larger and more complex regions when dealing with high-resolution images, so the size of a compressed FIF file does not have to increase in proportion to the number of pixels in the image. Instead of suppressing the higher-frequency data associated with sharp edges, fractal compression predicts edges at higher resolutions from the fractal model determined during compression.

The fractal-transform process is inherently asymmetric—more computation is required for compression than for decompression, so fractal-transform compression is relatively slow, while decompression is fast. Also, compression ratios can be improved by taking more time during compression without any increase in decompression time or decrease in image quality.

For example, in the JPEG version of the parrot in the photo, JPEG software compression and reading/decompression require 41 seconds each on a 386/33. By contrast, the fractal image compressed in 8 minutes, but it was read and decompressed in 7 seconds. Reading the original, uncompressed image required 14 seconds. Fractal compression time can be reduced by using fractal accelerator compression boards or by using a smaller compression ratio.

Decompression speed, resolution independence, and high compression ratios distinguish fractal image compression from JPEG/DCT. Many applications developers may find fractal image compression preferable for multimedia applications where quick access to high-quality images is essential. Microsoft, for example, currently uses fractal image compression in its Encarta multimedia encyclopedia. ■

Editor's note: *The listings for programs mentioned in this article are available electronically.* *See page 5 for details.*

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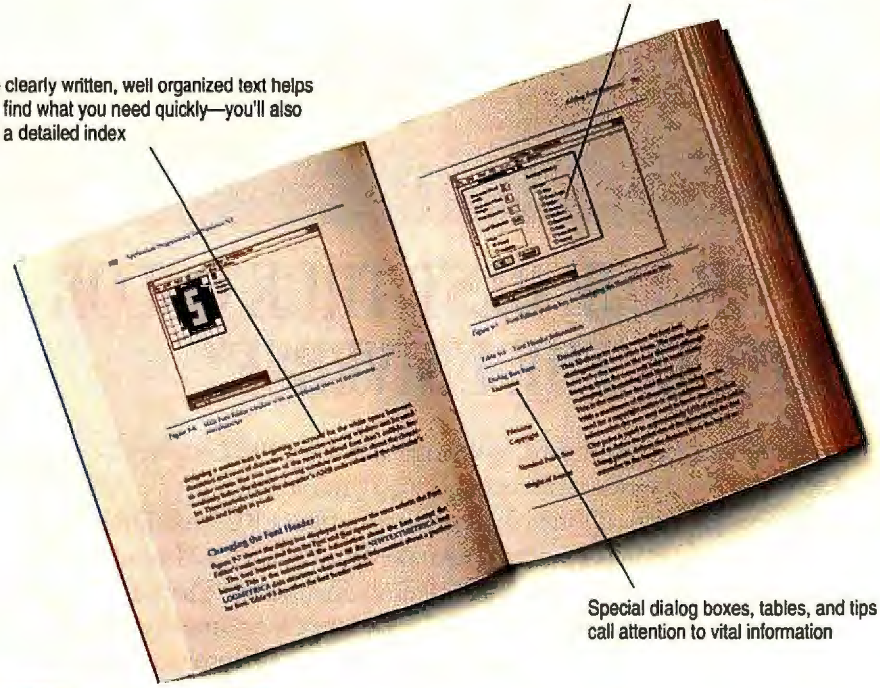

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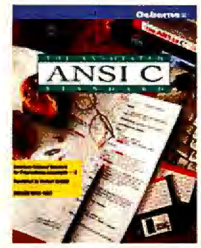

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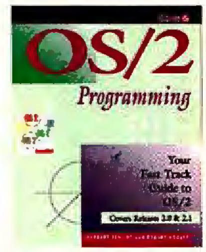

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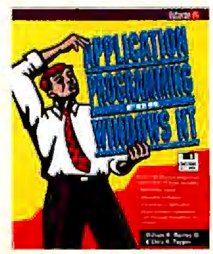

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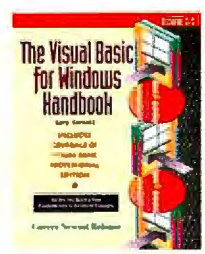

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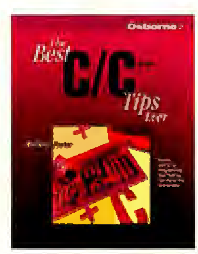

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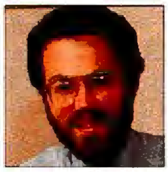

MARK J. MINASI

This month, I'd like to let you in on a little secret of mine: a quick way to build small OS/2 GUI applications. Now and then, a client needs a quick-and-dirty routine to "GUI-ize" something. They might want me to tie together several existing applications, put a GUI front end on something, or perhaps create a small stand-alone GUI application. Pulling out the C compiler can result in long hours of coding—something I know the client is not willing to pay for. That's when I reach for my visual toolbox.

You've probably heard of visual development systems like ObjectVision and Visual Basic for Windows. Borland even offers ObjectVision for OS/2, which is a great product for projects like putting a front end on a database. But for simpler tasks, a product like Visual Basic has been lacking.

For years, DOS users have turned to simple tools like QuickBasic to grind out simple character-based routines. But what do OS/2 users have to accomplish this? Since version 1.3, OS/2 has had something that has about the same level of power as BASIC, and it's built in: the REXX procedural language.

REXX is actually a more powerful language than BASIC when it comes to controlling the underlying operating system. It's integrated into OS/2 more closely than BASIC ever was with DOS. REXX isn't as well known or well documented as BASIC, but it's quite good nonetheless. As a simple command-line-oriented procedural language, however, it has been no good for controlling the Workplace Shell GUI. That has now changed. Recently, HockWare and Watcom introduced VisPro/REXX and VX-REXX, two similar products that add significantly to REXX.

VisPro/REXX vs. VX-REXX

I've had more experience working with VisPro/REXX than with VX-REXX, but I've put together applications with both. These products let you build Workplace Shell applications using just REXX and a few extra DLLs. You can build some nifty applications.

Visual Basic reworked the whole idea of BASIC, melding together a traditional BASIC interpreter with a screen-painting program to create a run-time environment. In contrast, VisPro/REXX is simply a bunch of new REXX functions.

For example, to put a window on the Workplace Shell, you just call the REXX function `VOpenWindow`, which takes as input parameters the dimensions of the window, the window's title, and the border color. `VOpenWindow`, if successful, returns a window ID, or *handle*, which you can use with `VForeColor` to set the foreground color, `VSetFont` to control the text font used in the window, or `VSay` to put text into the window. `VMsgBox` displays a simple text message box with programmer-selectable feedback buttons such as OK and Cancel.

In contrast, VX-REXX uses a slightly more object-oriented approach that relies, according to Watcom, on the SOM (System Object Model) support in OS/2. VX-REXX lets you define characteristics for different objects and change them with a `VRSet` command. For example, to change a button's background color to blue, you'd use the command `Call VRSet "PB_4", "BackColor","Blue"`. Here, `PB_4` is the name of the push-button object.

Creating dialog boxes is a snap in VisPro/REXX as well, and it even comes with some predefined dialog

CHRIS LOCKWOOD © 1993

boxes. To display a dialog box that looks like the standard OS/2 File Choose dialog box, for example, you just add the following line to your program: `button = VFile-Box('Pick a file...', 'c:\os2\*.exe', 'file')`. The result is indistinguishable from when you click on File/Open from inside the system editor. (VX-REXX has a function like that as well: `VRFileDialog`.) If you don't like the prebuilt dialog-box functions, you can build your own dialog boxes with functions to display command buttons, radio buttons, checkboxes, and the usual GUI tools.

For speed-critical applications, these visual tools are *not* the tools of choice.

Most VisPro/REXX programmers will never have to worry about these built-in functions, however. It has an integrated form painter (*form* is VisPro/REXX talk for window) that lets you drag and drop controls from a toolbar to your program, building entire applications with clicks and drags. Want a button in the middle of your program that says "Exit"? Just drag a button from the toolbar to wherever you want it, drop it, and edit its Settings notebook to specify the Exit text. To tell the system what to do when a button gets pushed, just click on the button, choose the When option on the Form menu, and code to your heart's content.

VX-REXX uses something like that, but with a look and feel more like Visual Basic's toolbar. I prefer its screen painter to VisPro/REXX's only because I've never found dragging and dropping a comfortable action.

Additionally, the defaults on colors and shading under VX-REXX produce somewhat more professional-looking programs. Those things can be accomplished by VisPro/REXX as well, but at the cost of a bit more programming. You get the feeling with VX-REXX that the designers thought a lot about what the programs that it produces look like.

VisPro/REXX knows graphics as well. You can draw objects with the `VDraw` and `VArc` functions. `VDraw` is very powerful, incorporating the ability to control line styles, endings, and colors. A demonstration program that HockWare ships with VisPro/REXX shows how to draw splines with `VDraw`. I found it quite simple to throw together a basic drawing package using largely `VDraw` commands. VX-REXX, in contrast, doesn't support any drawing tools, or at least none that I was able to find.

Missing Pieces

These visual tools are not without flaws. VisPro/REXX and VX-REXX are interpreted, which means that you won't use them to do your Mandelbrot calculations—at least not in this lifetime. For speed-critical applications, these are *not* the tools of choice.

VisPro/REXX includes a sample calculator application, and I found it easy to click on the number buttons too quickly for the calculator to catch on. When I entered the number 6542, it often registered as 64 on the display. In contrast, VX-REXX's calculator had no trouble following the keystrokes. VX-REXX's built-in objects made it possible to put together a better-looking calculator, as well.

VisPro/REXX is a good tool for building GUI batch files and light-duty programs, although the user interface is a little clumsy. For example, if you put a control into your new program and then change your mind about using the control, you can't just click on it and press the Delete key, as you do with VX-REXX. You've got to click on Edit/Cut.

Event-driven programming can be tough to get used to, but if you're willing to do some more work, you can avoid much of the event-driven stuff with VisPro/REXX and VX-REXX. Because they still incorporate the familiar input-processing-output paradigm of common procedural languages, you can choose to write the familiar interactive program that you'd write without any GUI in mind. Instead of PARSE, PULL, and SAY (REXX for INPUT and PRINT), you use the special GUI-ized functions incorporated in VisPro/REXX.

That design springs mainly from the fact that, again, this is not a whole new language—it's just a library you add to the already-existing REXX interpreter that's built into OS/2. As a result, you can opt not to completely rewrite REXX programs into VisPro/REXX or VX-REXX; you just modify the existing I/O sections.

That points to another potential problem for someone wanting to get started with one of these tools: They assume you know REXX. At some point, the clicking and dragging ends and the coding starts. I recommend getting a firm foundation in REXX before tackling these development tools. REXX is, however, simple to pick up, as it looks a lot like Pascal or QuickBasic.

Price Is the Object

VX-REXX is quite attractively priced at $99. VisPro/REXX, unfortunately, costs $299, and that's the so-called introductory price. It's hard to justify an interpreted tool for $299; $99, on the other hand, goes down smoothly. There are no royalties for distributing applications built with either tool, however. HockWare's Bronze Edition of VisPro/REXX sells for $99, but it does not include the business graphics, container control, notebook control, and slider control features.

If I have a major wish for these tools, it is that they let me make OS/2 API calls. Neither can do this, but VX-REXX can create and manage threads, a pretty nifty capability for a macro programming tool. Of course, both of these packages may be put to shame by a product that IBM is rumored to be working on, another visual tool that may be incorporated into a future version of OS/2.

If you want a good tool for prototyping OS/2 GUI programs, or a tool to quickly put a GUI front end on an existing OS/2 application, pick up one of these packages. Of the two, I prefer VX-REXX. But both are good examples of a new breed of visual development tools that will improve the general lot of GUI programs and simplify GUI programming. ■

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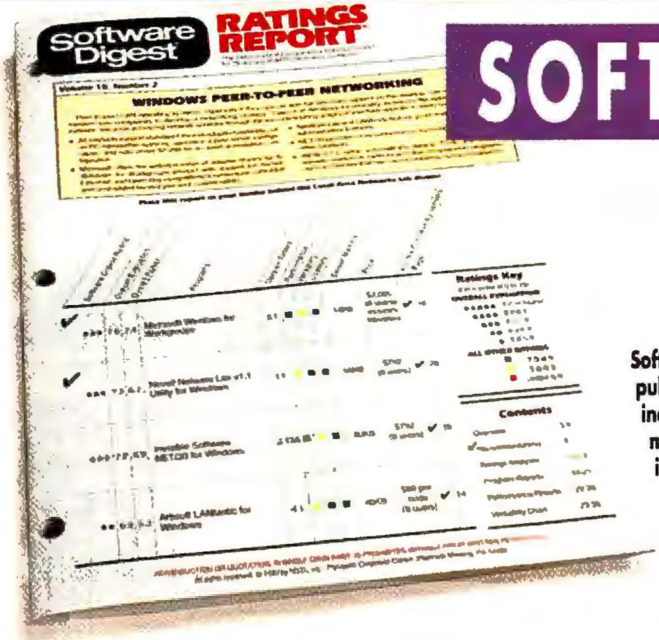

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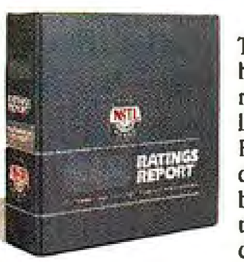

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Windows NT, OS/2, and Debuggers

A developer of programming tools looks at the power of debugging APIs in Windows NT and OS/2

MATT PIETREK

Last month I reviewed the fundamental services that operating systems must provide to a debugger. I showed the services that Microsoft Windows 3.1 provides and how a Windows debugger would use them. This month, I focus on debugger support under OS/2 2.1 and Windows NT on Intel-based systems.

Understanding debugger support in an operating system is important for any programmer—not just those who write debuggers. It's an essential part of writing many classes of tools and applications. For example, a program that wanted to monitor window messages and API calls would need to use the facilities designed primarily for debuggers.

The OS/2 2.1 Environment

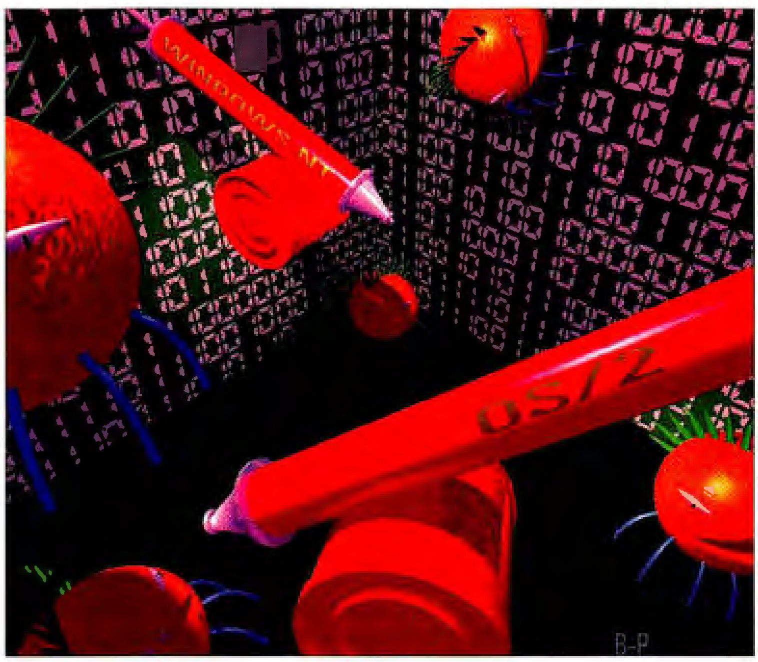
Unlike that of Windows 3.1, the OS/2 2.1 memory model provides for each application to have its own address space. Whenever the operating system switches to a new task, it changes the CPU's page tables so that memory used by one process is not accessible to another. DLLs, however, are a special case; they can have code or data that's visible in the address space of two or more processes.

In addition to address-space considerations, an OS/2 debugger also must contend with multithreaded processes. The debugger must track the comings and goings of threads in the child process. When displaying the call stack or registers, the debugger needs to be aware of and display the thread to which the stack or registers pertain.

In OS/2, your sole connection to the process that is being debugged is through the `DosDebug()` API. To use it, you create a command by filling in various fields of a DBGBUF structure. You then pass the structure to `DosDebug()`, which acts on it. When `DosDebug()` returns, it has filled in the structure with notification information. The notification may be a simple success code (`DBG_N_Success`), or it may be something complex, such as a notification of a DLL load occurring (`DBG_N_ModuleLoad`).

A short sequence of `DosDebug()` commands and notifications might resemble the following scenario: The debugger issues a `DBG_C_Go` command. When `DosDebug()` returns, the DBGBUF structure has fields specifying information about a module load (`DBG_N_ModuleLoad`). The debugger then does whatever housekeeping it needs to do for a module load and issues another `DBG_C_Go` command. This time, `DosDebug()` returns a `DBG_N_Exception` command, with one of the DBGBUF fields indicating that the exception was a breakpoint. At this point, the debugger could issue `DBG_C_ReadReg` and `DBG_C_ReadMemBuf` commands to get the current register and memory values to update the display.

If you were to believe the badly written `DosDebug()` documentation, you might think it's possible to get any `DBG_N_`*xxx* notification after giving any `DBG_C_`*xxx* command. In reality, the `DosDebug()` commands can be broken into two categories: commands that return immediately and commands that block until something happens in the child process.



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The commands that return immediately are information commands, such as `DBG_C_ReadReg` and `DBG_C_ReadMemBuf`. The commands that do not return immediately are the execution control commands, such as `DBG_C_Go` and `DBG_C_SStep`. The presence of commands that block until something takes place in the child process has a dramatic impact on the design of an OS/2 GUI debugger.

In OS/2, as in Windows, a GUI program that isn't pumping messages is a quick ticket to a deadlocked input system. Consider what would happen if an unsuspecting debugger were to call `DBG_C_Go` for a child program that was just about to enter into a 2-hour database sort. Until the child process stops for some reason (e.g., by hitting a breakpoint), the debugger user interface thread is blocked, waiting for the `DosDebug()` call to return. Since the single debugger thread is blocked in the `DosDebug()` call, the debugger isn't calling `WinGetMessage()` and `WinDispatchMessage()`, so the mouse and keyboard are useless. But OS/2 has preemptive multitasking, so it shouldn't matter if the debugger thread is blocked, right? While that's true, the design of the Presentation Manager input system still requires that applications call `WinGetMessage()` on a regular basis.

A GUI program that isn't pumping messages is a ticket to a deadlocked input system.

The solution to this problem is to start a second thread whose job is to perform `DosDebug()` calls. In this scenario, the primary user-interface thread tells the second thread to issue `DosDebug()` commands (think of the second thread as a `DosDebug()` server thread). When the second thread calls `DosDebug()`, it blocks with no ill effect on the user-interface thread. When the `DosDebug()` call finally returns, the `DosDebug()` thread indicates to the user-interface thread that there's new information available on the child process. A posted message is ideal for this.

