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Volume 21, Number 3

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PC Magazine, April 25, 1995

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PC MAGAZINE BEST OF 1995

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MVP PCComputing
December 1995
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intel inside pentium

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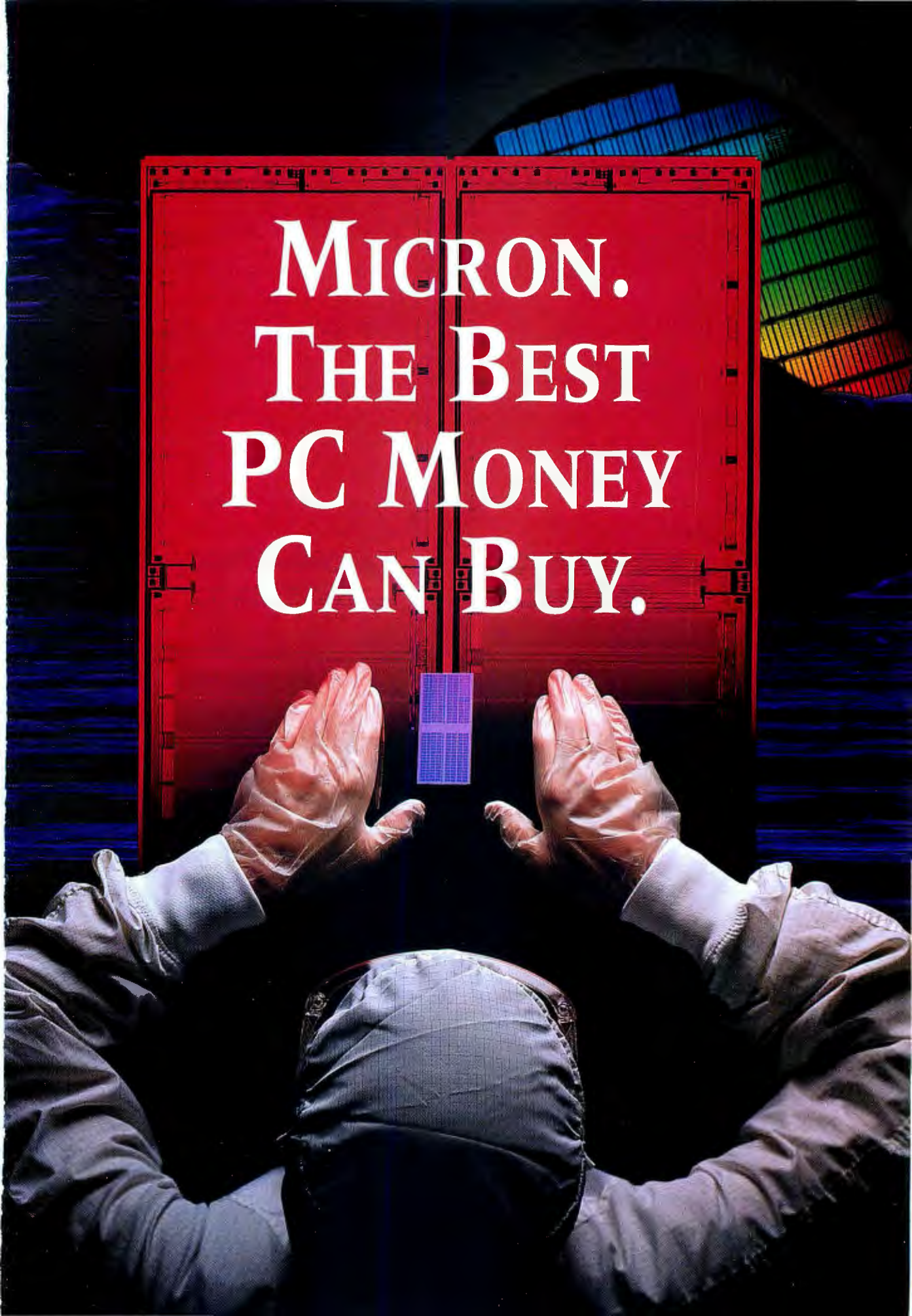
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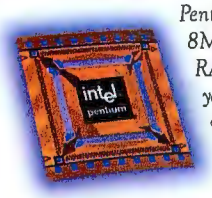

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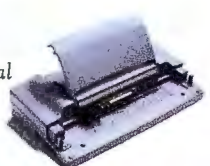

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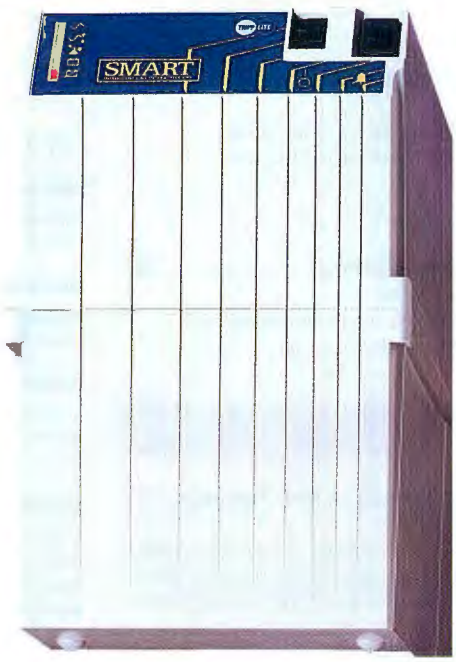

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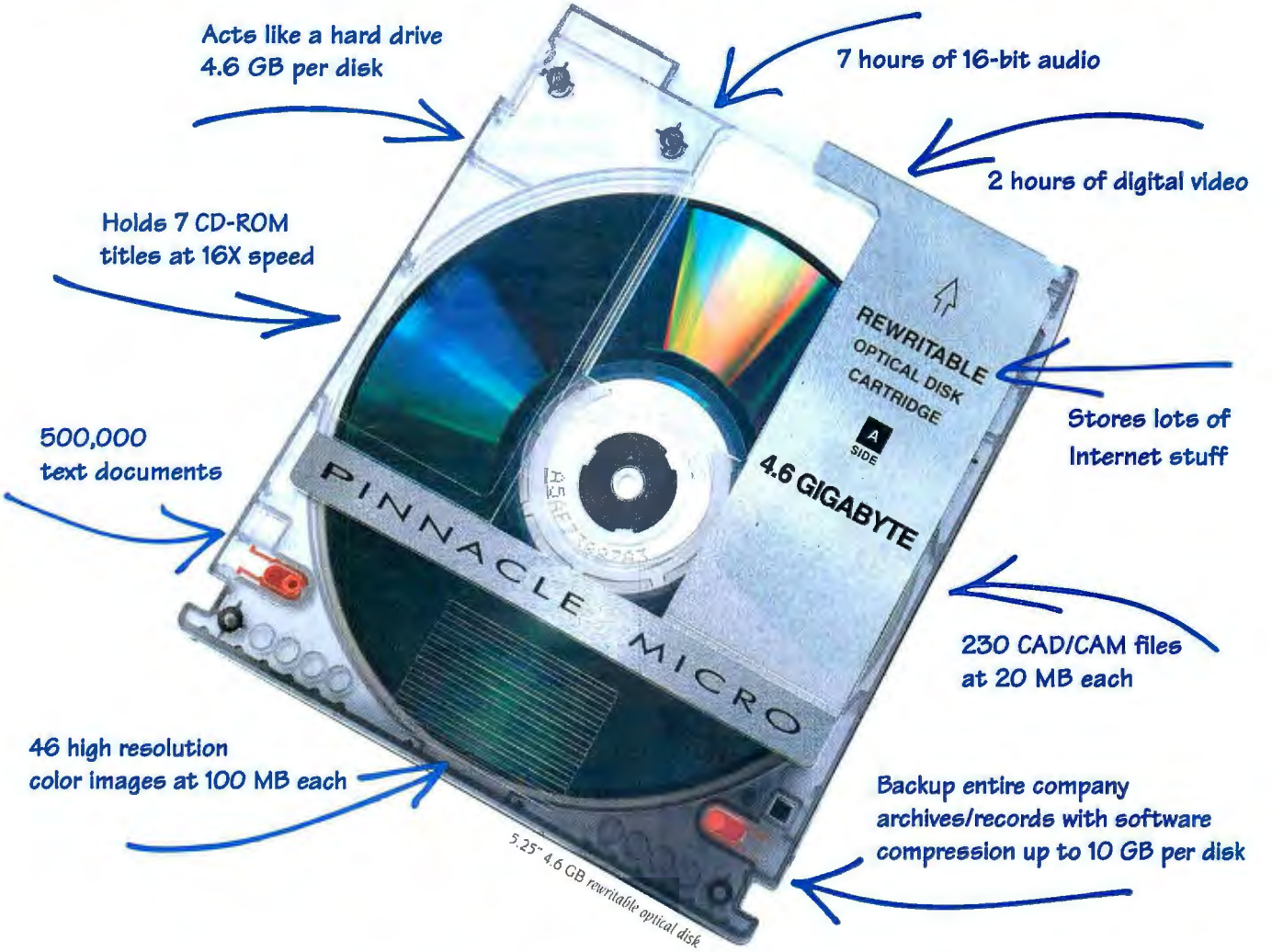

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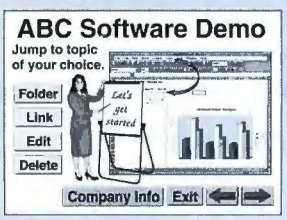

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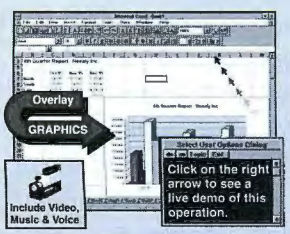

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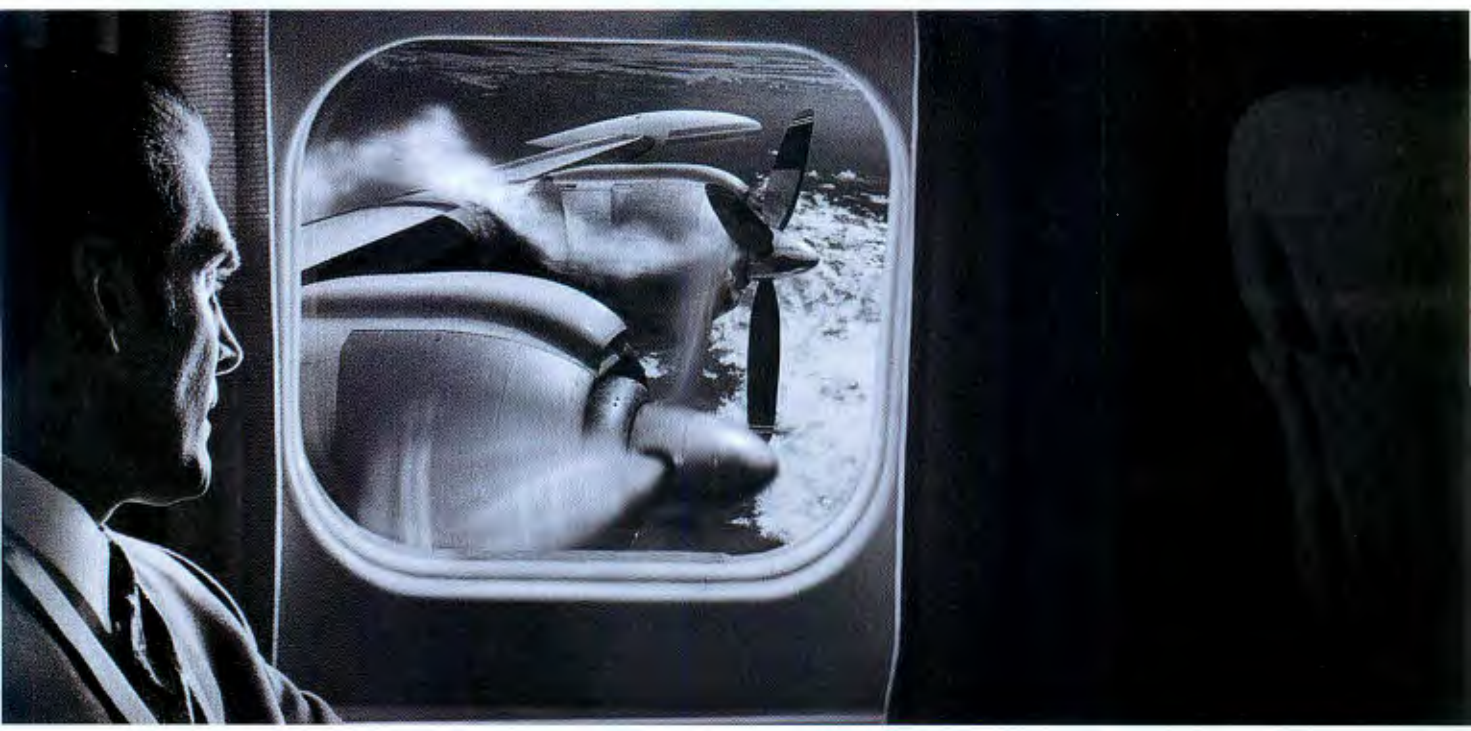

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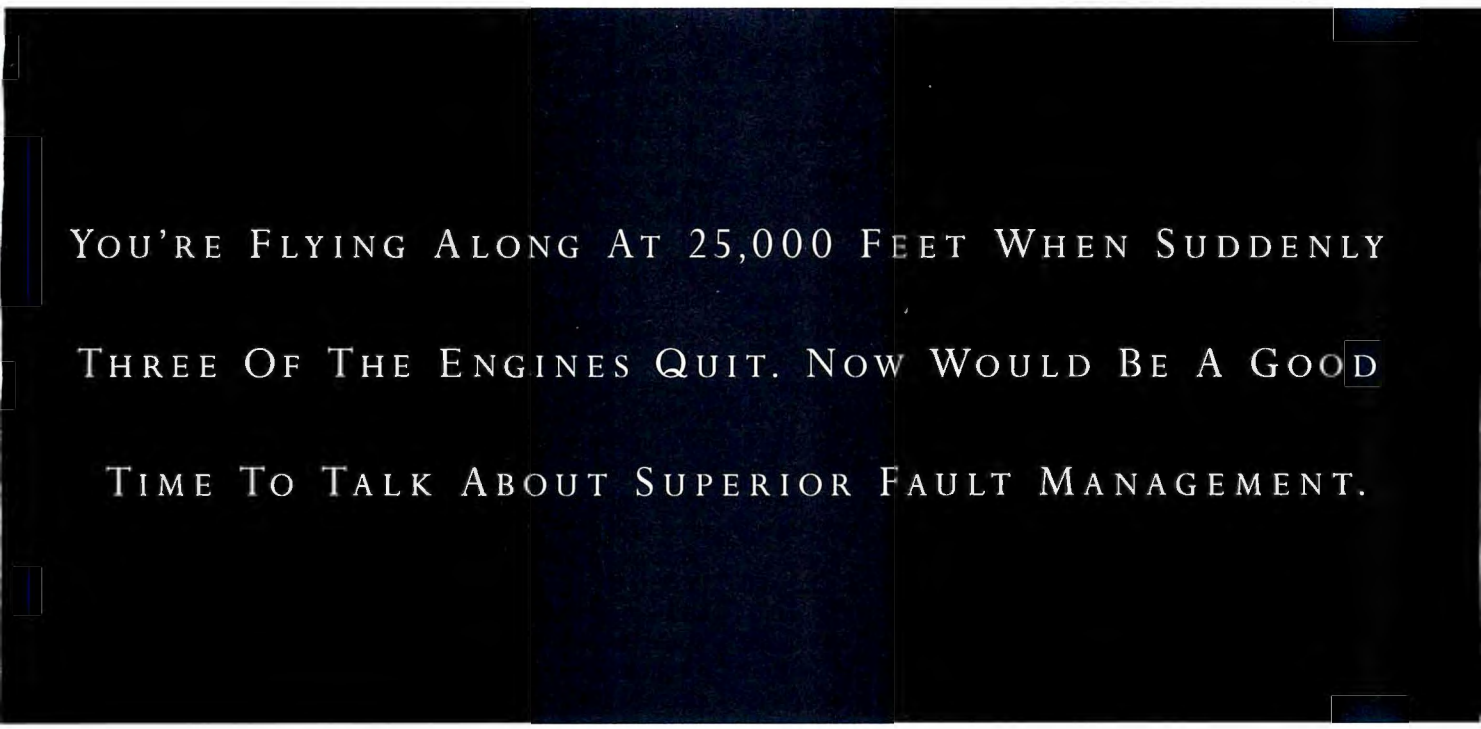

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Keep Your Eye Off the Ball

To successfully plan a strategy, sometimes you need to focus on the bigger picture and let the details take care of themselves

A lot of computers in the BYTE offices run Windows 95. You can tell with your eyes closed—if you walk around the editorial floor, you'll hear the weird error bleeps coming from customized Windows installations.

But you'll also see quite a few Macintoshes (not just in the art department) and a number of PCs running DOS. Furthermore, if you visit the homes of our editors, you'll find that the personal machines—the machines people here actually paid for with their own money—cover the complete historical spectrum of computing. Many of these machines are still being used.

Several editors have rather creaky DOS machines still being used for E-mail (cc:Mail and BIX) and word processing (XyWrite, mostly). Dave Rowell has an unusual Wells American 20-MHz 286. Ed DeJesus has an IBM XT he uses for voice mail (though how he can hear phone messages over the banshee scream of that machine's old hard drive is beyond me). And Tom Halfhill actually travels with a Toshiba T1000SE portable (8086 processor, 1 MB of RAM, 720-KB floppy drive, no hard drive). At home, I have an old Hi-Q 386SX machine (upgraded with a Cyrix 486 CPU) that I use exclusively to support my pathetic attempts to learn to play piano through the Miracle Piano Teaching system.

In our "glass house"—a raised-floor computer room that used to house a VAX but now holds about a dozen microcomputer servers—we run cc:Mail gateways on old reliable DOS computers, and file and print servers on 486s running NetWare. Our Pentiums are mostly reserved for NT and our Web servers.

Why This Matters

This hodgepodge of systems—some supported by our IS department, some not—all holds together, through no special architectural design or foresight on the part of software or hardware manufacturers. It holds together because as new technologies come along, we tend to adapt them piece by piece, and fix their integration problems as they occur. And it also holds together because what we need to do here isn't that complex; we're not putting a lot of stress on the capabilities of the systems.

Is this the right way to do things? I would wager that the majority of inexperienced systems administrators would look at our setup and gasp in horror. What is its architecture? Where's the three-year microcomputer plan?

There isn't a very detailed one, and there never can be. Sure, we have a plan; we know what we want to be able to do with our systems in three months, six months, a year. But we'd be kidding ourselves to predict which hardware we will need to support these tasks. ISDN? ATM? Who knows? Who cares?

To really be successful in planning information systems, you have to accept the fact that for a variety of reasons (most of them financial), you're going to be stuck with oddball "legacy" hardware and software for years. It's not a bad thing, either—Ed's old PC voice-mail system is certainly less expensive to operate than a fancy new one. Our cc:Mail gateways work just fine.

Furthermore, beyond some completely obvious areas, you simply cannot predict which specific products you'll need to support in order to realize your broader plans. Netscape or Microsoft Explorer? PowerPC or Pentium Pro? At BYTE, we try to help you answer these tactical questions, but we're always cognizant that these questions wouldn't even be worth asking were we not also asking the more important, larger questions: Electronic commerce or old-style banks? Private or public network services? Constant technology retraining or new hires?

The challenge is to keep one eye on the technology and the other on the bigger trends. You say you want to invest in the Web? Are you sure? Perhaps what you really mean is you want to invest in the emerging global electronic community. If so, be sure your plans aren't tied to a particular platform. After all, compared to how hard it is to change the culture of your business to support cyberspace, it's a snap to change technology platforms.

And no matter what hardware you have, it's really hard to learn to play piano. ■

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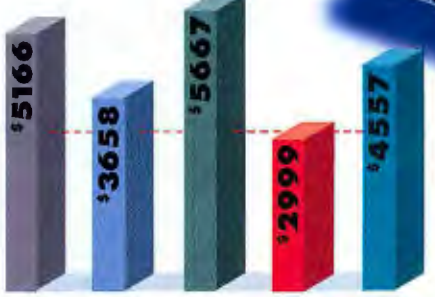

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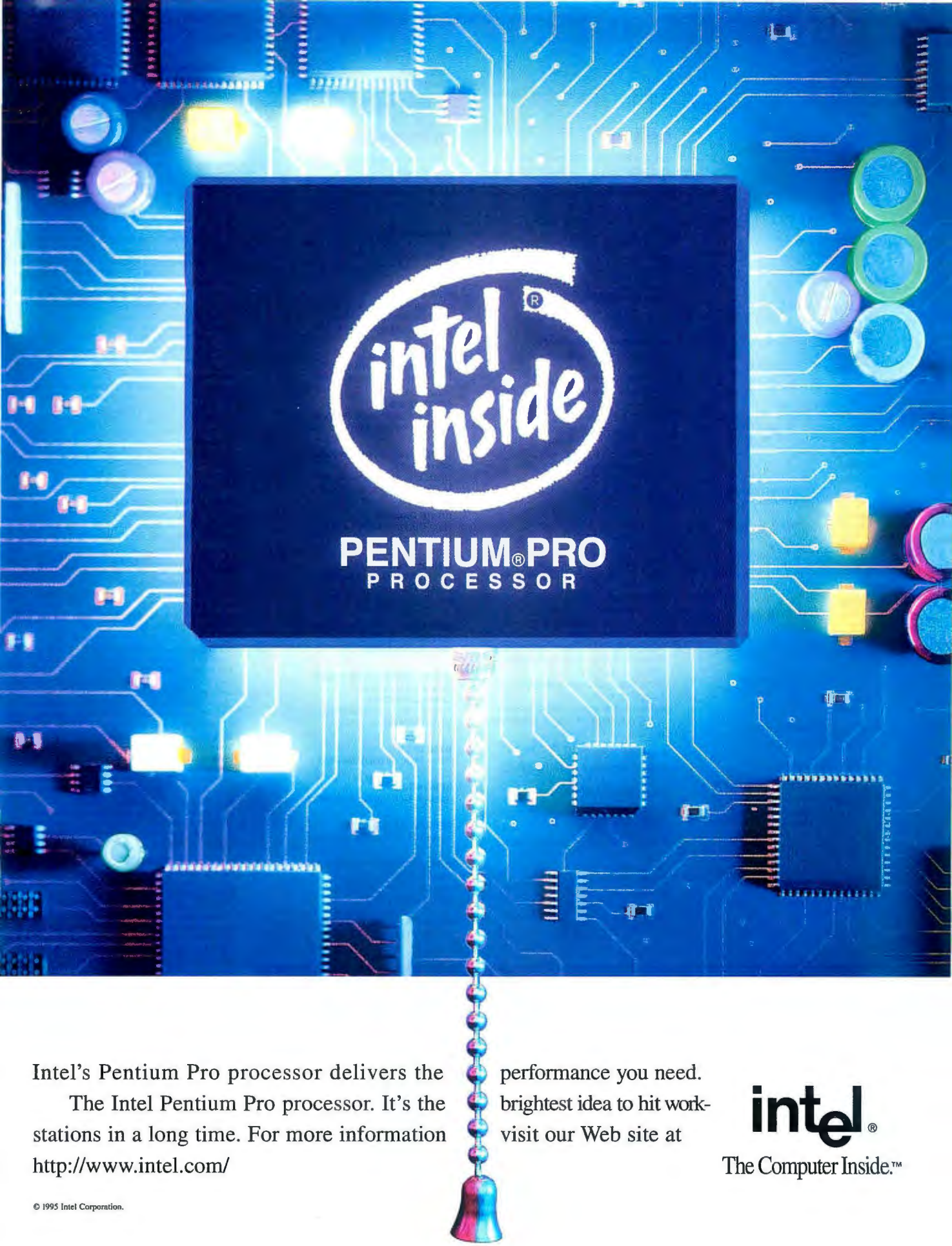

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Color Temperature Selection	•	•	•
UltraClear Coating™		•	•
Limited Warranty	3 Years	3 Years	3 Years

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SAMSUNG

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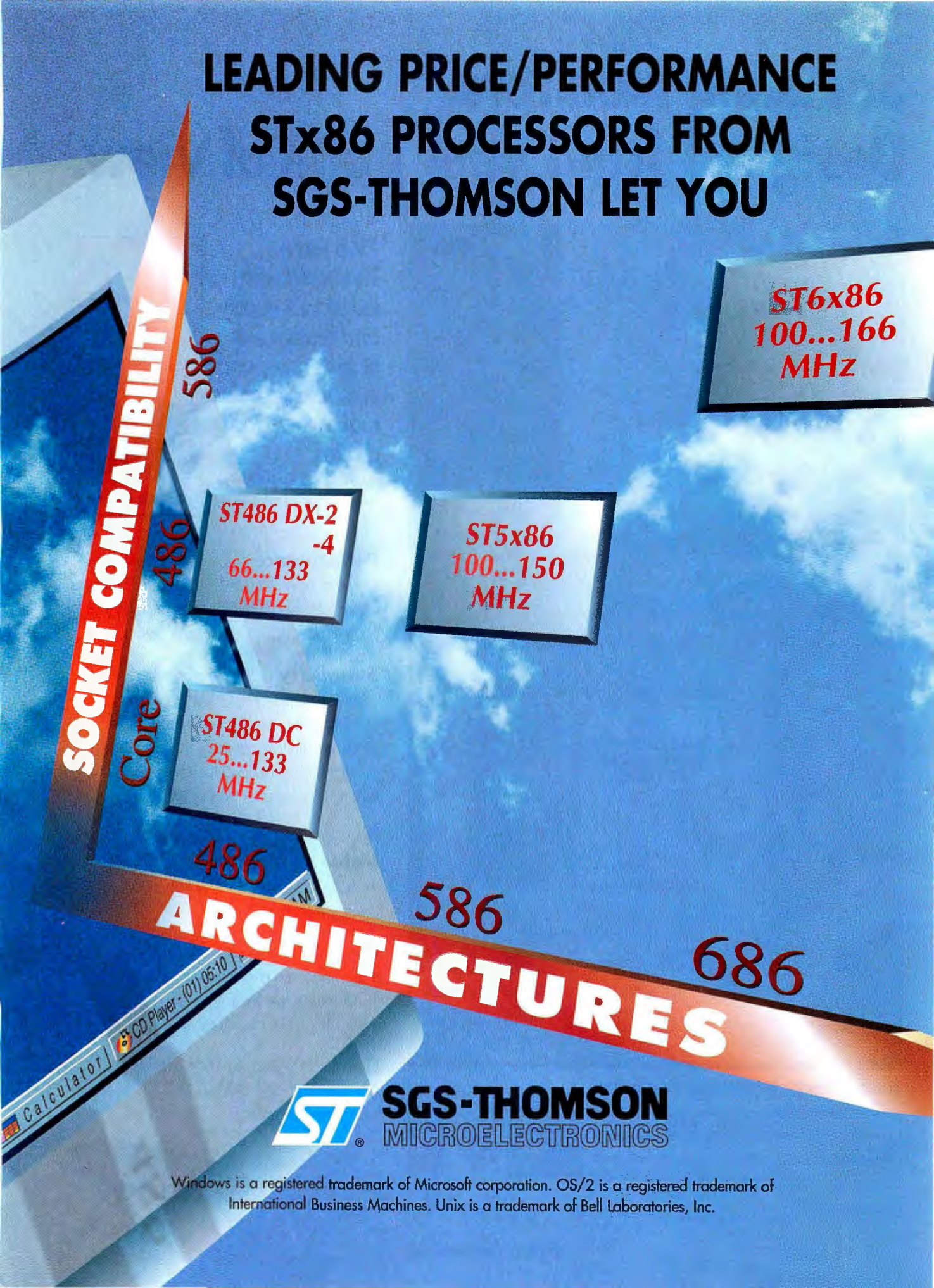

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Circle 71 on Inquiry Card.