Loading a New Process

Loading a process for debugging under OS/2 is a two-step procedure. First, you go through the laborious process of setting up a STARTDATA structure that you'll pass to `DosStartSession()`. To debug a program, it's essential that you specify the SSF_TRACEOPT_TRACE and SSF_RELATED_CHILD flags in the STARTDATA structure. You also need to specify what type of application you're debugging: PM, Windowable VIO (video input/output), or VIO.

After the process has been loaded and the new session started, you then call `DosDebug()` with the `DBG_C_Connect` command. When you return from this call, you are connected to the child process, but you're positioned in some OS/2 system DLL instead of at the first instruction. To get to your program's entry point, you need to set a breakpoint at the entry point and run the child process until it hits the breakpoint.

The only way I know to determine the starting EIP register is to parse the executable file directly. Once the breakpoint is set, you issue `DBG_C_Go` commands until you receive a `DBG_N_Exception` notification for the breakpoint. Between issuing the first `DBG_C_Go` command and finally hitting the breakpoint, you'll receive a slew of `DBG_N_ModuleLoad` notifications for all DLLs to which the program implicitly links. Unlike with Windows, you will receive a module load notification even if the DLL was already present in memory when the child process loaded. You can also receive more than one module load notification per DLL—for example, if a DLL is also using a DLL that your program is using.

Execution Control

Execution control over a child process boils down to letting you know about the process's exceptions and interrupts. In Windows, a debugger actually sees interrupts for the child task because it installs an interrupt handler for all tasks in the system. While this is good in some respects, it's not secure. A buggy debugger can bring the whole system down. OS/2, on the other hand, has "crash protection." While OS/2 users often get a laugh out of this name, it does at least mean that OS/2 attempts to isolate processes from one another.

Among other things, an OS/2 process is unable to handle the interrupts and exceptions of other processes. Since a debugger needs to handle these very things for the child process, some sort of compromise is necessary.

OS/2 provides for this case by putting a layer on top of the interrupt handler. Instead of the debugger handling interrupts directly, the OS/2 kernel handles all interrupts. If the interrupt is for a process that is being debugged, the kernel interrupt handler passes the debugger a sanitized report of the relevant information in the form of a `DosDebug()` `DBG_N_Exception` notification.

One of the nice features of `DosDebug()` is that it attempts to handle some of the housekeeping chores for you. For instance, it takes care of setting the trap flag to indicate whether the child process will single-step or run. To make the child process run, you'd use `DBG_C_Go`. To make it single-step, you would use `DBG_C_SStep`. Without these commands, you would need to read in the child process's register set, modify the trap flag image, and write the registers back out.

When the child process encounters an exception of some kind (an INT 1 single-step, an INT 3 breakpoint, or something like an exception 13 general protection fault), the debugger needs to issue a `DBG_C_Continue` command eventually. When it does, a separate field in the DBGBUF structure indicates to OS/2 how the exception should be handled. The debugger has three possible choices of action.

For normal single-step and breakpoint exceptions, the debugger specifies XCPT_CONTINUE_STOP. This tells the OS/2 kernel that the debugger has handled the exception and wants the child process to stop (usually so that it can update its display and receive a new command from the user). In this case, the child process will not see the exception.

The second possibility is that the debugger specifies XCPT_CONTINUE_EXECUTION, which tells the operating system that the child process should resume execution and not see the exception. A debugger uses XCPT_CONTINUE_EXECUTION if it wants the child process not to see signal exceptions, such as Control-C.

The final option for handling an exception is to specify XCPT_CONTINUE_SEARCH, telling OS/2 that it should search for exception handlers installed by the child process. If the kernel finds an exception handler, it passes control to it. If the child process hasn't installed an exception handler, the kernel invokes

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the default operating-system handler, which typically terminates the process.

Memory Access

The most obvious way to read and write child-process memory in OS/2 is with `DBG_C_ReadMemBuf` and `DBG_C_WriteMemBuf`, but I've found that these commands can be relatively slow. If you need to access the child process's memory space frequently, consider using `DBG_C_MapROAlias` and `DBG_C_MapRWAlias`. These commands let you specify a range of memory in the child process's address space that is also accessible in the debugger's address space. This can be done through the magic of page tables.

One of the joys of writing an OS/2 debugger is having to contend with 16-bit segments. The `DBG_C_ReadMemBuf` and `DBG_C_WriteMemBuf` commands deal only with 32-bit linear addresses, so a debugger needs to convert any segment:offset address into its linear equivalent. The `DBG_C_SelToLin` `DosDebug()` command is useful for this.

Register Access

Since OS/2 supports multiple threads, it's important for the debugger to remember the thread for which it's manipulating the registers. The `DBG_C_ReadReg` and `DBG_C_WriteReg` commands force you to specify the thread for which the register set should be retrieved. Often, though, when `DosDebug()` returns with a notification, it has filled in DBGBUF with the register set of the current thread.

The `DBG_C_ReadCoRegs` and `DBG_C_WriteCoRegs` commands access the 387 floating-point registers. To save space, the DBGBUF structure doesn't contain fields for the floating-point registers. Instead, you include a pointer to a buffer in the DBGBUF structure that's passed to `DosDebug()`. `DosDebug()` fills in this buffer in the format that the FSAVE and FRSTOR instructions use.

Event Notification and Address Mapping

As with interrupts, the OS/2 kernel has a layer that keeps the debugger from direct contact with the operating-system notifications. The kernel packages just the notifications that a debugger needs to know about and sends them to the debugger. The debugger sees these notifications as DBG_N_*xxx* values in the DBGBUF structure upon returning from `DosDebug()`.

To convert an OS/2 logical object number to its starting linear address, a debugger can use the `DBG_C_NumToAddr` command. For the purpose of address mapping, each segment in a 16-bit EXE or DLL file is considered to be an object. To convert from a linear address to a logical address, `DosDebug()` has the `DBG_C_AddrToObject` command. `DBG_C_AddrToObject` accepts a linear address and returns a module handle and logical object number.

Isolating a Child Process

As with Windows, the OS/2 input system doesn't deal well with a process that doesn't handle messages in a timely manner. The problems are essentially the same as with Windows (described last month), but the solutions are different.

In OS/2, each message queue is associated with a particular thread, and only that thread can retrieve messages from the queue. As a result, when the child process is stopped, an OS/2 debugger can't simply subclass the child process's windows and read messages intended for the child process. Instead, it has to call `WinThreadAssocQueue()` to reassign ownership of the queue to a debugger thread.

Once you get past the nuisance of reassigning the message queue, another problem arises. When a program calls `WinDispatchMessage()`, PM happily maps the message's HWND value to the address of the window procedure to be called. Unfortunately, the window procedure address is valid only in the context of the child process, not the debugger. When PM calls an address in the wrong context, the result is almost assuredly a general protection violation.

To make things even more complicated, an OS/2 process can have more than one thread/queue combination. When entering soft mode, therefore, an OS/2 debugger needs to set up a unique *message pump* thread for each child-process thread that owns a message queue. (Note that *soft mode* is a state in which the debugger has taken over message processing for the child process. All applications other than the child process continue to run normally. By contrast, *hard mode* is a special mode of the windowing system. Only one process—the debugger—receives messages; all other tasks are suspended. See last month's column for details.)

Mercifully, like Windows, OS/2 has a hard mode that is substantially easier to use than soft mode. You enter hard mode in OS/2 by calling `WinLockInput()`. To make the debugger writer's life interesting, only the thread that will be the sole active message thread can call `WinLockInput()`. Since the thread doing the `DosDebug()` calls is usually not the user-interface thread, some complicated gyrations are necessary. The debugger needs to somehow perform a synchronized thread switch so that the user-interface thread is the one that calls `WinLockInput()`.

In keeping with the spirit of isolating the debugger from the lowest level of system access, an OS/2 debugger cannot set hardware breakpoints by reading or writing the debug registers. Instead, a debugger uses the `DBG_C_SetWatch` and `DBG_C_ClearWatch` commands.

Windows NT

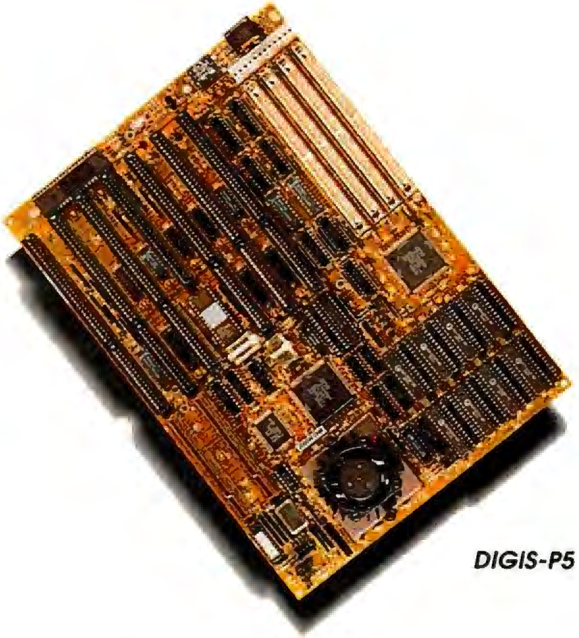
The debugging support in Windows NT is a hybrid of the OS/2 2.1 and Windows 3.1 models. The replacement for OS/2's `DosDebug()` is the `WaitForDebugEvent()`/`ContinueDebugEvent()` combination, along with a handful of other APIs. In the main process loop of an NT debugger, you pass a pointer to a DEBUG_EVENT to `WaitForDebugEvent()`. When the function returns, some sort of notification information appears in the DEBUG_EVENT buffer. Unlike OS/2, NT doesn't have different commands for stepping, running, and continuing after an exception. Instead, all this functionality is wrapped up in the `ContinueDebugEvent()` API.

As for retrieving information about the child process, NT provides individual API calls for each area of consideration. This is in contrast to OS/2, which forces all requests for information through the `DosDebug()` API. Of the two models (OS/2 versus Windows NT), the NT model is far easier to work with.

Loading a New Process

Loading a process for debugging under NT is as simple as adding the DEBUG_PROCESS flag to the `fdwCreate` creation flags parameter of `CreateProcess()`. Unlike with OS/2, there's no need to connect to the child process.

continued



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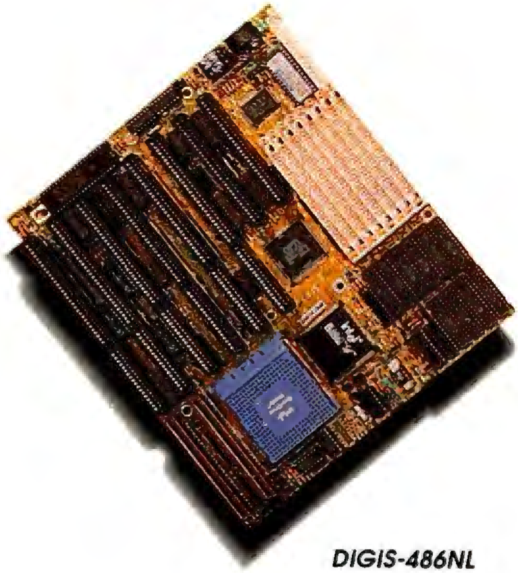

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Once the child process has been created, the debugger can immediately go into its `WaitForDebugEvent()` loop. If the debugger wants the child process not to start execution until the debugger has a chance to set breakpoints, it can also specify the CREATE_SUSPENDED flag to `CreateProcess()`.

Execution Control

There's no explicit support for single-stepping an instruction or setting breakpoints in NT. An NT debugger is in the same boat as its Windows 3.1 siblings in that it needs to set or clear the trap flag, write breakpoint op codes (0xCC) to memory, and watch for INT 1 and INT 3. On the other hand, as in OS/2, an NT debugger doesn't have to install an interrupt/exception handler. Rather, NT tells the debugger about interrupts in the child process via EXCEPTION_DEBUG_EVENT events returned by `WaitForDebugEvent()`.

An NT debugger gets two chances to handle an exception. The first time it sees the exception, NT sets the `dwFirstChance` flag in the EXCEPTION_DEBUG_INFO structure returned by `WaitForDebugEvent()`. When the debugger starts up the child process again after receiving a child-process exception, it specifies one of two possible flags. The DBG_CONTINUE flag tells the NT kernel to start the child process running again and not to invoke any structured exception handlers in that process. If the debugger specifies the DBG_EXCEPTION_NOT_HANDLED flag, the NT kernel invokes any structured exception handlers that the child process may have set up.

If the NT debugger specified DBG_EXCEPTION_NOT_HANDLED and the child process doesn't have any exception handlers, the NT kernel tells the debugger of the exception again. This time, if the debugger specifies DBG_EXCEPTION_NOT_HANDLED to `ContinueDebugEvent()`, the operating system terminates the child process.

Memory and Register Access

The `ReadProcessMemory()` and `WriteProcessMemory()` APIs are the ticket for accessing the memory of the program being debugged. These APIs are similar to the `MemoryRead()` and `MemoryWrite()` APIs in Windows 3.1. The key difference with NT is that you have to specify a handle for the process whose memory you'll be accessing (separate address spaces, remember?).

The keys to accessing the registers of the process being debugged are the `GetThreadContext()` and `SetThreadContext()` APIs. Both take a thread handle and pointer to a CONTEXT structure.

The CONTEXT structure has space for holding practically all the registers of the CPU, including the 387 floating-point registers and the debug registers. Because some of the flags in the CONTEXT register (e.g., the protected-mode flag) have systemwide ramifications, `SetThreadContext()` won't allow you to alter those flags.

Event Notification

Events such as DLL loads and thread creations are returned in a DEBUG_EVENT structure by `WaitForDebugEvent()`. The list of events under NT is small compared to the collection of possible OS/2 events.

Like OS/2, Windows NT tells the debugger about DLL loads and unloads for each process. Under Windows 3.1, a debugger knows about DLL loads and unloads only when the DLL is actually loaded into memory or freed. If the DLL was already in memory when the Windows 3.1 debugger spawned the child process, the debugger won't receive any notifications for the DLL. In NT, by contrast, each DLL that a process uses is shown as loaded or unloaded, even if another program has already loaded it. In a sense, loading and unloading a DLL under NT is more like attaching and detaching.

Address Mapping

It took a long time to figure out how to go from a logical section number in the EXE/DLL file to a linear address in memory. Unlike Windows 3.1 or OS/2, NT has no explicit APIs to do this.

It appears that the only way to convert between logical and physical addresses is to watch the process creation and DLL load notifications. Both of these notifications give you the base address where the EXE or DLL file is loaded in memory. By reading the section table of the PE (portable executable) file, you can convert the relative virtual addresses stored there into actual linear addresses in memory.

Isolating a Child Process

In NT, a process that's not pumping messages doesn't affect other processes. Instead, a special thread is devoted solely to placing messages in the appropriate queues of each process. As a result, all these horrible contortions with hard and soft modes go away in Windows NT.

Although NT debuggers are free of the tyranny of hard and soft modes, they're still likely to have separate threads for handling user input and waiting for debug events. In NT, you don't *have* to pump messages in order for the system to remain usable; if you don't, however, your user interface won't respond. An NT debugger that calls `WaitForDebugEvent()` in its user-interface thread won't respond to the mouse or keyboard until the child process stops for some reason. An unresponsive debugger won't win you any awards for user-interface design. If you look at the DEB sample application in the \MSTOOLS\SAMPLES directory of the March 1993 NT Preliminary SDK (Software Development Kit), you'll see that it has a multithreaded design to avoid this problem.

Miscellaneous Support

Other miscellaneous support includes the ability to use the CONTEXT record to set and read the values of the debug registers. This capability lets you add hardware breakpoints to an NT debugger.

There doesn't appear to be any explicit support for walking the heaps, listing the modules and tasks, and so on. However, the collection of tools that comes with the March 1993 SDK shows that it is possible to do these things. For instance, PVIEW uses the `VirtualQueryEx()` API to walk the heap of a process.

System-Level Debuggers

Application-level debuggers focus on application programs and perhaps an occasional device driver. Because these debuggers are themselves applications, they are subject to the restraints and design flaws of the underlying operating system. The primary problem is that, since they're applications themselves, these debuggers affect the very system that they're trying to debug (a computer science equivalent of the Heisenberg Uncertainty Principle).

For example, these debuggers use the operating system's task-switching mechanisms to switch between themselves and the

child process. This makes them unsuitable for stepping through the operating system's task-switching code.

The places where normal application-level debuggers fear to tread are the domain of the system-level debuggers. These special debuggers use few, if any, of the operating-system services. Instead, they perform all their input and output themselves, talking directly to the hardware so as not to alter the state of the operating system. As a result, the user interfaces of these debuggers are typically much cruder than the interfaces you'll find in application-level debuggers, but the user gains the ability to step through just about any piece of code in the machine. Additionally, system-level debuggers can display the operating system's internal data structures.

Because they can go anywhere and see anything, these debuggers are the tool of choice for operating-system writers and other low-level programmers. You can bet that the operating-system developers at Microsoft and IBM aren't tracing through their bootstrap code in, say, Microsoft's CodeView.

Under Windows 3.1, there are two primary system-level debuggers. WDEB386 comes with the Windows 3.1 DDK (Device Driver Kit) and requires a second machine or terminal. It is a command-line debugger, and as such, it requires that you type in text commands and read scrolling output.

Another system-level debugger for Windows 3.1 is Nu-Mega Technology's SoftIce/W. The user interface is command-line driven, but more commonly used information is shown in windows; less often used information is shown in a scrolling command buffer. SoftIce/W understands the debugging information that Borland's Turbo Debugger and CodeView use, so it's also usable as an application-level debugger. You start both WDEB386 and SoftIce/W after you boot DOS but before you start Windows.

In OS/2 2.1, the system-level debugger is integrated into the operating-system kernel. IBM supplies a special version of the OS2KRNL file that replaces the original. The debug OS2KRNL communicates to the user via a serial connection, in a fashion similar to WDEB386. The basic command set for the debug OS2KRNL is very close to WDEB386's, so it's relatively painless to switch between the two environments.

For Windows NT, Microsoft provides I386KD. This debugger requires two NT machines and is similar to WDEB386 and the OS/2 kernel debugger.

API Power Tools

Despite all the complexity you've just waded through, there are a lot of common concepts in writing a debugger for Windows 3.1, OS/2, and Windows NT. Once you get past the initial hurdle of learning one debugging API, learning the others is easy.