LETTERS

Bells and Whistles

In "How Software Doesn't Work" (December 1995), I believe you presented a balanced view of the problems and existing approaches to software development. More important, I didn't see a bias for any technique or method.

Jim Cardow
Director of Software Development
Tybrin Corp., Shalimar, FL
jimc@hq.tybrin.com

While I never thought that developing software programs was easy, "How Software Doesn't Work" helped me to understand the complexity of the development process. On the one hand, consumers want reliable software with all the bells and whistles. On the other hand, they want that software to be affordable. The conflict between delivering a product on time—or ahead of a competitor—and developing a reliable product is usually resolved by compromise.

James Tyrone Cooper
jamesco@ix.netcom.com

Frame It

I just checked out your virtual press room. Great stuff! But I don't care for the graphics being constantly reloaded as I go from page to page. A suggestion: Start using frames, an enhancement found in Netscape 2.x. This saves a lot of reloading and at the same time saves bandwidth.

Ed Berlot
edber@hookup.net

We're working on a frame implementation for the article archive. It's very Smalltalk-browser-like, which is our preference. But we also believe strongly in remaining open to the broadest spectrum of browsers, which complicates matters a good bit.
—Jon Udell, executive editor

The Importance of Being Text

I appreciate the clean look of BYTE's World Wide Web pages. I am also glad they're compatible with my browser, Lynx. I and other blind computer users are fearful that text information on the Web will suffer with the advent of interactive graphics, Virtual Reality Markup Language (VRML), and Java. Access to the Windows environment has been difficult until lately, and the graphical Web could also prove difficult for the blind to manage. The greatest problems with Windows and other GUIs are nonstandard icons and buttons that are not clearly labeled with text. These are still problem areas for makers of screen-reading packages for Windows 3.1; even Microsoft chooses not to follow its own standards for some applications.

Bob Logue
boblogue@freenet.edmonton.ab.ca

We're working on alternate E-mail interfaces to our Web-based services because we realize that not everyone has convenient access to the Web. But the concerns you raise make our effort even more important. Thanks for the feedback. —Jon Udell, executive editor

Real Performance Peaks

I read "The World's Fastest Computers" (January) with great interest, but I was quite disappointed to see that you have fallen prey to the "peak performance" trap. Peak performance has little relation to what can actually be sustained on a supercomputer. Supercomputers should be presented in terms of classes of applications and their sustained performance. The Intel TFLOPS, which you tout as the world's fastest, is actually so only on a very small set of applications. For most general-purpose scientific computing applications, a Cray will be faster.

Peter Van Roy
Programming Systems Lab, DFKI
Saarbruecken, Germany
vanroy@dfki.uni-sb.de

According to Intel, the TFLOPS system operates with a sustained rate of 1 TFLOPS. As stated in the text box on page 62, this supercomputer will run some very specific research applications for the U.S. Department of Energy. The Cray T3E, pictured on the January cover, is a massively parallel processing (MPP) system capable of 1-TFLOPS operation, and it doesn't require a government grant to own and operate. Presumably it will run many of the applications written for Cray systems over the years. How well these existing commercial applications can be made to exploit its massive parallelism remains to be seen.
—Tom Thompson, senior technical editor

BYTEmark Bug Bitten?

In regard to "BYTEmark Bug Bashed" (December), it appears to me that the bug is with the compiler vendor's `malloc()` rather than with your code. The C Standard section on memory management functions states that "the pointer returned if the allocation succeeds is suitably aligned so that it may be assigned to a pointer to any type of object and then used to access such an object or an array of such objects in the space allocated (until the space is explicitly freed or reallocated)." If double requires 8-byte alignment to work properly, and double has the strictest alignment requirements, then `malloc()` should return memory aligned to at least 8-byte boundaries.

Fred J. Tydeman
Member, X3J11 (ANSI C Committee)
tydeman@tybor.com

You may be right. We have received several letters suggesting that the problem lies with the C library's implementation of `malloc()`*, not with our benchmarks; however, we have not yet found any documentation that explicitly states that a* `malloc()` *returning data not* optimally *aligned is in error. It's not quite accurate to say that "double requires 8-byte alignment to work." The algorithm works even if the data is not aligned. It just works more slowly.*
—Rick Grehan, senior technical editor

Where's the GNU Hurd?

The November 1995 articles "NT Roars on the 604" and "CPU Scorecards" were

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quite welcome. But the Special Report on operating systems did not mention GNU Hurd. This OS is based on the Mach microkernel, and thus it has been essentially ported to a wide variety of hardware platforms—nearly as many as NetBSD. To learn more about Hurd, and especially about its binary portability, visit http://www.cs.pdx.edu/~trent/gnu/hurd/. Contrary to what you say in the text box "Operating-System Research: Dim or Bright Future?" (page 116), microkernel technology has not been exploited to its maximum capability, as the Hurd philosophy demonstrates.

Todd Hutchinson
jasper@terra.3rdplanet.com

DB2 Pricing

While your November 1995 review "Enterprise Database Managers" was fair, accurate, and thorough, the comparison chart of features and prices on page 216 was not accurate. The correct suggested retail pricing for 50 users for IBM's DB2 2.1 is $91.40 per user (server with five licenses, $1495; five-user entitlement, $359; four 10-user entitlements, $679 each). In addition, IBM's DB2 does offer row locking, which was not properly indicated in the chart. Also, you state that DB2 for AIX "has relatively little third-party support." IBM has listed in its solutions catalog more than 440 applications available for DB2 on AIX from 254 vendors, with support growing at a rate of more than 200 percent per year.

Tim Negris
Vice President, Sales and Solutions Marketing
IBM Software Solutions Division

IBM informed us that the price of the DB2 server had changed from $1995 to $1495 as we finished the review. While that change was reflected in the Product Information summary, it was not incorporated into the chart, which should have shown a per-user cost of $106. We were not informed at the time of further reductions in client prices. We also reported an incorrect price for Microsoft SQL Server; we should have indicated a per-user cost of $145. To be fair, we've also learned that Oracle recently changed the price of Workgroup Server 7.1 to $295 per concurrent connection and eliminated the per-server fee.

The reference to page locking came from the DB2 technical documentation; we reported what we found there. While support for DB2 for AIX is growing, it lacks the breadth of third-party support that Oracle for AIX enjoys.

—Barry Nance, consulting editor

FIXES

Due to an error at our printer, a line of text was lost in the January review "Sumo Graphics Giants Weigh In." The partial sentence at the top of page 130 should read "*Corel has made some features, such as* layer control in CorelDraw, easier to use by bringing more functions to the first level of a roll-up menu."

In "The World's Fastest Computers" (January), the system pictured in the text box on page 52 is the Cray T90 vector-processing system, not the CS6400 parallel-processing system described in the text. The system pictured on the cover of the magazine is the Cray T3E, which is Cray Research's new commercial TFLOPS machine.

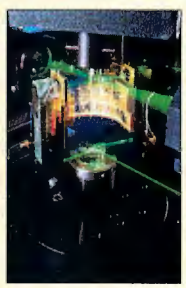
In "PDA Vendors Improve PC Links" (January), we printed an incorrect area code for AllPen. The correct number is (408) 399-8800.

In "A Data Miner's Tools" by Karen Watterson (October 1995), we inadvertently omitted the SAS System, including OLAP++ ($30,000 and up; SAS Institute, Cary, NC, (919) 677-8200; fax (919) 677-4444; E-mail software@sas.sas.com or http://www.sas.com).

In "The Data Gold Rush" by Sara Reese Hedberg (October 1995), we inadvertently omitted CrossTarget Builder ($7500–$29,500; Dimensional Insight, Burlington, MA, (617) 229-9111; fax (617) 229-9113; E-mail sales@dimins.com).

The first chip set to implement the PCI bus was not the Intel Mercury, as we indicated in the article "Most Important Chips" (September 1995), but a 486 chip set named Saturn. The Intel Mercury was the first chip set for the original 5V Pentium processors. ■

COMING UP IN APRIL



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Live auto-line routing	YES	NO
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Number of color models supported	8	2

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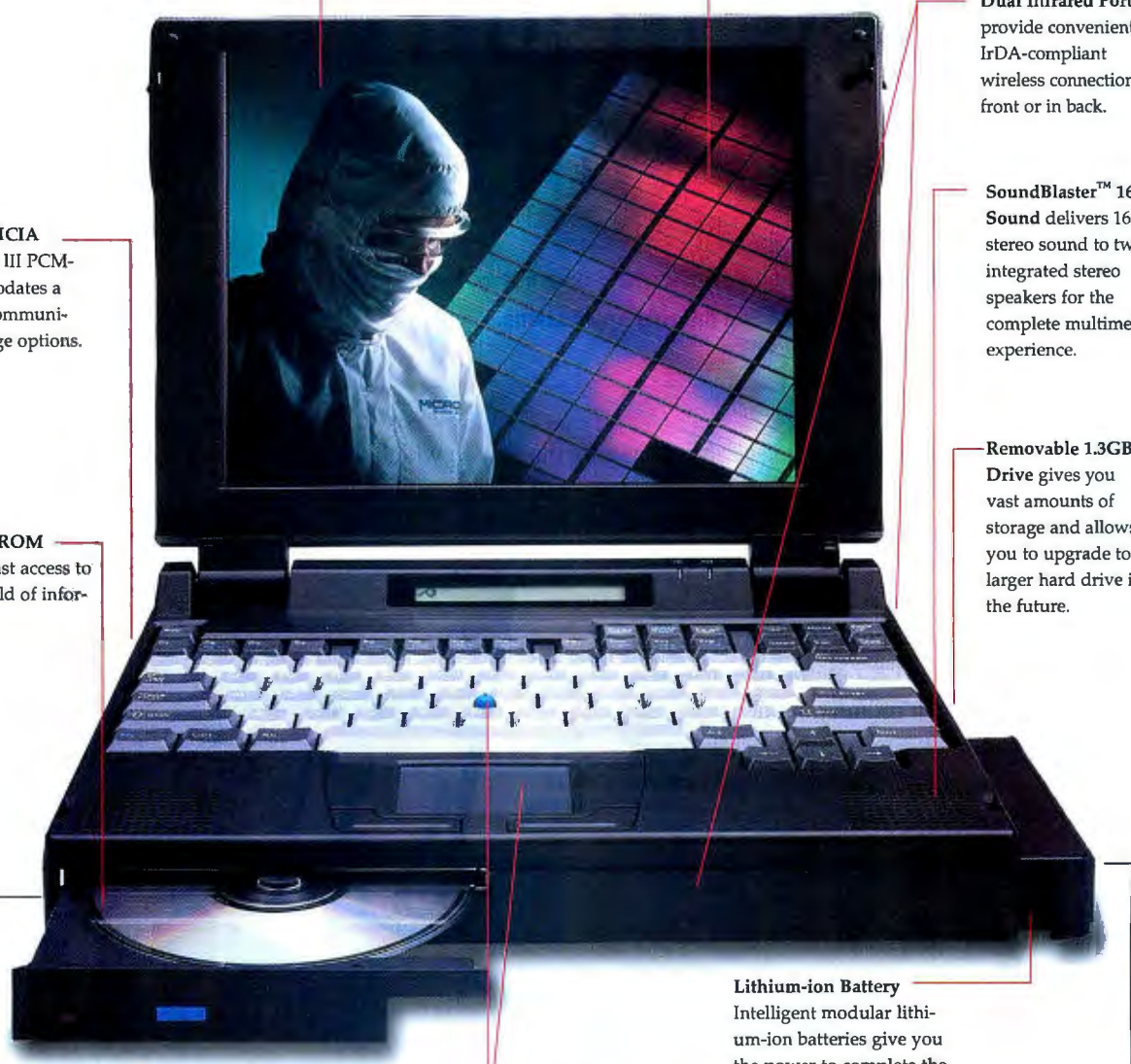

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NEWS & VIEWS

APPLICATION TRENDS

Virtual Reality Goes to Work

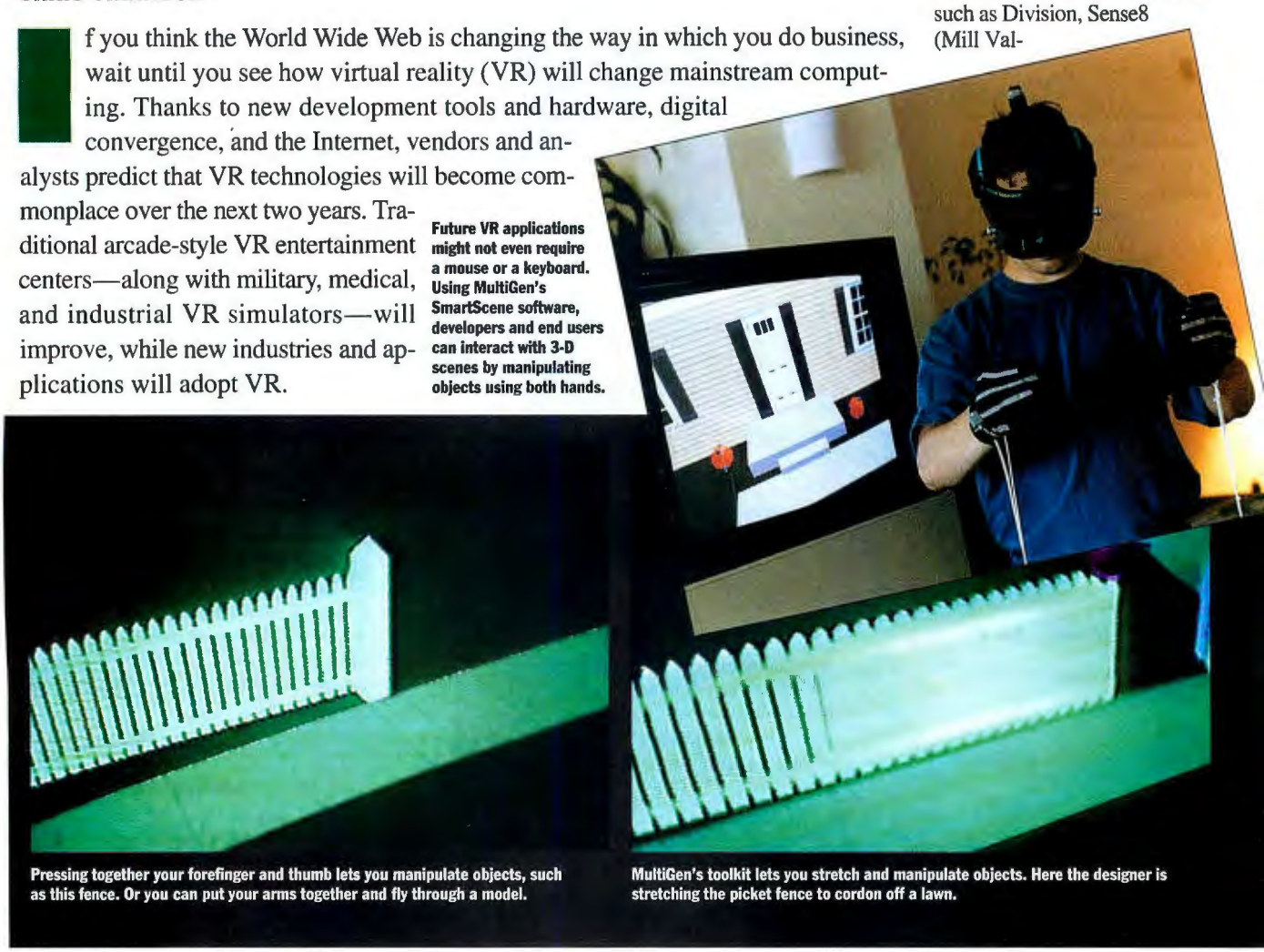
Virtual reality is not for games and entertainment software only. Here's how it will influence mainstream business and Internet applications.

CHRIS CHINNOCK

If you think the World Wide Web is changing the way in which you do business, wait until you see how virtual reality (VR) will change mainstream computing. Thanks to new development tools and hardware, digital convergence, and the Internet, vendors and analysts predict that VR technologies will become commonplace over the next two years. Traditional arcade-style VR entertainment centers—along with military, medical, and industrial VR simulators—will improve, while new industries and applications will adopt VR.

Doug Schiff, vice president of marketing at VR-tool developer Division (Chapel Hill, NC), says a key trend in VR is decreasing prices for high-performance graphics platforms. "Until very recently, serious VR developers needed to spend several hundred thousand dollars on a hardware platform," Schiff says. "But we're now starting to see platforms that can support immersive, high-performance VR applications in the $10,000-to-$50,000 range." PCs using Intel's Pentium Pro processor, as well as workstations from Hewlett-Packard (Palo Alto, CA), Silicon Graphics, Inc. (SGI, Mountain View, CA), Sun Microsystems (Mountain View, CA), and others, will continue to deliver increasing power at decreasing prices.

Another key trend: VR development software is getting easier to use and less expensive. Software from vendors such as Division, Sense8 (Mill Val-



Future VR applications might not even require a mouse or a keyboard. Using MultiGen's SmartScene software, developers and end users can interact with 3-D scenes by manipulating objects using both hands.

Pressing together your forefinger and thumb lets you manipulate objects, such as this fence. Or you can put your arms together and fly through a model.

MultiGen's toolkit lets you stretch and manipulate objects. Here the designer is stretching the picket fence to cordon off a lawn.

One example of how VR is changing business is at Ford Motor Co., where researchers use Division's dVise and dVS VR software to evaluate new arrangements for instrument panels.

ley, CA), Superscape (Palo Alto, CA), and others let nonprogrammers build 3-D worlds via menu selections. "This is extremely important, because it means you no longer have to be a VR expert to build a 3-D virtual world," says Schiff.

VR development tools are also immersing the developers themselves. New tools slated for release in May on SGI platforms from MultiGen (San Jose, CA) let developers build, stretch, and color 3-D scenes literally by waving their hands around (see the photos).

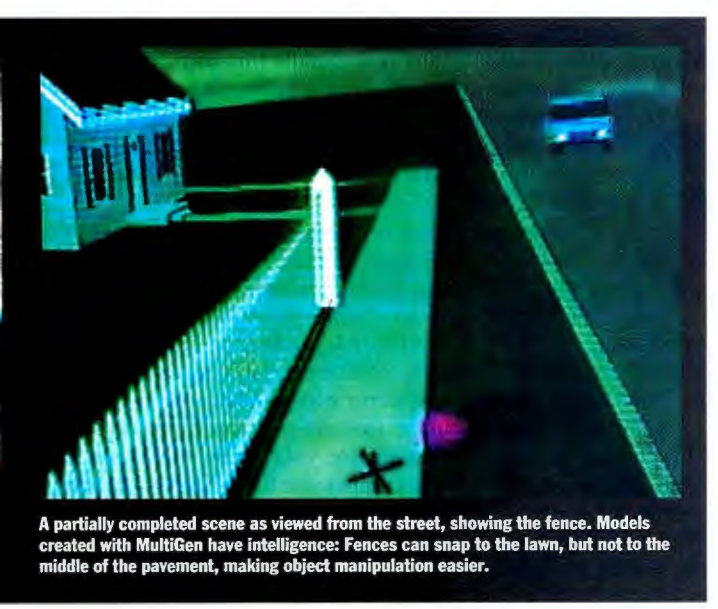
Although VR development tools can still be pricey (e.g., MultiGen's SmartScene will likely sell for over $10,000), prices for other toolkits and components are dropping. For example, Apple recently eliminated royalty fees from its $495 QuickTime VR authoring tool. A turnkey development system from Division that costs $75,000 would have cost $250,000 two years ago. Dive Labs' (Santa Cruz, CA) $150 C++-based VR development toolkit, called Amber, runs on Windows 95 and NT. A version for SGI and other workstation platforms costs just $199. Another Dive toolkit, vrTrader, lets business managers monitor financial data in animated 3-D scenes (see "Assets in Wonderland," July 1995 BYTE). Company officials say they expect to release a toolkit for Visual Basic developers later this year. And Polhemus (Colchester, VT) now sells its two-input body-motion tracking unit for PCs at $999, down from $2200.

Patricia Glovsky, an equity analyst with Kaufman Brothers (New York, NY), says that digital media—the blending of graphics, animation, and video—will eventually supplant graphics-only VR environments. "Three-dimensional worlds will soon evolve from computer-generated, graphics-only-based environments into full digital-media worlds. These new environments will be quite compelling for developers and users alike," she says.

An especially intriguing new development will be the merging of VR technology with the Internet. For example, Virtual Reality Markup Language (VRML) allows designers to create entire 3-D environments, such as a downtown shopping district, that users can explore over the Internet (for more information, see "Put the Space in Cyberspace" on page 61). Microsoft's Internet Studio (aka Blackbird), a Web and multimedia toolkit, will enable developers to create virtual 3-D worlds. Java-based development environments will allow developers to build applets that have the ability to interact with objects within these worlds.

In addition to navigating 3-D Internet worlds with *avatars*, computer reincarnations of yourself (for more information, see "Agents and Avatars," February BYTE), you will also interact with other avatars in a shared virtual environment. Such interaction might be based on the DIS (Distributed Interactive Simulation) protocol, which enables thousands of entities (e.g., tanks, planes, and people) to interact in a huge virtual space. Another exciting possibility is distributed gaming.

"Three-dimensional worlds on the Internet will be popular because it's a metaphor that everybody can relate to," Glovsky says. "This is exactly what is needed to bring non-computer-literate mass markets online."



A partially completed scene as viewed from the street, showing the fence. Models created with MultiGen have intelligence: Fences can snap to the lawn, but not to the middle of the pavement, making object manipulation easier.

New Batteries Will Keep You Running

New battery technologies that let notebook PCs run longer without a recharge might make the transition from the laboratory to commercial products this year. However, notebook manufacturers, wishing to avoid such problems as battery overheating, remain cautious and say they will incorporate these new technologies only after careful evaluation.

One technology, lithium metal polymer, offers the possibility of high energy density (perhaps as much as double that of today's lithium ion). But lithium in its metallic form in a rechargeable battery poses safety risks: After repeated charging, the battery can short-circuit internally. Vendors are anxious to avoid the bad press and poor customer relations related to notebooks that overheat or catch fire.

A more promising technology, from Ultralife Batteries (Newark, NY), which may ship in commercial products later this year, uses both a solid-state electrolyte and a lithium-ion chemistry. Ultralife officials say its battery has a high duty cycle (up to 1200 recharge cycles, compared to about 500 for nickel metal hydride) and high energy density (comparable to today's lithium ion with liquid electrolyte). The battery's solid-state electrolyte allows design flexibility (batteries can be made in ultrathin rectangular shapes) and a high degree of safety (the solid electrolyte cannot leak).

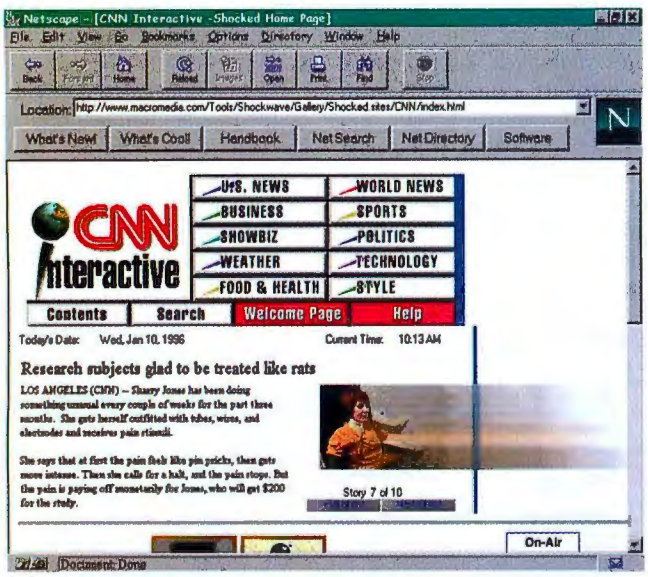
Meanwhile, AER Energy Resources (Smyrna, GA) says it will soon release to computer manufacturers the first prototypes of a new version of its zinc-air battery that can run a full-size notebook up to 12 hours between charges. Previous versions of the company's zinc-air batteries, such as the PowerPro for certain Toshiba notebooks, weighed 4½ pounds. But AER says the new version, thanks to a second air electrode that doubles the surface area for the battery's chemical reaction, will weigh only 1.8 pounds. Commercial products based on the new prototype might ship sometime in 1997, the company says.

—Dave Andrews

INTERNET DEVELOPMENT

Multimedia Tools Animate the Web

Vendors of multimedia development toolkits are preparing a variety of tools that can make your World Wide Web site come alive with music, animation, and video. While such companies as Symantec are releasing new development kits based on the Java programming language (see "Code Talk" on page 38), others offer alternatives that don't require you to learn Java, which loosely resembles C.



Web sites are becoming much more interactive, thanks to new development tools. With Macromedia's new ShockWave player, Web developers can use the Director multimedia authoring package to create virtual magazines in which headlines, photos, and text move across your computer screen.

Macromedia's (San Francisco, CA) new ShockWave for Director allows multimedia movies created with its Director authoring package to play over the Web. ShockWave will be supported by several Web browsers, including Netscape and Internet Explorer, and it supports on-the-fly compression. Macromedia's ShockWave for FreeHand, which will provide the capability to display native FreeHand vector-graphics files with extreme close-up and zoom-out capabilities within Web pages displayed in Netscape Navigator 2.0, is slated to ship this quarter.

Microsoft says it will release a new beta version of its Internet Studio Web publishing system in March, with plans to release the product commercially sometime this year. With Internet Studio, Web developers can create multimedia pages without programming. Meanwhile, IBM, Microsoft, and others have proposed various extensions that improve upon the Virtual Reality Markup Language (VRML) standard's support for 3-D animation and interactivity.

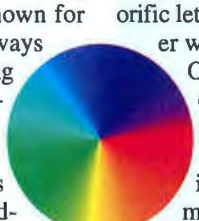
Adding interactivity is a good way to advertise on a Web page without insulting your readers. "Interactivity provides a way for end users to enjoy an advertisement and not be offended by it," says Heather Rose, senior product manager for network technologies at Macromedia. "The Web today is very similar to print, and your browser today is more like a world-wide library card. These new tools give more of a TV feel to the Web, but without turning end users into total couch potatoes."

—D.A.

COLOR PRINTING

Simple Color Matching for Everybody

Purchasers of low-cost color ink-jet printers are learning something that graphics professionals have known for years: What you see on the computer screen isn't always what you get from the printer. To make color matching more accessible to small-business and home users, vendors are preparing solutions that make color matching easier and more affordable.



Today's latest entry-level color matching eliminates expensive hardware standards that require you to periodically attach devices called colorimeters to your monitors. These new software solutions use existing systems, such as Kodak's Precision Color Matching or Apple's ColorSync, to reproduce consistent colors on monitors and printers. Self-calibrating monitors, such as Apple's AppleVision 1710, which includes the DigitalColor internal calibration scheme, can also continually compare themselves to factory settings and adjust themselves as needed.

One low-cost solution is Sonnetech's Colorific, a software-based color-matching program that calibrates and adjusts monitor color balance and compensates for ambient light factors. Many monitor manufacturers now bundle this software. "Colorific lets users match colors between the monitor and the printer without bulky devices or extensive training," says Chris Ota, general manager of Nanao, which now includes Colorific with its products. "It's a simple, one-time-only process."

The ultimate goal is invisible, automatic color matching. "We anticipate that an increase in bidirectional communication will make calibration easier and more automatic," says Tom Paterniti, senior marketing manager at Mitsubishi. "We foresee device-independent color, so regardless of the system or hardware, colors created in a certain program will travel among different systems without change."

Customers who shop on the Internet will especially benefit. "[Technology will] someday enable your Internet browser to adjust your color on-screen to compensate for the color biases in your monitor," says Bill Hilliard, managing partner at Sonnetech. "Color management can provide the Internet with 'What you see is what you buy.' This should help catalog sellers face fewer returns due to wrong colors."

—Wayne Kawamoto

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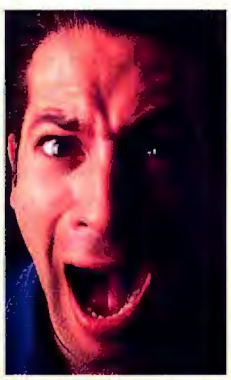

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PC VOICE DICTATION

I'll Talk to You Soon

By the year 2000, the mouse and the keyboard might be obsolete for text input. The steady increase in affordable desktop-computing power, combined with improved speech-recognition software, could bring unconstrained continuous voice-dictation systems to PCs within two or three years, vendors and analysts say. Meanwhile, sales of current voice-dictation products continue to increase as products improve and prices drop.

"Unit sales of shrink-wrapped dictation systems are doubling or tripling each year," says William Meisel, editor and publisher of *Speech Recognition Update*, a newsletter published in Encino, California. The consulting firm Venture Development (Natick, MA) says that in 1995, 44,000 dictation systems were sold. Over a million units will be sold in 1998, the consultancy predicts.

Vendors continue to improve their products by making them more accurate, faster, and easier to use. They're also delivering tighter integration with key office applications (see the text box "Battle of the Dictation APIs" for more information). But commercial dictation programs still can't handle unconstrained-dictionary, continuous speech, which is the natural manner of talking that we use in conversations. "That's the holy grail," says Neal Bernstein, North America marketing manager for IBM Voice Recognition. Today's voice-dictation products require you to speak discretely, by speaking carefully and pausing between words.

Some analysts say that today's discrete-speech English dictation products are sufficiently fast to improve productivity. And dictation can provide tremendous benefits to users whose language requires a laborious effort to input characters. Apple says that users of its Chinese Dictation Kit for the Power Mac can input text approximately five times faster than they can using the most popular Chinese keyboard-input methods. But discrete speech requires practice and might even contribute to voice strain, so efforts continue on the improvement of continuous-speech products.

Vendors are already preparing commercial continuous-speech programs with specific speech dictionaries for the medical and legal fields. Philips Dictation Systems (San Francisco, CA) says that it will release its SpeechMagic system for Windows 3.1 in March at a price to be determined (officials say it will probably sell for at least $1000). However, delivering a continuous-speech dictation product for everyday language is a greater challenge, due in part to the higher degree of variability of words that occur in casual conversation.

Estimates vary as to when an unconstrained continuous-speech dictation product will arrive. "We believe that it will be there in two to three years," says IBM's Bernstein. Others say such a time frame is optimistic, but not by much.

Prices for dictation products range from $700 to $1000 or more for systems with a full-size vocabulary, but Dragon Systems also sells an entry-level version with a 10,000-word dictionary for $395. Venture Development predicts that by 1998 dictation systems will cost less than $100, which the consultancy believes is "a critical price point necessary for mass-market acceptance." —Rob Dieterich

BATTLE OF THE DICTATION APIS

One way in which speech-recognition vendors hope to increase their penetration into the market is through speech APIs. "The true value of speech technology is realized when it's integrated with applications," says IBM's Neal Bernstein.

At present, two standards are competing. One is Microsoft's Speech API (SAPI); the other is Speech Recognition API (SRAPI), spearheaded by Novell.

SRAPI will get its rollout with the release of WordPerfect 7.0 and Perfect Office 7.0, both of which will be SRAPI enabled. Leading voice-recognition system vendors, such as Dragon Systems (Newton, MA), IBM (Boca Raton, FL), and Kurzweil Applied Intelligence (Waltham, MA), worked on SRAPI.

SAPI, which went out to developers late in 1995, currently addresses command and control (but not yet dictation) in its high-level API. Company officials say they are not yet convinced of the dictation market's potential. —R.D.

Dive! Dive!

Games Get Voice Recognition

Voice recognition adds realism to games. With Sierra Online's Command: Aces of the Deep, you shout commands to your crew instead of typing on your keyboard.

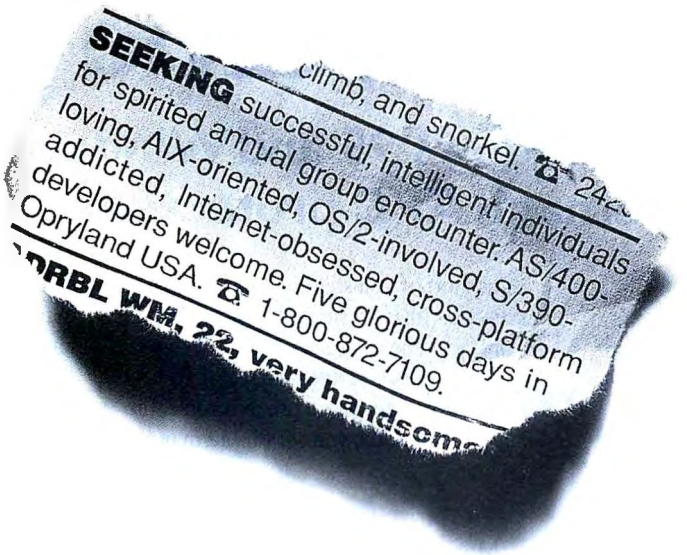
The next trend in computer-entertainment-control devices is one of the oldest forms of communication: the spoken word. New titles, such as Command: Aces of the Deep—a realistic World War II U-boat simulation game for Windows 95 from Sierra Online (Bellevue, WA)—and IBM Multimedia Studio's (Atlanta, GA) upcoming Jungle Book, use voice-recognition technology to let you play by speaking into a microphone.

Frank Evers, producer of Command: Aces of the Deep ($54.95; (800) 757-7707 or http://www.sierra.com) says voice recognition can make a game more realistic. Instead of using just a keyboard and a mouse, you also get to give orders as a submarine commander would.

IBM's Jungle Book game ((800) 426-7235), which is slated for release in April for Windows 3.1, features voice recognition with a twist: Players must learn to communicate with and speak like the creatures of the jungle to win. "Voice activation frees the user from hand-eye coordination and can allow for a more intellectual game," says Cal Morrell, IBM Brand Manager. "This freedom can lower the barrier for children who have not fully developed their motor skills. The use of voice has its greatest potential in education and in products for small children."

Effectively incorporating voice recognition into games means that the software must recognize a range of words in different tones and accents and allow time for the computer to process the voice commands. For now, Command: Aces of the Deep does a decent job of understanding spoken commands. But players still occasionally hear their virtual crews respond, "I don't understand"—something you wouldn't want to hear if you were actually under attack.

Sierra might add voice-recognition support to other games in the future. For example, a future flight-simulation game might let you communicate with virtual wingmen or call up different virtual screens. Another possible scenario is in networked versions of games in which you communicate with other human players over a network while a computer monitors the conversation and takes actions based on what it hears. —W. K.



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Experts agree: Windows 95 and Windows NT Workstation demand APC protection

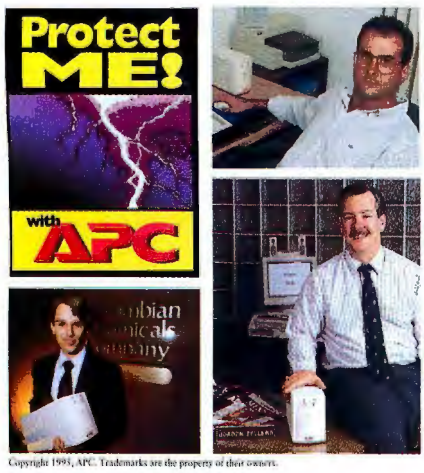
If you're using a computer, few things are more certain than power problems. If you haven't yet had a blackout, lost a hard drive, or toasted a modem, you will. It's almost a statistical certainty.

No surprise that *PCWeek* showed power problems such as blackouts, brownouts, and surges accounted for almost as much data loss as all other factors combined, or that a leading accounting firm attributed the largest single cause of computer downtime to—you guessed it—bad power.

MULTI-TASKING MULTIPLIES YOUR RISK OF *"THE BIG ONE"*

Multi-tasking operating systems like Windows 95 and Windows NT Workstation let you open and manipulate multiple files and applications at the same time. That's why, unfortunately, as *PC Magazine* says "When Windows 95 does crash, it's a horrible mess..."

Moreover, if you are "wired" to the Internet, an on-line service, or dialing into the office, you'll discover that phone lines are common paths for surges taking the express route direct to your motherboard.



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In short, if you still don't have proper protection (that $5 surge strip doesn't count) it's time to protect yourself before you kick yourself. Experts agree: If you choose not to decide on proper protection now, the next time you see this ad may be too late.

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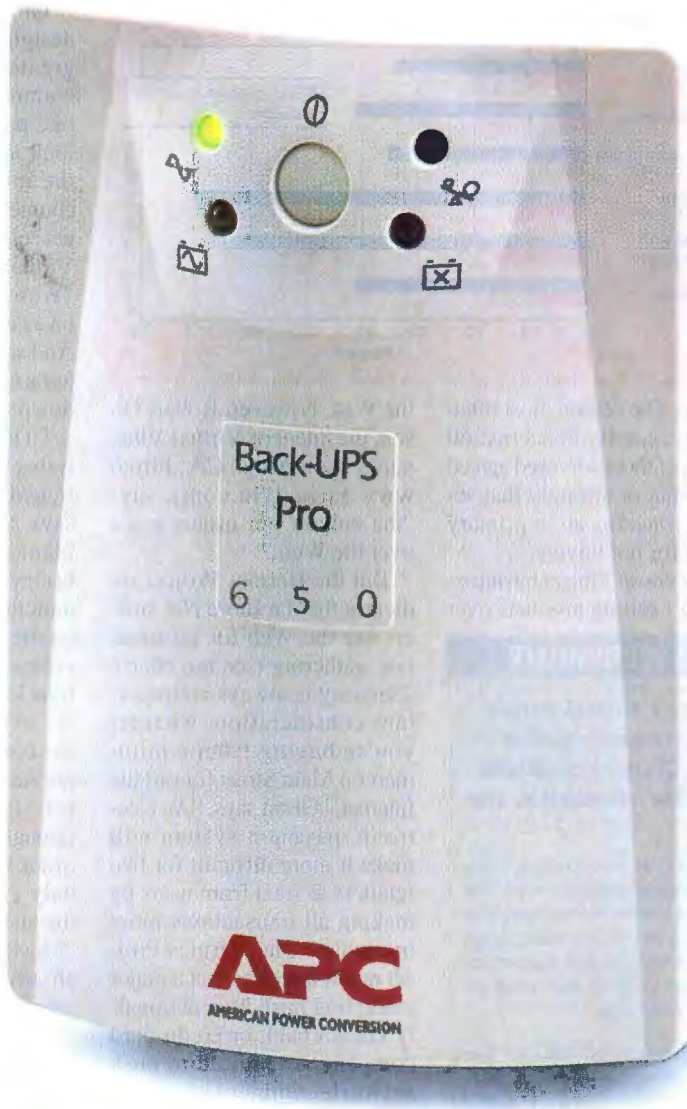

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600	(software not included)	$359	31 min
900	(software not included)	$529	47 min
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*Runtime shown is for typical Pentium desktop system and may vary with your actual load. Note: Back-UPS 200 not recommended for Pentium systems

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INTERNET COMMERCE

On-Line Shoppers: "Just Looking, Thanks"

Security concerns, clunky interfaces, and other factors continue to stymie Internet commerce. The result: On-line users see the Web primarily as a channel for information gathering rather than for actually buying products.

According to an ongoing survey of over 23,000 Internet users done by Georgia Tech and the University of Michigan, one major obstacle to on-line purchases is security. As people learn more about the Internet, they grow less inclined to trust it with their financial transactions.

The survey, called the Hermes Project, found that people are less likely now than they were just six months ago to post credit-card information on-line. The reason most often cited is security concerns: 60 percent of those surveyed agreed somewhat or strongly that security concerns are a primary reason for not buying.

This doesn't mean businesses aren't selling products over the Web, however. Robert Olson, president of Virtual Vineyards (Los Altos, CA; http://www.virtualvin.com), says "the bulk of our orders come over the Web."

But the Hermes Project indicates that far more Net surfers use the Web for information gathering (see the chart). "Security is always an important consideration, whether you're buying from a mini-mart on Main Street [or on] the Internet," Olson says. "An electronic-payment system will make it more difficult for bad retailers to steal from users by making all transactions more traceable." The Hermes Project report indicates that a major marketing push by a nationally known bank or credit-card company is required to push network commerce into the mainstream.

Experts contend that virtual businesses need to pay attention to other factors as well. Officials at Intuit (Menlo Park, CA), which offers (or will offer) electronic bill-payment services through on-line services, banks, and the Internet, say the fees that banks charge users for electronic-payment services are a bigger factor in stifling on-line banking than security concerns. They add that once the fees come down, the number of users paying bills electronically will start to increase.

Others say that the interface design of Web sites is a much greater inhibitor to Internet commerce than security. Unlike paper catalogs, which all look approximately the same, the interfaces that users encounter when purchasing products electronically vary widely, Virtual Vineyards' Olson says. "Web marketers need to settle on a common format," he adds. And some companies' Web interfaces for buying products are downright clunky.

"The problem with the Web is that it's not always a very efficient shopping experience," says Andrew Singleton, president of Money.Com (Cambridge, MA), a provider of financial-information services on the Internet. He says that a colleague recently compared how long it took to buy a product over one company's Web site compared to using the telephone to buy the same product. "It took 10 minutes to poke through the Internet catalog and order the product, but it took only 2½ minutes to do it over the telephone," says Singleton. "Most people aren't concerned about security; they are concerned about convenience."

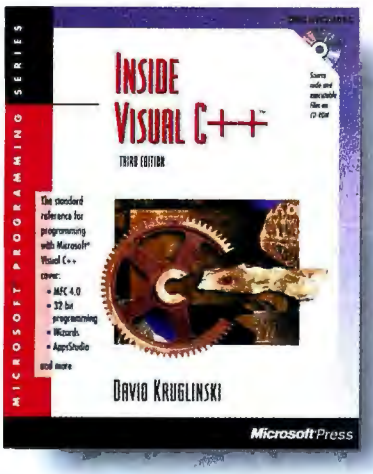
Still, vendors believe it's only a matter of time before attitudes about electronic commerce change. "Once secure transactions become more prominent, the Web will be for people of this century what the Sears Roebuck catalog was for consumers in the last century," says Robert Marczak, president of Marczak Business Services (Sharon Springs, NY, (800) 573-8721; http://www.reu.com), an Internet marketer. Marczak says that people laughed at the Home Shopping Network when it first came out, but it's now a proven money-winner.

—Steven J. Vaughan-Nichols

10 REASONS WHY YOU NEED A WINDOWS 95 UNINSTALLER

Although Windows 95 applications must have a deinstall routine to qualify for Microsoft's Windows 95 logo, companies such as MicroHelp (Marietta, GA, (770) 516-0899), Quarterdeck (Marina del Rey, CA, (310) 309-3700), and others have released their own Windows 95 uninstallers. Here's why:

1. Users have 16-bit and 32-bit applications and need uninstallers to manage and remove 16-bit applications.
2. The deinstall routines in Windows 95 applications don't usually remove data files. Third-party deinstallation programs do.
3. Third-party software utilities remove noncompliant Windows 95 programs.
4. Uninstallers that automatically make a compressed backup copy of deleted files allow easy file restoration if you change your mind.
5. Mobile users need to move applications and data files from desktop PCs to notebooks and home PCs. Some third-party programs offer transport features that make this process fast and easy.
6. Windows 95 applications share files, but program-deinstall routines usually have minimal knowledge of other applications. Third-party programs perform a system scan the first time they run, which helps ensure that they know about all the applications and shared files on the system, including those installed before the deinstallation software.
7. Third-party programs that routinely scan a system can deinstall directories, temporary files, and registration entries created by a Windows 95 application after its installation.
8. Third-party utilities provide cleanup tools that eliminate unnecessary files on precious hard disk space.
9. Archive tools compress infrequently used programs, thus saving hard disk space.
10. Before upgrading to Windows 95, users need to free up some hard disk space. It's easier to clean up a hard disk with an uninstaller.



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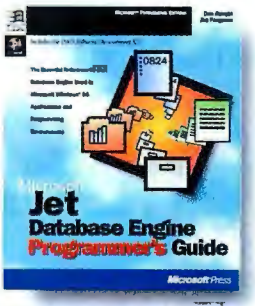

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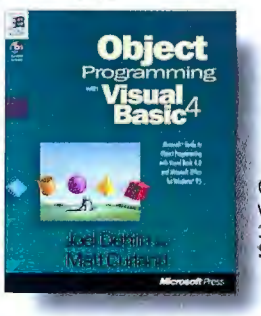

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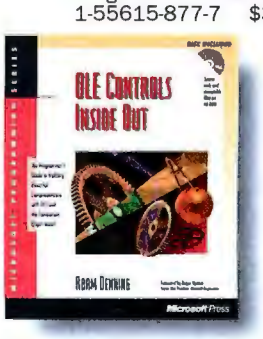

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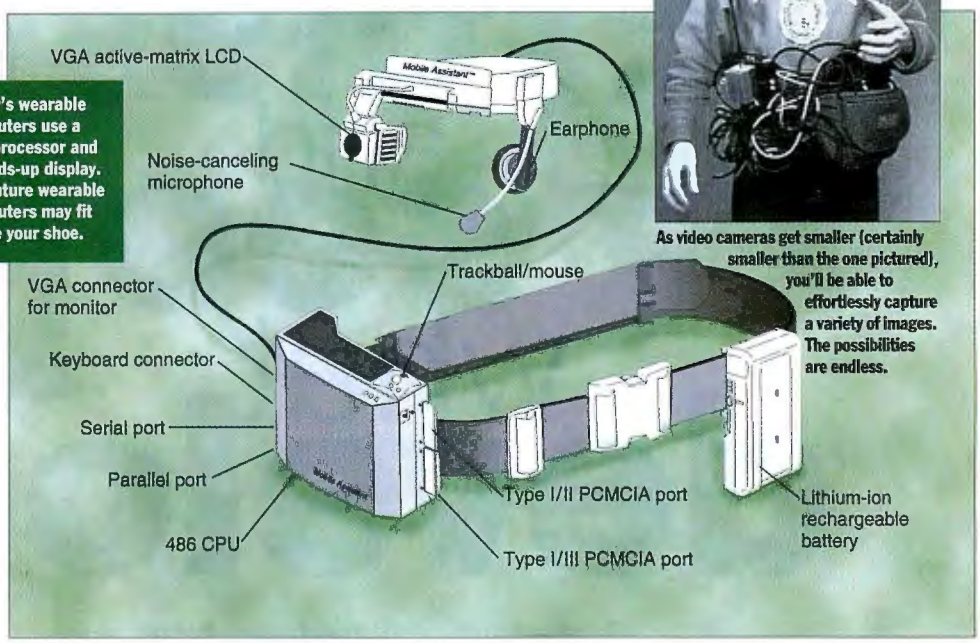
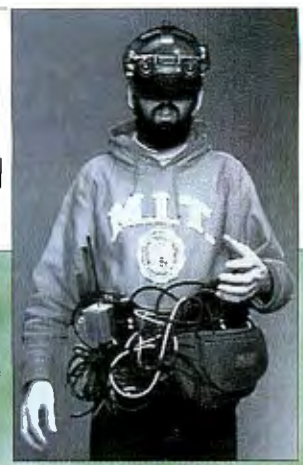
MOBILE COMPUTING

Get Smart—Wear a PC

In the old TV series *Get Smart*, good guy Maxwell Smart occasionally communicated using his shoe phone. Now some researchers at the Massachusetts Institute of Technology in Cambridge, Massachusetts, and elsewhere have gone one better. Envision a PC that goes far beyond Agent Smart's wearable telephone—a PC that actually fits into the heel of a shoe and is powered by electricity captured from the mechanical energy of walking. This and other advancements come from research in miniaturization and wireless communications revolving around the so-called wearable computer.

Today's wearable computers use a 486 processor and a heads-up display. But future wearable computers may fit inside your shoe.





As video cameras get smaller (certainly smaller than the one pictured), you'll be able to effortlessly capture a variety of images. The possibilities are endless.

In its current configuration, a typical wearable computer consists of a small PC and a battery pack, usually worn on a belt, and a head-mounted display consisting of a 0.7-inch-diagonal active-matrix LCD. Companies such as Computer Products and Services, Inc. (CPSI, Fairfax, VA), and InterVision Systems (Raleigh, NC) sell commercial versions of wearable computers.

CPSI's wearable unit, called the Mobile Assistant, consists of a belt-worn 486 unit with a 340-MB internal hard disk, a lithium-ion battery pack, and a head-mounted 0.7-inch VGA display that's manufactured by Kopin Systems using the Smart Slide technology (see News & Views, April 1994 BYTE). This system costs at least $10,000, depending on options, which include a voice-activated Windows interface and a variety of wireless options, such as a global-positioning system and a cellular modem. These systems are used primarily in industrial and field applications for storing documentation, entering inventory data, and similar applications.