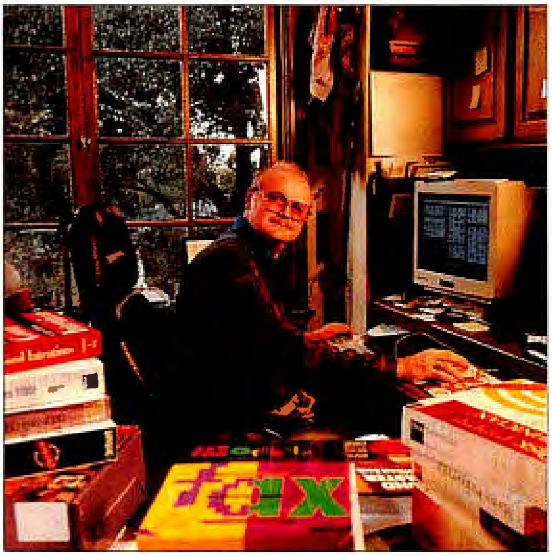
In a sense, the debugging facilities are a chink in the operating system's armor. The operating system needs to allow a debugger special powers that ordinary applications don't have. However, nothing prevents applications that aren't debuggers from using these same facilities. With this newfound knowledge of the debugging APIs, you have a whole new bag of tricks to apply to those nasty problems that don't seem to have a solution. ■

Editor's note: *Some Assembly Required has no listings this month.*

Matt Pietrek specializes in debugging tools at Nu-Mega Technologies (Nashua, NH). He is the author of Windows Internals *(Addison-Wesley, 1993). You can reach him on BIX c/o "editors," or on CompuServe at 71774,362.*

JERRY POURNELLE

The State of Multimedia



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Multimedia hardware is here, but the world still awaits useful application programs

I can remember when going to the National Computer Conference and the West Coast Computer Faire was enough to keep me up-to-date on the computer revolution. Then came Comdex, which rapidly cloned into Fall and Spring shows. After that, there was an explosion of conferences, some general and some specialized, and no one could possibly get to all of them.

One I do try to make is Jonathan Seybold's Digital World. It's held in Beverly Hills in early summer, and it brings together venture capitalists, journalists, educators, Hollywood, the record industry, Silicon Valley, and nearly everyone who's interested in the rather indefinable phenomenon known as multimedia. There aren't too many exhibits, but the hall conversations are wonderful, and it has the best sessions of any conference I attend.

This year, the most interesting session was on education. Ron Rescigno, district superintendent of the Hueneme School District, is interested in what his students learn, not how they feel about things. He showed ways to use multimedia in education and demonstrated the kind of equipment setup a good school district can put together at reasonable costs.

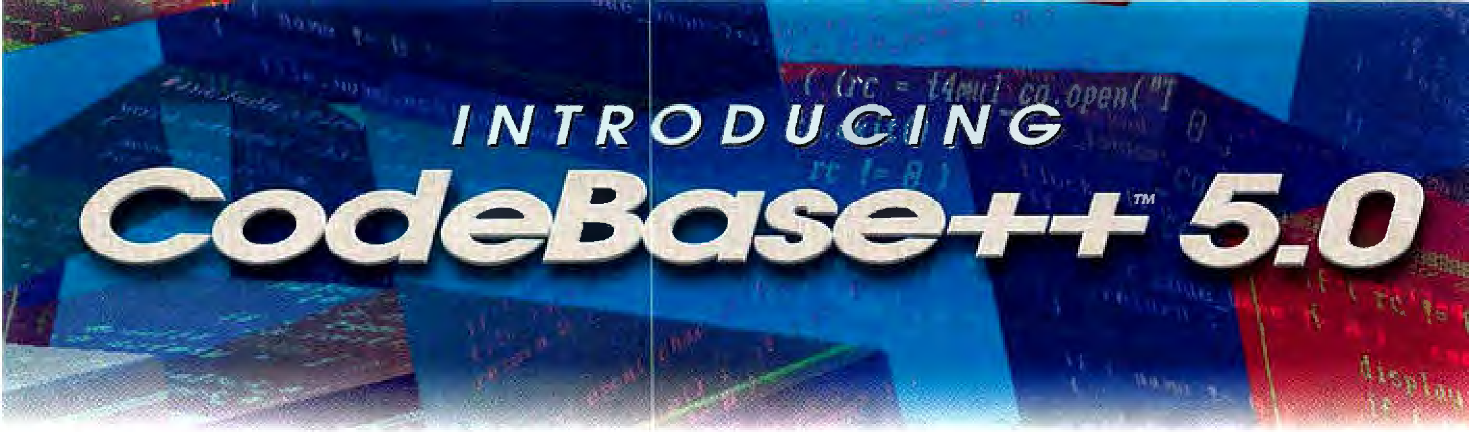
The district's CD-ROM on the Lewis and Clark Expedition uses photos, text excerpts from the expedition's journal, full-motion video clips, and sound recording to build a hypertext account that integrates geography, history, and natural science. The project is still in development, but it was already fascinating. They're presenting real history and useful information in new ways.

There was also the usual twaddle from an Ohio State professor of education, who "isn't interested" in standardized tests or the "usual definition of literacy." He's interested in "how well kids do things differently." I used to be in operations research (see my June column), and I recognize what he's doing: if you can't solve the real problem, change the definitions and criteria so that you can work on something else. It's called "dazzling them with footwork." The result isn't very useful to the customer, but it gets you off the hook.

In this case, he was redefining literacy as reacting to TV, and of course the students are "successful" in doing that. Students will always be successful if you redefine success. Anyone can hit a target glued to the end of a rifle.

He also showed one of the usual gosh-wow contentless multimedia films that abound in our schools now. It took several minutes to convey perhaps three English sentences' worth of information, and it was a dramatic contrast to the excellent Lewis and Clark film.

There's an odd myth making the rounds of the education establishment: skill doesn't exist, and you can't learn by study. This is best illustrated by Chaplin's film *City Lights*, in which a thoroughly inept character is suddenly transformed into the world's greatest political satirist. He never studies or works at developing any skill: it just happens, presumably by osmosis. The osmotic theory of learning appears to be increasingly popular in education: if the school



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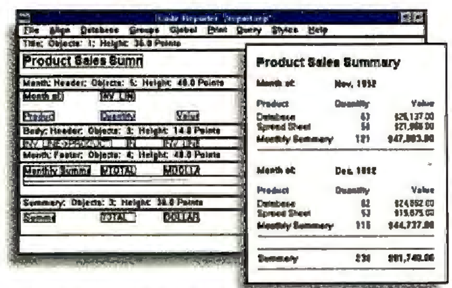

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uses computers just right, skills will appear. The practical result is to assure a continued supply of clients for the social work establishment and exacerbate the already-too-large gap between the productive and the needy.

In the real world, the freedom to study is the real key to liberation. Moreover, the secret of learning to study is like the secret of learning to be a writer: you have to do it. You can't just think about it, talk about it, get in touch with your feelings, or absorb it by osmosis. It doesn't even much matter *what* you study, as long as you master something. Once you have learned to do one thing well, you're a long way down the path to knowing how to do anything well.

Programmers discover this after they've learned one programming language. Not only is the next one easier, but so are a lot of unrelated subjects. Moreover, most humans find learning a skill—any skill—highly rewarding. You don't have to motivate people who have really begun to learn. They'll learn *something* no matter what you do.

This is obvious on 10 minutes' thought, which is why it's surprising when you meet professors of education who don't realize it. I'm reminded of George Orwell's remark at a party: "You must be an intellectual. An ordinary person would never have said a thing like that."

Computers in general and multimedia in particular can be useful in developing study skills. But if we think they're going to negate the need for study and hard work, we're in for a big shock.

Multimedia is nearly all potential at the moment, with few programs to make use of it. However, Kaleida Labs introduced the first public demonstration of the PC version of ScriptX at Digital World. This is a device-independent multimedia programming language that's supposed to make it easy to author multimedia applications. Kaleida is a joint venture of Apple and IBM; they hope to create a standard authoring system that will work on any computer, and I wish them well.

Kaleida is taking applications from developers. Joining up isn't cheap, but if you're planning on doing multimedia applications for Windows, System 7.1, or OS/2, you should be aware of what Kaleida is doing.

Until ScriptX comes out, the best way to play with multimedia is to use a Mac, System 7.1, and QuickTime. QuickTime 1.6 has incremental improvements over previous versions, and it works fairly well. As was true in previous years, most of the exhibits at Digital World were either big workstations or Macs, although this year there were a significant number of high-end desktop PCs.

If you want to do multimedia in Windows right now, your best bet is Asymetrix's Multimedia ToolBook. This has built-in macro recorders, a run-time package you can freely distribute with your program, and a whole bunch of object-oriented programming tools. You can build very complex multimedia projects with this, and while they won't be machine-independent, it's surprising how easy it is to do complex stuff for Windows.

Mrs. Roberta Pournelle has spent the past several months converting her reading-instruction program to the Mac. She's using SuperCard and learning more about managing programmers than she really wanted to know. When she's done with it—version 1 is in beta testing now, and the schools and parents who have seen it love it—I'll use Multimedia ToolBook to convert the new version to Windows.

The current versions of her program—

PC and Mac—require a tutor to read the screens to the student. The tutor needn't be trained. Any literate person—parent, older sibling, classmate who can read, or teacher's aide—will do. But it does require the tutor's constant presence.

Roberta is now playing with a beta version of the PlainTalk TTS (a text-to-speech engine that is Apple's successor to MacinTalk) to turn her program into a nearly stand-alone package. Sit the student down at the computer, go away, and 75 lessons later, you've got someone who can read. By read, incidentally, we mean read anything, not just controlled-vocabulary grade-level stuff.

Like regular ToolBook, the multimedia version is a bit slower than I'd like, but it does the job, and there are plenty of examples to work from. If you're interested in multimedia, this is a good way to get started, and you won't regret the time you spend learning this, no matter where multimedia programming goes.

The Mac world continues to improve, and they haven't neglected the low end. The Mac Classic II has a street price well under a grand, and that's complete: keyboard, small screen, 68030 chip, and System 7.1. It's one heck of a bargain. Sure, you can do a lot more with your guru-friendly Windows machine, but for beginners, it's good enough to get going. There's a lot of Mac in there. Tom Clancy did his first two novels on no better machine, and, like my partner Larry Niven, Tom steadfastly refuses to learn much about computers. (Larry uses a Windows machine, but he doesn't mind that his system sometimes needs a guru: he's got my home phone number.)

My son Richard got through two years at UCLA with a Mac Classic. Eventually he converted to an AT&T Safari laptop with Windows, but if we'd just handed him that in the first place, he might still be using pen and paper.

Last month, I talked about the Tandy Sensation as a beginner's machine, and I haven't changed my mind: if you want to learn Windows from scratch, there's nothing better. However, it costs over $900 more than the Mac Classic II.

If you'd asked me five years ago, I'd have said that given the number of computers appearing in classrooms across the country, it wouldn't be long before everyone left school exposed to the little beasts; but I would have been wrong. We still have computer-illiterate kids graduating from high school. Alas, about a quarter of them leave the school system book- and newspaper-illiterate, too, so I suppose I was overly optimistic.

Anyway, the Mac Classic II is a good start, and it won't be long before Roberta's reading program will be available for it. She operates the Educational Roundtable on GEnie and probably hears from more teachers on a regular basis than anyone in the country. Roberta reports that the Mac Classic II is what most schools are buying now.

If you tried System 7.0 and got fed up, try 7.1, which is a genuine improvement, not just a maintenance release. For example, it now puts your fonts into a fonts

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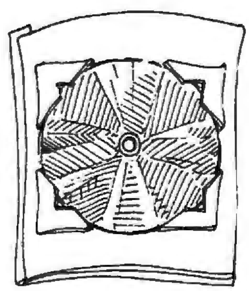
folder, so that your system folder isn't so huge. Unlike Windows, if you have more than 128 fonts, System 7.1 will tell you that you can't use them all and must get rid of some.

Windows never tells you this, but it happily goes on using up the mysterious "resources" trying to support fonts you won't be able to use anyway. If you've recently installed CorelDraw 3 or 4 and your Windows system seems slow or hangs for lack of resources, the problem is probably an excessive number of fonts.

Our Mac Quadra 700 needed a CD-ROM drive, and Roberta wanted it *right now* on a Saturday night. Thus, Alex installed our Pioneer DRM-604X "six-pack" CD-ROM drive on the Quadra. Roberta could read her CD-ROM, but the drive didn't work well. The Mac insists on looking at discs it isn't using, and it almost drove Roberta nuts. We need new software before we'll try that again.

That's the only problem we've had with the new Pioneer DRM-604X drive, which has returned to its primary job as a resource on my Windows for Workgroups network. The old Pioneer drive was amazingly fast; the new one is four times faster in retrieving information, and twice as fast at changing from discs. The old version was pretty good. This is great.



We've had the DRM-604X in continuous service for several weeks, and like the old one, we've had absolutely no problems with it. The older one was in continuous use—turned off only when we were on a trip—for years, and I could always count on it. Indeed, it's still in service at a local school's network, and they don't have any problems with it. That is certainly a rugged machine.

The Pioneer CD-ROM drive is just right for individual users and small networks, where you don't have a lot of users accessing the drive at the same time. Actually, with good caching software like Norton Speedcache+ from Symantec, even that needn't be a problem. Clearly, two people can't access the same physical disc at the same time, but there's nothing to stop you from putting two copies of the same CD in the same drive. That's what I do if Niven and I both want to use the integrated Microsoft Word for Windows and Bookshelf CD-ROM on two different machines. We still have four others we can share alternately, and with a good caching program, you hardly notice that another person is sharing the drive.

Just about everyone needs CD-ROM resources, sometimes a lot of them: I typically draw on at least four CD-ROMs every day. My present setup has a local CD-ROM drive (run by a Sound Blaster Pro card at the moment, but I'll soon be converting to the Future Domain SCSI CD-ROM kit) and network access to the Pioneer drive. The Pioneer drive is in the cable room, where I have to fight through monsters to get at it, so I don't change those discs often.

I could have yet another Pioneer drive available here on my desk. The cost of two "six-pack" drives is pretty small compared to the cost of a dozen individual drives, and having two units with one locally accessible is darned near as flexible. If you're setting up a small business network and don't yet know what CD-ROM systems you'll need, get the Pioneer DRM-604X until you figure it out. It will do more of your job than you think. Highly recommended.

We still needed to get a CD-ROM drive for the Mac. One good solution is to buy one from Apple and have done with it. That will work, but we were in a hurry. Thus, we got a Chinon drive made by Toshiba America. You'll pay a premium price for double- or quad-speed CD-ROM drives. As a bonus, however, they almost all come with multisession Photo CD capability, which lets you view and edit your photographs as high-resolution images on CD-ROM. (For an extra charge, your local film developer will put them on a Photo CD for you when you have your film processed.) Be sure you get that capability when you buy a CD-ROM drive, because Kodak's Photo CD is really worth having. If you don't use it now, one day you will.

When you get your CD-ROM drive for the Mac, get the CD-ROM Toolkit from FWB. This has the Photo CD software, good caching, easy installation, and support for almost every CD-ROM drive made. In fact, you should probably get the CD-ROM Tool-kit first, and then make sure to buy a drive that FWB supports. The CD-ROM Toolkit takes most of the sting out of installing a CD-ROM drive for the Mac, although as I noted above, it doesn't support the Pioneer drive too well. I am told that a new version out about the time you read this will take care of the

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problems with the Pioneer drive.

Alex installed our Chinon drive without the CD-ROM Toolkit and then added it later for comparison. A CD-ROM drive is not inherently designed to be optimum for random access—it's a continuous spiral rather than a series of concentric tracks—but as Alex puts it, FWB's CD-ROM Toolkit speeds up searches something fierce. Recommended.

The big news at Chaos Manor is that I'm becoming fond of OS/2; so much so that if I were starting over on hardware, I'd be careful to make sure everything I bought was OS/2-compatible.

OS/2 isn't for unaided beginners. Setting it up won't be difficult for most BYTE readers. It's not simple; but neither is Windows. Once you have OS/2 set up properly, you can give it to new users with some confidence, particularly if the programs they'll be running are written for DOS and OS/2. I've less experience running Windows programs under OS/2, but I've tried the Windows programs I use frequently—Ami Pro, Microsoft Word, and Ascend—and those do just fine.

I've known for a couple of years that OS/2 is a better DOS than DOS, and it multitasks much better than Windows. It's not necessarily a better Windows than Windows, but it seems to be good enough; and I'm seriously considering converting to OS/2 for all my operations once I get proper networking.

Longtime readers will know this has been no snap decision, and I've still got some reservations. One concern isn't new: I'm still not sure IBM knows how to market software. On the other hand, they sure know how to support it, as I've learned in the past few days. More on this in a moment.

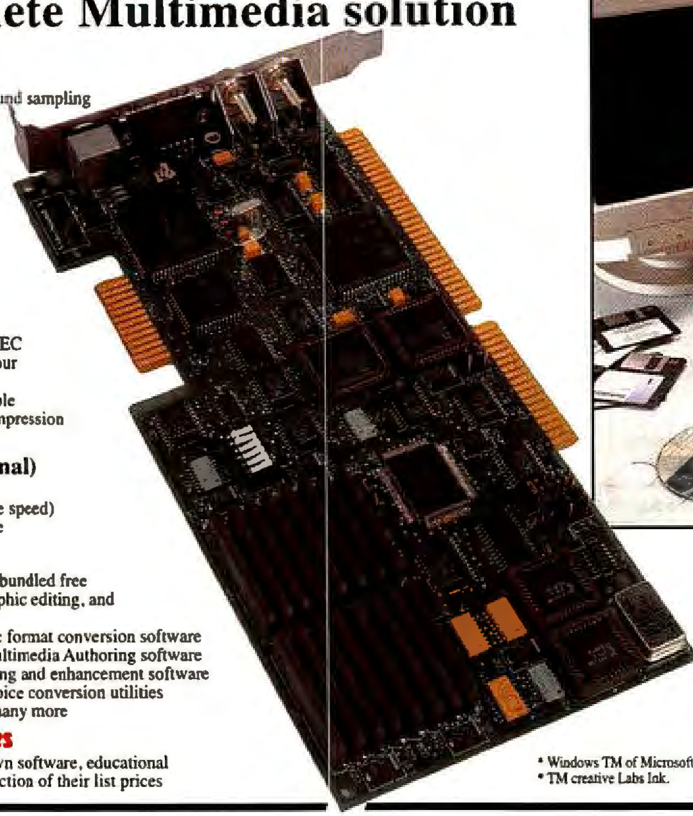
I've been meaning to get to OS/2 for some time now, but the immediate motivation was a new version of Norton Commander for DOS. I've long been in the habit of using Commander as an automated way to deal with my MCI Mail.

This doesn't work as well as MCI's Mail Express. For one thing, MCI gives rather minimal support to the only phone line Commander can use (only 2400 bps and not enough lines; thus, you often get a ring but no answer, or worse, an answer but you can't get into MCI).

Worse, though, Commander 3.0 has some serious design defects. You can't sort the address book, and when you add too many entries to your address book, weird things start to happen to them. On the other hand, I haven't had time to install and learn MCI Mail Express, and warts and all, Commander 3.0 got the job done.

Commander 4.0 has taken care of almost every objection I ever had to its mail handler. It automatically adds names to the address book, and you can have more than one of them. It sorts the addresses. There's good mouse support. The mail viewer is better, and you can incorporate the received message into the reply. There are significant nonmail improvements, too. In a word, if you use Commander 3.0, you will want the upgrade; and if you use MCI Mail, you'll really like Commander as a mail-retrieval tool.

Unfortunately, the Commander 4.0 mail



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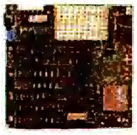

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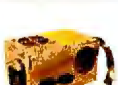

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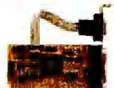

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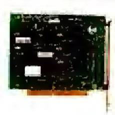

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handler wouldn't work properly on my 486/66 running Windows for Workgroups. For a while I thought this was MCI's wretched line support, but that wasn't it. I could try several times with Commander 4.0 and get nowhere, and then switch back to Commander 3.0 and get access to MCI first try. Also, I could drop out of Windows and use Commander 4.0 under DOS, and that worked; but when I returned to Windows for Workgroups, it would generally fail again.

When it did work, it was slow, really slow compared to the same program doing the same thing under DOS. I know there are those who say Windows is a plot to slow down your machine, but this was ridiculous.

Meanwhile, I got E-mail from OS/2 enthusiast friends who'd been using Commander 3.0 and had switched to 4.0, and they loved it. I'd already determined to give OS/2 2.1 a good try, and since I liked Commander 4.0's mail-handling capability a lot, this seemed like a good time to get OS/2 going.

I did, and I don't regret it, as you'll see in a moment. Meanwhile, if you use Commander, get the upgrade; even without the mail handler, it's a solid improvement over Commander 3.0. If you don't use Commander, you ought to try it. Even under Windows, I use it a lot more than I use File Manager. With Commander, it's easy to view and edit files and generally do housekeeping. Recommended.

Using OS/2 is as easy as using Windows, but it's different. For one thing, OS/2 makes use—good use in my judgment—of the right mouse button, and that takes getting used to. But I can now get around in OS/2 well enough to get my work done.

I use a PS/2 Model 77 486DX2

as my CD-ROM test-bed, so I can rule out hardware incompatibility if I run into problems. Even so, there had been some difficulties installing OS/2 2.0 the first time; but I'm pleased to report that the installation of version 2.1 went like magic. My Model 77 has a CD-ROM drive, and that's what I used to install OS/2 2.1. However, I have reports from many others who say that installation from disks, although more tedious, is no harder. In addition to everything else, they've enormously improved OS/2's installation. (If you buy a PS/2, you can skip the installation entirely, since OS/2 2.1 comes installed.)

Using OS/2 is as easy as using Windows, but it's different. For one thing, OS/2 makes use—good use, in my judgment—of the right mouse button, and that takes getting used to. When you click on an icon with the right mouse button, nothing happens for a good part of a second; then a small menu panel with a bunch of options opens. It's handier than the pull-down or drop-down menus you get with Windows or the Mac.

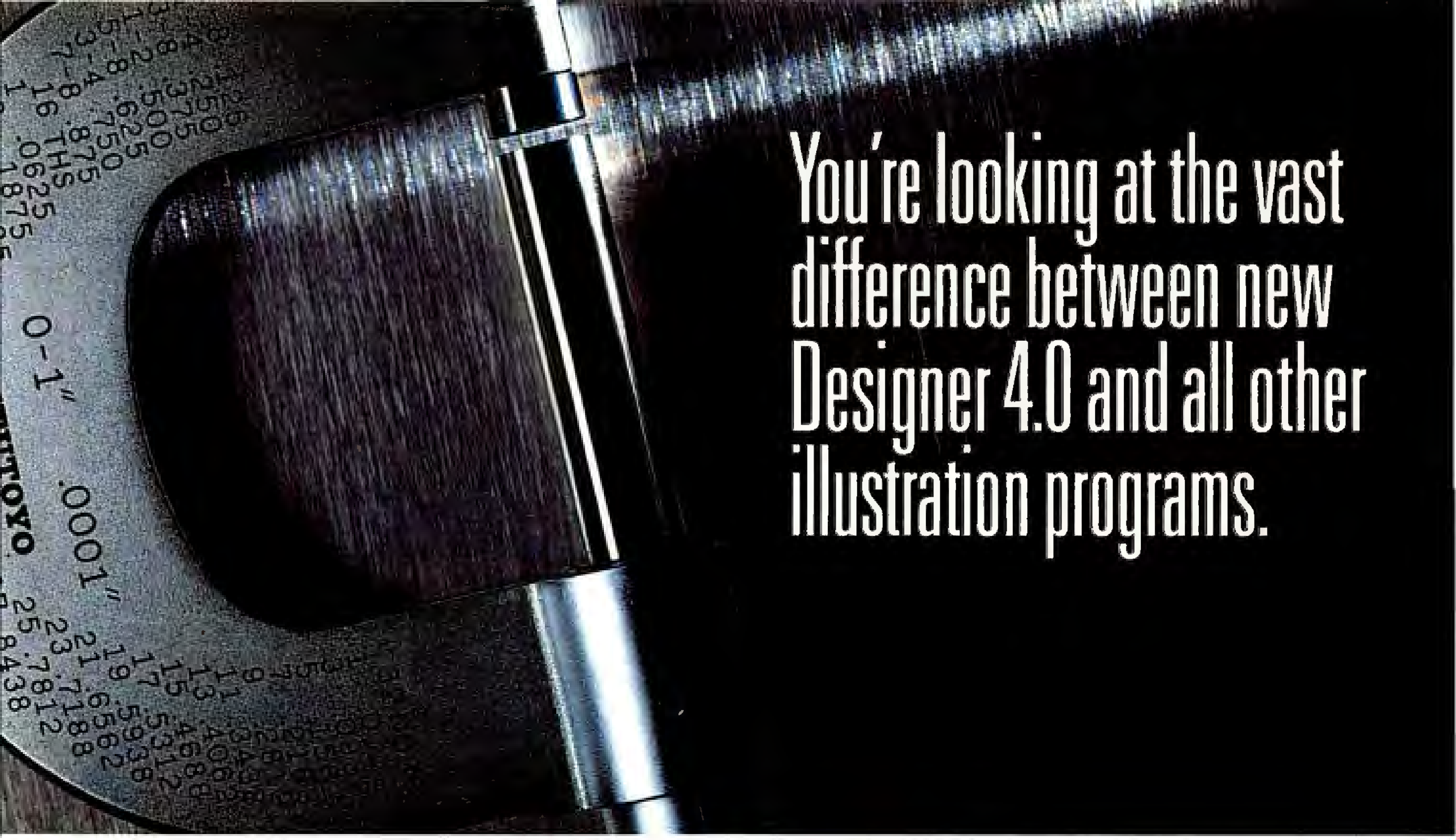
I spent some time fooling around with OS/2. There's a great deal I have to learn, but I can now get around in it well enough to get my work done, and I can make use of some of its features. I particularly like having the ability to set up different CONFIG.SYS and AUTOEXEC.BAT files for each DOS window. I've got a lot more to learn, but it looks as if it will be worth the trouble.

My next step was to transfer a bunch of programs and files. Alas, I have no network board for the Model 77, which is a Micro Channel architecture machine, but that's a minor problem. I installed Traveling Software's LapLink from floppy disks and used the parallel port to connect the PS/2 with one of the machines on my Windows for Workgroups network. That gave me access to every disk drive on the network, and it wasn't long before I had a whole bunch of DOS and Windows programs transferred.

The next step was to migrate the programs. Migration is OS/2 terminology for making them usable under OS/2. The procedure is a bit odd, but it's more than adequately described in the manual. In fact, it's pretty simple if you have faith and follow directions. You end up with your program icon in a general folder with the program set to run under the default OS/2 run-time values. You can then move or copy that program to another location—a different folder, or for more important programs you use a lot, just lay it out on the desktop—and proceed to customize the installation.

This, too, is a process that is easier to do than to explain. It involves opening an on-screen book of values that are associated with this particular program and changing the settings. There are a *lot* of those settings, and using them is not always terribly obvious.

It's particularly important to get them right for communications programs. In addition to using Commander for MCI Mail, I use Procomm Plus to connect to BIX and Aladdin as a front end for GEnie. In each case, my preference is to send a program



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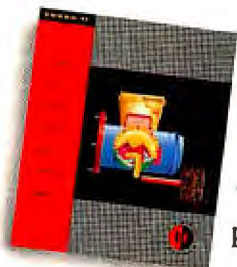

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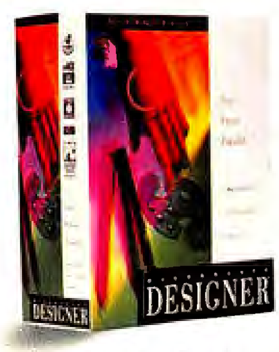

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script out to collect all my E-mail and BBS messages so that I can compose replies off-line. Naturally, I want those communications to run in the background so I can get other work done while everything is downloading.

That sort of works in Windows. By sort of, I mean that most times everything is all right, but sometimes when I run communications in the background, I later find that I've downloaded garbled messages. Everyone tells me that OS/2 never has that problem, so I was eager to convert all my communications to the OS/2 machine.

> I first tried the OS/2 manuals, which are vastly improved.

So, of course, immediately I watched it drop characters from incoming messages, and this was when the program was operating in the foreground. It didn't drop just a few characters, either. When I told OS/2 users my tale of woe, they were universally astounded. Time to check the various OS/2 settings. This is sort of equivalent to looking at the program's PIF (program information file) for Windows, but with OS/2 you have many more knobs to twist.

I first tried the OS/2 manuals, which are vastly improved over earlier versions. There's a section on what to do if your communications program drops incoming letters. Like the section on migration, the instructions were easy to follow, even if I didn't completely understand the reasons for doing things that way.

I took the manual's advice and changed various settings. One pair of them, IDLE_SENSITIVITY and IDLE_SECONDS, have a function that is similar to setting the time ticks in Windows and determine the priorities when OS/2 allocates computer cycles among programs running in the foreground and background. The manual also suggested changes in my start-up CONFIG.SYS file. I did all that, rebooted, and tried again. Same result. Dropped letters. I decided it was time to get on-line and ask for advice again.

It wasn't long before someone solved the problem. The very first OS/2 configuration variable is COM_DIRECT_ACCESS. I wasn't too clear on what that did, but it seemed reasonable that it should be set to on for a communications program. That turns out not to be the case: for nearly all communications programs, it must be off. Once that was done, there were no more dropped letters, foreground or background. Indeed, I even ran Aladdin on COM1 to download some mail while simultaneously using LapLink to bring a file over from the network through the parallel port. All files arrived intact. OS/2 runs communications in the background just fine.

The next problem was even more mysterious. Procomm Plus would communicate all right, but when I told it to download some files, it would beep as if it had already done that—but there were no files.

I played with the OS/2 environment settings. Same result every time. I called IBM technical support. That turned out to be a relatively pleasant experience. First I got

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Booth 1544

Sure, the Compex ParaPort™ and Xircom's pocket LAN adapter seem comparable. Except Xircom doesn't have a printer pass-through port, so you lose your printer slot. And then there's price. Whammo! A whopping 82% cost difference at retail.

The important thing about ParaPort is that you sacrifice nothing by paying less.

Because ParaPort comes with ThruPort™, a printer pass-through port, you can connect the adapter to a PC without losing the use of its printer port and without a cumbersome splitter device.

Small enough to fit in a shirt pocket, ParaPort eliminates fumbling with slots and wires. With both coax and twisted pair on board it gives you hassle-free connections between PCs and compatibles, an Ethernet network, and a personal printer.

ParaPort supports standard and enhanced mode. The enhanced mode is compatible with the emerging EPP standard.

ParaPort doesn't need bulky power supplies because it connects to an external keyboard connector with a slim cable. The keyboard cable "splits" the keyboard connection so the connector is still available for an external keyboard or other peripheral devices. It even comes with a handy carrying case.

ParaPort. Unbeatable performance. Unbelievable price. No wonder when it comes to Ethernet LAN adapters, Compex keeps out-connecting the rest.

Find out more!

COMPEX® Inc., U.S.A.

Out-connecting the rest

U.S.A. Office
Compex, Inc.
4055 E. La Palma, Unit C, Anaheim, CA 92807
(714) 630-7302 • Fax (714) 630-6521

Singapore Office
Compex Systems Pte Ltd
4 Kim Chuan Terrace, Singapore 1953
(65) 288 8220 • Fax (65) 280 9947

Germany Office
ReadyLINK Networktechnology GmbH
Albert-Einstein-Strasse 42, 6074 Rödermark, Germany
49 (0) 6074-98017 • Fax 49 (0) 6074-90668

Circle 504 on Inquiry Card (RESELLERS: 505).

a pleasant young person who gave me a "problem number" and then transferred my call to a technician. That resulted in a very long wait, punctuated by recorded messages telling me to hang on. Since I'd originally called an 800 number, it didn't cost anything, and I used the speakerphone, so I wasn't sitting with a dead telephone attached to my ear. After about 15 minutes, I was connected to a young man named Suman Reza. He asked several questions, and finally, "It's probably pretty stupid, but are you sure you have Procomm Plus set up properly?"

"Yes, of course—" And it struck me. I'd brought Procomm Plus over from the Cheetah, where it resides on the C drive; but on the PS/2, I've been putting OS/2 and Windows programs on the C drive and DOS programs on the D drive. I looked at the Procomm Plus setup, and sure enough, it was told to put downloads in the C:\PROCOM2\ subdirectory; only there was no C:\PROCOM2\ subdirectory. When Procomm Plus made noises as if it had already downloaded what I was after, it was trying to tell me it couldn't open a file.

PCMCIA is a slot that takes a card about the size of a business card, only thicker. It's really an external means of accessing your computer through a new expansion bus. You can use PCMCIA slots to connect your system to many types of devices.

I don't think that's a very helpful way to tell me that, but telling Procomm Plus that the default directory for downloads was D:\PROCOM2\ fixed the problem. I've now tried OS/2 with several communications programs, and they all work without dropping characters. Meanwhile, I learned that IBM's OS/2 2.1 technical support works just fine. It takes a while, but you get to talk to smart people.

I'm running OS/2 on the PS/2 Model 77 with a built-in sound board, a CD-ROM drive, and 8517 terminal support. It's a good computer that's solidly built—heavy plastic lined with metal on the inside—and everything works.

The keyboard has a good, solid feel, as IBM keyboards do. This one has the function keys across the top rather than over to the left side, and I find that annoying. Niven, on the other hand, loves that arrangement and everything about the keyboard.

Keyboards can be replaced, although the PS/2 has a nonstandard keyboard connector, so you can't just plug your old keyboard in. Fortunately, you can get an adapter: the difference between the PS/2 connector and a standard one is mechanical, not electrical.

The biggest problem with the PS/2 is the video. The video board and 9517 monitor work all right—it's good color—but it's pretty slow compared to the ATI Technologies board in my big Cheetah. Also, I'm not entirely pleased with the DOS character set when I run DOS programs full-screen. I'm told there are ATI PS/2 boards with OS/2 drivers, and I'm angling to get one. I expect it will take care of any reservations I may have about the PS/2 Model 77, since I like everything else about it.

I'm tempted to keep Publicity Builder to myself and not tell you about it. That way, I can use it to promote Roberta's program and my books without competition. But that wouldn't be fair to you or to JIAN Tools for Sales, so suffice it to say that this program does a darned good job of explaining how you should go about publicizing your products. It has everything you need, from template press releases to tips on who you ought to be sending them to.

I suppose Publicity Builder is primarily intended for start-up companies, but the program gives tips and advice at quite an advanced level. Perhaps the most experienced PR people won't need this program, but everyone else who wants to publicize products will find it a useful product. Recommended.

PCMCIA is a name no one can love. There's a PCMCIA Association, and by the time you read this, they may have a better name for the product. I certainly hope so, because PCMCIA is going to be a very important technology in years to come.

PCMCIA is a slot that takes a card about the size of a business card, only thicker. It's also known as flash memory and credit-card memory, and that's an important function; but in fact it's more than that. It's really an external means of accessing your computer through a new expansion bus. You can use PCMCIA slots to connect your system to a modem, network, or SCSI devices, as well as use it as a memory system. The latest portables have PCMCIA slots; indeed, the new Hewlett-Packard laptop has four. If they get the standards problem solved, it's likely that in a couple of years all palmtops and most laptops will have PCMCIA slots.

Alas, while committees are working on them, there aren't any standards yet; while the hardware is final, software glitches have meant that cards aren't always interchangeable between machines. There are several standard PCMCIA cards. These are largely determined by the thickness of the card they'll accept. That thickness goes up to Type III, which is large enough to accommodate a small hard drive. (Toshiba uses a nonstandard Type IV specification, which is even larger.)