Due to the high cost and the currently awkward nature of these commercial systems—the head-mounted display is obtrusive, to say the least, and the belt-mounted system weighs 3.3 pounds or more—the wearable-computer market remains a small, niche market. But as microprocessors, battery packs, and miniature hard drives continue to improve in power and capacity, the design of wearable computers will probably change.

Thad Starner and Steve Mann of MIT Media Labs are working on far more sophisticated systems than the current belt-mounted 486 PCs. For example, the shoe PC described above could connect to a one-handed wireless keyboard that fits into your pants or coat pocket. The display could be contained in eyeglass frames, with laser optics located in the earpiece and projected onto a small lens. Because CD-ROM is not very reliable in a wearable-PC scenario (too much bouncing), a wireless connection to files on the Internet is the preferred solution for data storage.

"The goal," says Starner, "is to have the computer disappear into your clothes so that no one knows you have it." Starner believes this type of system is only a few years away. And talk about handshake protocols: One of Starner's more bizarre ideas is to use human skin as the transport medium for an Ethernet network. Starner claims that in a test of this concept, one person transmitted the contents of his business card to another person's wearable computer by means of a handshake.

Starner and Mann are also working on applications that go far beyond taking inventory and consulting user's manuals. "The real strength of wearable computing is not in controlling unskilled labor remotely," says Mann. "It's better used as clothing, owned and operated by individuals, rather than as uniforms, which are turned in at the end of the day." Mann sees wearable computers as assistants for the visually impaired or for people with memory disabilities. Starner and Mann are developing software that helps people keep track of and remember items that they have previously entered into their wearable computers. To learn more about wearable-computing research at MIT Media Labs, visit its World Wide Web site (http://www.media.mit.edu).

Wearable computers could change our lives in a wide variety of areas, ranging from business to recreational. Imagine one day when, instead of buying a postcard and sending it during your vacation, you transmit over the Internet an electronic postcard taken by your wearable video camera. An application for crime enforcement could let police match a live video image of a suspect with a record from a database of convicted criminals. Or, instead of relying on filtered news from major broadcast networks, users could access video feeds on the Internet to get another viewpoint. Perhaps one day Salvation Army collection boxes will even have a bin for obsolete wearable computers. **—Nick Baran**

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WINDOWS 95 SUITES

Users Like SmartSuite's Team Computing

Although Microsoft's 32-bit version of Office was the first integrated business suite to ship for Windows 95, Lotus's SmartSuite 96, which is now available, leapfrogs the competition with impressive team-computing capabilities. BYTE interviewed seven beta testers of Lotus's new suite to find out what their favorite features were. We also learned what users would like to see in future versions of SmartSuite.

In general, users liked the suite's workgroup-collaboration features. They were also looking forward to using the new BASIC-like Lotus Script programming language, but most hadn't fully evaluated that yet. Users were disappointed in the lack of full 32-bit versions of 1-2-3 and Organizer. What follows is a detailed list of what they liked.

1 Team-review capabilities. Users like team-computing features that allow you to share documents and gather comments in an automated process. For example, in Word Pro, you can assign editing rights for specific people, as well as markup options for each reviewer. When you get back all the different edits and consolidate them into one file, you can quickly see who made which edit.

2 Tight integration of 1-2-3 with Lotus Notes. Most of the SmartSuite beta testers use Notes, including some users who were evaluating the beta version of Notes 4.0, which was slated to ship in January. Users mentioned they like other applications' (e.g., the Approach database) tight links to Notes, but 1-2-3 was mentioned the most. For example, one company that raises investment funds uses 1-2-3 as a front end to a Notes database. Data is first entered in 1-2-3, where employees can do instant what-if analysis and then route the data throughout the company in Notes.

3 Tight integration of Approach with Lotus Notes. This integration enables Approach users to generate mailing labels and reports that are based on Notes data, among other things.

4 Remote presentations using Team Show in Freelance. Many users commented that it's getting harder to gather many people at one time for a group presentation. Freelance allows you to give a presentation to other users over a network. It also allows you to save a presentation as a self-running presentation, send it over E-mail, and then let the audience members review it at their leisure.

5 Tight integration with E-mail. You can access E-mail menus for engines such as cc:Mail or Notes Mail from within a SmartSuite application. You can route a message through a sequence of people using Team Mail, which provides a mechanism for basic workflow applications without requiring Notes.

6 Tight integration among SmartSuite applications. For example, if you want to create a mailing label in 1-2-3, you are automatically brought into Approach.

7 Support for the Internet. Users liked the ability to open up a document in Word Pro over the Internet, as well as Freelance's ability to allow you to convert a presentation into Hypertext Markup Language (HTML) format for display on the World Wide Web.

8 Support for Notes F/X 2.0. Notes Field Exchange lets you send information from applications into Notes and vice versa. Notes F/X 2.0 allows users to access Notes action menus from within SmartSuite applications, providing a more seamless integration with Notes than previous versions of Notes F/X.

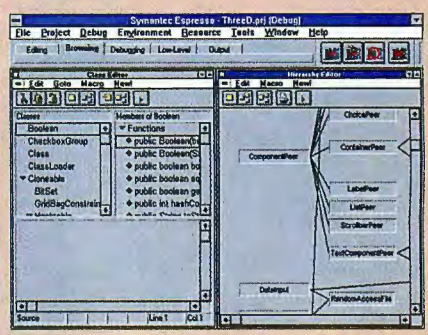
—D. A.

CODE TALK

RICK GREHAN

Symantec Pours Java into Its Development Environment

From the outside, Symantec Cafe (called Espresso in its formative stages) appears indistinguishable from the company's C++ 7.2 IDDE (integrated development and debugging environment). However, once you get inside the IDDE, you find that Symantec Cafe is a Java development system.



Users who've found other Java development environments a little too Spartan should investigate Symantec Cafe, which wraps the company's C++ 7.2 IDDE around a Java compiler.

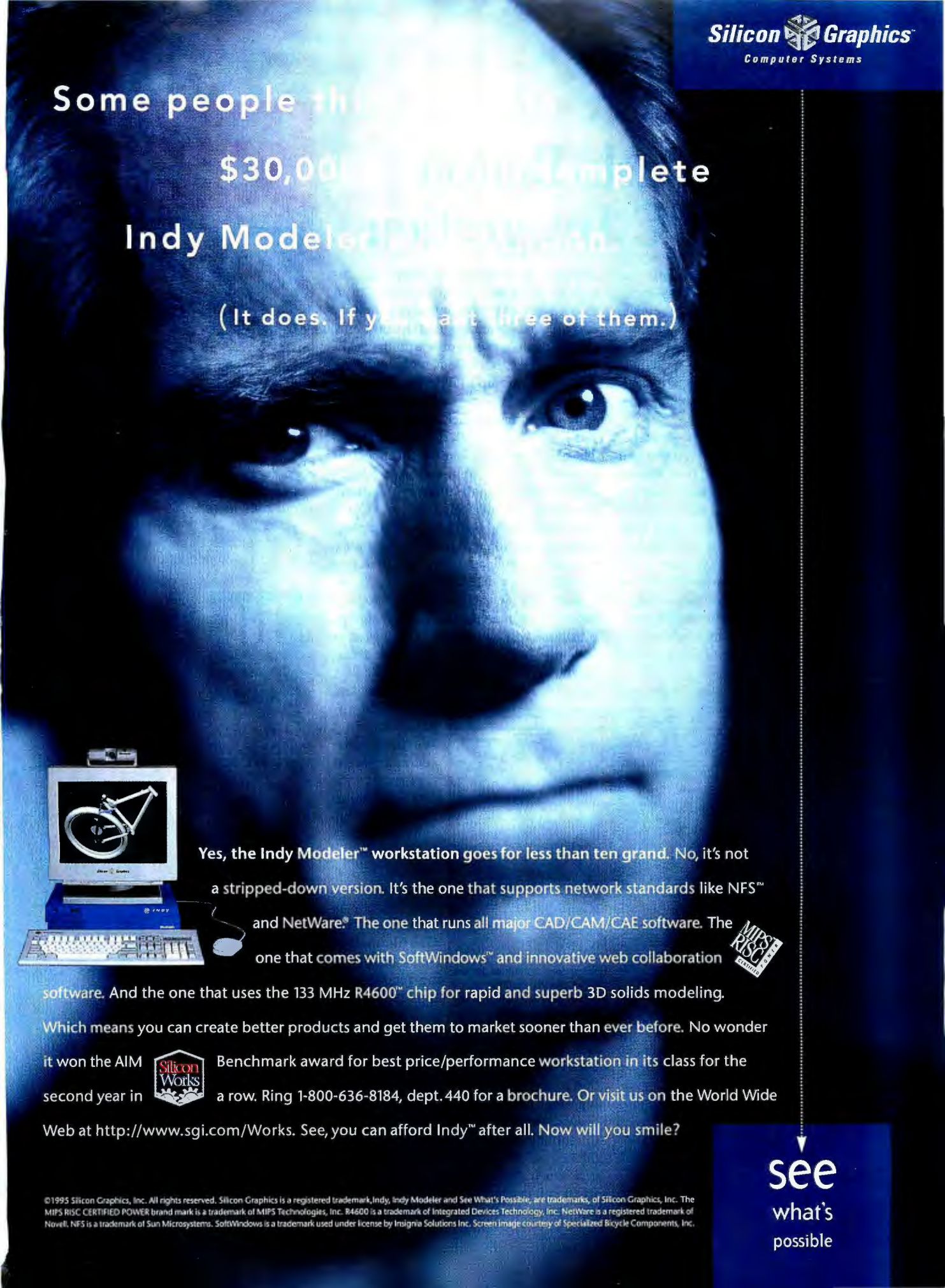
In what resembles an organ implant, Symantec has inserted a Java compiler into its development system. It has also added a Java browser and "Java-aware" editor (i.e., Java source code is displayed in different colors, depending on the syntax and the keyword). Because Symantec is using the same IDDE it used in C++ 7.2, Cafe acquires piles of features for free.

For example, the IDDE's class editor and hierarchy editor function within Cafe just as they do within C++ 7.2. The former is a three-pane Smalltalk-like browser/editor that lets you rapidly navigate through Java classes and class members, such as functions and variables, down to the source code. The latter is a graphical viewer/editor into the inheritance hierarchy of a Java application's classes. It bears the distinction of "editor" because you can, by grabbing and dragging the connections between displayed classes, alter the inheritance relationship between a subclass and its parent class. Such alterations are automatically reflected in the source code.

Symantec Cafe also comes with its own Express helpers, the Symantec equivalent to wizards. AppExpress guides you through the creation of Java skeleton source code for bootstrapping your Java project—be it a console (i.e., command line) or Single Document Interface (SDI) application or a Java applet. For example, if you step through the AppExpress-led build of a Java SDI project and enter nothing more than the name of the application, Cafe will pour out enough code to build a working window with an operative file/edit/help menu.

The weak link in the package is the debugger. Cafe includes Sun's Java debugger, which, compared to debuggers such as Symantec's own within C++ 7.2, is a step back in time. The debugger is command-line-oriented, amounting to a text window into which you type your commands. In a sense it's a remote debugger, since it controls the Java application under test via TCP/IP (which you must install to run the debugger). You can suspend and resume threads, peek into source code, examine an individual thread's stack and local memory, and more. Still, I hope Symantec works on a visual debugger for the package.

At the time of this writing, Cafe was available in demo form from Symantec's Web page at http://www.symantec.com; you can also get more information by calling (800) 441-7234 or (541) 334-6054. It's actually a patch to the Symantec C++ 7.2 compiler, so you'll need that before you can use Cafe. Although Symantec plans to provide Cafe separately, the company did not yet have pricing information available.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HAND-HELD DEVICES

Finally, Push-Button PDA-to-PC Integration

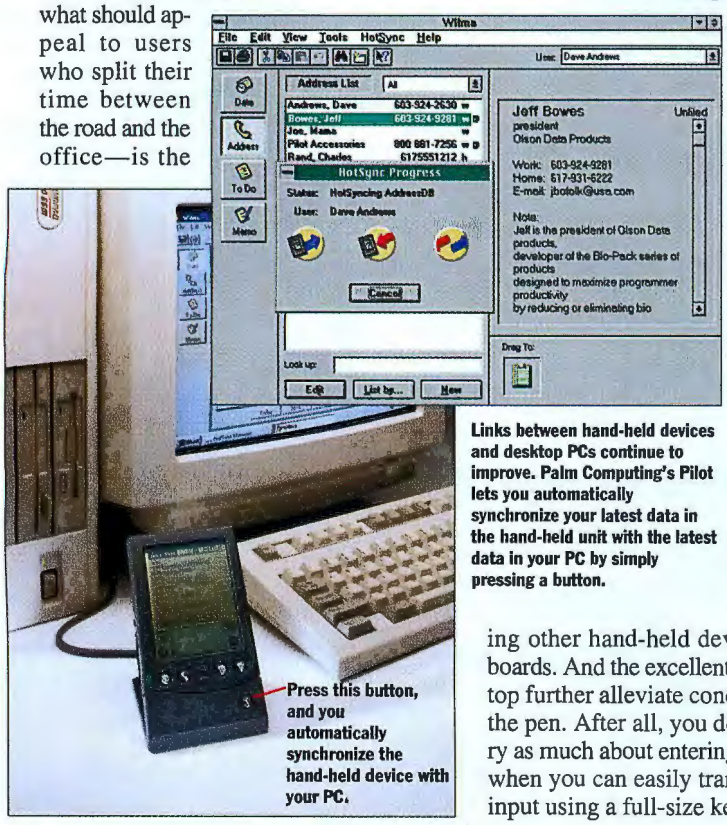
Vendors of personal hand-held devices (aka personal digital assistants, or PDAs) are constantly improving the links between these small portable wonders and desktop PCs and Macs. Now Palm Computing (Los Altos, CA), a division of U.S. Robotics, has released a hand-held device that makes synchronizing with a PC ridiculously easy.

Palm's Pilot ($299, (415) 949-9560; fax (415) 949-0147) weighs 5½ ounces and easily fits into a shirt pocket. It includes a docking station, called the Cradle, that sits atop your desk and connects to your PC via a serial link. The device works with complementary Pilot Desktop software (the Windows version is available now; the Mac version will ship in the first half of this year) that provides contact management, calendar, and other information management functions that you would expect to find in a basic personal information manager (PIM) program.

But what distinguishes the Pilot—and what should appeal to users who split their time between the road and the office—is the device's HotSync button. When you return to the office, you place the Pilot in the Cradle and press the HotSync button, and your new contacts and action items automatically synchronize with the desktop. In a flash, both the hand-held device and the PC are up to date. You can also HotSync the Pilot over a modem.

The Pilot runs for eight to 12 weeks (depending on use) on two AAA batteries. The 68000 processor is powerful enough to drive the built-in applications with acceptable speed, and other applications should be available this year from third-party developers. For example, Campbell Services, developer of the OnTime group-scheduling application, says it will develop software for the Pilot.

Palm plans on releasing a developer's kit in the second quarter of this year: Applications will be developed on a Mac in C using Metrowerks development tools. Developers will also be able to write data links between existing applications and Pilot ROM applications using Windows tools, such as Visual C++ and Microsoft Foundation Classes (MFC).



Links between hand-held devices and desktop PCs continue to improve. Palm Computing's Pilot lets you automatically synchronize your latest data in the hand-held unit with the latest data in your PC by simply pressing a button.

My initial concern about the Pilot, its pen interface, dissipated rapidly as I worked with Graffiti, the device's handwriting-recognition application. After a bit of practice, I found myself entering data as quickly using it as I could using other hand-held devices' small keyboards. And the excellent links to the desktop further alleviate concerns about using the pen. After all, you don't have to worry as much about entering data using a pen when you can easily transfer data you've input using a full-size keyboard. —D.A.

Blasts from the Past

5 Years Ago in BYTE

A company called Nutek (Cupertino, CA) said it had developed technology for creating a Mac clone without requiring the use of Apple's own Mac ROM chips. The company hoped to sell its chips and software to other companies that wanted to produce Mac clones. In later issues, BYTE editors evaluated prototype systems based on the technology but found that they weren't totally compatible. Ironically, Apple is now sanctioning and encouraging vendors that want to create low-cost Mac systems. And Nutek appears to have closed shop: Our attempts to contact the company were unsuccessful.

10 Years Ago in BYTE

Raymond Kurzweil, founder and chairman of Kurzweil Applied Intelligence, wrote about speaker-independent, voice-activated word processors that let you write by talking. Initial price was $20,000. Now that PCs are powerful enough to tackle the daunting task of speech recognition, such systems are now available for under $1000. And as Rob Dieterich's article on page 30 indicates, prices will get even lower.

15 Years Ago in BYTE

BYTE ran the first installment in a series of how-to articles on how to accomplish 3-D programming. Fifteen years later, 3-D is increasingly appearing in mainstream computing through games, business applications, and the Internet. We also reviewed Tandy's Color Computer.

3D VIRTUAL COMMUNITIES
PC USERS MIGRATE TO A NEW GATHERING PLACE
INTEL TECHNOLOGY BRIEFING
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PC COMMUNICATIONS MOVES TO A NEW DIMENSION

Through the convergence of several technologies, the PC is enabling users to communicate in a brand new way—via 3D virtual communities. Users can enter 3D worlds through detailed graphical interfaces and can communicate with other users from around the world. In this briefing, we'll explain how today's PC and communications technologies are making 3D virtual communities a reality.

A whole new way for PC users to interact. A 3D virtual community is a digital environment where multiple users can meet and interact with each other as well as with the environment itself. Shared environments such as text-based, online chat rooms are not new, but the addition of 3D graphics and voice brings a new dimension to the multiuser experience. 3D virtual communities allow users to represent themselves as graphical characters, or "avatars," to explore 3D worlds through simulated movement, real-time graphics, and voice/text communications.

This is all possible because of advances in PC technology. Creating, moving, and displaying 3D images is extremely processor-intensive. The microprocessor must perform complex mathematical calculations to create and manipulate a graphic image. And the more detailed and realistic the image, the more complex its digital representation.

But realistic, detailed graphics are not the only elements that make a 3D virtual community come alive—a communications infrastructure is critical as well.

Virtual community users can communicate with each other through one of several technologies, including telephone lines, the Internet or high-speed digital networks. These are the conduits used to transmit voice and text communications and to periodically update everyone's view of the virtual world, whether that world is downloaded onto the PCs or is maintained on a central server. The latter requires an enormous amount of bandwidth because every time someone moves, the entire world must be redrawn on the server and sent out to all the PCs. But if the world resides on a powerful PC, only the new coordinates need to be sent.

3D VIRTUAL COMMUNITIES

A real-world example of a 3D virtual community is STARBRIGHT* World, created by STARBRIGHT Foundation, with technologies from Intel, Sprint,* UB Networks,* and Worlds Inc.* It is a fully-navigable, virtual-reality play space using powerful PCs on a high-bandwidth network. This program enables children who are ill to escape from their hospital surroundings to play with children in other hospitals in a real-time, virtual environment.

Above is a screen capture of STARBRIGHT's Tropical World. What you see are some of the "avatars," or characters, that the children use to represent themselves while communicating with each other.

Graphical Interface

The graphical interface in a 3D virtual community includes the environment and the avatars within it. Today's high-performance PCs allow the 3D graphical interface to appear more realistic with the addition of such things as textures, colors and light sources. STARBRIGHT World's 3D graphical interface consists of three different worlds as well as a wide variety of avatars. When multiple children are in these worlds, they can all see and interact with each other as they move around.

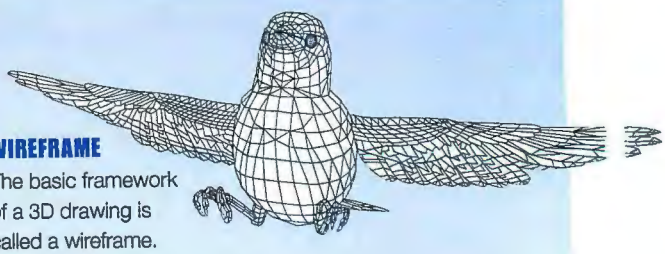
Powerful PCs

High-performance, Intel Pentium® processor-based PCs with PCI local bus technology provide the raw processing power needed for complex calculations involved in manipulating and displaying 3D images. These technologies are critical in STARBRIGHT World since most of the processing is done directly on the PCs to ensure faster response times. These powerful PCs also have Intel's ProShare™ video conferencing, which allows the children to see each other in person.

Communications Infrastructure

The Internet, telephone lines or private networks can be used to transmit voice and text communications as well as to update remote users' views of the virtual world. In STARBRIGHT World, a 45Mb/s advanced, fiber-optic, digital line connects PCs in hospitals all over the country to a single, remote server. This high-bandwidth connection is primarily to support the video conferencing. Once at the hospitals, the lines feed into a router which sends the data to the individual PCs via an Ethernet LAN.

CREATING 3D GRAPHICS



WIREFRAME
The basic framework of a 3D drawing is called a wireframe.

Today's high-performance PCs make the task of creating and manipulating realistic 3D images much easier. This allows 3D virtual communities to truly come alive with real-time motion and realistic graphics.

The creation of a 3D image starts with a wireframe skeleton, which is comprised of polygons and stored as a complex mathematical model. Because these models are truly three-dimensional, an object can be rotated to any point of view and can be manipulated in many ways. To make the wireframe appear solid, it is then "dressed" with color, texture and light. Each of these stages requires additional processing power because each time the model is changed, the calculations need to be redone.

BASIC RENDERING
To make the image appear solid, a layer of flat color is rendered.

FINAL RENDERING
Texture, light, reflections, and shadows are then added to complete the 3D image.

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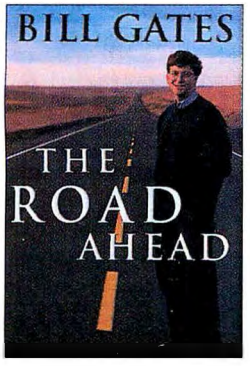
The Future, According to Bill

DAVE ANDREWS

Bill Gates's *The Road Ahead* provides an interesting summary of the oncoming changes that the information highway will have on our lives. However, if you're looking for a detailed accounting of the author's life and times in the world of microcomputers, you will have to look elsewhere. And if you expect the chairman/CEO of Microsoft to provide definitive answers to some of the more difficult questions that face us, such as privacy, censorship, and equal access, you will also be disappointed. Gates admits he doesn't have the answers and—indeed—cannot even foresee all the future problems and opportunities the information highway will bring.



I suspect that the typical BYTE reader won't find anything too new in *The Road Ahead*. Gates speaks in generalities when he discusses important components of the electronic marketplace. But he has penned a good general travel guide for people who want to know where the information highway may take us. Government officials, educators, business executives, and anyone else who has resisted learning about the information highway and how it may change our lives would be well served by reading *The Road Ahead*.

THE ROAD AHEAD

Bill Gates, Nathan Myhrvold, and Peter Rinearson
Viking Penguin
ISBN 0-670-77289-5

$29.95

Dave Andrews edits BYTE's News & Views section. You can reach him on the Internet or BIX at dave.news @bix.com.

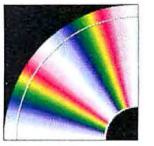
A MUST FOR MAC PROGRAMMERS

A FRAGMENT OF YOUR IMAGINATION by Joe Zobkiw, Addison-Wesley, ISBN 0-201-48358-0, $39.95

This is the best programming book for PowerPC-based Macs I've seen to date. It discusses in great detail how to use code fragments, those basic code resources of the Power Mac OS. The book starts with a description of the various species of code fragments (e.g., private and accelerated) and when you use them. It mentions how they can appear as "fat resources," which are code resources composed of both 680x0 and PowerPC code, and can thus run on any Mac.

Such information demands lots of source code examples to illustrate the concepts, and Joe Zobkiw doesn't disappoint. Sample code is provided that illustrates how to write fragments that are plug-in modules for Adobe Photoshop and others that add functions to HyperCard (XCMDs). Trap patching is explained, along with code that implements a "fat trap," a patch made of 680x0 and PowerPC code. Finally, there are examples of writing resources that implement custom dialog box controls (CDEFs), lists (LDEVs), and windows (WDEFs).

This sort of information is scarce and difficult to find, and it's nice to see it, along with useful source code, under one cover. Best of all, *A Fragment of Your Imagination* fulfills my "no toy programs" requirement. That is, most of the supplied sample code accomplishes practical tasks. The CDEF sample implements a slider, which is one of the most difficult items to program because of the way the code must respond to the user's actions. All in all, this book is a great resource for anyone doing serious programming on a Power Mac. ■ **—Tom Thompson**



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Finding it on the Internet is easy—if you already know where to look. Sure, *browsing* will turn up all sorts of interesting things, but 5 hours after you began your search, you may find yourself no closer to answering the question that prompted your leap into cyberspace than you were when you started. That's the problem robot-built catalogs like Lycos are meant to solve.

Frontier Technologies has integrated the "small" Lycos catalog (about 500,000 World Wide Web pages) with its browser to enable you to run searches off-line. The small Lycos catalog consists of Web pages that Lycos has had time to analyze and abstract. The large catalog, the one you search when you access Lycos directly, includes the small catalog and link information for about 9.5 million other uniform resource locators (URLs) for which abstracts have yet to be created.