If your system doesn't have a PCMCIA slot, the simplest way to read PCMCIA cards is with Adtron's IC Card Drive: just connect the drive to the parallel port and

For More Information

If you're buying a CD-ROM drive for the Mac, get **CD-ROM Toolkit** ($79) from **FWB, Inc.** (2040 Polk St., Suite 215, San Francisco, CA 94109, (415) 474-8055). The package supports most CD-ROM drives; includes caching and Kodak Photo CD software; and makes installation easy. **Circle 1146 on Inquiry Card.**

Pioneer's new **DRM-604X** six-disc high-speed CD-ROM drive ($1845) is four times faster than my old model, and it's ideal for sharing a suite of CD-ROM applications over a network. Highly recommended. Contact **Pioneer Communications of America**, 600 East Crescent Ave., Upper Saddle River, NJ 07458, (201) 327-6400. **Circle 1147.**

Don't have a PCMCIA slot? The **IC Card Drive** ($295) is an external PCMCIA drive that attaches to any parallel port or serial port. An internal version ($395) hooks up to your system's IDE interface or ISA bus slot. Contact **Adtron Corp.**, 3050 South Country Club Dr., Suite 24, Mesa, AZ 85210, (602) 926-9324. **Circle 1148.**

The **Mac Classic II** is a great starter machine for computer novices, and it's a heck of a bargain to boot. Prices start at $1079 for a system with 4 MB of RAM, an 80-MB hard drive, a keyboard, a built-in monochrome monitor, and System 7.1. If you want multimedia capability, however, you'll need a color system and the **QuickTime 1.6 Starter Kit** ($139). If you're using System 7.0, I recommend **System 7.1** ($99), which puts your fonts into a separate fonts folder and supports Worldscript for international language support. Contact **Apple Computer, Inc.**, 20525 Mariani Ave., Cupertino, CA 95014, (408) 996-1010. **Circle 1149.**

Multimedia ToolBook ($695) is your best choice for creating multimedia applications. It includes built-in macro recorders and a freely distributable run-time package. Contact **Asymetrix** at 110 110th Ave. NE, Suite 717, Bellevue, WA 98004, (800) 448-6543 or (206) 637-1500. **Circle 1150.**

Norton Commander for DOS 4.0 is a solid improvement over the previous version. The mail handler works better, and even under Windows I often use it instead of File Manager to view and edit files. Recommended. **Symantec Corp.**, 10201 Torre Ave., Cupertino, CA 95014, (800) 441-7234 or (408) 252-3570. **Circle 1151.**

OS/2 2.1 multitasks much better than does Windows 3.1, and I like it enough to seriously consider converting to OS/2 for all my operations. OS/2 2.1 was specially priced at $119 at press time (the regular price is $249), but the deal was to run out on September 14. Contact **IBM Corp.**, 1 Old Orchard Dr., Armonk, NY 10504, (800) 633-8266 for the latest information. **Circle 1152.**

Procomm Plus 2.01 has some peculiarities, but it's easy to use and handles all communications in Chaos Manor. It's available for $129 from **DataStorm Technologies, Inc.**, 3212 Lemone Blvd., Columbia, MO 65201, (314) 443-3282. **Circle 1153.**

IBM's **PS/2 Model 77 486DX2** is my machine of choice for running OS/2. The 33-/66-MHz processor has plenty of power. The PS/2 comes with a 212-MB SCSI hard drive, a 2.88-MB floppy drive, 8 MB of RAM, XGA graphics (no monitor), a mouse, a keyboard, and OS/2 for $3335. The Micro Channelarchitecture bus limits expansion options, but the three-year parts and labor warranty and 24-hour support line are top-notch. Contact **IBM Personal Computer Corp.**, Rte. 100, Somers, NY 10589, (800) 772-2227. **Circle 1154.**

Publicity Builder ($129) does a good job of helping you publicize your products. It includes PR templates, tips on who to send your releases to, and more. Contact **JIAN Tools for Sales, Inc.**, 127 Second St., Los Altos, CA 94022, (415) 941-9191. **Circle 1155.**

ScriptX isn't shipping yet, but this device-independent multimedia programming language should make developing platform-independent multimedia applications much easier. Contact **Kaleida Developer Services**, Kaleida Labs, Inc., 1945 Charleston Rd., Mountain View, CA 94043, (415) 966-0400. **Circle 1156.**

SuperCard ($299) is a hypertext scripting language for the Mac that we're using at Chaos Manor to convert Roberta's DOS-based reading program. Recommended. Contact **Aldus Consumer Division**, 5120 Shoreham Place, San Diego, CA 92122, (619) 558-6000. **Circle 1157.**

run the software. Obviously, this isn't going to transfer files at bus speeds (there's a serial-port connection capability that's even slower), but you will be able to read most PCMCIA cards. If you have a portable with PCMCIA capability, this is a very convenient sneakernet capability; and you can use the Adtron box with a portable that doesn't have PCMCIA.

Adtron also makes a bus-card IC Card Drive, which installs more or less like a standard disk drive. It's much faster than the parallel-port version and lets you experiment with various PCMCIA connector devices like modems and Ethernet connections. One warning: I got my unit directly from Adtron, and it didn't come with a bezel or mounting hardware. That's not a serious problem, but you will need to arrange for that. Otherwise, there are no installation difficulties.

The big breakthrough with this type of PCMCIA drive will come when all computers have the new superfast parallel-port hardware. Some machines already have it, and the rest will have to follow suit: it's enormously convenient to move data through a port at what amounts to bus speed.

The book of the month is Rita Kramer's *Ed School Follies: The Miseducation of America's Teachers* (Free Press, 1991), a warmly written critical look at what our teachers are learning—and not learning—in our colleges. She has important things to say about why our school system doesn't seem to work so well.

The computer book of the month is Ed Krol's *The Whole Internet Users Guide & Catalog* (O'Reilly & Associates, 1992). Just about everything you'd want to know about the Internet. Back in 1975, I said that by the year 2000, anyone in the Western world would be able to get the answer to any question. That's on schedule, and the Internet is helping to make it happen.

Next week I travel to Brazil for a computer show; a full report next month. Also, SyDOS Personal CD, the latest marvels from BSE, the wonderful little MX Modem, and more on my experiences with OS/2. It's a full life. ■

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."

Juggling Standards?

Why Not Keep Them All In One Place?

Getting PCs to co-exist with diverse computing standards means keeping a lot of balls in the air.

As the pioneer in developing X Servers for Microsoft Windows™ · VisionWare™ understands how to unite Windows, X™, NT™, networks, UNIX™ and VMS™ to bring all your computing standards together at the PC desktop.

XVision 5 sets a whole new standard for PC X Servers as a smart, environment-aware server. XVision 5 *automatically* detects underlying network transports, *automatically* optimizes graphics speed to any PC hardware configuration, *automatically* aliases fonts and *automatically* eases the installation process.

Not stopping there, XVision also features transport-independent file transfer, local terminal emulation and an object-oriented, *drag & drop desktop integrating DOS/X/Windows.*

XVision 5 ties it all together. Instead of another ball to keep in the air, XVision provides a *real* solution that finally frees you from the whole juggling act.

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What's New Hardware

A SCANNER SCOOTER ▲

A self-moving hand scanner for graphics and text, ScanMaker Scooter ($549) has a built-in motor that steadily moves it across an image. The scanner automerge function creates a seamless finished scan that ensures that the halves of a large image will merge precisely. The Microtek (Torrance, CA) Scooter can stitch images at a resolution as high as 400 dpi. The 24-bit scanner reproduces images in color, gray scales, and black and white.

Phone: (213) 321-2121.

Circle 1084 on Inquiry Card.

WIZARD CONNECTIONS ▼

The BSE Connectivity Kit ($99.95) and the BSE Serial Kit ($49.95) for the Sharp OZ-9600 let you connect your palmtop computer to other PCs, printers, and peripherals. The BSE Company (Flagstaff, AZ) Connectivity Kit includes a compact RS-232 converter cable and a self-power serial-to-parallel converter. The Serial Kit has the serial cable converter and a null modem adapter.

Phone: (602) 527-8843.

Circle 1087 on Inquiry Card.

FAX MODEM FOR THE THINKPAD

The V.32bis fax modem ($569) from Apex Data (Dublin, CA), designed for the ThinkPad 720 and 720C, has data and V.17 fax speeds as high as 14.4 kbps. The modem goes into hibernation along with the ThinkPad to save battery life.

Phone: (800) 841-2739 or (510) 803-2020.

Circle 1082 on Inquiry Card.

SCSI-2 ADAPTER FOR PCI-BASED SYSTEMS

Creating a direct channel from SCSI peripherals to a host computer, the BT-946C ($499) host adapter makes 32-bit data transfers at up to 132 MBps across a PCI (Peripheral Component Interconnect) bus. The BusLogic (Santa Clara, CA) unit is compatible with PCI Specification revision 2.0 for use with Pentium-based PCI systems and supports up to 8-GB hard drives. A maximum of three adapters can run simultaneously. Fully programmable, the adapter includes a standard PCI 2.0 connector, a 50-pin SCSI-2 connector, and PCI software utilities.

Phone: (408) 492-9090.

Circle 1083 on Inquiry Card.

PC SECURITY

Provide security for your PC with Creative Secure ($139) from Applied Systems (Deerfield Beach, FL). Capable of storing a master and 64 user passwords, Creative Secure records a time-stamped audit trail of computer boot activity. A motion detector and antitheft sensor sounds an alarm if the computer is moved, and you can tie directly into a remote alarm system.

Phone: (800) 338-0463 or (305) 428-0534.

Circle 1086 on Inquiry Card.

SPEEDIER DATA TRANSFER

Designed to handle multiple-sector transfers, the ATI-Ideal Enhancer card ($29.95) lets you enhance your ISA system without upgrading to the VL-Bus. The card, compatible with DOS, Windows, OS/2, Unix, and NetWare, increases IDE-drive data transfer rates by as much as 91 percent, according to Atronics International (Fremont, CA).

Phone: (510) 656-8400.

Circle 1088 on Inquiry Card.

PACKED FOR PERFORMANCE

The Pro-System 486 PCs from National MicroComputers (Salt Lake City, UT) ship with a 245-MB hard drive, 4 MB of RAM, and a 32-bit S3 805 VGA accelerator card with 2 MB of RAM. The system board has a ZIF (zero insertion force) socket that will accommodate the Pentium SX processor. A 32-bit VL-Bus hard drive controller, 128 KB of static RAM cache, and a flat-screen color monitor round out the units. Prices start at $1850.

Phone: (801) 265-3700.

Circle 1089 on Inquiry Card.

POCKET MULTIMEDIA AND CONNECTIVITY

Franklin Electronic Publishers (Mt. Holly, NJ) has put speech, sound, and serial connectivity in its latest Digital Book System. The 4.6-ounce DBS-2 ($129) reads two matchbook-size digital-book ROM cards, each of which contains up to 20 MB of

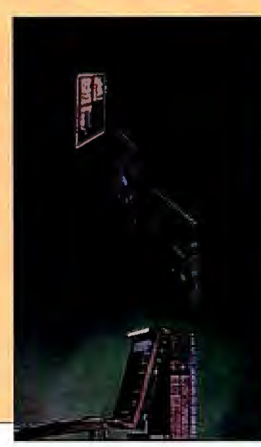
compressed information. You access the data by entering key words or the first few letters of a word, and you can cross-reference the two installed books.

Phone: (609) 261-4800.

Circle 1085 on Inquiry Card.

A POWERFUL PORTABLE, ANY WAY YOU SLICE IT

The MediaMach family of integrated-presentation portables provides a complete portable multimedia production and delivery system. You use the ComposerSlice (from $1731) and the PresentationPlayer (from $7195) joined together while you create your production; then you take only the PresentationPlayer on the road for the show. All required sound, video, and other hardware and software are installed, giving you a ready-to-run system. Systems are available for the major video compression and playback standards, such as DVI, AVI, and JPEG; a PresentationPlayer is also available for MPEG playback.



Contact: Dolch Computer Systems, Milpitas, CA, (408) 957-6575.

Circle 1078 on Inquiry Card.

Hardware

FAST THERMAL COLOR

A 2-ppm plain-paper printer, the SpectraStar GT ($4495) color thermal printer runs at 33 MHz and supports PostScript Level 2. Two built-in cartridge slots accommodate plug-in cartridges. The General Parametrics (Berkeley, CA) printer comes with Pantone-certified color matching, 6 MB of RAM, and 52 fonts.

Phone: (510) 524-3950.

Circle 1090 on Inquiry Card.

LOCAL-BUS DISPLAY

The Legend 24VL/IDE VL-Bus controller provides Windows acceleration, a 32-bit local-bus IDE hard drive interface, a floppy drive controller, two serial ports, and a parallel port. The $199 card, from Sigma Designs (Fremont, CA), supports 24-bit color at 640- by 480-pixel resolution.

Phone: (800) 845-8086 or (510) 770-0100.

Circle 1092 on Inquiry Card.

LAN FAXING

A network fax server the size of an external modem, the LanFax/V (from $1795) offers fax on demand along with multiline, broadcast, and automatic routing capabilities. From Vidicode (Wilmington, NC), the server automatically routes incoming faxes to the proper node and is operative even when the network is unavailable.

Phone: (919) 452-5600.

Circle 1093 on Inquiry Card.

DOUBLE DOCKING

Besides being a standard HDI-30-to-DB-25 cable adapter, SCSI DOC ($49) lets your PowerBook dock as a SCSI device with another Mac when coupled with a cable. A switch on the APS Technologies (Kansas City, MO) adapter provides the dual personality.

Phone: (816) 373-5800.

Circle 1094 on Inquiry Card.

Another way to dock your Mac is via the Lapis (Alameda, CA) SCSI Dock ($199). A small docking station for the PowerBook Duo 210 and 230, the unit lets you dock the Duo to any other Mac and operate in SCSI disk mode. You can also connect the Duo directly to an external SCSI device.

Phone: (510) 748-1600.

Circle 1095 on Inquiry Card.

MAC FAXING AND MORE

The TelePort/Bronze II fax modem ($109) from Global Village Communication (Mountain View, CA) lets you send faxes at 9600 bps, receive faxes at 4800 bps, and access on-line services at 2400 bps. The TelePort/Bronze II cable plugs into the serial port for fax and data communications. The modem is powered by the Mac via the ADB (Apple Desktop Bus) port.

Phone: (415) 390-8200.

Circle 1096 on Inquiry Card.

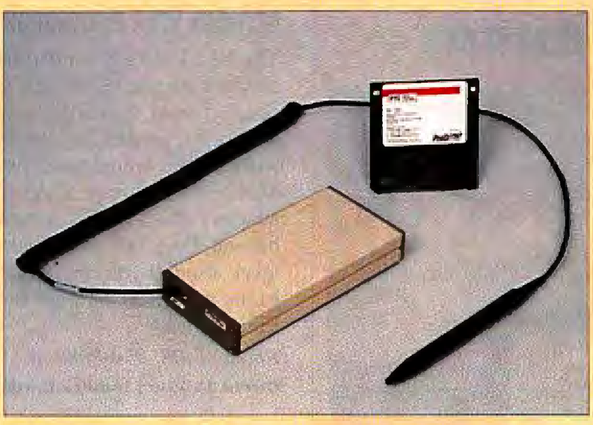
MULTIMEDIA ▶ ANYWHERE

The portable LitePro 550 active-matrix LCD projector from In Focus Systems (Tualatin, OR) accepts European and U.S. video formats and power sources. Compatible with most PCs and Macs, the $8999 LitePro 550's TFT (thin-film transistor) screen can display more than 1.4 million colors simultaneously at a resolution of 640 by 480 pixels. The hand-held SmartRemote control lets you switch seamlessly between video and computer sources.

Phone: (800) 327-7231 or (503) 692-4968.

Circle 1091 on Inquiry Card.

ATTACH A LIGHT PEN TO YOUR PC



Bringing pen computing to desktop PCs, PenDirect for Windows ($498) consists of a light pen, a light-pen interface, and Pen Extensions for Windows. Able to recognize handwriting, the software also responds to editing gestures, providing on-screen editing capabilities; you use the pen to make your changes on the screen of your desktop system. All common mouse actions are available at the stroke or tap of the pen, and you can sign your name to an electronic document. A pen holder attaches to the side of the monitor so you can park the pen when you're using your mouse or keyboard.

Contact: FTG Data Systems, Stanton, CA, (800) 962-3900 or (714) 995-3900.

Circle 1079 on Inquiry Card.

MAKE YOUR PC A HUB

The DigiBoard PC IMAC/4 expansion card (from $1195) turns your PC into an ISDN communications hub for remote LANs and telecommuters. With the DigiBoard (Eden Prairie, MN) card, you can support up to 40 simultaneous telecommuter calls with a single PC.

Phone: (612) 943-9020.

Circle 1110 on Inquiry Card.

SINGLE-SLOT SPARC SERVER

Although it provides 64 serial ports for Sparc-based LANs, the 6400S terminal and peripheral server occupies only a single SBus slot. From Aurora Technologies (Waltham, MA), the $5999 6400S has 16-byte-per-channel I/O buffers to preserve data integrity. All 64 lines can operate simultaneously at speeds of up to 38.4 kbps. The server includes on-board 80-MIPS RISC processors and a Streams-based device driver.

Phone: (617) 290-4800.

Circle 1097 on Inquiry Card.

SCAN COLOR TRANSPARENCIES

From Tamarack Technologies (Milpitas, CA), the 12000C 1200-dpi, 24-bit color flatbed scanner ($1995) has an optional Slide Kit ($795) attachment for scanning transparencies. With an 8½- by 11¼-inch scanning surface, the unit includes hardware gamma correction, 200 levels of brightness and contrast, and built-in Mac and PC SCSI connections.

Phone:(408) 956-0144.

Circle 1098 on Inquiry Card.

VOICE JOINS THE FAX MODEM ▲

A Type II PCMCIA card, the Mercury card ($395) combines fax, modem, and voice for notebook, palmtop, and pen-based computers with PCMCIA Type II or III slots. The Magic RAM (Los Angeles, CA) card has full send and receive fax capabilities, with transmission rates of up to 9600 bps. The data modem operates at speeds of up to 2400 bps, with V.24 MNP 2 to 4 error correction and V.24bis MNP 5 data compression.

Phone: (213) 413-9999.

Circle 1103 on Inquiry Card

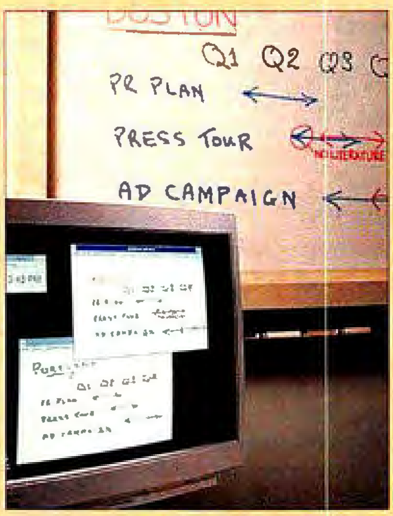
OPEN-SYSTEM WORKSTATION

The AV 500 2-D graphics workstation from Data General (Westboro, MA) is binary compatible with other Aviion open-system units. The expandable $15,000 system has 16 KB of on-chip cache and 256 KB of integrated secondary cache, 16 MB of error-correction-code memory, integrated SCSI-2 and Ethernet interfaces, and a 17-inch monitor with 1280- by 1024-pixel resolution. You can use the AV 500 for software development and as a client in distributed enterprise computing.

Phone: (508) 898-4000.

Circle 1099 on Inquiry Card.

WRITE IT ON A SOFTBOARD, READ IT ON A MONITOR



When you write on SoftBoard ($2995), your information is simultaneously displayed on your PC or Mac monitor. You can save the data, print it, use it in other applications, and share it with others either locally or at a remote location. SoftBoard works via two laser beams that continuously scan a whiteboard. The lasers locate, identify, and track in real time the position of the markers you use to write on the board. They then translate the data onto your computer display. You can set up multisite sessions using a modem and standard phone lines.

Contact: Microfield Graphics, Inc., Beaverton, OR, (800) 334-4922 or (503) 626-9393.

Circle 1080 on Inquiry Card.

DATA MANAGEMENT RELIEF

With an on-board processor and data management algorithms, the powerStore IDE drive controller ($295) takes over all low-level management functions from your CPU, predicting and holding the most-often-used data in cache memory. From Perceptive Solutions (Dallas, TX), powerStore's accuStat monitoring software assists in this management.

Phone: (214) 954-1774.

Circle 1101 on Inquiry Card.

REMOTE-CONTROLLED DMM

Prairie Digital's (Prairie du Sac, WI) Model 150-02 digital multimeter ($179) connects to your PC via a serial port for data output and control input. The remote-controlled front panel lets the host computer request readings, change ranges, select AC or DC current, enter or exit hold mode, and reinitialize the unit.