The centerpiece of the browser is an Internet Organizer with 49 folders, which have interesting pages, and a search folder, into which your own search results appear as bookmarks. You can move bookmarks or deposit them directly into preexisting folders, create new folders for them, and copy or move them from one folder to another. The search form is simple: Type in your search terms and go. You can't do anything fancy, though you can play with the "advanced" options to effect a Boolean AND query. (The default search type is OR.) Once on-line, a double-click of the mouse sends you directly to the site. On-line accesses can run in the background, so you can conduct multiple searches.

By the time you read this, CyberSearch will work with Windows 95 versions of Netscape Navigator, Microsoft's Internet Explorer, NCSA Mosaic, and GNN/GNN Works. Off-line searching won't give you the *feel* of Web surfing, but it might save you time and money. **—Rowland Aertker**

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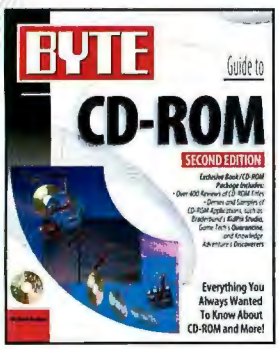

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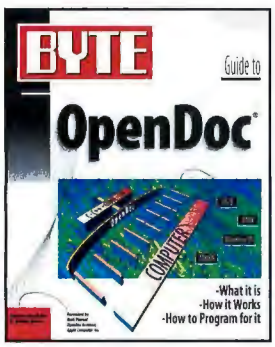

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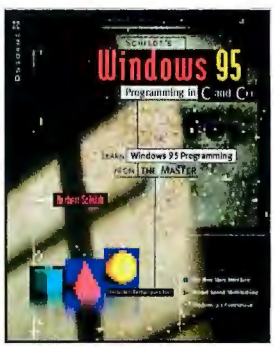

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INSIDE THE Web PC

$500 network-centric computers will soon roll off assembly lines. Should we take them seriously?

Tom R. Halfhill

Are network computers just another false alarm, like the first personal digital assistants (PDAs)?

That's the down-to-earth question you can't help asking when high-profile CEOs such as Oracle's Larry Ellison, Sun Microsystems' Scott McNealy, and IBM's Lou Gerstner describe their utopian vision of a $500 Internet appliance that could replace today's PCs. It's a question that provokes strong reactions from both the visionaries (network computers are coming soon, and they'll change everything) and the naysayers (network computers are impractical, underpowered throwbacks to dumb terminals).

This much is certain: The idea is sweeping the computer industry like wildfire. Acorn Computer, Apple Computer, Geoworks, IBM, LSI Logic, Oracle, Silicon Graphics, and Sun Microsystems are just a few of the companies that are either developing network computers or licensing their technologies to other vendors.

In late January, Oracle unveiled a prototype of its network computer in Japan (see the photo on page 50). Bandai, a Japanese company, licensed Apple's Pippin architecture and plans to ship a low-cost system this month (see "Inside the Pippin" on page 54). Many sources predict that network computers will be in mass production by the end of the year.

Things are moving so fast that people are still inventing new names for the machine. Network computer (NC), Internet appliance, Web PC, Java terminal, Internet access device, browser box, net-top box—they're all minor variations on the same concept.

The concept is a dirt-cheap computer that discards today's overweight OSes and bloated, platform-specific applications. Instead, it runs a microkernel OS and platform-independent software written in an interpreted language such as Sun's Java. Monolithic, kitchen-sink applications give way to component-based programs and applets that you download from a network or the Internet only when you need them. In theory, you could do almost anything with an NC that you do with a PC, except it will cost you a lot less for the hardware and software. Connectivity costs, however, may be significant.

To transform that theory into reality, NC vendors must capitalize on four key technologies: cheap, speedy microprocessors; lightweight system software and componentware; platform-independent programming languages; and fast, affordable access to networks.

But the biggest question is: Who needs one?

Not Just for Neophytes

NCs aren't just for home users who can't afford or can't comprehend a full-blown PC. In fact, proponents expect the early adopters to be Fortune 500 companies. "The key to [the corporate] market is for people to be able to do what they do today, but with less hassle," says Andrew L. Laursen, vice president of Oracle's Network Computing Division. (Although Oracle says it has no plans to manufacture NCs, it is licensing technology to other vendors and is hoping that NCs will create more demand for server software.)

Corporations are the first target for NCs for two reasons: They already have high-speed networks in place, and their administration costs for conventional PCs are soaring. Administration costs have become so significant, the low purchase costs of NCs won't likely be their main attraction for corporations. According to studies by the Gartner Group (Stamford, CT), the five-year cost to a business of owning a Windows PC is about $40,000. By moving software maintenance to servers and limiting the ability of users to tinker with their machines, NCs could be easier for MIS departments to maintain and less susceptible to user errors.

So far, no one has predicted the ownership costs of an NC, but X Window System terminals provide a good starting point. The Gartner Group estimates that companies with a 24-user X-terminal and Unix-server network can save more than $200,000 over five years compared to companies with a PC-based LAN of the same size. The X Business Group—which is a more biased source—estimates that network administration of a 40-seat X-terminal network could be $270,000 less expensive over five years than a similar PC LAN.

NCs could also save money by slowing the costly spiral of upgrades. Each new release of a behemoth business package,

ILLUSTRATION: ALAN MAZZETTI © 1996

such as Microsoft Office, requires more memory, more hard drive space, and more CPU cycles. More powerful computers, in turn, spur developers to create even bigger programs. If programmers broke up those monolithic applications into smaller, dynamically loaded components, the computer could accomplish (in theory) the same tasks more efficiently.

It would be more efficient because you would be loading only the part of the program that you need, when you need it. A simple example: One sample Java applet is a small (27 KB) spreadsheet. It doesn't perform linear regression or offer the extensive graphics of Microsoft Excel. However, the idea of components is that complex mathematics and graphics would be separate modules that you would download when you need them. At 28.8 Kbps, it would take about 7 seconds to download such a spreadsheet—or about the same amount of time it takes to load Excel 7.0 on a 120-MHz Pentium system.

Although componentware was invented for conventional PCs, NCs could benefit from it even more. NC proponents envision hardware designed for a distributed environment in which administrators store and maintain the software components on a network, not on the client. That network could be a corporate LAN, an enterprise WAN, the Internet, or a secure intranet. Once the NC downloads the software from the network, however, the components execute locally on the client. NCs are not dumb terminals, nor are they X terminals, where applications (called clients in X) execute on a central server.

Some analysts aren't convinced that NCs will save corporations significant money. Improved system management tools could wipe out any cost advantage of NCs, and some corporations are turning conventional PCs into virtual NCs by modifying the hardware and software to prevent user tampering.

"This is a race between tools for better desktop manageability and a special appliance that is effectively lobotomized to make manageability easier," says Bill Kerwin, an analyst for the Gartner Group. "While network computers are a much more manageable environment, the bottom-line cost might be about the same."

The second major market for NCs is schools. Schools desperately need more computers to prepare their students for a job market in which PCs are becoming as common as telephones. Yet according to a study by the Arrington Research Group (Monterey, CA), the ratio of students to computers in U.S. public and private schools (grades K-12) is nearly 7 to 1. Almost half of those computers are 8-bit Apple IIs, Commodore 64s, Commodore PETs, and TRS-80s.

"School districts have told us that $500 is an important entry point, a price point that would allow them to buy computers en masse," says analyst Michael Arrington. "It could move computers from the media lab onto the students' desktops."

Finally, there's the consumer market. Nobody knows how many people would be interested in buying a home computer if it cost only $500 and gave them access to the burgeoning services on the Internet. The potential is so lucrative, however, that at least a dozen companies—including Asian conglomerates that specialize in high-volume manufacturing of consumer-electronics products—are rumored to be hotly pursuing the idea.

The push for NCs is also a rare chance to outflank Microsoft. As the biggest vendor of monolithic, PC-centric applications and system software, Microsoft seems most vulnerable to a paradigm shift that could make its underlying platform obsolete. Some proponents of NCs can barely conceal their glee over Microsoft's recent defensive moves, such as its licensing of Java and its announcement of VB Script. The danger is that wishful thinking could cloud the vision of network computing and lure its supporters over a cliff.

Four Key Technologies

NC Enablers	Products to Watch
Fast, affordable access to networks	Cable modems, ISDN, ATM
Fast, affordable microprocessors	IDT R4640 NEC VR4300 Ultra-64 (Nintendo and SGI) StrongARM Superchips (e.g., MicroUnity's Mediaprocessor)
Platform-independent programming languages	Java, JavaScript Visual Basic, VB Script
Lightweight OSes	NCOS (Oracle) RISCOS (Acorn) GEOS (Geoworks)

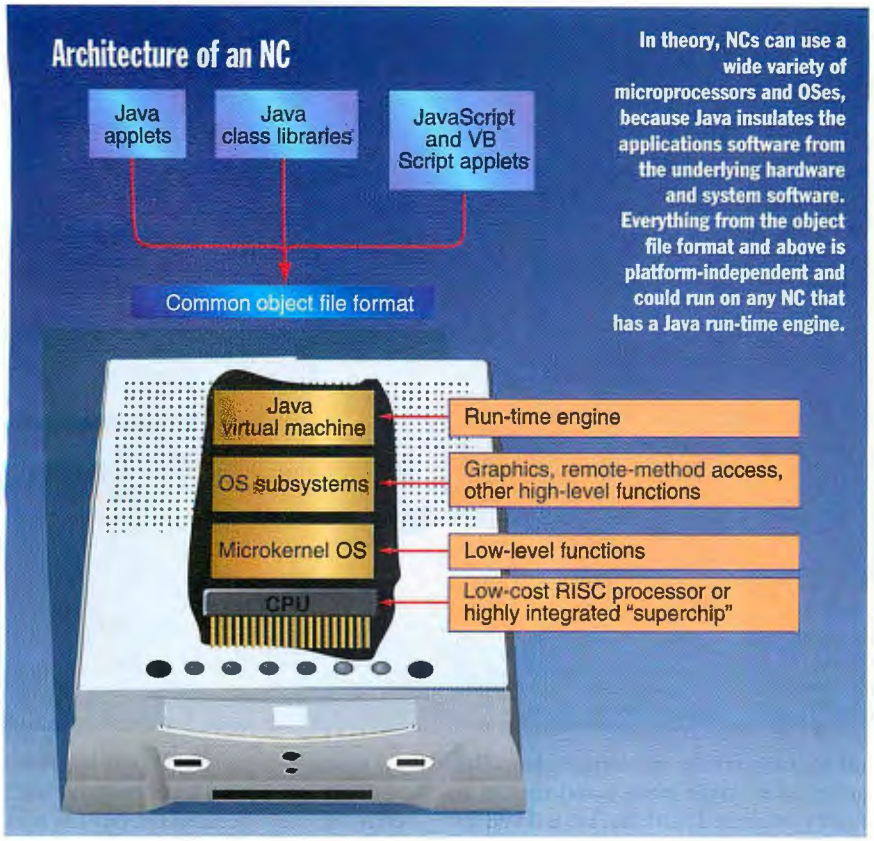
Dream Machines

Microsoft CEO Bill Gates is skeptical about inexpensive NCs. "When someone talks about a terminal at a certain low price, ask them what they dropped from a PC," Gates said at a recent Internet Strategy Workshop in Seattle. "Did they drop 3-D browsing? Did they drop motion video? Did they drop local storage? PCs have to drop in price, but they also have to advance in capability."

Indeed, some observers scoff at the idea that vendors can build and profitably sell a useful computer for only $500. Yet the industry sold millions of sub-$500 computers in the early 1980s, before the IBM PC standard raised expectations and prices. Perhaps the best-selling computer of all time was the Commodore 64, which made its debut in 1982 at $595 and soon fell to $200. Today, a 486/33 with a small hard drive and minimal RAM could probably sell for about $500. Such a system might represent a low-end NC.

Of course, a Commodore 64 isn't powerful enough for the kind of applications users demand today. However, computer technology has come a long way over the past decade, and it's possible to build surprisingly powerful boxes at low prices. Apple designed the Pippin before the current hype over network computing, but the Pippin, which uses the Power Mac architecture, could easily become a $500 NC. The latest home game machines from Sega, Sony, and Nintendo also come close to the design points for NCs, and they're capable of graphics that would put most PCs to shame. They all cost less than $500.

The question isn't whether $500 computers are possible; it's whether a $500 computer can meet the expectations of users. Those expectations vary widely, depending on the market and the application. A business user who's juggling spreadsheets has different needs than an eighth-grade student who's researching a



report using the Internet, or an adult who's interested in home shopping. Therefore, it is unlikely that a single machine at a single price will fit the needs of the corporate, education, and home markets.

"Network computers will not replace PCs on the desktop," says John Robb, an analyst with Forrester Research (Cambridge, MA). "They're more of a supplement to PCs. They'll go into places where there are ease-of-use issues or cost issues."

Mobile PCs will prove even more resistant to obsolescence, because it will be a while before wireless networks are ubiquitous and fast enough to make mobile NCs practical. Eventually, however, public NCs could become as widespread as public phones. Instead of toting a notebook and a bag of accessories, all you'll need is a credit card. After you log on to the network from the airport, airliner, or hotel room, the NC will download your working environment and all your files.

Network Catalyst

The four technologies required to make NCs practical are all important, but networking is the keystone that supports the entire structure. The World Wide Web, which didn't even exist five years ago, is the most remarkable networking development for NC proponents.

On the surface, the Web is just a visual, point-and-click user interface on the Internet. Seemingly overnight, however, it has transformed a bleak, text-based landscape into a colorful cyberworld brimming with opportunities, both artistic and commercial. As Netscape's initial public offering proved, the Web may be sparking the last great gold rush of the millennium.

The Web and the Internet enable network-centric computing on a global scale. However, only a few million users with high-end PCs currently have access to the Web. And few of those users enjoy the kind of bandwidth that's required to fulfill the grander ambitions of Web visionaries.

NCs could get by with the narrowband access provided by analog modems (14.4 to 28.8 Kbps) or basic-rate ISDN (64 to 128 Kbps). However, a device that drinks most or all of its software from a network really needs a bigger straw. That's why the ultimate fate of NCs may depend on the adoption rate of technologies such as asynchronous transfer mode (ATM) and cable data modems.

Cable modems could be the primary catalyst; hundreds of millions of homes, schools, and office buildings throughout the world are already wired for cable. Hewlett-Packard and Motorola have announced contracts to sell more than half a million cable modems this year. A proposed industry standard (IEEE 802.14) would codify the protocols for data access over cable at a speed of about 10 Mbps. (Theoretically, 25 Mbps is possible, but line noise is a major problem.)

Further out is ATM, which can range from 1.544 to 622 Mbps. If ATM becomes widely available, network-centric computers could become a lot more attractive.

"Once people get access to the Web at broadband speeds, there's no going back—especially if it can happen at a price point that's competitive with narrowband access," says Tony Stelliga, vice president of product marketing for MicroUnity Systems, whose innovative Mediaprocessor could be the CPU in tomorrow's broadband NCs.

One catch: If cable modems take off, can the networks keep up? The Internet may bog down under the strain of millions of new users, and cable TV companies will have to invest in new equipment. To minimize their investment, cable companies may link anywhere from 500 to 2000 customers to a single data network node. If 10 percent of those customers subscribe to cable data services, as many as 50 to 200 users might be sharing the same slice of bandwidth during peak hours.

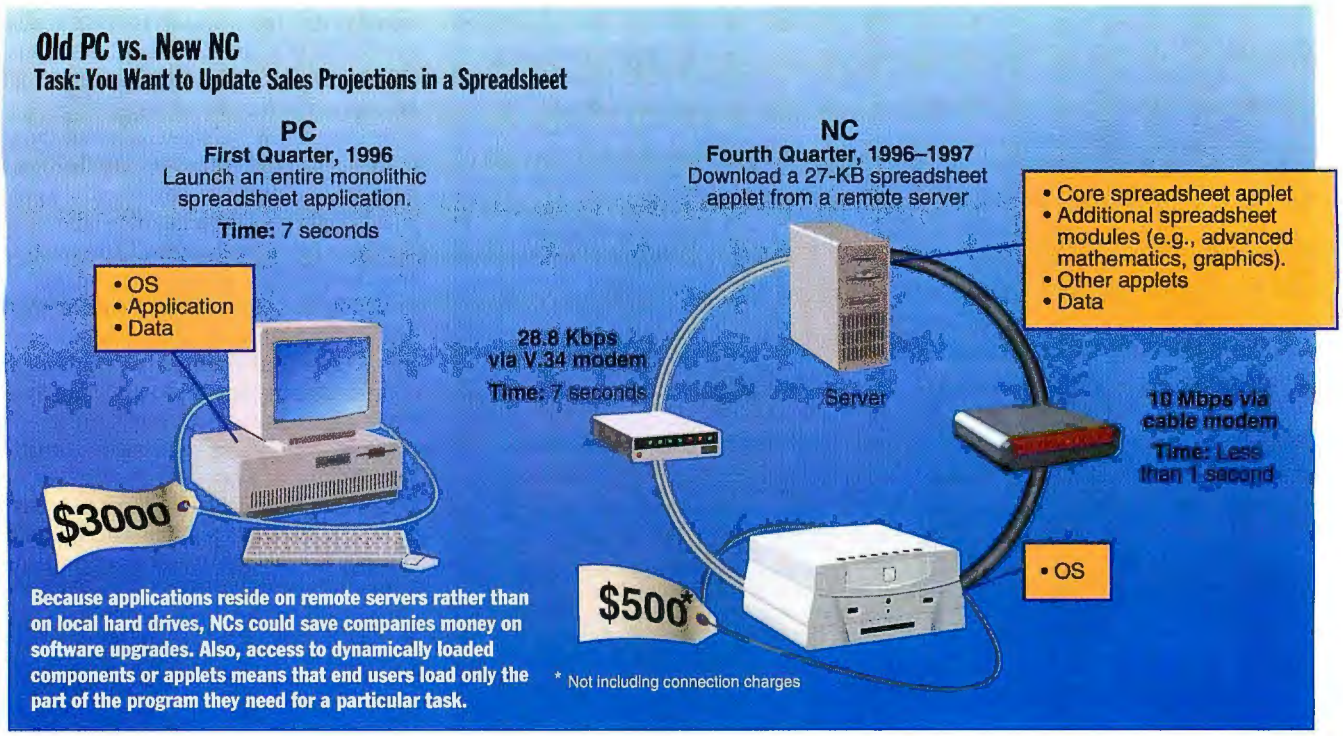
"It's a nightmare in the making," says Vincent Schmidt, product manager for ADC Telecommunications, which makes T1 modems. "Cable data modems are only the tip of the iceberg. The back end cannot handle that many high-speed users."

Schmidt thinks that phone companies—which have more sophisticated switching networks already in place—will intervene with their own high-speed alternatives to cable modems. Some analysts expect these alternatives to be in place in 1997. "Eventually these problems will be solved," Schmidt says. "If there is a path to money, people will find it."

Cheap Chips

High-speed networking won't save the day if NCs are stripped-down boxes that run like slugs. For NCs to seriously challenge PCs, they must deliver comparable user experience and performance. That's not easy for a product that retails for $500 or even $1000. A 120-MHz Pentium chip alone costs about $350, and some versions of the Pentium Pro cost nearly $2000.

That's OK, respond NC proponents, because NCs don't need leading-edge microprocessors. Instead, NCs will ride the trailing edge of the price/performance curve, where they can reap the benefits of plunging prices. The industry focuses so much attention on state-of-the-art CPUs that you can forget how much processing



power is available for just a few dollars.

For example, Integrated Device Technology (IDT) and NEC Electronics manufacture a wide range of 64-bit RISC processors based on R4000 cores from Mips Technologies. IDT's R4640 executes 175 MIPS (Dhrystone: 2.1 MIPS)—comparable to a 100-MHz Pentium—and costs only $28. NEC's new 133-MHz VR4300 executes 120 MIPS (or 80 SPECint92, 60 SPECfp92) and costs only $35. Versions of the new StrongARM processor, a joint project of Digital Equipment and Advanced RISC Machines (ARM), deliver from 115 to 230 MIPS. The StrongARM is expected to cost about $30 to $50 (see "StrongARM Tactics," January BYTE).

This kind of bargain-basement CPU power makes the latest generation of home game machines possible. Nintendo's new Ultra-64, designed in partnership with Silicon Graphics, uses a 100-MHz version of NEC's VR4300.

"When we first showed people what the Ultra-64 could do, some Silicon Graphics engineers were stunned," says John McCrea, the manager of Silicon Graphics' WebForce unit, which is making tools for Web developers. "The Ultra-64 has graphics equal to a $100,000 Silicon Graphics workstation of five years ago." The company is putting that same graphics-rendering technology into its Cosmo Motion engine, part of a graphics library for Java.

By using modern design tools and standardized modules, today's engineers can integrate fast RISC cores with numerous other components on a single chip. This saves even more money and results in highly integrated parts that are tailored for specific customers. For instance, Sony's PlayStation, which is a $299 game console, has a single ASIC that integrates a Mips R3000A CPU core, a specially designed geometry transform engine, a graphics processing unit that can render 1.5 million polygons per second, a sound processor, a JPEG decompressor, and miscellaneous I/O logic.

LSI Logic custom-designed Sony's ASIC in only eight months. LSI has a new fabrication process that can squeeze 49 million transistors on a chip. (By comparison, a Pentium Pro CPU has 5.5 million transistors.) LSI recently announced a superchip that's intended for low-cost NCs. Called the Internet on a Chip, it can include a Mips R4x00 CPU core of the vendor's choice, a graphics processor, a sound processor, a memory controller, and circuitry for a V.34 modem—all for $50.

Alternatively, LSI can replace the V.34 modem with an ISDN interface for about the same price. And the CPU cores aren't slouches. For midrange NCs, LSI suggests a 40-MHz R4010 that executes 100 MIPS; for higher-end requirements, LSI offers an R4020 core that delivers 200 MIPS.

To make an NC, says LSI, all the vendor needs to add is 4 MB of DRAM ($110 at current wholesale prices), an analog chip for the V.34 modem ($2 to $5), and perhaps some ROM for the OS kernel and Java engine (the price varies according to how much, but mask ROM is inexpensive).

"There has been a lot of negative reaction in the press because nobody has been able to show a bill of materials that would make a sub-$500 box possible," says John Daane, who is vice president and general manager of LSI's Communications Products Division. "We designed the Internet on a Chip to prove it could be done at this price point."

The Internet on a Chip is part of a wave of highly integrated superchips coming this year from suppliers like Chromatic Research, MicroUnity, Nvidia, Philips Semiconductors' Trimedia Product Group, and Vadem (see "Chip Fashion," November 1995 BYTE). Intel is less likely to be a player in this market. It prefers to sell cutting-edge microprocessors, which are much more profitable. Those profits pay for the billion-dollar foundries that Intel needs to maintain its leads in production capacity and process technology.

Another company that's a pioneer in low-cost systems is Acorn, which has been making inexpensive computers for years. In 1995, Acorn introduced the A7000, a machine aimed primarily at the U.K. educational market. The A7000 is based on the ARM 7500 microprocessor, which is comparable to a 486DX2/66. Although the A7000 has only 2 MB of RAM, its RISCOS OS is capable of multitasking several programs in that space, says Peter Bondar, director of Acorn's Applied RISC Technologies Division.

Bondar says Acorn is in "advanced

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stages of discussion" with U.S., Japanese, and Korean companies that want to build NCs with technologies licensed from Acorn and ARM. (Acorn founded ARM and owns 42 percent of the company.) Acorn is offering its efficient RISCOS, its low-cost board manufacturing, and ARM's processors.

"The debate over the $500 Internet computer is a moot point as far as we're concerned," says Bondar, who adds that his company's low-cost computers prove the NC concept is viable.

Because $500 computers will be a low-margin business, the market probably won't attract many U.S. manufacturers. More likely, Pacific Rim companies that specialize in high-volume consumer electronics will make NCs.

Where's the Software?

Hardware is only half of the equation—perhaps the easiest half. In a market where many people shun the Mac because it has merely thousands of applications instead of tens of thousands, NCs are at a real disadvantage: They have no software at all.

"A dedicated Java machine can't run one line of code that's currently for sale anywhere, and that's a major obstacle to overcome," says Michael Goulde, an analyst for the Patricia Seybold Group (Boston, MA). "Have you ever seen a football game in which the receiver starts running downfield before he finishes catching the pass? He ends up dropping the ball. I think that's what is happening here."

Everything seems to depend on Java. Other programming languages may have roles to play—Telescript, VB Script, and TCL come to mind—but Java was largely responsible for igniting the mania over NCs, and Java is the critical element that will make NCs from different vendors compatible with each other.

Java is a high-level interpreted language that runs on a virtual machine. In other words, the Java engine is a run-time interpreter that insulates applications from the nitty-gritty details of the OS and hardware. That's why it hardly matters which OS or CPU is inside the NC. Vendors can choose what delivers the best price/performance advantage, and they can even change the OS and CPU when something better comes along—without breaking any applications software. As long as there's a Java engine on the computer, it can run any program written in Java or JavaScript (see "Wired on the Web," January BYTE).

This architecture is crucial to the platform independence and low-cost model of NCs. It's also the next logical step in the evolution of software development. In the 1970s and early 1980s, programmers wrote software in assembly language because it was fast and memory-efficient.

ORACLE'S NETWORK COMPUTER

Here's the first photograph of the prototype Web PC that Oracle CEO Larry Ellison unveiled in January at a trade show in Japan. Designed by Frogdesign, this multimedia version of the Web PC has room for a built-in CD-ROM player and vertical speakers. Oracle has trademarked the name Network Computer and is negotiating with several Asian companies to manufacture variations of this reference design. Oracle also has a prototype for a laptop Network Computer.

As PCs grew more powerful and the pressure for new features became more urgent, programmers began working with high-level compiled languages such as Pascal, C, and C++. Compiled code runs slower and requires more memory than hand-tooled assembly language code, but it's easier to write. It runs acceptably fast on today's systems. Interpreted languages such as Java are even easier to work with than compiled languages, and developers don't have to port their code to different platforms.

The flip side of interpreted programs is that they're even slower than compiled programs. This could be the Achilles' heel of NCs, whose low prices will preclude the fastest microprocessors.

If performance becomes a major problem, full native compilation could be the fallback position. Java programs are compiled into a *bytecode* format that's interpreted by the run-time engine. It's possible to create a compiler that turns Java bytecode into native machine code. To preserve software portability, the compilation could happen automatically when the NC downloads Java objects from the network. In a business environment, the server could store precompiled objects. Some NCs may cache the compiled binaries of frequently used objects on a local hard drive. (Caching would also help compensate for slow network connections.)

To attract developers to Java, Sun and Oracle are sponsoring a Java Cup contest with $1 million in prizes. According to Geoff Baehr, Sun's chief networking officer, there will be no shortage of entries. "People are actually writing this stuff," he says. "This isn't one of those things where people will be saying, 'Whatever happened to Java?' in a few years."

Proponents claim that Java will unleash a wellspring of entrepreneurial spirit that dominant software companies and a restrictive distribution system currently stifle. NCs could alter that balance of power in two ways.

First, a shift toward components and applets could make room for smaller developers. Second, because NCs by definition live on a network, they will encourage new models for merchandising software. Instead of buying an unlimited-use license, as you do now, you may pay a small fee every time you download an object. Or you'll pay a small monthly fee for unlimited use. Or perhaps you'll pay nothing at all—just as most people today don't pay for Netscape Navigator.

"We're on the brink of having someone with a good idea being able to deliver that good idea to literally millions of people overnight," says Oracle's Laursen.

Microsoft Fights Back

The debate over NCs has led to much loose talk about the destruction of Microsoft. Can a company with enough programmers to populate an infantry division compete in this brave new world? At the Internet Strategy Workshop, Gates said he isn't worried. "We've always competed with free software. For about $10, you can buy 10 CD-ROMs with lots of free software, and that software will be available on the Internet, just as it's been everywhere else.

"We think most companies would rather pay $100 per module to make sure their employees have the best spreadsheet or the best word processor," Gates continued. "We think they'd rather pay 0.1 percent of the employee's salary to make sure they can use that software all they want instead of leasing it on a per-use basis."

Still, Microsoft was compelled to license Java from Sun. This isn't the cataclysmic event some observers think it is, however. Microsoft needed Java to keep its Web browser competitive with Netscape's. There are no indications that Microsoft is shifting emphasis away from Visual C++ and Visual Basic.

In fact, Microsoft announced VB Script, a subset of Visual Basic that's intended to compete with JavaScript, the Java-based

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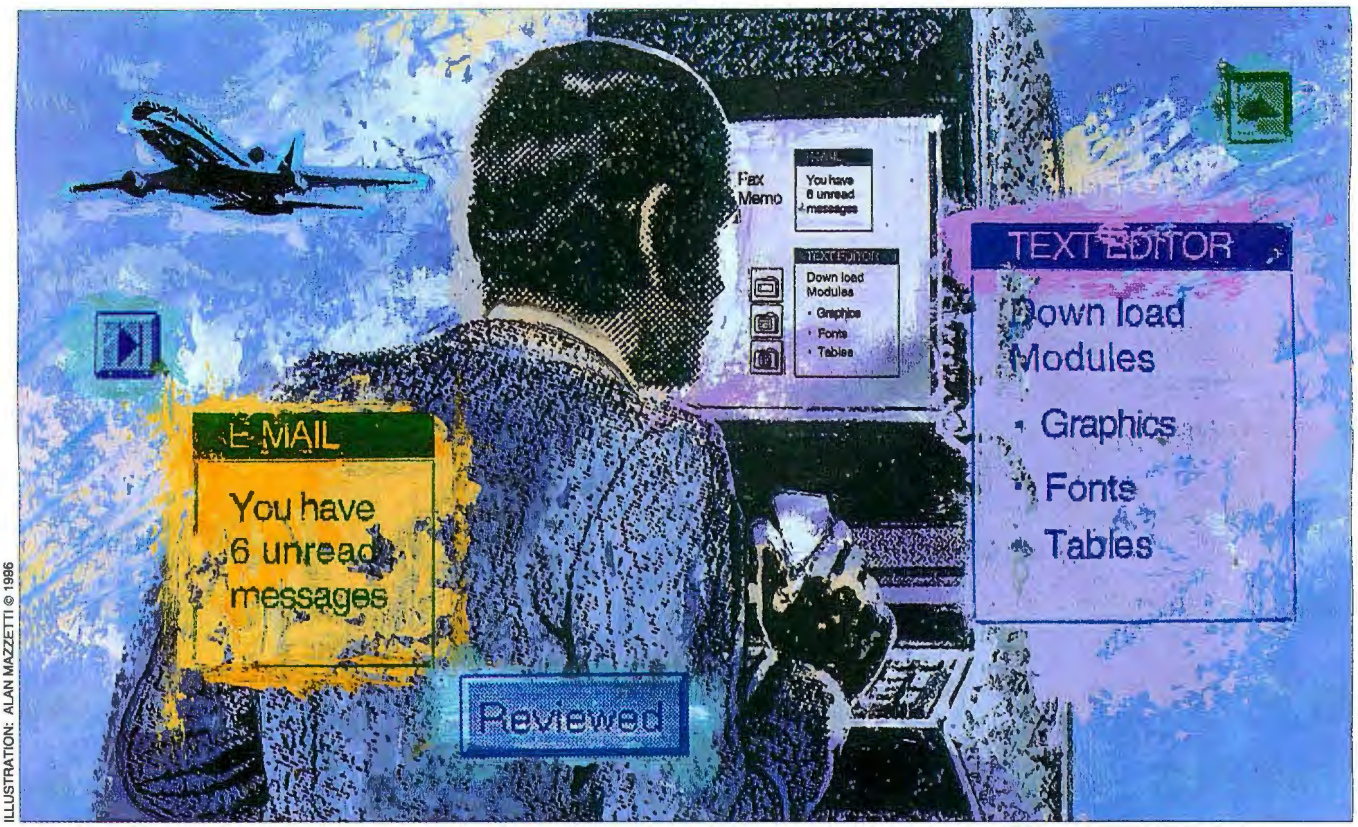

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scripting language in Netscape Navigator. Because VB Script is an interpreted language—and because Microsoft will freely distribute the run-time engine—it, too, has the potential to become a platform-independent standard for Web developers. It's likely that all Web browsers and NCs will support both JavaScript and VB Script.

In theory, the regular version of Visual Basic could have been Java. Both are high-level interpreted languages whose programs are compiled into an intermediate bytecode or p-code that in turn executes on top of a run-time engine. But Microsoft has not ported Visual Basic to other platforms, except for the abbreviated version in Microsoft Office.

Until now, Microsoft's idea of "cross-platform" has been Windows 3.1, Windows 95, and Windows NT. However, we hear rumors that Java delivered the jolt that Microsoft needed to rethink this strategy. Don't be surprised if Microsoft ports the full Visual Basic run-time engine—though probably not the development environment—to the Mac later this year.

Paradoxically, Microsoft's greatest strengths are the very things that opponents claim are its greatest weaknesses: Windows and Office. Although both are behemoths, there's undeniable value in those megabytes of code. Writing a collection of Java components and applets that duplicate the functionality of Word,

NCs could make it possible for us to carry around smart cards instead of a notebook. We would use the card to log on to the network from a remote office, the airport, or a hotel room, and an NC would call up all our personal files and applications.

Excel, PowerPoint, and Access is what's known in the industry as a "nontrivial task." So don't hold your breath. Yet if NCs are to make inroads into the corporate market, the industry must measure their worthiness against the prevailing standard, and the standard is Microsoft Office.

Similar reasons motivated Apple to base Pippin on the Power Mac architecture. "Ultimately, the success of these machines will depend on the applications that are available for them," says Mark Orr, Apple's manager of business development for Pippin. "Anytime you launch a new platform, you've got the classic chicken-and-egg problem. You need content to attract an installed base, but you need an installed base to attract developers to create content."

Of course, NCs don't necessarily have to battle PCs head-to-head for the same kinds of applications. Some observers think corporations will dedicate NCs to other tasks: presentations, self-guided training, on-line documentation, Internet research, E-mail, database access, and light-duty spreadsheet functions. "There may still be many employees in the world who don't have a computer because their job doesn't revolve around Microsoft Office," says Silicon Graphics' McCrea.

In Search of a Kernel

One of the most crucial technical challenges will be finding a lightweight OS that will let NCs compete against Microsoft Windows. Although the OS doesn't matter in the sense that Java programs will run on any system that supports the Java engine, the OS must be small and fast enough to run within the reduced resources of a low-cost machine.

There are many memory-stingy microkernels around, but they're generally designed for embedded applications and lack such luxuries as high-level graphics libraries. The OS in an NC must satisfy the needs of programmers, who have grown accustomed to the rich APIs of Windows, the Mac OS, and the various flavors of Unix. Also, to make the basic concept of an NC feasible, the OS must have some mechanism for dynamically loading distributed objects over a network.

Fortunately, this problem has attracted a great deal of attention in recent years from companies that are working on technologies for interactive TV set-top boxes. The futuristic TV networks appear to be a little further in the future than experts once predicted, so set-top-box designers are eager to adapt their technologies to NCs. (A skeptic might wonder if the whole push

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Inside the Pippin

Alexander Graham Bell set out to invent a multiplex telegraph and hearing aids for the deaf, but he found lasting fame by inventing the telephone. Apple Computer set out to design an interactive media appliance for homes and schools, but it may have created the first network computer (NC) instead.

Strictly speaking, Apple's Pippin is not a product—it's a low-cost system architecture based on the Power Mac. Apple has no plans to manufacture Pippin devices. Instead, it is licensing the architecture to other companies.

The first Pippin device is a low-cost multimedia system, manufactured by Bandai, the Tokyo-based corporation best known for introducing the Power Rangers into the world. Code-named the Power Player (but marketed in Japan as the @t Mark), the system is intended for home entertainment, education, and on-line communications. Bandai hopes to ship the Power Player to Japanese stores this month and introduce it to other world markets later this year.

At the time we went to press, Bandai had not determined the retail price for the Power Player, but estimates it will be about $500. Bandai plans to bundle a modem in the package and launch a new information service that provides Internet access.

Although Apple didn't design the Pippin to be the kind of NC envisioned by Oracle, Sun Microsystems, IBM, and others, the architecture has the flexibility, horsepower, and economy to meet all the requirements. Last December, Apple and Bandai demonstrated a Power Player browsing the World Wide Web with Netscape Navigator.

The Pippin's biggest advantage is that it's not an entirely new platform. Developers can port thousands of existing Mac applications to the Pippin with relatively little effort.

Essentially, developers have to modify their software to work with a system for which a keyboard, a hard drive, and a floppy drive are optional. On the Power Player, for instance, the primary input device is a hand-held game controller with a trackball. Developers also have to put some elements of the Pippin OS on their CD-ROMs.

After an application is ported to the Pippin, it's upward-compatible with the Power Mac. It's even possible to produce a hybrid CD-ROM that runs on the Pippin, the Mac, and Windows PCs.

In place of the familiar Mac Finder is whatever user interface developers choose for their applications. For example, if you're using a multimedia encyclopedia, the first screen you'll see is the encyclopedia's title screen. All Pippin titles run entirely from CD-ROM. All you'd have to do is supply a CD with a Java-enabled browser to turn the Pippin into a functional NC, and there would never be any software to install or maintain.

What does $500 buy you? Bandai's NC offers a 66-MHz PowerPC 603 processor, a quad-speed CD-ROM drive, and two serial connectors.

The Bandai Power Player is more powerful than many desktop PCs. It contains a 66-MHz PowerPC 603 microprocessor; 6 MB of RAM (expandable to 38 MB; 2 MB are reserved for the OS and video); 4 MB of ROM (which contains the Mac OS Toolbox); a quad-speed CD-ROM drive; 640- by 480-pixel video with 8- and 16-bit color depths; NTSC, PAL, and VGA video outputs; 16-bit, 44-kHz audio output; two Mac-standard serial ports (one supports AppleTalk; the other is a GeoPort); two Apple Desktop Bus (ADB) ports; a Peripheral Component Interconnect (PCI)–compatible expansion slot for adding a hard drive or a floppy drive; and a stereo headphone jack.

What's missing, compared to a Power Mac? There's no external SCSI port, no Ethernet port, no writable storage devices, and not as many expansion slots. The Pippin version of the Mac OS is also missing a few elements, such as the PowerTalk and QuickDraw GX extensions. "Fundamentally, in terms of architecture, the Pippin is a Power Mac," says Mark Orr, manager of business development for Pippin.

It wouldn't take much to turn the Pippin into a formidable NC. However, Orr insists that hardware isn't the issue. "The talk about $500 is the wrong way to look at the problem," he says. "The biggest challenge will be to create content that is compelling enough to attract users to the Internet so they'll want to buy these boxes."

for NCs is merely an attempt to amortize the R&D expended on set-top boxes.)

Oracle is developing an OS called NCOS for its NC reference design. The company has released little information about this OS, except that it's based on a microkernel that supposedly runs in "considerably less" than 1 MB of memory. One reason NCOS is so small is that it dispenses with the big APIs of conventional OSes. Instead, separate subsystems and class libraries of Java objects will handle high-level functions. For example, Oracle claims it has a subsystem for remote-method access that runs in about 64 KB, and a graphics subsystem that needs only 300 KB. "And it's just as rich as the Mac OS and the graphics subsystems in Windows," says Oracle's Laursen.

"There's going to be an ultralightweight version of CORBA [Common Object Request Broker Architecture] that lets me communicate between my Java objects across the network," Laursen says. "The name services are pretty straightforward. They just have to cache the set of objects I've been communicating with, so I don't have to do a name lookup every time I access some remote object. So through a hierarchical caching architecture and a lightweight distributed-object environment, I can do everything I do with PCs."

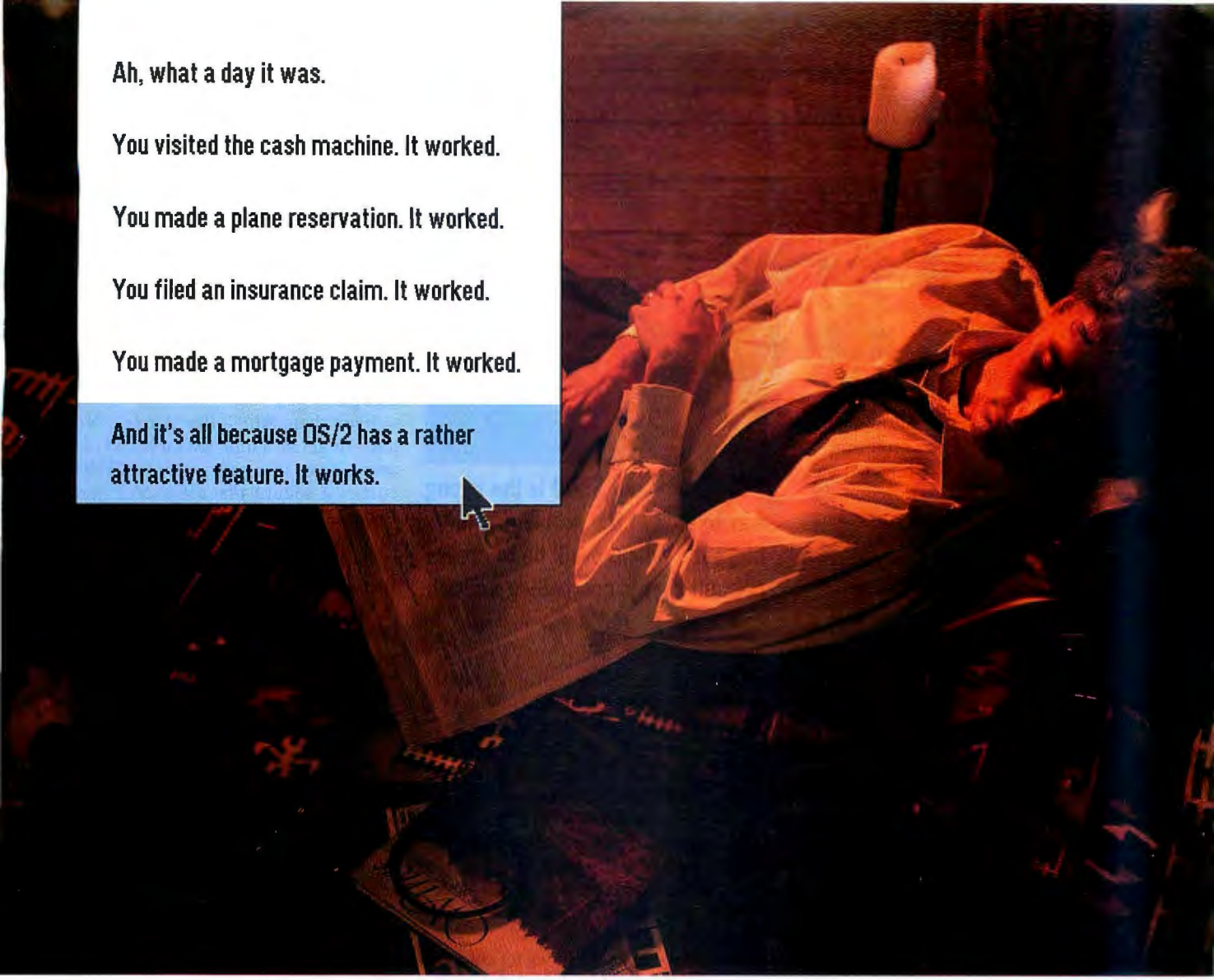
Laursen points out that today's OSes and applications are memory hogs. They load the bulk of their code into RAM at start-up, and that code stays in RAM whether you need it or not. With an NC, the OS and applications could be more object-oriented, and the objects won't load into memory until the OS summons them.

Two other OSes that seem particularly well suited for NCs are Acorn's RISCOS and Geoworks' GEOS. Both run well on one-generation-old CPUs with as little as 1 MB of RAM, yet both are rich OSes that offer much to developers and users.

Introduced in 1987, RISCOS is a 32-bit OS with cooperative and preemptive multitasking. It can reside and execute in 4 MB of ROM, and multiple applications can run in as little as 2 MB of RAM. RISCOS supports a general-purpose desktop GUI and more than 2000 applications. It also has the advantage of running on inexpensive ARM processors.

GEOS traces its ancestry back to the Commodore 64 but currently runs on x86-compatible CPUs. Geoworks says it is porting GEOS to multiple RISC chips, partly because some of its licensees want to introduce NCs later this year. (Geoworks won't name the customers who are planning NCs, but GEOS licensees include Brother, Canon, HP, Nokia, and Toshiba.) GEOS, like RISCOS, can reside and execute in 4 MB of ROM, and that includes some built-in applications. It can get by with as little as 1 MB of RAM.

Geoworks CEO Gordon Mayer notes



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that Canon and Brother already sell GEOS-based dedicated word processors that are really thinly disguised PCs. They include a full suite of applications plus a floppy drive, an ink-jet printer, and a color monitor—all for about $500. "If you add a modem or a cable modem, you've got a network computer," says Mayer.

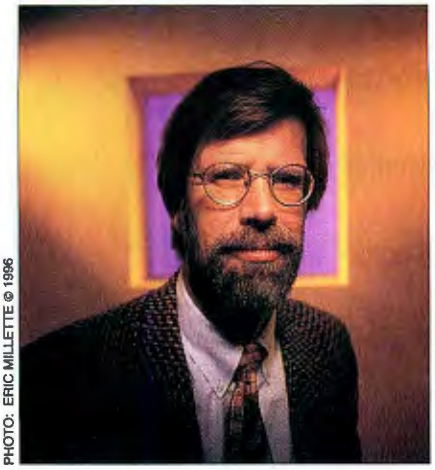
In other words, packaging may define an NC as much as technology. Conceivably, someone could turn a warehouse of old 486-based PCs into trendy new NCs by stripping the systems down to their essentials. Simply replace Windows with a smaller OS, install the Java run-time engine, and bundle them with a cable modem or a network card.

Nintendo, Sega, and Sony could likewise turn their home game consoles into consumer browser boxes with little effort. Nintendo has already demonstrated a Web browser on its Ultra-64. Microsoft has shown a Web browser running on a set-top box designed with NEC. Especially for the consumer market, there's a fine line between a game machine, a set-top box, and a scratch-built NC.

Reality Check

Before hailing the birth of a new era, consider two disturbing facts. First, as we go to press, nobody is willing or able to demonstrate a functional system that was designed from the start to be an NC. That's rare for a technology that's supposedly a few months away from mass production. IBM, which made a big fanfare about NCs at Comdex, refused to discuss the subject.

Second, there seems to be an attitude that "If we build it, they will come." The assumption is that a $500 NC will uncork pent-up demand that's currently frustrated by the high prices and intimidating complexity of PCs. But easy to afford doesn't necessarily mean easy to use. Business-people who are already familiar with PCs will adapt quickly to NCs, but the holy grail is to lure millions of new users.



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"The talk about $500 is the wrong way to look at the problem. The biggest challenge will be to create content that is compelling enough to attract users."—Mark Orr, Apple

"I don't want to have to buy a book that's called *$500 Network Computers for Dummies*," says Apple's Orr. "Too many people are assuming that the biggest barrier to personal computing is price, when in fact there's all kinds of research that shows most people simply see no relevance in personal computing."

The corporate applications for computers are well established, but where are the breakthroughs that will make NCs both compelling and accessible to the 65 percent of U.S. households that don't own a PC? Will NCs simply reinvent the wheel at a lower price?

Possible answers: The Web will supply the compelling applications, and the point-and-shoot user interfaces developed for set-top boxes will mollify computerphobes.

Neither answer is farfetched. The Web is evolving rapidly, and the killer application seems within reach. It could be home shopping, if Web browsers become as easy to use as mail-order catalogs. It could be home banking, especially if cashless debit cards catch on, turning NCs into automatic teller machines that dispense electronic cash. It could be something nobody has thought of yet.

Even then, NCs—like Apple's Newton—might be a little too far ahead of the curve. Years may pass before the Web becomes a secure place for commerce. Nathan Myhrvold, group vice president of Microsoft's Application and Content Group, thinks that PCs will drive the Web's growth in the foreseeable future.

Myhrvold estimates that 100 million people in the world who have PCs aren't on the Internet, despite so many free browsers. "It's actually more expensive for [these people] to get on the Internet by buying a $500 terminal," he says. "So where are the next 100 million users of the Internet going to come from? The people with PCs, or some small percentage of people who buy $500 terminals?"

Oracle's Laursen acknowledges that NCs probably won't be an overnight success, but he predicts they will be a major force by the turn of the century. "I think it's a 10-year play," he says. "If you look at the changes that happened over the last 10 years with PCs, I think these changes are equally fundamental. Except I don't think it will be as hard."

It's Inevitable

The concept of a $500-or-thereabouts computer is undeniably appealing—just as it was 15 years ago, when low-priced computers were commonplace. But two things have changed since then. First, the Web is creating a giant electronic library that globalizes information. Second, millions of people will need access to that library to keep up with a world that's fueled on information. Computers aren't luxury items anymore; they're survival tools, but they're still priced like luxury items.

Without question, the technology exists to produce a low-priced volkscomputer that could serve those millions of workers, students, and consumers. By year's end, we'll have one. ■

Tom R. Halfhill is a BYTE senior editor based in San Mateo, California. You can reach him on the Internet or BIX at thalfhill@bix.com.