Phone: (608) 643-8599.

Circle 1102 on Inquiry Card.

NETWORK YOUR POWERBOOK

The SCSI-490PB multimedia network adapter ($299) lets you connect your PowerBook to a network regardless of the network media being used. From MacNet (San Jose, CA), the adapter, which is fully compatible with EtherTalk at the register level, also lets you connect most Macs with a SCSI port to an Ethernet LAN.

Phone: (408) 954-8888.

Circle 1106 on Inquiry Card.

SENSITIZE YOUR MONITOR

Now you can retrofit your monitor with a touchscreen. From MicroTouch Systems (Methuen, MA), the pocket-size SMT-1 ($318), with CMOS circuitry, plugs into your monitor's housing and can be mounted on the monitor. The needed 5 V of power comes from the monitor's power supply, the PC, or an external power supply.

Phone: (508) 659-9000.

Circle 1112 on Inquiry Card.

NOTEBOOK COLOR

The 5½-pound ColorBook (from $1995) is a 486SX-based notebook that features a 9.4-inch backlit VGA LCD with dual-scan STN (super-twist nematic) color. The expandable unit, from Gateway 2000 (North Sioux City, SD), has 4 MB of RAM,

an 80- or 170-MB hard drive, an integrated trackball, and a PCMCIA Type III slot.

Phone: (605) 232-2000.

Circle 1100 on Inquiry Card.

MOUSE TRACKS

Version 4.0 of the Expert Mouse trackball (from $149.95) from Kensington Microware (San Mateo, CA) adds a software application that integrates the hardware features for complete cursor control. This includes the ability to jump the cursor to any spot on the screen using the Brilliant Cursor technology, pixel-by-pixel control with the Slow Cursor technology, custom acceleration that matches the way you work, and programmable mouse buttons that let you do such things as chording.

Phone: (415) 572-2700.

Circle 1116 on Inquiry Card.

The Freedom Station ($29.95) mousepad from CPResearch (Augusta, ME) has a projection-suspension tower through which you feed your mouse cord to let the mouse glide around the mousepad unencumbered. The Freedom Station simulates the feel of a wireless mouse via the length, tensile strength, and projection angle of the tower.

Phone: (207) 622-1867.

Circle 1117 on Inquiry Card.

Poetic License $99.*

The True, Cross-Platform C++ Object Database.

Empower yourself to create the C++ applications you've always envisioned. For a limited time, you can get a single-user POET Personal Edition for Windows for just $99. The Personal Edition is 100% compatible with the client/server Professional Edition and supports either a Borland or Microsoft Compiler.**

POET is truly object-oriented. It saves you time because complex objects do not need to be broken up into tables. POET requires only one command to store, read, or delete them.

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POET Software International Offices: POET Software - Europe +49 (0) 40/6 09 09-0 Silicon River - United Kingdom +44 (0) (81) 317-7777

Circle 196 on Inquiry Card.

What's New Hardware

SIMPLIFIED NETWORK CONNECTION

The LPM2, LPM4, and LPM8 (from $395) from Lantronix (Laguna Hills, CA) have two, four,

and eight ports, respectively, that let you connect up to eight nodes on an existing network via a single transceiver. In stand-alone mode, the LPMs let you set up a two-, four-, or eight-node LAN.

Phone: (800) 422-7022 or (714) 367-0050.

Circle 1108 on Inquiry Card.

LAN TO WAN

Able to provide a seamless link between multiple LANs on a WAN (wide-area network), the WIN card ($995; software, $205) can also link a PC on the LAN and a host on the WAN, thus eliminating bridges and routers. The WIN card, from Network Automation (Northboro, MA), includes built-in emulations for IBM, Unisys, DEC, Tandem, and Fujitsu and is X.25 compliant.

Phone: (508) 393-1777.

Circle 1107 on Inquiry Card.

SEND VOICE MAIL FROM YOUR NOTEBOOK ▼

The Inex 4000 Series upgradable 486SX notebooks (from $2199) feature pocket-size high-speed communication modules that support LANs and WANs (wide-area networks), including wireless cellular data. With an AudioDrive multimedia chip, the Inex Technologies (Santa Clara, CA) notebooks provide the means for audio presentations, vocal script, and voice E-mail. The units support up to 20 MB of main memory and up to 200 MB of storage on the removable hard drives. The LCD screen is also upgradable.

Phone: (800) 783-4639 or (408) 986-9941.

Circle 1105 on Inquiry Card.

CHECK THE HANDSHAKE

Chefford Canada's (Nepean, Ontario, Canada) LanLoc works with PC and Unix networks or systems to prevent unauthorized users from gaining access via a modem. Customized to fit each application, the combination hardware and software LanLoc uses an encrypted challenge/response handshake to verify a name and password. Prices start at $80 per node ($155 per node with communications package).

Phone: (613) 596-4108.

Circle 1109 on Inquiry Card.

PCMCIA FAX MODEM

A V.32bis fax modem in a PCMCIA card, the PractiCard 144 ($499) from Practical Peripherals (Thousand Oaks, CA) provides 14.4-kbps data transmission as well as Class 1 and Class 2 14.4-kbps send and receive fax transmissions. Providing V.42 error correction and V.42bis data compression, the PractiCard is able to reach computer-to-modem speeds as high as 115.2 Kbps.

Phone: (805) 497-4774.

Circle 1111 on Inquiry Card.

LARGER, FASTER STORAGE

Memorybank (Ann Arbor, MI) has added two members to its Memorybank II line of disk and tape subsystems. A Memorybank II with a 3-GB hard drive (from $9520) features a seek time of 12 ms, 5400-rpm disk speed, and a Fast SCSI-2 connection; the unit holds two drives, for up to 6 GB of disk capacity. A Memorybank II with a Tape Autoloader (from $7040) has a 732-KBps data transfer rate and uses standard 4-mm DAT (digital audiotape) cartridges.

Phone: (800) 562-7593 or (313) 761-2782.

Circle 1104 on Inquiry Card.

KEYBOARDS TWO WAYS

A 101-key keyboard with an integrated IsoPoint, the ISO-1000 ($189) performs all the functions of a mouse. From Key Source International (Hayward, CA), the IsoPoint is a linear control device that provides on-screen cursor movement that is directly proportional to the movement of your hand or finger.

Phone: (510) 783-6066.

Circle 1113 on Inquiry Card.

The VersaKey Mac ($395) lets you capture repetitive functions with a single keystroke. From Quest Computers International of Adelaide, Australia, and available from People & Profits (St. Paul, MN), the programmable keyboard has 60 additional keys, to double the number of key definitions available. To program it, you turn on the Learn key, select a Special Application key, input the keystrokes you want saved, and turn off the Learn key.

Phone: (612) 452-8018.

Circle 1114 on Inquiry Card.

SPEEDY DIAL-UP MODEM

Western DataCom's (Westlake, OH) 672 Quadra Pump V.35-based modem operates synchronously over standard switched phone lines without needing special services from long-distance carriers. Batch file transfer speed is 72 kbps. Price is $1895.

Phone: (800) 262-3311 or (216) 835-1510.

Circle 1115 on Inquiry Card.

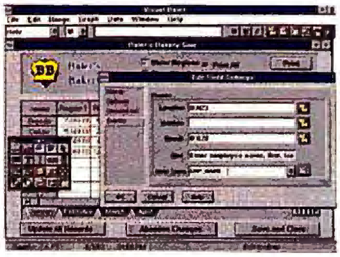
A SMART LEGACY

The Legacy SmartArray (from $7460) incorporates monitoring and sensing components such as audible alarms and visual messages to alert technicians to a failure in a storage device, power supply, or fan. This equipment is hot-swappable, so you can replace it without system or network downtime. Temperature sensors inform the network administrator of abnormal temperature fluctuations. The SmartArray accommodates as many as nine half-height hard drives configured as a RAID level 0 or 1 or RAID level 5 disk array; total storage capacity is as much as 12.6 GB.

Contact: Legacy Storage Systems, Inc., Hopkinton, MA, (508) 435-4700.

Circle 1081 on Inquiry Card.

What's New Software



WINDOWS APPLICATION ▲ BUILDER

Visual Baler ($495), a spreadsheet-based visual development tool for creating stand-alone Windows programs, lets you build your application using spreadsheet-like components such as @ functions and macro commands. From Baler Software (Rolling Meadows, IL), Visual Baler also lets you import existing spreadsheets, such as those created with 1-2-3. You can add security controls to your spreadsheets and design graphical input screens with custom dialog boxes, radio buttons, and check boxes.

Phone: (800) 327-6108 or (708) 506-9700.

Circle 1122 on Inquiry Card.

QUICK FILE CONVERSION

An HPGL/2-to-AutoCAD DXF converter, Tailor Made Software's (Kent, WA) entry-level Hp2Design LFV ($99) can convert all or some of the files in a directory at once, in batch or interactive mode. Typically handling a conversion in less than 15 seconds, the program gives you control over functions such as choice of line-end character, whether mapping is by color or by layer, and whether colors are mapped in HPGL number sequence or as in AutoCAD.

Phone: (800) 732-2585 or (206) 631-1513.

Circle 1124 on Inquiry Card.

WINDOWED BAR CODES

PrintBar Bar Code Fonts for Windows and OS/2 1.0, from Bear Rock Technologies (Shingle Springs, CA), supports most bar code symbology families and all Windows 3.1–compatible printers. When you highlight the information to be converted into a bar code and select the proper font from the pull-down menu, a bit-map image of the bar code appears on the screen, and PrintBar automatically translates the text and numbers into a bar code. Prices: Postnet and FIM, $79; others, $179.

Phone: (800) 232-7625 or (916) 672-0244.

Circle 1125 on Inquiry Card.

PRINT BOOKLET PAGES

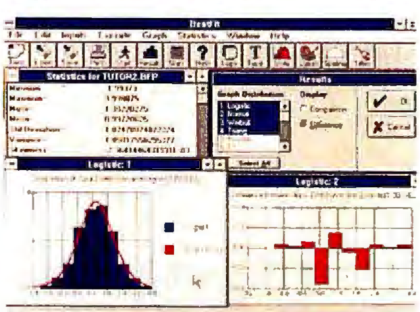
ClickBook ($69.95) from BookMaker (Palo Alto, CA) is a Windows printing utility that lets you turn any Windows document into a double-sided booklet. ClickBook automatically reduces pages and positions them for double-sided printing. The program supports several personal-organizer paper sizes and types, including DayRunner, Franklin, Filofax, and Day-Timer.

Phone: (415) 617-1101.

Circle 1131 on Inquiry Card.

▼ FIT YOUR DATA TO THE BEST DISTRIBUTION

BestFit ($299) works in Windows to give you the best probability distribution to fit your data.



In addition to providing a running graphical display of possible best fits, the software, from Palisade (Newfield, NY), also builds difference graphs of the fits, giving you a visual connection between the actual data and the various distributions. An optimizing algorithm ensures that you get the best distribution type with the best parameters.

Phone: (800) 432-7475 or (607) 277-8000.

Circle 1123 on Inquiry Card.

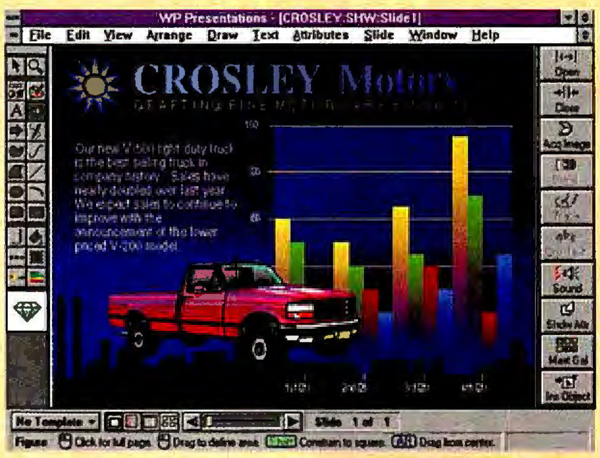
COLOR PRINTING UNDER UNIX

Chameleo universal print-imaging software, designed for working in multiple applications, runs on Silicon Graphics workstations in support of color printers and film recorders. From GW Hannaway & Associates (Boulder, CO), Chameleo lets you print Unix raster files from files such as TIFF, SGI, X Window System, and Wavefront to a variety of SCSI color-output peripherals. Chameleo supports printer-independent scaling and orientation, as well as volume and animation batch printing. The plug-in-module architecture lets you add or change printers easily. Price: $595, plus $395 and up for plug-in modules.

Phone: (303) 440-9631.

Circle 1143 on Inquiry Card.

COMPREHENSIVE WINDOWS PRESENTATION PACKAGE



WordPerfect Presentations 2.0 for Windows ($495), all-in-one Windows presentation graphics software, supports the TWAIN interface, letting you scan images directly into your file using any compatible scanner. (The Logitech ScanMan hand-held scanner is included in initial shipments.) You can edit the bit-map image and convert it into a vector image with Autotrace. The package includes QuickTutors, on-line tutorials from Usability Sciences.

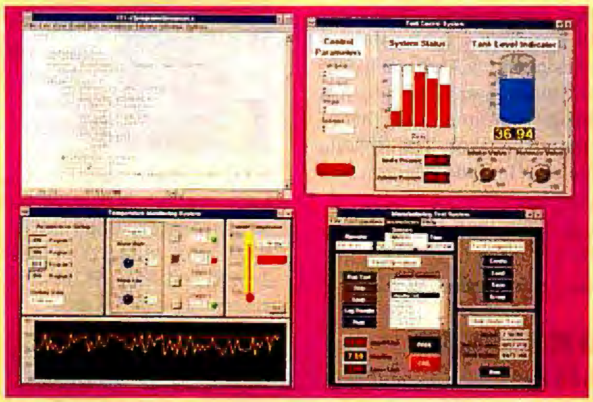
As an OLE server and client, Presentations supports direct CD-ROM sound, as well as the Roland Audio Producer Card, which lets you combine and edit WAV and MIDI sound files. The split-screen chart editor allows you to adjust your text at the top of the screen and see the changes reflected in your chart on the bottom of the screen. Drawing tools include Bézier curves, transparent shadow, and cross hair and ruler. The Slide List and Slide Outliner are among the presentation tools.

Contact: WordPerfect Corp., Orem, UT, (800) 451-5151 or (801) 225-5000.

Circle 1118 on Inquiry Card.

Software

Develop Multiplatform Applications in C



A 32-bit development environment, LabWindows/CVI is automatic code-generation software for designing instrumentation applications with C under Windows and Solaris. The software includes an ANSI C compiler as well as a linker, a debugger, a variable-trace display, and memory-checking capabilities. Libraries are included for designing GUIs; acquiring, analyzing, and presenting data; and networking. You can incorporate your own C source files, object modules, and DLLs, and port programs developed with the LabWindows/CVI between Windows and Solaris. Price: $1995 for the full development system for Windows; $3995 for a Solaris single-user floating license, available in December.

Contact: National Instruments, Austin, TX, (800) 433-3488 or (512) 794-0100.

Circle 1119 on Inquiry Card.

PUT IT ON A CD

CD-IT software ($1295) from OptImage Interactive Services (West Des Moines, IA) enables you to record CD-ROM, CD audio, or CD-I mixed-mode and multisession CDs directly from your Macintosh computer. You use a Philips CDD-521 Recorder to record data to a WORM CD. Software for all the modes, as well as the Philips CDD-521, is available in the CD-ITALL package ($7995).

Phone: (515) 225-7000.

Circle 1127 on Inquiry Card.

NUMERICAL DATA ANALYSIS

A numerical data analyzer, Mathplot from Dynacomp (Webster, NY) is able to analyze up to 200 data points, calculate simple statistical parameters, fit least-squares polynomials, and numerically integrate under a curve defined by the points, among other functions. A menu lets you display the results numerically and graphically. Price: $49.95.

Phone: (716) 265-4040.

Circle 1128 on Inquiry Card.

BECOME CUSTOMER-AWARE ►

An application to record and track customer problems, Aware can import data from business applications such as Act and DacEasy. From Integritech Software (Bedford, TX), Aware also provides user-definable pick lists for data entry fields and lets you add solutions to new problems, among other features. Single-user version, $99; network version, $399.

Phone: (800) 942-6499 or (817) 267-3163.

Circle 1126 on Inquiry Card.

GAIN FINANCIAL ACUITY

Competence Software's interactive tutorial program Financial Competence ($99) covers the principles of business finance, how they are reflected in financial statements, how they can be used in managing your business, and how the statements relate to one another. The program, consisting of seven 30-minute lessons, guides you through parts of an income statement, a balance sheet, and a cash-flow report. The lessons also help you create a financial statement line-by-line. Tests at the end of each lesson identify specific sections of the lesson you should restudy based on incorrect test answers.

Phone: (603) 435-7042.

Circle 1121 on Inquiry Card.

SOPHISTICATED FILE MANAGEMENT

The Radix2 ADI (Advanced DOS Interface) system ($249) lets you custom-configure and manage any directory in a DOS system. From Radix2 Software Engineering (Libertyville, IL), Radix2 ADI is based on a hierarchical command-concatenation processing engine that integrates DOS wild cards, file attributes, a quick sort, and a multiple-file text-string search, providing a high level of control over file manipulation.

Phone: (708) 549-6733.

Circle 1140 on Inquiry Card.

Software Update

Improv for Windows 2.1, Lotus (Cambridge, MA), adds data access to Paradox, dBase, text, Btrieve, and Excel via drivers from Q+E Software; support for .WK4 1-2-3 Release 4 for Windows files; and Notes-specific Application Field Exchange, which lets you exchange Improv worksheets with Lotus Notes fields. $495.

Phone: (617) 577-8500.

Circle 1145 on Inquiry Card.

M-Mail 3.0, InterActive (Humboldt, SD), adds auto color conversion; printing of multimedia elements such as pictures and text without leaving the application; message forwarding with annotation; OLE support; a playback

capability; and E-mail functions. $89.

Phone: (605) 363-5117.

Circle 1271 on Inquiry Card.

K-Star 9.2 software upgrade kit for FastPath 5, Shiva (Burlington, MA), adds TunnelTalk, zone filtering, device filtering, an SNMP community table, a UDP time server, syslogging, log message filtering, and improved DECnet management. $199.

Phone: (617) 270-8500.

Circle 1272 on Inquiry Card.

PortShare Lite 2.0, Stalker Software (Moscow, Russia; Campbell, CA), adds support for Apple Remote Access software. **PortShare Pro 2.0** adds a statistics panel that logs real-time serial-port throughput and network transmission errors. Lite, $49; Pro, $149.

Phone: (800) 262-4722; fax (408) 370-3170.

Circle 1273 on Inquiry Card.

What's New Software

Synchronize Your Audio and Video

The Audio Visual Recorder ($149) lets you work in Windows to record, play back, and save video sequences in AVI (Audio Video Interleave) file format. You need a video-capture card with an AVI driver and an MPC-compatible sound card.

The software lets you record audio and video from most sources and then save the video files at any size. Since you can view audio-wave and video information simultaneously, you can easily edit your work. You can import and export Autodesk animation files as well as WAV, PAL, and single or serial BMP files. You can also export video sequences to FLC and FLI files, map them onto objects in 3D Studio, and then reimport them into Audio Visual Recorder and add a sound track. The package includes Microsoft and Intel Indeo compressors.

Contact: In Sync Corp., Bethesda, MD, (301) 831-5008.

Circle 1120 on Inquiry Card.

3-D Virtual Exploration

An object-oriented, interactive 3-D modeling program, Virtus WalkThrough for Windows ($595) from Virtus (Cary, NC) displays in one window a 3-D representation of an object that you're drawing in an adjacent window. With your mouse, you can navigate within the space, viewing the object from different perspectives.

Phone: (800) 847-8871 or (919) 467-9700.

Circle 1132 on Inquiry Card.

PC Braille Translation

MegaDots ($500) from Raised Dot Computing (Madison, WI) is a braille translation program for the PC. Based on the rules of braille's contraction system, MegaDots uses a style-based word processor for formatting and has automatic table formatting and an easy-to-use interface.

Phone: (800) 347-9594 or (608) 257-8833.

Circle 1133 on Inquiry Card.

Industrial Designs in 3-D

Built-in photorealistic rendering with a ray tracer lets you see natural illumination effects, such as shadows, reflection, and refraction, in DeskArtes ($14,995) from Nth Graphics (Austin, TX). DeskArtes has new techniques for creating complex 3-D surfaces, and it includes texture-mapping and lighting tools. The computer-aided industrial design program can exchange data with other CAD/CAM systems.

Phone: (800) 624-7552 or (512) 832-1944.

Circle 1134 on Inquiry Card.

Decipher a New Language

The Rosetta Stone ($395), an interactive multimedia program, combines more than 3600 color pictures, voices of native speakers, and written sentences in 12 run modes to teach Spanish, German, French, or English to a beginner. The software, from Fairfield Language Technologies (Harrisonburg, VA), has a listen-record-play mode that lets you compare your voice with that of the native speaker. The Rosetta Stone also includes diction and test modes.

Phone: (800) 788-0822 or (703) 432-6166.

Circle 1135 on Inquiry Card.

Unix Moves Mac and DOS Files

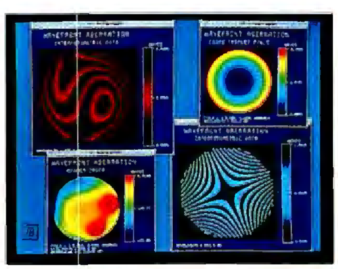
From Digital Instrumentation Technology (Los Alamos, NM), TransferPro for Solaris 2.1 and TransferPro for Motif ($349 each) let Unix systems read and write DOS and Mac disks. Thus, Unix users can move data among different types of computers without a network. The company claimes that TransferPro is faster than Sun's PC NFS.

Phone: (505) 662-1459.

Circle 1136 on Inquiry Card.

Real-World Optical Design ▼

You can now run Code V from Optical Research Associates (Pasadena, CA) on your PC to develop and analyze optical design systems and configurations. The Global Synthesis feature solves practical problems in real-world design. Vector diffraction-based image evaluation includes polarization effects, and MTF tolerance allows you to simulate and predict fabrication problems. Nonsequential surface modeling is also included. You can specify and define tasks via menus and screens. Monthly lease (including maintenance), $800.



Phone: (818) 795-9101.

Circle 1137 on Inquiry Card.

Software Update

Failure Mode, Effects and Criticality Analysis FME-2.0, Powertronic Systems (New Orleans, LA), adds support for MIL-STD-1629A, Notice 1, MIL-STD-2165, MIL-STD-1388 2A/2B, and AMC-P 750-2; enhanced modes of entry; analysis at assembly, subassembly, and part levels; built-in libraries of failure modes; support for NetWare and NetBIOS; and enhanced report outputs. $1700.

Phone: (504) 254-0383.

Circle 1284 on Inquiry Card.

SpaceManager 1.5, Vertisoft Systems (San Francisco, CA), adds SuperCompress; memory reduction of module sizes; and SelectCompress, SuperExchange, SuperMount, FortuneTeller, and Super-Monitor modules. $49.95 through November 15.

Phone: (415) 956-5999.

Circle 1274 on Inquiry Card.

LANlord 2.0, Client Server Technologies Group, Microcom (Yonkers, NY), adds support for LAN Manager and LAN Server and compatibility with NetBIOS-compatible networks; remote control based on Carbon Copy for Windows; support for multiple LANlord servers; alert forwarding capabilities; and a stand-alone PC inventory program. 50-user license, $2495.

Phone: (914) 968-2300.

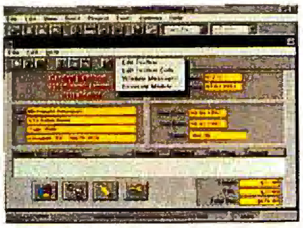
Circle 1275 on Inquiry Card.

Red Brick Warehouse 2.0, Red Brick Systems (Los Gatos, CA), adds support for databases in excess of 75 GB, new business extensions and a report generator to RISQL, and incremental load capabilities. From $23,000.

Phone: (408) 354-7214.

Circle 1276 on Inquiry Card.

Software



VISUAL DEVELOPMENT ▲ SYSTEM

A fully integrated visual development workbench, ProtoGen+ (introductory price, $199) from ProtoView Development (Dayton, NJ) enables you to develop C/C++ and Pascal Windows applications more quickly. Key features of the open environment include recent advances in object-oriented programming; a live, interactive test mode; range validation; DDE-link field editing; MDI (multiple document interface) support; toolbar support; dynamic status-line functions; and 3-D effects.

Phone: (800) 231-8588 or (908) 329-8588.

Circle 1130 on Inquiry Card.

ENHANCED CONNECTION

The PowerConnection utility ($59.95) from Performance Technology (San Antonio, TX) provides two-way access between users on a Windows for Workgroups network and someone using a DOS-only PC running Workgroup Connection. PowerConnection lets the Windows for Workgroups users access disks, printers, and CD-ROM drives attached to the DOS-only machine.

Phone: (800) 327-8526 or (210) 349-2000.

Circle 1138 on Inquiry Card.

ART HISTORY ON CD-ROM

Cameron's Fine Art Poster Catalog on CD-ROM ($49) presents in three segments more than 580 works of art and more than 450 fine art posters, all accompanied by music. Pictures at an Exhibition shows paintings from the Old Masters through contemporary painters, along with the history of each work and artist. Sculptures on Video displays pieces from the Tang Dynasty to Rodin, with historical facts on each. The third segment consists of a collection of fine art posters. You can also use the software, from Cameron Enterprises (Roswell, GA), as a sound and video utility.

Phone: (800) 765-1278.

Circle 1144 on Inquiry Card.

FAX UNIX DRAWINGS DIRECTLY

You can fax large-format drawings directly from your Unix workstation to conventional fax machines using CADfax (from $1999). The computer-aided distribution sends the faxes over standard phone lines. The Formtek (Pittsburgh, PA) software uses an intuitive Motif GUI with pop-up windows that guide you through the procedures. CADfax operates directly on the native CAD file, eliminating the fax scanning process.

Phone: (800) 367-6835 or (412) 937-4900.

Circle 1141 on Inquiry Card.

SPREADSHEET SQUEEZER

An on-the-fly compression utility for spreadsheets, CompressMate ($79 through December) achieves an average compression ratio of 10 to 1 for typical spreadsheet files of text, values, and formulas. Large files can be compressed at ratios of more than 100 to 1. From Intex (Needham, MA), the utility can be used by itself or with disk doublers such as DoubleSpace and Stacker.

Phone: (617) 449-6222.

Circle 1142 on Inquiry Card.

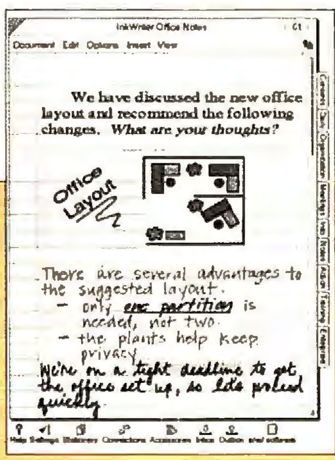
CUSTOMIZE YOUR CURSOR

Magic Cursor II ($39.95) customizes Windows mouse cursors. The Fanfare Software (Santa Monica, CA) toolkit has more than 300 color and monochrome cursors, as well as the Cursor Editor, which lets you adjust any cursor, create your own cursor, or import from any icon. User-defined hot keys let you activate a CAD-style full-screen cross-hair cursor, a real-time magnifying glass, and the blinking rate of the main arrow cursor.

Phone: (310) 828-8448.

Circle 1139 on Inquiry Card.

INK FOR PEN PADS



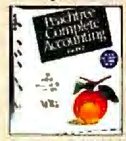
The first in Aha Software's (Mountain View, CA) InkProcessor product line, InkWriter ($249) lets you edit and search computer text and handwritten notes on a pen-based device. Based on SmartInk technology, InkWriter automatically recognizes when you are writing paragraphs, making lists, marking up, drawing, or editing, and handles each item appropriately. You can search through documents to find a word. The initial release runs under Go Corp.'s PenPoint, on 386-/486-based tablets, or on an EO communicator.

Contact: Aha Software, Mountain View, CA, (800) 242-7638 or (415) 988-2080.

Circle 1129 on Inquiry Card.

Software Update

Peachtree Complete Accounting 7.0, Peachtree Software (Norcross, GA), adds an Order Entry module and enhancements to most other modules. $249.



Phone: (404) 564-5700.

Circle 1279 on Inquiry Card.

MKS RCS 6.1 configuration management software, Mortice Kern Systems (Waterloo, Ontario, Canada), adds support for Windows 3.1, a GUI, the MKS Make configuration tool, and additional prefixes to configuration options. $349.

Phone: (519) 884-2251.

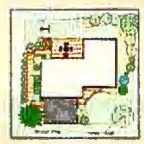
Circle 1280 on Inquiry Card.

Accent GraphicVUE Project Management System 1.4, National Information Systems (San Jose, CA), adds compatibility with DEC's Alpha AXP computers running OSF/1 Unix. From $1450.

Phone: (408) 985-7100.

Circle 1281 on Inquiry Card.

LandDesigner 3.0, Green Thumb Software (Boulder, CO), adds easier editing capabilities, additional graphical symbols, a database search function, a high-resolution printing capability, and new text sizes and styles. $89.



Phone: (303) 499-1388.

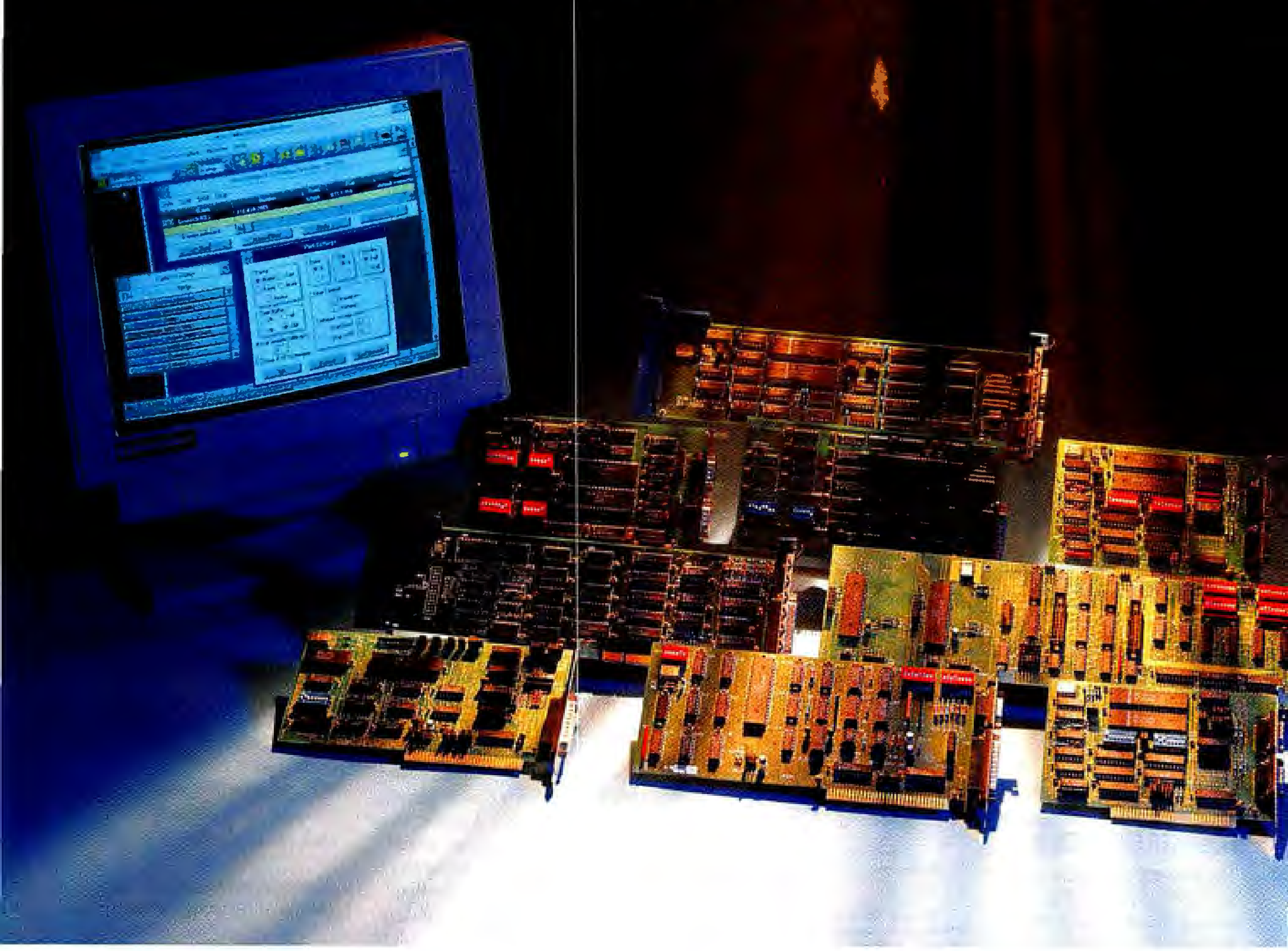
Circle 1282 on Inquiry Card.

LanSoft 3.1, Imagine LAN (Nashua, NH), adds Windows support, coexistence with NetWare, the EPAX 1.0 PC protection tool, improved client/server module performance, and support for many network interface cards. $64 per user at four-user level.

Phone: (603) 889-5889.

Circle 1285 on Inquiry Card.

Quatech, your communication source for RS-232, 422 and 485 adapters.



Quatech manufactures a complete line of communication adapters for PC/XT/AT®, Micro Channel® and compatible buses to meet asynchronous and synchronous, serial and parallel communication requirements with protocols such as RS-232, RS-422, RS-485, Current Loop and IEEE488.

Software support for SCO Unix®, Windows®, Xenix®, OS/2® and DOS.

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Communication adapters featuring: selectable/shareable interrupts, 16550 availability (baud rates up to 256K on standard asynchronous adapters) and address configurable as any COM port. Multiport adapters feature 2, 4, and 8 ports with independent serial interfaces. Most adapters provide AT interrupts (IRQ 2-7, 10-12, 14, 15).

Technical support for our products are available free of charge.

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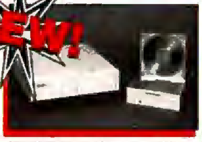

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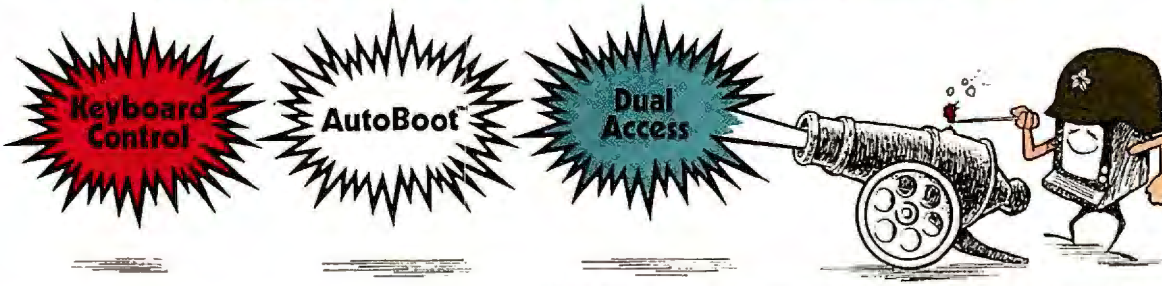

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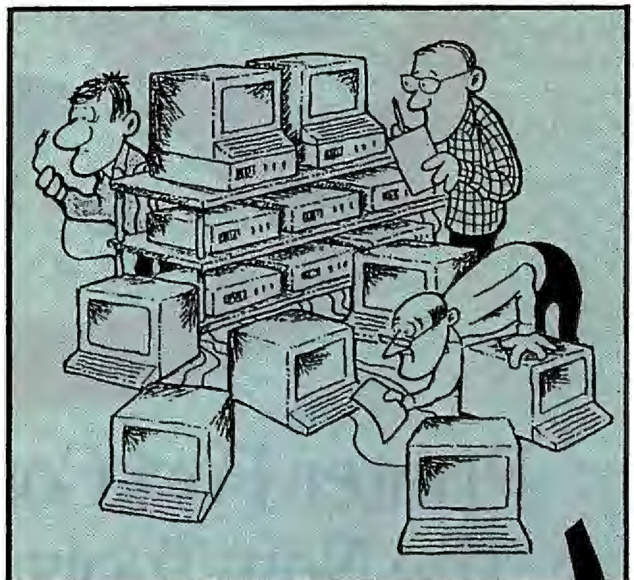

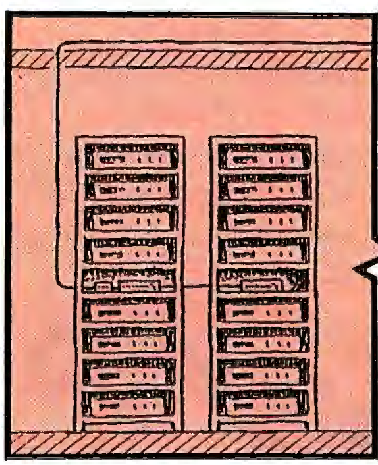

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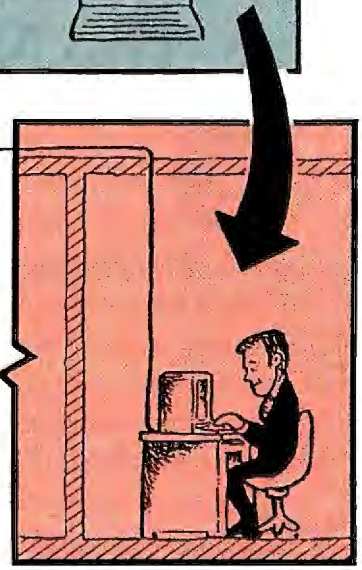