Where to Find

Acorn Computer
Cambridge, U.K.
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http://www.acorn.co.uk
http://www.ant.co.uk
sales@applied-risc-tech.co.uk

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+44 1223 400400
http://www.arm.com

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http://www.pippin.apple.com
pippindev@apple.com

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http://www.geoworks.com

Integrated Device Technology, Inc.
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http://www.idt.com

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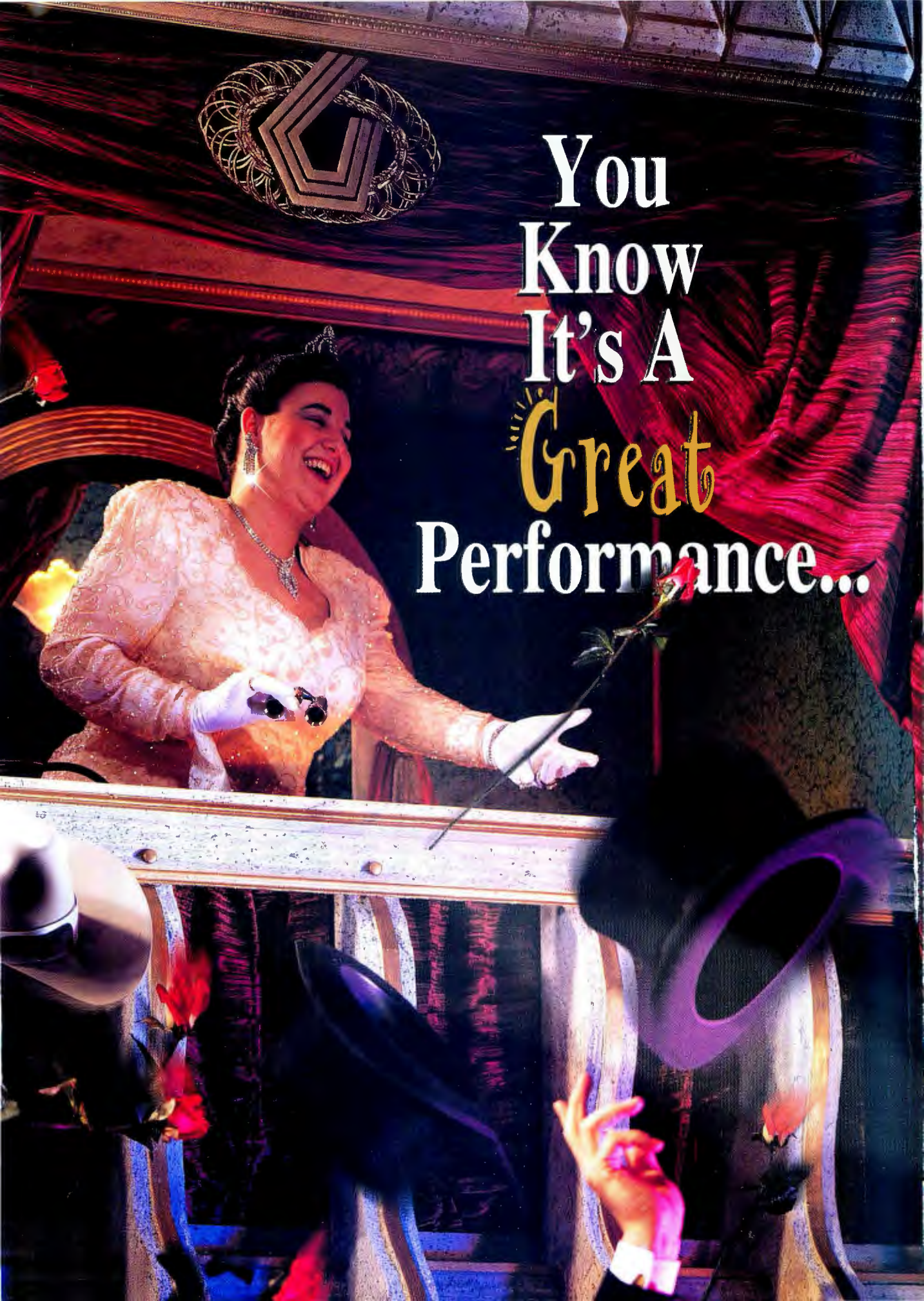
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And if it belts out power performance and sound like no other, then it's gotta be a Gateway 2000® computer! Gateway's high-end P5-166XL professional multimedia system gives you extraordinary performance, even for your most robust computing needs. Top it off with the Gateway-exclusive Altec™ Lansing ACS-400 speakers, and the P5-166XL ushers you into first-rate stereo sound! And our new P5-150 Professional system delivers the performance your heavy-duty business applications require — for just $2,899! The Intel® 166MHz and 150MHz Pentium® processors, included on these systems, are the fastest Pentium processors available today. These systems also include the new ATX motherboard, giving you enhanced functionality, usability and reliability.

An Encore 166MHz Performance

Bravo! Gateway's P5-166XL is *"the fastest* Windows 95 PC ever," per *Windows Sources*, February 1996. You'll leap to your feet when you experience all the powered-up features of the P5-166XL. This impressive system is built with 16MB EDO performance DRAM, 512K pipelined burst cache and 2GB hard drive for unbeatable performance.

Maestro of Multimedia

Spine-tingling, heart-thumping stereo sound resonates from your Altec Lansing ACS-400 speakers, standard on the P5-166XL and exclusively from Gateway 2000. Including the Altec ACS-250 subwoofer, these speakers give you thunderous bass and extraordinary Dolby® Surround Sound, breathing new life into all your multimedia applications and music CDs! And you'll be amazed by the ultra-realistic sound achieved with the included Ensoniq® Wavetable sound card. Add these performance features to a Matrox® 2MB WRAM graphics accelerator with MPEG video scaler and your 3-D graphics and multimedia applications will run with incredibly smooth video playback.

The Speedy 6X CD-ROM Drive!

Now standard on all Gateway Professional systems is the 6X CD-ROM drive. This super-fast CD-ROM drive accelerates all your computing experiences to the next level of CD-ROM technology and performance so your applications run ultra fast, *and* you'll be more than ready for tomorrow's complex software applications.

The Right System For All Your Hit Applications

All Gateway Pentium processor-based PCs include Microsoft® Windows® 95, and our Professional models also include MS Office 95, Professional Edition, compatible with 32-bit applications and with backward compatibility for 16-bit applications. If you prefer a different operating system, Gateway gives you a choice of MS-DOS® and Windows for Workgroups, Windows NT™, or Windows 95, and we'll preload your operating system so your PC is ready to run!

Software Diva

The grand finale: The P5-166XL has one of the *best* software bundles found *anywhere* with MS Office 95, Professional Edition and Gateway's Generations II Software Collection for use with the Windows 95 operating system. It's just what you need for business applications in the Windows 95 environment, *and* for the most complete, updated versions of the latest and greatest multimedia applications, most optimized for Windows 95. A gaming pad is included for use with all your entertainment software.

And Introducing Gateway's P5-150 Professional PC!

For extraordinary levels of performance, Gateway introduces our P5-150 Professional system! It includes the ultra-fast 150MHz Pentium processor, 16MB EDO performance DRAM and 256K pipelined burst cache. All Gateway Professional Pentium processor-based systems have 16MB EDO performance DRAM, and most are standard with pipelined burst cache, adding up to the ultimate in system performance. These features also give you a faster, more cost-effective means to great performance. The P5-150 comes in a new "mini" tower case with similar expansion space found in a desktop case. Because the mini tower case is so compact, you can put it just about anywhere. Call Gateway 2000 today and find out about all our legendary performance machines!

If You're In Awe Of Your High-Flying Multitasking Machine...

The Gateway 2000® G6-200: A Legendary Performance

And if you just can't function without jet-set workstation power and performance — we're talking the top-flight machinery available today — then a new Gateway 2000 G6-200 is definitely for you! This new generation of workstations combines a 150MHz or 200MHz Intel® Pentium® Pro processor with Windows NT™ Workstation operating system and a configuration that'll send you soaring into the wild blue computing yonder!

Pilot Your 200MHz Pentium Pro

The Pentium Pro processor is Intel's latest generation processor designed to provide workstation users with ultra-high performance in true 32-bit environments. The Gateway G6-200 is classified as a value workstation, perfect for CAD applications, intense desktop publishing, and graphics and design applications. If you require a load of memory and storage space to run your heavy-duty network applications, you won't find a better value from any other workstation manufacturer.

High-Flying Performance Features

To achieve the high throughput and superior performance your intense applications require, we've included a 2GB Fast SCSI-2 hard drive on the Gateway G6-200. SCSI technology offers better performance in workstation environments. And the SCSI interface allows you to connect up to seven internal SCSI devices, so you can expand like never before. The G6-200 also includes an Adaptec® 2940 32-bit PCI Ultra SCSI Fast-20 controller. Combine all this with 64MB DRAM and your workstation applications will fly!

Gearing Up for Great Graphics!

With the Matrox® 4MB WRAM video card standard on our G6-200, you'll get incredible graphics support at higher resolutions, along with hardware accelerated 3-D support and increased color depth.

Workstation Wonderland with Windows NT Workstation

All right, Windows NT Workstation customers, you know who you are. And we want to get to know you! Gateway 2000 now proudly offers you the best value on the Windows NT Workstation 3.51 operating system in the industry, and standard on Gateway's G6 models. This is one of the most powerful operating systems for any organization that depends on a computer for today's most demanding data-intensive business applications. And if you value the reliability and security of privacy in large workstation environments, Windows NT Workstation is perfect for you.

Great news Windows NT 3.51 users! Your Gateway 2000 G6 system will arrive preloaded with Windows NT Workstation ready to run! Simply determine and enter your individual security codes and passwords during initial setup. We'll configure all G6 systems with the appropriate Windows NT 3.51 drivers, loaded and optimized for compatibility with Gateway hardware and software.

Along with Windows NT, you get MS Office 95, Professional Edition for the best 32-bit business software applications available. And you can upgrade Pentium processor-based and Pentium Pro processor-based PCs to Windows NT for a value that can't be beat!

Call today for more information on our new G6 computers.

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If You've Found The Ultimate Communications Device ...

And if your family has a penchant for the latest (*and coolest*) in multimedia, then it's just got to be a Gateway! All Gateway 2000® Family PC™ multimedia systems provide everything your family needs for education, entertainment and for your home office. And our TelePath® fax/modem with a Telephone Answering Device lets you reach out to neighbors next door or across the globe!

Out Of This World Performance and Features For Your Family!

Along with great multimedia features, the Gateway P5-120 Family PC system includes 16MB EDO performance DRAM and a 1.2GB EIDE hard drive. A 6X CD-ROM drive, standard on all Family PC systems, gives your family the power and performance to get down to serious business or to play thrilling multimedia games.

Holy amplifiers PC buyers! It's Gateway 2000's super stereo sound system: our exclusive Altec™ Lansing ACS-40 speakers and 16-bit Gateway sound card on Family PC systems. Your multimedia applications will blast off with realistic sound, and music CDs will be like *super* music to your ears!

Get Hooked Into MPEG Technology

We wouldn't lead you up an outdated technology tree. No way! Now all Gateway 2000 Family PC multimedia systems include MPEG (Moving Picture Experts Group) data compression technology. MPEG provides superior stereo sound, along with incomparable full-screen, full-motion video right from your CD-ROM drive. Video from MPEG multimedia applications will be smoother. And your multimedia images come to life when combined with the MPEG video scaler, standard on Family PC systems.

Reaching Out To New Worlds With The Gateway 2000 TelePath 28.8

Your communication needs are satisfied with the TelePath 28.8 fax/modem standard on most Gateway Family PC systems! The TelePath fax/modem state-of-the-art with the ability to fax, transfer files and access online services. But there's more! It's also a complete communications tool with a Telephone Answering Device (TAD) for answering machine capabilities. It also includes Gateway's exclusive Information Highway communications CD, with a user-friendly interface and easy-to-use tutorial of included trial memberships to CompuServe®, Prodigy®, America Online® and Reuters Money Network. You also get GNN (Global Network Navigator) for easy Internet access.

Gateway's Generations II Software Collection!

There's virtually no end to your family's educational and entertainment opportunities with the Gateway Generations II Software Collection, for use with the Windows® 95 operating system. Standard on Family PC systems and the P5-166XL, Generations II includes 45 of the latest versions of the world's most popular software applications such as MS Encarta® 96 and MS Cinemania® 96!

Industry-Wide, Prize-Winning Service and Support!

All Gateway systems come with our superb Gateway Gold™ service program for award-winning support, including toll-free technical support for the life of your Gateway computer. When surveyed, *Computer Shopper* readers answered "Gateway 2000!" unequivocally and bestowed us with *Computer Shopper's* 1995 Best Overall Hardware Service and Support award.

Multimedia Systems

P5-100 FAMILY PC ™

- Intel® 100MHz Pentium® Processor
- 8MB EDO Performance DRAM
- 1.2GB 9ms EIDE Hard Drive
- 2MB DRAM, 64-Bit PCI Graphics Accelerator with MPEG Video Scaler
- 6X EIDE CD-ROM Drive
- 16-Bit Gateway Sound Card
- Altec™ Lansing ACS-40 Speakers
- TelePath® 28.8 Fax/Modem with TAD*
- Gateway Information Highway CD
- 3.5" Diskette Drive
- CrystalScan®15 .28dp Color Monitor (13.9" viewable)
- 7-Bay Desktop Case
- 104+ Keyboard & MS Mouse 2.0
- Microsoft® Windows® 95
- Generations II Software Collection
- Gateway Gold™ Service & Support

P5-100 $2099
P5-75 $1749

(75MHz Pentium processor, 1MB DRAM, 850MB HD, TelePath 14.4 fax/modem, CrystalScan14 w/ 13.4" viewable screen)

P5-120 FAMILY PC

- Intel 120MHz Pentium Processor
- 16MB EDO Performance DRAM
- 1.2GB 9ms EIDE Hard Drive
- 2MB DRAM, 64-Bit PCI Graphics Accelerator with MPEG Video Scaler
- 6X EIDE CD-ROM Drive
- 16-Bit Gateway Sound Card
- Altec Lansing ACS-40 Speakers
- TelePath 28.8 Fax/Modem with TAD*
- Gateway Information Highway CD
- 3.5" Diskette Drive
- Vivitron™15 .26dp Color Monitor (13.9" viewable)
- 7-Bay Desktop Case
- 104+ Keyboard & MS Mouse 2.0
- MS Windows 95
- Generations II Software Collection
- Gateway Gold Service & Support

$2499

P5-133 FAMILY PC

- Intel 133MHz Pentium Processor
- 16MB EDO Performance DRAM
- 1.62GB 9ms EIDE Hard Drive
- 2MB DRAM, 64-Bit PCI Graphics Accelerator with MPEG Video Scaler
- 6X EIDE CD-ROM Drive
- 16-Bit Gateway Sound Card
- Altec Lansing ACS-40 Speakers with ACS-250 Subwoofer
- TelePath 28.8 Fax/Modem with TAD*
- Gateway Information Highway CD
- 3.5" Diskette Drive
- CrystalScan17 .28dp Color Monitor (15.7" viewable)
- 7-Bay Desktop Case
- 104+ Keyboard & MS Mouse 2.0
- MS Windows 95
- Generations II Software Collection
- Gateway Gold Service & Support

$2899

P5-166XL

- Intel 166MHz Pentium Processor
- 16MB EDO Performance DRAM
- 512K Pipelined Burst Cache
- 2GB EIDE 10ms Hard Drive
- Matrox® 2MB WRAM Graphics Accelerator w/ MPEG Video Scaler
- 6X EIDE CD-ROM Drive
- 16-Bit Ensoniq® Wavetable Sound Card
- Altec Lansing ACS-400 Speakers with ACS-250 Subwoofer
- TelePath 28.8 Fax/Modem with TAD*
- Gateway Information Highway CD
- 3.5" Diskette Drive
- Vivitron17 .26dp Color Monitor (15.9" viewable)
- 12-Bay Tower Case
- 104+ Keyboard & MS Mouse 2.0
- MS Windows 95
- MS Office 95, Professional Edition**
- Generations II Software Collection with Gaming Pad
- Gateway Gold Premium Service

$3899

** Telephone Answering Device (TAD) gives you complete voice messaging capabilities.*

Professional Systems

P5-75

- Intel 75MHz Pentium Processor
- 16MB EDO Performance DRAM
- 850MB 10ms EIDE Hard Drive
- 1MB DRAM, 64-Bit PCI Graphics Accelerator
- 6X EIDE CD-ROM Drive
- 3.5" Diskette Drive
- CrystalScan15 .28dp Color Monitor (13.9" viewable)
- 7-Bay Desktop Case
- 104+ Keyboard & MS Mouse 2.0
- MS Windows 95
- MS Office 95, Professional Edition**
- Gateway Gold Service & Support

$1899

P5-120

- Intel 120MHz Pentium Processor
- 16MB EDO Performance DRAM
- 256K Pipelined Burst Cache
- 1.2GB 9ms EIDE Hard Drive
- 2MB DRAM, 64-Bit PCI Graphics Accelerator
- 6X EIDE CD-ROM Drive
- 3.5" Diskette Drive
- Vivitron15 .26dp Color Monitor (13.9" viewable)
- 7-Bay Desktop Case
- 104+ Keyboard & MS Mouse 2.0
- MS Windows 95
- MS Office 95, Professional Edition**
- Gateway Gold Service & Support

$2299

P5-133

- Intel 133MHz Pentium Processor
- 16MB EDO Performance DRAM
- 256K Pipelined Burst Cache
- 1.2GB 9ms EIDE Hard Drive
- 2MB DRAM, 64-Bit PCI Graphics Accelerator
- 6X EIDE CD-ROM Drive
- 3.5" Diskette Drive
- Vivitron15 .26dp Color Monitor (13.9" viewable)
- 7-Bay Desktop Case
- 104+ Keyboard & MS Mouse 2.0
- MS Windows 95
- MS Office 95, Professional Edition**
- Gateway Gold Service & Support

$2399

P5-150

- Intel 150MHz Pentium Processor
- 16MB EDO Performance DRAM
- 256K Pipelined Burst Cache
- 1.62GB 9ms EIDE Hard Drive
- 2MB DRAM, 64-Bit PCI Graphics Accelerator
- 6X EIDE CD-ROM Drive
- 3.5" Diskette Drive
- Vivitron17 .26dp Color Monitor (15.9" viewable)
- 7-Bay Mini Tower Case
- 104+ Keyboard & MS Mouse 2.0
- MS Windows 95
- MS Office 95, Professional Edition**
- Gateway Gold Service & Support

$2899

Workstations

G6-150

- Intel 150MHz Pentium Pro Processor
- 32MB DRAM
- 256K Internal Cache
- 2GB 10ms EIDE hard drive
- Matrox 2MB WRAM Graphics Accelerator w/ Video Scaler
- 6X EIDE CD-ROM Drive
- 3.5" Diskette Drive
- Vivitron17 .26dp Color Monitor (15.9" viewable)
- 12-Bay Tower Case
- 104+ Keyboard & MS Mouse 2.0
- MS Windows NT Workstation 3.51
- MS Office 95, Professional Edition**
- Gateway Gold Service & Support

$4299

G6-200

- Intel 200MHz Pentium Pro Processor
- 64MB DRAM
- 256K Internal Cache
- 2GB Fast SCSI-2 9ms Hard Drive
- Adaptec® 2940 32-bit PCI Ultra SCSI Fast-20 Controller
- Matrox 4MB WRAM Graphics Accelerator w/ Video Scaler
- 4X SCSI-2 CD-ROM Drive
- 3.5" Diskette Drive
- Vivitron21 Color Monitor (19.9" viewable)
- 12-Bay Tower Case
- 104+ Keyboard & MS Mouse 2.0
- MS Windows NT Workstation 3.51
- MS Office 95, Professional Edition**
- Gateway Gold Service & Support

$6999

*** MS Office 95, Professional Edition includes Word, Excel, PowerPoint® presentation graphics program, Schedule+, Access database and Bookshelf® '95.*

Gateway 2000 Manufacturing, North Sioux City, South Dakota, is ISO 9002 certified.

ISO 9002 SGS

GSA Schedule
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Generations II SOFTWARE COLLECTION

■ Microsoft Encarta® 96 ■ MS Cinemania® '96 ■ MS Julia Child: Home Cooking with Master Chefs ■ MS Bob,™ For Gateway 2000 ■ MS Works 95 ■ MS Publisher 95 ■ MS Money 4.0 ■ MS Golf 2.0 ■ MS Music Central™ 96 ■ MS CD Sampler ■ MS Entertainment Packs 1-4 (31 fun games!) ■ Ca$h Graf Home Office Plus™ ■ Mayo Clinic® Family Health Book ■ Mediamatics Arcade™ MPEG Player ■ The Masters®: Interactive Journey Through Its 60-Year History, for MPEG

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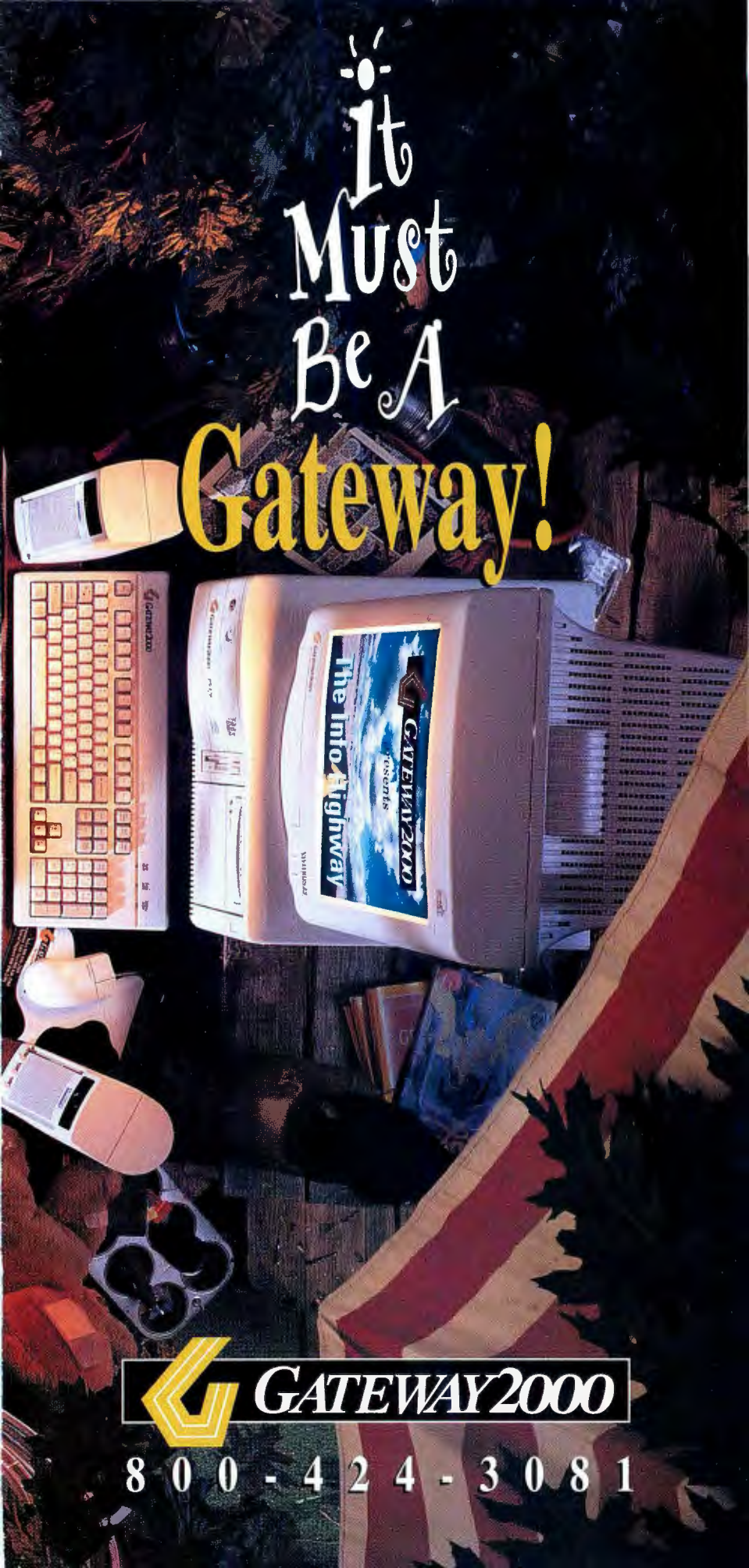
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Multimedia (Sold only with the purchase of a system)

Audio Multimedia Kits

Choose a Gateway 16-bit CD-quality sound card or an Ensoniq® Soundscape™ 16-bit wavetable sound card. Both are Sound Blaster™ compatible and include two Altec™ Lansing ACS-40 speakers.

$95 *(Gateway 16-bit sound card and Altec ACS-40 speakers)*
$155 *(Ensoniq Soundscape 16-bit wavetable and Altec ACS-40 speakers)*

Multimedia Speaker Upgrades

Add the all-new Altec ACS-250 subwoofer for up to 40 watts of additional bass.

$75 *(upgrade from systems which include Altec ACS-40 speakers)*

The Dolby® Surround Sound Gateway-exclusive ACS-400 speaker system will make your multimedia applications come alive with true theater-like surround sound. Complete with two Altec ACS-400 satellites and ACS-250 subwoofer.

$120 *(upgrade from systems which include Altec ACS-40 speakers)*

4X Three-CD Changer

Enhance the value and usefulness of your PC with a 4X three-CD changer. You'll have access to three times the amount of information of a single CD-ROM drive.

$40 *(upgrade from systems with 6X CD-ROM drive)*

Communications & Storage

(Sold only with the purchase of a system)

TelePath® 28.8 Fax/Modem with TAD

Internal fax/modem, 28,800bps modem, V.34, with 28,800bps fax capability. Sends and receives data and faxes, and includes Telephone Answering Device (TAD) for full voice mail capabilities. Includes trial memberships to CompuServe®, AOL and Prodigy® and more! **$149** *(TelePath 14.4 Fax/Modem $79)*

Colorado Memory System Jumbo 1400 TBU

CMS Jumbo 1400 internal tape backup unit with up to 1.36GB compressed (680MB native) storage capacity per tape. Comes with MS Windows and DOS® software, one tape and cable. **$199**

Monitors (Sold only with the purchase of a system)

Gateway Vivitron™ Color Monitors

Non-interlaced color monitor using Sony® Trinitron® tube technology, capable of 1280 x 1024 resolution.

Gateway Vivitron15 Color Monitor, .26 dot pitch (13.9" viewable)
Upgrade from a CrystalScan®14 (13.4" viewable) to Vivitron15 **$150**
Upgrade from a CrystalScan15 (13.9" viewable) to Vivitron15 **$65**
Gateway Vivitron17 Color Monitor, .26 dot pitch (15.9" viewable)
Upgrade from a CrystalScan15 (13.9" viewable) to Vivitron17 **$355**
Upgrade from a Vivitron15 (13.9" viewable) to Vivitron17 **$290**
(Upgrade prices good only at time of system purchase.)