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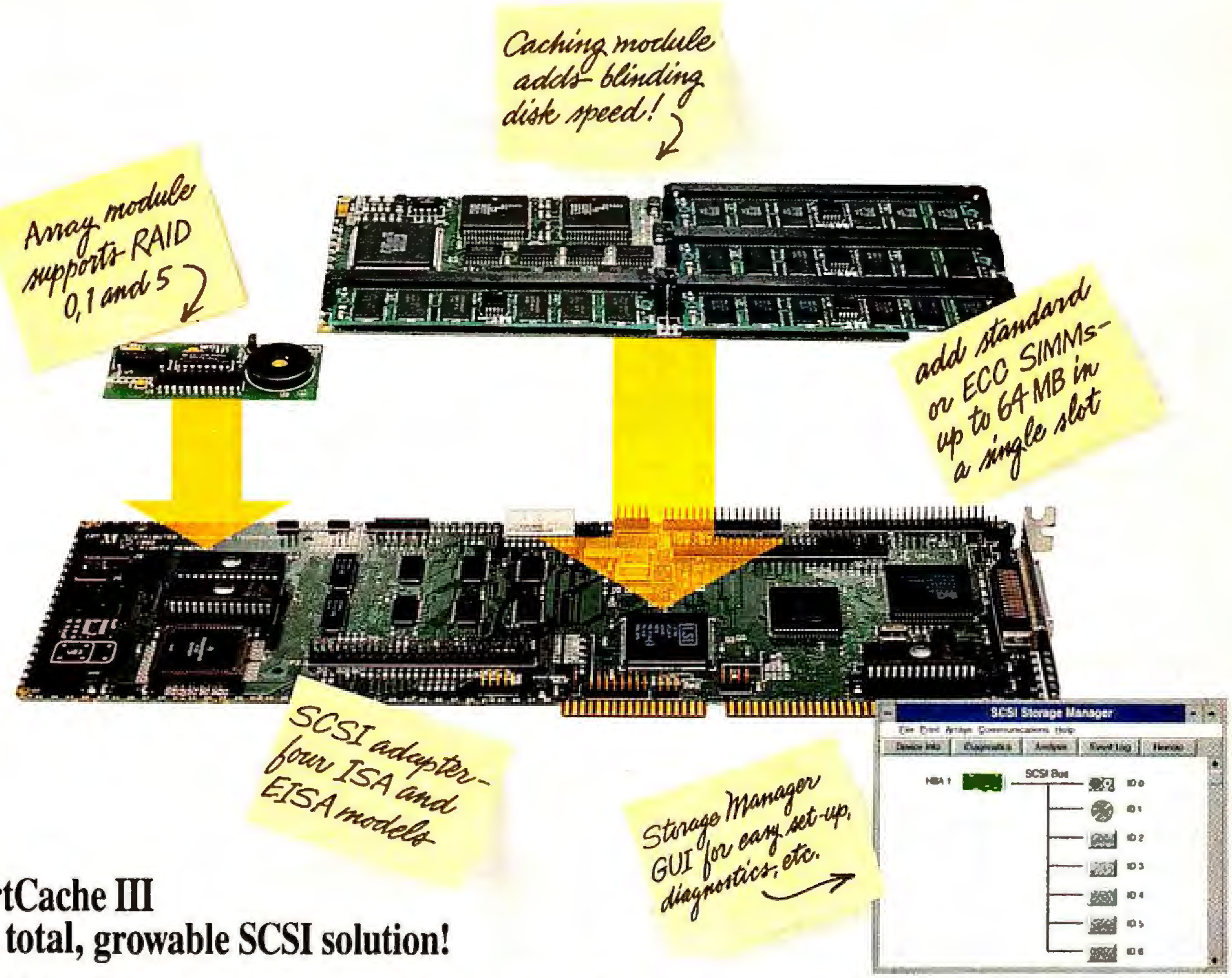

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DeskPro 386/20E	1Meg Exp Bd	113644-001	119.00
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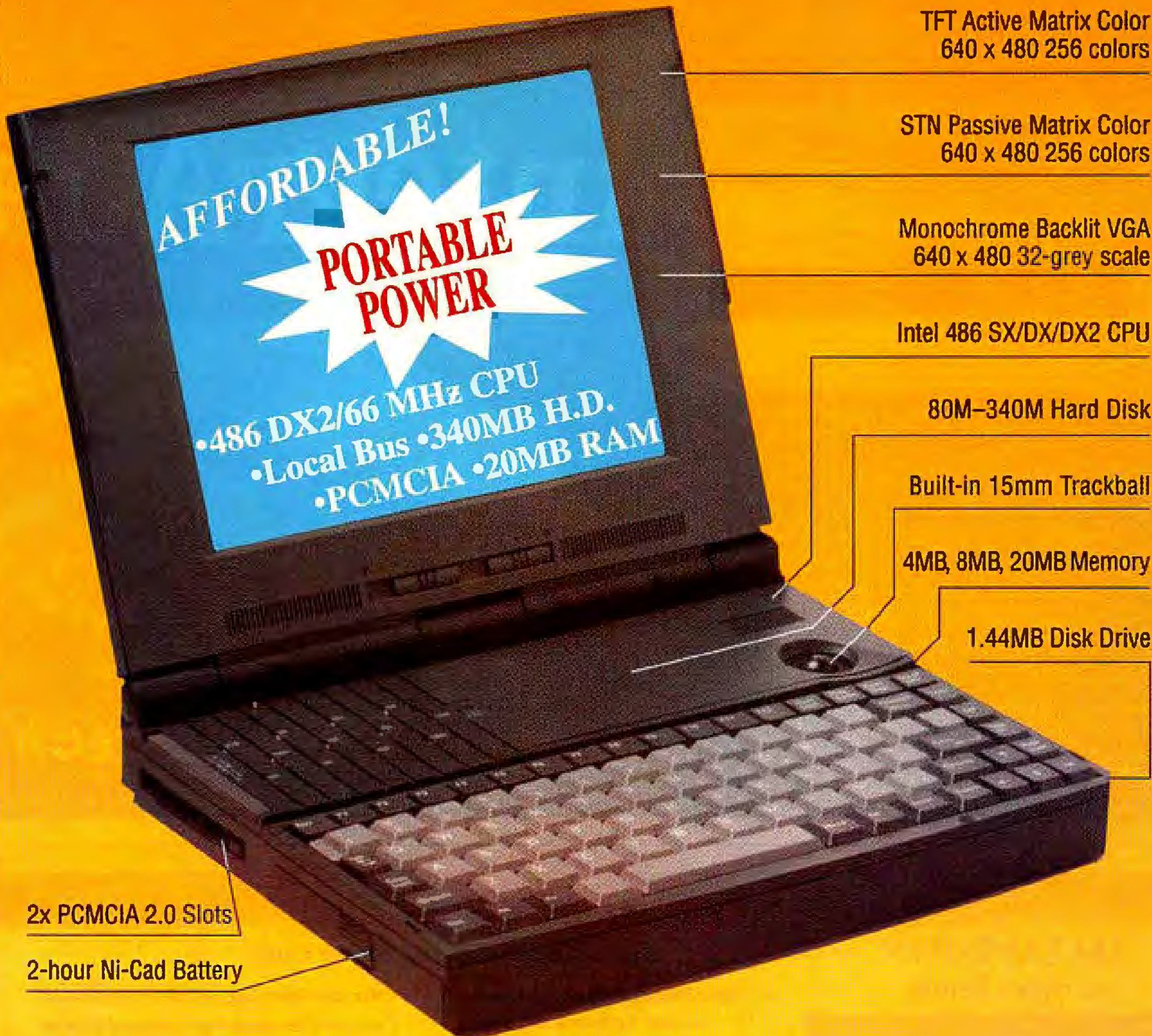

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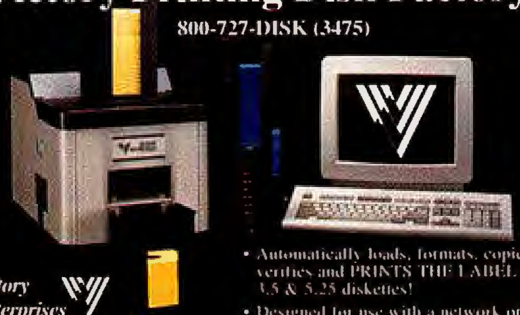

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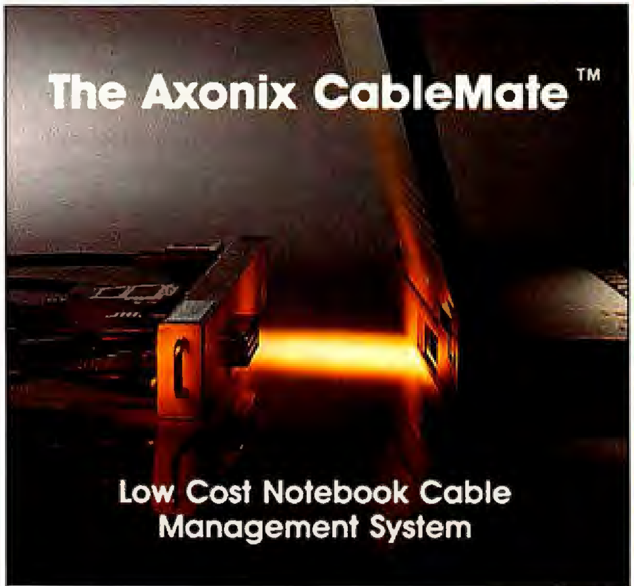

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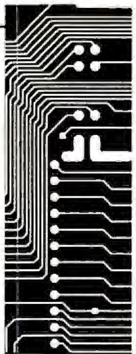

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EDN-Hands On Section, EDN magazine, June 1993.

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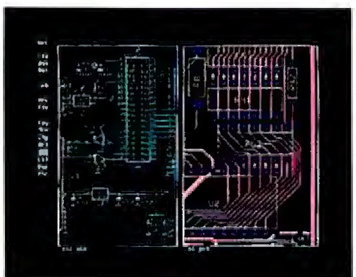

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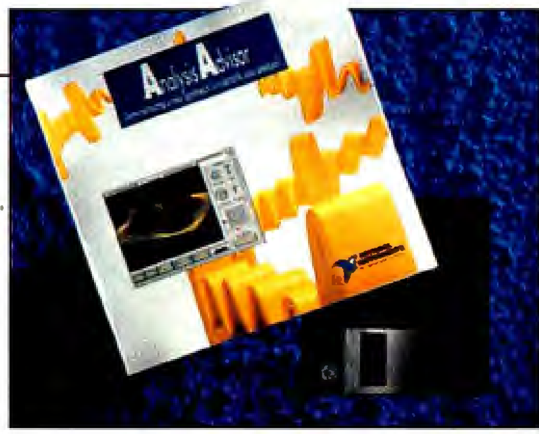

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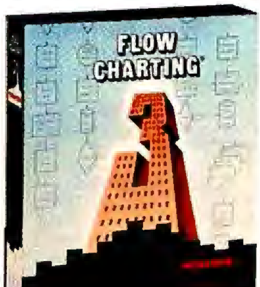

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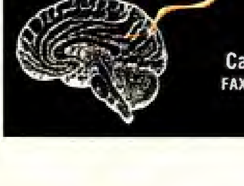

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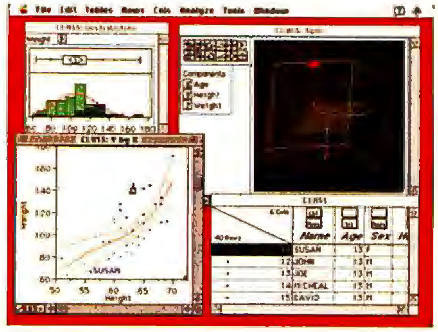

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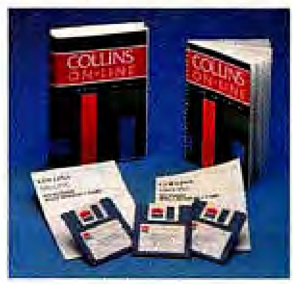

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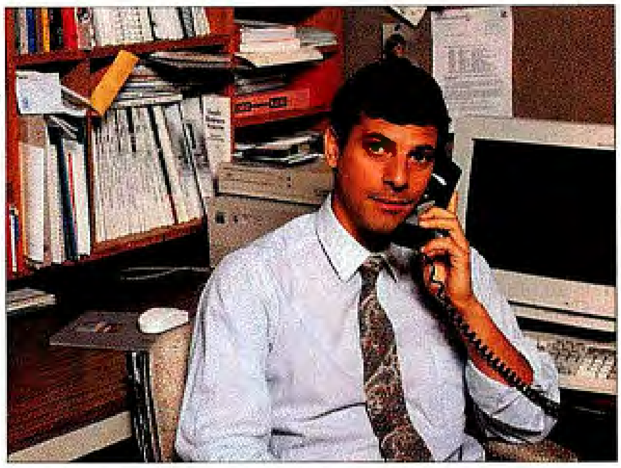
Building Component Software

GUIs have driven the development of component software; distributed objects are the next frontier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Nowadays, when a software developer visits BYTE to show us a new application, we're not surprised to see that it can run on Windows and the Macintosh and perhaps also Motif. But this routine mastery of multiple GUIs is, in fact, astonishing. It's instructive to think about just why applications have been able to pick themselves up and move from platform to platform.

Remember when everyone worried about the GUI wars? Well, nobody really won, but in the end it didn't matter. What we got was a convergence on some useful things—movable windows, dialog boxes, scroll bars, and so on. That convergence has made applications easier to use, but it has had other powerful benefits, too.

The Holy Grail of software development is reusable components, prefabricated "software ICs" you can pull off the shelf and use. Some say these things are still years in the future. I think they're right under our noses. You needn't look any further than the GUIs: Windows, the Mac, and Motif. These building blocks do a lot of work for the applications layered on top of them. Thanks to the convergent evolution of GUIs, an application built on one GUI can pretty easily move to another.

Things get really interesting when the building blocks themselves start to move from platform to platform, carrying whole families of applications with them. That's happening now. The new generation of operating systems, including Windows NT, IBM's Workplace OS, and the Novell/Unix Systems Laboratories version of Unix, are all built to accept pluggable GUI components. That means you'll be able to run Windows and Mac applications on all these operating systems. Better yet, the operating systems are portable and will run your applications on any of the up-and-coming processors.

The new RISC PCs don't have Intel inside, and they sure don't boot DOS when turned on. So can they really become a major force in computing? I think they can, thanks to a building block called Windows. But this isn't just a Windows phenomenon. I'm just as bullish on the prospects of another RISC PC on the horizon—a new kind of Mac built around the PowerPC chip.

The success of these new RISC PCs will depend on two things. First, today's Windows and Mac applications will have to run on them acceptably and without change. Second, the applications will have to port, with minimal change, to the native RISC hardware. GUI building blocks make both of these things possible.

To run existing Windows and Mac software on a RISC PC, you need software emulation of the Intel and Motorola chips. But you want to avoid pure processor emulation that turns the Alpha or Mips or PowerPC chip into a 286 or 68000. Fortunately, a strategy I call *hybrid emulation* buys back a lot of the performance lost with pure emulation. Windows and Mac programs spend a lot of time executing code inside the GUI building block. On a RISC PC, that building block talks straight to the hardware, giving a big performance boost over pure emulation.

Eventually, you'll want to run your Windows and Mac applications natively on your RISC machine. That will be pretty straightforward, too, again thanks to the use of components. Existing Windows programs can be rebuilt to run natively under NT on any of the processors NT supports. Early indications are that Mac programs will migrate just as easily onto PowerPC systems.

With the GUI problem largely solved, distributed computing is the next great challenge. Here, we lack the necessary building blocks. The network equivalents of movable windows, dialog boxes, and scroll bars don't exist. What we have are a bunch of promising technologies that all seem to have the word *object* in their names: Microsoft's Object Linking and Embedding, IBM's Distributed System Object Model, Sun's Distributed Objects Everywhere, and some others. No one knows yet just how these objects are going to work, but they'll deal with things like directory services, interapplication communication, and distributed compound documents.

Should we now worry about distributed-object wars? Will developers have to back the winning standard to survive? I hope not. With luck, we'll see a repetition of what happened with GUIs. Applications will increasingly rely on several competing distributed-object technologies. The features and capabilities of these building blocks will converge, the benefits of reusing them will accrue to everyone, and distributed computing will suddenly seem quite ordinary. ■

Jon Udell is a BYTE senior technical editor at large. You can reach him on BIX as "judell" or on the Internet at judell@bytepb.byte.com.

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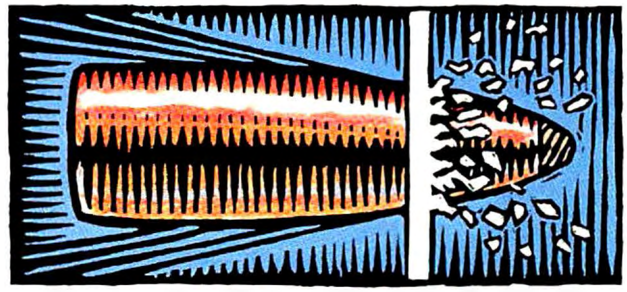

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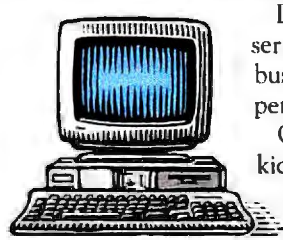

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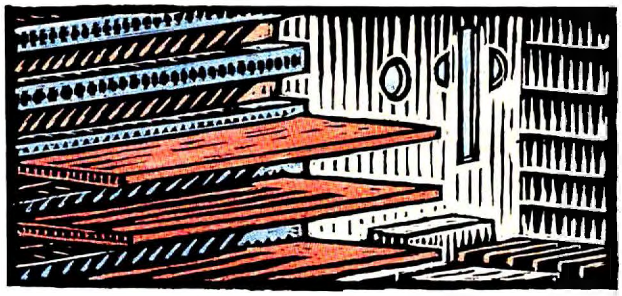

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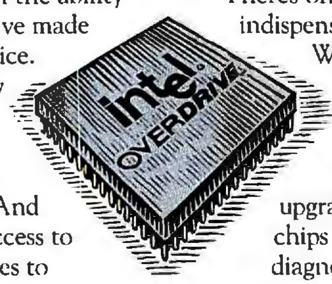

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