Networking (Sold only with the purchase of a system)

3Com® Ethernet Adapters

High-performance 16-bit Ethernet cards.
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16-bit Card with only RJ-45 connector **$79**

SMC® ISA Ethernet Adapters

- 16-bit Triple Media Card with BNC, AUI and RJ-45 connectors **$79**
- 16-bit Card with only RJ-45 connector **$59**

Software (Available to both existing and new Gateway customers)

MS Windows® 95 Upgrade

Only available to our valued customers! Windows 95 will make your system faster and easier to use. Order your copy today! **$79** *(On diskettes $89)*

10th Anniversary Software Bundle

Includes BioForge™; Wing Commander® III: Heart of the Tiger™; Magic Carpet™ II: The Netherworlds; and a Gateway 2000 10th Anniversary T-shirt. **$49**
(BioForge may not be suitable for younger children.)

Kid's BackPack™ II

Includes What is a Bellybutton?; The Tales of Peter Rabbit; Cinderella, The Original Fairy Tale; Freddi Fish™ and the Case of the Missing Kelp Seeds™; Pocahontas Reading Adventure, and a Gateway cow-spotted backpack. **$59**

New

Gateway Gamer's Pack

Includes Command & Conquer™, Virtual Pool™, Straight/8, The Journeyman Project 2®: Buried in Time™, Terminal Velocity™, Primal Rage™, and a Gravis™ GamePad™. **$79**

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Starter Pack: the Sequel

A new twist on our favorite software bundle! Includes Tuneland™, Cyberia™, Rand McNally TripMaker™, 70 Million Households Phone Book, Hometime® Weekend Home Projects, SimCity™, Consumer Survival Kit, and The 7th Guest™. **$99**
Call and ask about our other value-priced software bundles!

Printers (Available to both existing and new Gateway customers)

Epson® Stylus™ Color IIs Ink Jet Printer

Photo-quality printing in color and black-and-white. Easy-to-use drivers are compatible with virtually all MS applications. **$259** *(plus $30 rebate)*

Epson Stylus Color II Ink Jet Printer

Perfect for the small business or home office, providing vivid color and crisp black-and-white printing at 720dpi. Plus it's quiet and compact! **$399**

Hewlett® Packard DeskJet 600C Inkjet Printer

The HP 600C ColorSmart technology produces clear, vibrant color with 16.7 million colors to choose from! Black 600dpi printing on plain paper or up to 600 x 300dpi color printing. Includes 34 scalable typefaces. **$259**

Hewlett Packard LaserJet 5L Printer

Add a professional edge to your outputs with 600dpi and HP Resolution Enhancement technology. Fast laser printing at four pages per minute. **$479**

Hewlett Packard LaserJet 5P Printer

Full-featured HP LaserJet printer for your business printing needs. Provides up to 600dpi resolution at six pages per minute. **$849**
All printers include parallel cable. Call for more printer options!

Service & Support

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- Extended Three-Year On-Site Agreement
- Priority 800 Number For Access To Technical Experts

$99 at point of system sale
$129 upgrade within current on-site service agreement

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Put the Space in Cyberspace

UDO FLOHR

DOUGLAS FRASER © 1996

Create and explore 3-D Web worlds with the Virtual Reality Markup Language

The world isn't flat, so why should the World Wide Web be? The Virtual Reality Markup Language (VRML) enables you to create and navigate through 3-D worlds on the Web.

What's it good for? Try this: Imagine a travel agency's home page. Instead of a boring list of choices or photos of destinations, you find yourself in a 3-D scene—a virtual travel agency. While waiting for the "agent," you step up to a poster of a resort. A mouse-click takes you into the scene in the poster, complete with trees, mountains, and a country club. Ordinary, flat Web pages will seem snore-inducing by comparison. In addition, the "no-interface" interface will appeal to the neophyte net surfer.

VRML (it rhymes with thermal) is a specification for defining 3-D environments—worlds—on the Web. It aims to create a Web environment requiring no training, no metaphor, and no interface. In Mark Pesce's groundbreaking book *VRML—Browsing and Building Cyberspace* (New Riders Publishing), Web creator Tim Berners-Lee reasons that navigating 3-D space is more natural than clicking through hyperlinked text pages. You can explore virtual cities or museums and view 3-D representations of data. Like hot-linking through the Web, you can jump from one 3-D VRML world to another.

A Language of Space

VRML's designers (Pesce, Gavin Bell, and Tony Parisi) had three requirements for VRML 1.0: It had to be platform-independent, suited for low-bandwidth network connections, and extensible. They sacrificed other features, including interactivity. You can see that virtual basketball and move around it, but you can't dribble it—not yet, anyway.

They postponed interactivity to avoid a language war. People don't get excited about the syntax of a language for describing polygonal objects, says the VRML specification, but they do get excited about syntax for manipulating "real" objects. They know they can't avoid the issue of adding "real" language features to VRML forever—arbitrary interactive behavior is critical to VRML's long-term success. Therefore, the plan is to include it in version 2.0.

Although it's not an extension to the Hypertext Markup Language (HTML)—and HTML browsers cannot interpret it—VRML is similar to HTML in a few ways. Like HTML, VRML is a platform-independent, document-centered ASCII language. Unlike HTML, it tells the computer how to create 3-D worlds. Developers construct complex objects—nodes in VRML parlance—from polygons and solids. However, VRML is more than geometry: You can specify light sources, the object materials, and effects such as fog.

Besides polygons and 3-D items, a node can contain a JPEG image or even MIDI sound data. A VRML page can also include links (which are called anchors) to other VRML documents, HTML documents—whatever. A VRML object (or part of an object) can link to any other item on the Internet. All this information goes into an ASCII text file that typically has the extension .wrl. When you point your VRML-enabled browser at a

A World with a View

Not all Virtual Reality Markup Language (VRML) viewers are the same, or even equivalent. Distinguishing features include the speed and quality of the rendering software that displays VRML worlds on different platforms. Here are some of the most notable viewers:

- **WebSpace.** Not surprisingly, Silicon Graphics, whose Open Inventor graphics library provided the basis for VRML, announced the first VRML browser, WebSpace. Template Graphics developed WebSpace, and it's available (http://webspace.sgi.com/) for multiple platforms, including Silicon Graphics' workstations and Windows NT.
- **WebFX.** Paper Software's viewer for Windows is a helper application within popular World Wide Web browsers (including Quarterdeck's Mosaic and Netscape). According to Paper Software's president Michael McCue, the company's Web site (http://www.paperinc.com/worlds.html) registered 13,000 hits on the first day that WebFX became available.
- **WorldView.** Intervista is a company that involves VRML originators Mark Pesce and Tony Parisi. Its WorldView viewer is compatible with all flavors of Windows. WorldView (http://www.intervista.com/worldview.html) uses RenderMorphics' RealityLab, which Microsoft acquired, for rendering.
- **Fountain.** Caligari's stand-alone browser (for Windows) supports both the Hypertext Markup Language (HTML) and VRML. It was a finalist in BYTE's Best of Comdex Awards. Fountain (http://www.caligari.com/ws/fount.html) can also build and edit worlds.
- **Whurlwind.** For a while, there was a shortage of viewers for the Mac, but then came Whurlwind (http://www.info.apple.comqd3d/Panel/page1_3_1.html). Created by Bill Enright and John Louch, it requires Apple's QuickDraw 3D, which doesn't fly short of a Power Mac with 16 MB of memory.
- **Voyager.** Virtus (http://www.virtus.com/virtuspro.html), maker of the 3-D modeling package WalkThrough Pro, created this Mac browser. It works without QuickDraw 3D.
- **VRweb.** The Hyper-G team at the University of Graz (Austria), cooperating with the National Center for Supercomputing Applications (NCSA) and the University of Minnesota, has developed VRweb, a VRML viewer for Unix and the three Windows platforms.
- **Internet Explorer.** At press time, Microsoft was offering a beta VRML add-in for its browser at http://www.microsoft.com/windows/ie/ie.htm.

To find information on VRML browsers, builders, tools, documentation, and sample VRML worlds, check out San Diego Supercomputer Center's VRML Repository at http://www.sdsc.edu/vrml.

A VRML programming library, with source code for virtual-reality rendering tools, is freely available in the public domain at http://www.eit.com/vrml/qv.html).

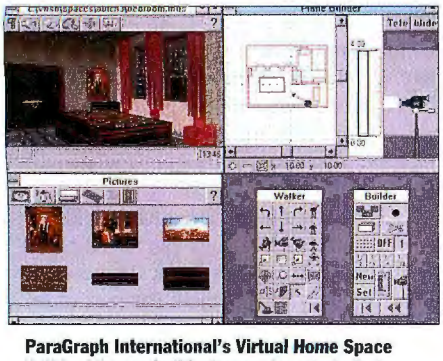
VRML page, you enter the world that's described by the file.

As the World Downloads

VRML operates within the basic Web browser-server paradigm. Servers interpret browser requests and, with any luck, return the requested document, preceded by the document's tag, or Multipurpose Internet Mail Extensions (MIME) type. The MIME type for VRML documents is x-world/x-vrml. You can view them with a VRML viewer and a browser configured to use that viewer. It's simple.

On the server side, you may distribute a VRML world across several servers. Part of a scene may come from one place, and links may connect to a different server at a different location. VRML files use a nested-object representation, sending the overall picture information first and the details later. In practice, this means scenes and objects first display as a rectangle (the bounding box) and the detail increases as more information arrives. Consequently, you can start navigating with your VRML viewer while not-yet-visible details and objects load. This makes VRML more bearable on slow connections and machines.

The viewer's navigation interface typically includes directional buttons or a joystick or handlebar. It can also use just mouse-clicks and drags. As the mouse pointer passes over a link (e.g., an elevator button in the scene), that object changes color. If you click on a link, a new document loads: another VRML world, an audio or video document, or a dull, old 2-D Web page. If the VRML viewer comes across a link to a non-VRML data type, it brings up a helper application.



ParaGraph International's Virtual Home Space Builder lets you build, view, and navigate 3-D scenes in VRML.

Hunger for World Power

VRML is definitely not for the fainthearted CPU. Animated 3-D scenes are heavy computing applications, even if you're not fussy about photo-realistic rendering. If you have insufficient computing power, you should expect to see sluggish navigation, stuttering frames, and artifacts (e.g., jagged edges).

Developers can use a few VRML features to lessen these performance horrors.

continued

World Processing

You probably don't want to plan on writing the Virtual Reality Markup Language (VRML) in your text editor. Even though VRML's designers wanted to let nonprogrammers create their own virtual spaces quickly and painlessly, it's not quite as simple to describe a 3-D scene as it is to describe a page in the Hypertext Markup Language (HTML). Fortunately, many existing modeling and CAD tools now offer VRML export, and VRML-centered tools are arriving. Animation, texturing, and photo-realistic rendering are among the qualities that distinguish VRML authoring tools from one another. Here are some of the top tools:

- **Open Inventor (Silicon Graphics):** This object-oriented 3-D toolkit for Silicon Graphics workstations provided the basis for much of VRML. Think of it as the original.
- **Virtual Home Space Builder (ParaGraph International):** Based on the Virtual Home Museum System for children, this Windows VRML modeler is less complex than others, but it's easy to use, inexpensive, and less demanding on the hardware.
- **Genesis World Builder and G Web (Virtual Presence):** These tools are used for building worlds and VRML publishing, respectively, for Windows and various Unix workstations.
- **WalkThrough Pro (Virtus):** A high-end Mac and Windows 3-D scene designer with VRML export, WalkThrough Pro even supports stereo glasses. It creates stand-alone models to distribute with the freeware Virtus Player.
- **StudioPro (Strata):** A high-end modeling and rendering application, it provides output for both VRML and QuickTime VR. StudioPro makes full use of QuickDraw 3D and requires a Power Mac.

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For example, VRML's point of view is a camera. Normally, as you navigate through a VRML scene, you move the camera around—which is a compute- and bandwidth-intensive process. So, often a world's creator will define vista points—predefined viewpoints that you can jump to directly—to speed motion to important points of view.

Another trick is to vary the level of detail. If you're far away from an object, you don't need the same level of detail as you would if you're close to it. The VRML definition cleverly uses this opportunity for optimization by employing a nested format for objects. The level of detail (LOD) feature switches between different representations of an object automatically, from low to high detail, depending on how close the object is.

Even with these tricks, it makes sense that Silicon Graphics is big on VRML: Virtual reality and 3-D rendering still work best on high-end graphics workstations. For the rest of us, a 100-MHz Pentium machine with 32 MB of memory and Windows acceleration hardware or a Power Mac will do.

Ample bandwidth is a necessity. Even though VRML describes 3-D objects efficiently, a complex scene has many polygons, and textures require much data. Some experts suggest that ISDN is the minimum to explore the 3-D Web seriously. Unless you enjoy watching virtual grass grow, a 28.8-Kbps modem is the minimum.

Worlds to Come

Future VRML objects will know about physics, for animation and user interaction. You will be able to rearrange the furniture or bounce a ball. Apparently, VRML developers are contemplating using Sun Microsystems' Java programming language, which downloads small applets, to execute functions. Future VRML will also support video and sound data streams, both ambient and tied to specific objects.

After all that comes user-user interaction. Researchers at the German National Research Center for Information Technology are developing a multiuser extension to VRML. It will control how and when users appear to others in a virtual environment.

IBM is also getting involved, although it's been vague in its statements. In August 1995, IBM announced a VRML extension called VRML+. According to IBM multimedia director Willie Chiu, it will make "a lot more services available." So far, the impact of IBM's initiative has not been apparent.

Where To?

It's not as if VRML viewers are going to replace existing HTML-based Web browsers. HTML will remain the standard for text pages with hyperlinked graphics and text. Is it true then that VRML brings us the Web without the interface? Not exactly. Walking or flying through a scene might be more natural than scrolling through a Web page, but you still have to learn how. Also, authoring tools are complex to use.

So what is it good for? As a new medium within a new medium, it's difficult to predict. Initially, Web sites will probably use it as they use RealAudio and ShockWave—for extra glitz. But it can do far more. Already, architecture and industrial-design firms are using VRML to construct static models to display to customers and the general public. Some companies are experimenting with using 3-D effects to aid in navigation around their Web sites. And it won't be long before we see sites using moving 3-D representations of dynamic data. ■

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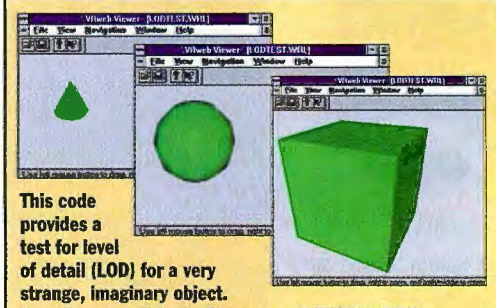
Exploring the Worlds

With your hardware and software in order, it's time to explore the brave new worlds of the Virtual Reality Markup Language (VRML). As is usual on the Internet, there's a tremendous variety of material. Here are some of the most interesting sites:

- http://bug.village.virginia.edu
  Filmmaker David Blair, with artists and virtual-reality gurus, is turning his movie *WAX: or the Discovery of Television Among the Bees* into a 9000-virtual-room 3-D experience, with a soundtrack in English, Japanese, French, or German.
- http://www.addict.com/ATN/Sonic_Lodge/register.html
  The Internet Underground Music Archive (IUMA), a popular site to download off-mainstream tunes, is now working with Mark Pesce. It contains a Sonic Lodge living room with a virtual sofa, virtual magazines (that tap into existing IUMA World Wide Web pages), and a virtual CD player to play music.
- http://www.hyperion.com/planet9/vrsoma.htm
  Virtual SoMa links the Web pages of businesses in the South of Market neighborhood of San Francisco in a 3-D street scene.
- gopher://boombox.micro.umn.edu:70/11/gopher/Macintosh-TurboGopher
  The University of Minneapolis gopher team offers TurboGopher VR, a client application that shows "Gopherspace" as virtual buildings representing files and directories, and advertising their content on billboards.
- http://www.sgi.com/products/webforce/stock1.wrl
  A Web-server script can generate VRML images on the fly. For example, Clay Graham of Silicon Graphics has a script to display the company's current stock price as a financial thermometer.



This code provides a test for level of detail (LOD) for a very strange, imaginary object. From far away, it looks like a cone (LODCONE.PCX). From the middle distance, it looks like a bumpy sphere (LODSPHER.PCX). From close up, it looks like a cube (LODCUBE.PCX).

VRML Sample Code

```
#VRML V1.0 ascii
# test file for LOD (level of detail)

Material { diffuseColor 0 1 0 }
LOD {
center 0 0 0     # center of children
range [ 5, 10 ]  # increasing ranges
# for n ranges there should be n+1 children
# too few children: use last one
# too many children: ignored
  Cube { }       # for [0, 3)
  Sphere { }     # for [3, 5)
  Cone { }       # for [5, inf)
# Cylinder { }
}
```

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Opening PBX Doors

SALVATORE SALAMONE

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Once the mainframes of telephony, PBXes are making their way onto PC networks

I'm going to conference-in Bob now. If I lose you, I'll call you right back." An excuse to hang up on you? Or is setting up a conference call really that confusing? Probably the latter, considering that a typical office phone has a few dozen features and maybe 20 keys. You might complain about computer user interfaces, but nothing tops a telephone. Imagine if your banker said, "I'm going to try to withdraw the money for you now, but I may just stop halfway through and leave you standing there."

Conference calls may seem like small potatoes, but they're part of the larger issue of getting PBXes to talk to computers. There is hope. We're starting to see the first of many data-friendly PBXes. Major players in the PBX market, including AT&T, Fujitsu, Mitel, NEC, Nortel (formerly known as Northern Telecom), and Siemens ROLM, are offering better connectivity between the PBX and the LAN. They're also opening up the architecture of the PBX so it's easier to tap a PBX's functions and services. And they're making the PBX a better network citizen by adding support for traditional data network management.

How It Works

Before you start plugging cards into your server and installing software on your PBX, you should probably know what's going on in there. A PBX is easy to understand, at least from a high level: it's a switch. It has a bus into which you plug cards that provide various functions, such as ISDN and Switched 56 service, or for plugging telephones (or other devices) into the outside world.

These devices, which all have their own unique addresses, set up virtual circuits with other devices. When you pick up your telephone and dial an internal extension, the PBX basically hands your phone's address to a memory location that's reserved by the other extension's telephone, and vice versa, then sends a ring signal to the other phone. Easy enough. The switch part of the PBX keeps track of all the exchanged memory locations and routes signals to the appropriate ones. A central processor and a real-time operating system control the switch.

Recently, PBX vendors have added the capability to handle data directly from PCs and LANs. There are two approaches to handling data traffic in a PBX. One is to dedicate PBX channels to data traffic and circuit-switch that traffic; basically, the PBX handles voice and data the same way (see the figure "Dialing for Data" on page 64NA 2). The other approach is to switch voice traffic through the PBX but use LAN-based packet switching for the data, essentially creating a hybrid PBX/LAN hub (see the figure "Bringing It Together" on page 64NA 2).

Today it makes sense that you could run data and voice over a PBX. It's just a digital signal, after all. PBX vendors even created digital PBXes that could handle both voice and data as many as 10 years ago. But it's not that simple. The problem lies in the PBX's closed architecture.

The first PBXes had closed hardware and software architectures that were tightly integrated. Hardware was usually proprietary—the processors were often designed specifically for a vendor's

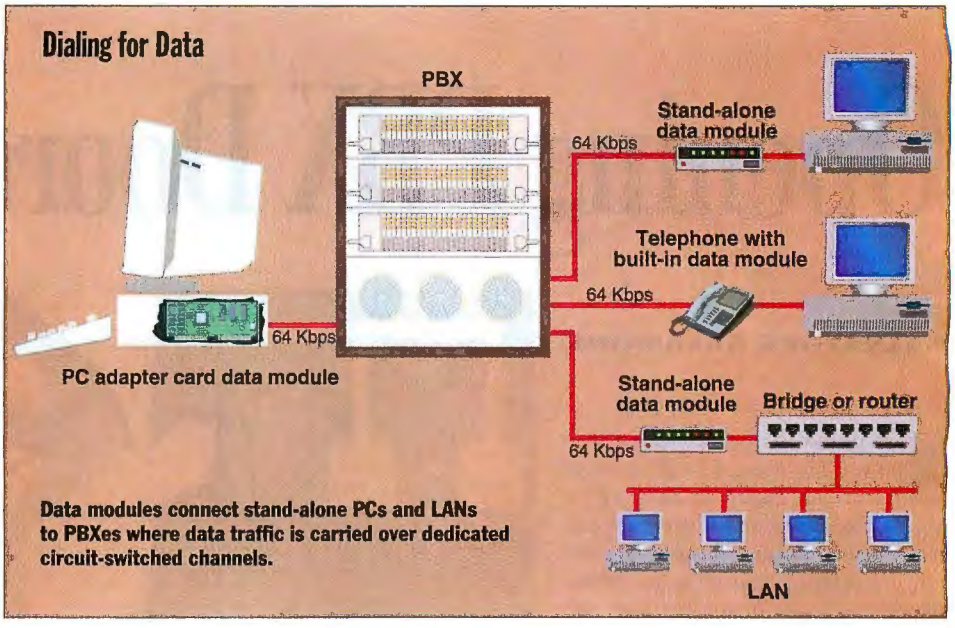
PBX. Since the hardware was proprietary, so was the OS. And since the OS was proprietary, all the applications were, too. Consequently, PBX functions like call processing were closely tied to a specific PBX model (or, if you were lucky, to a PBX family). With all this proprietary design, software vendors were a little concerned about developing for a PBX that would become extinct. Consequently, they didn't develop the software that would have facilitated the joining of PBX and computer or network.

Today, most vendors build their PBXes around commonly available processors running common operating systems (typically Unix) and use common programming languages (C and C++). Modular architectures have replaced monolithic, and all functional aspects, such as systems management, applications, and applications management, are decoupled from each other (see "Building Blocks Stack Up" on page 64NA 6).

This architectural change makes it much easier to develop, troubleshoot, and add new applications to a PBX. Granted, you probably won't go off and develop a quick telephony app, but you're no longer stuck waiting for the PBX vendor to modify its software for a new service or function. You can now choose from many telephone VARs and systems integrators to write applications for you.

The modular software approach also makes it easier to take advantage of new telecommunication services, such as wireless networks, as they become available. A PBX manufacturer would have to provide only wireless network interfaces and wireless call-management software in order for you to connect to a wireless service.

Additionally, the modular approach decouples the call-processing functions of a PBX from the actual switching fabric. That means the same administrative and management functions can be applied to different switch fabrics. In essence, you can upgrade a PBX's switching fabric to a new technology, such as asynchronous transfer mode (ATM), without having to redo all the software.



PBX Glasnost

Thanks to open hardware and software architectures, PBX vendors can now offer more features and newer WAN services faster than they could in the past. Suddenly, PBXes look pretty attractive to data networking folks. And additional modifications will enhance the PBX's status as a data network element.

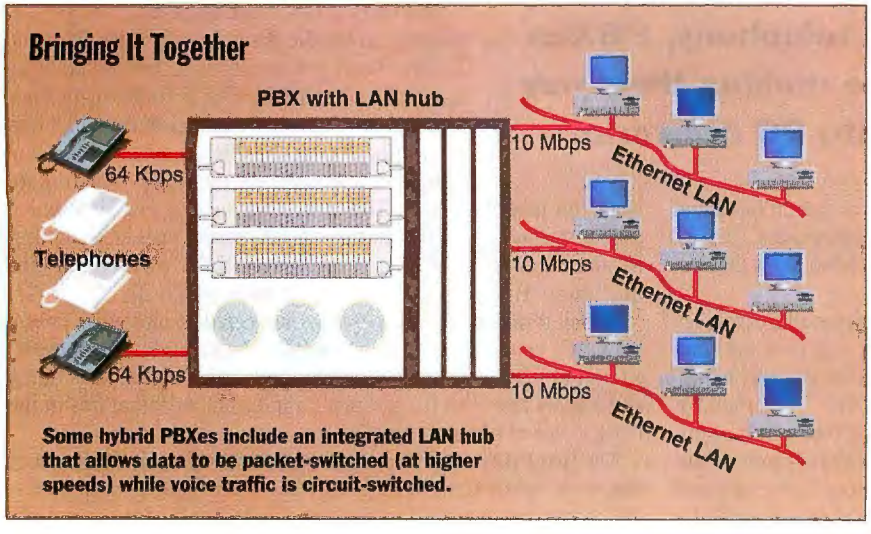
For example, it's now easier to connect a PC or a LAN to a PBX. Older PBXes have low-speed, proprietary connections between the PBX and any data device—64 Kbps was typical.

Much has changed. PBX vendors have added higher-speed data interfaces and embraced standard approaches to connect the networking environment with the PBX. These approaches include TCP/IP connections and support for new APIs.

A Uniform Language

Probably the most important development in the last two years is the near universal support by PBX vendors of two programming interfaces: AT&T and Novell's Telephony Services API (TSAPI) and Intel and Microsoft's Telephone API (TAPI). These two APIs provide standard ways for PCs to give PBXes orders and receive information back. Historically, integrating computers and PBXes was expensive—it was something you did with several hundred-thousand dollars' worth of hardware and software. Today you can buy VBXes and OLE Controls that you can plug into any Visual Basic application. You can generate a telephony-enabled application for about a hundred dollars, and ready-to-roll applications would cost you only a few hundred dollars per seat.

TSAPI creates a logical connection over a LAN between the computer and the telephone on a person's desk (see "Logical Links" on page 64NA 8). It defines the function calls the client and server applications use to manage and execute telephony services. This has been possible for a while, but older systems used a physical connection between the computer and



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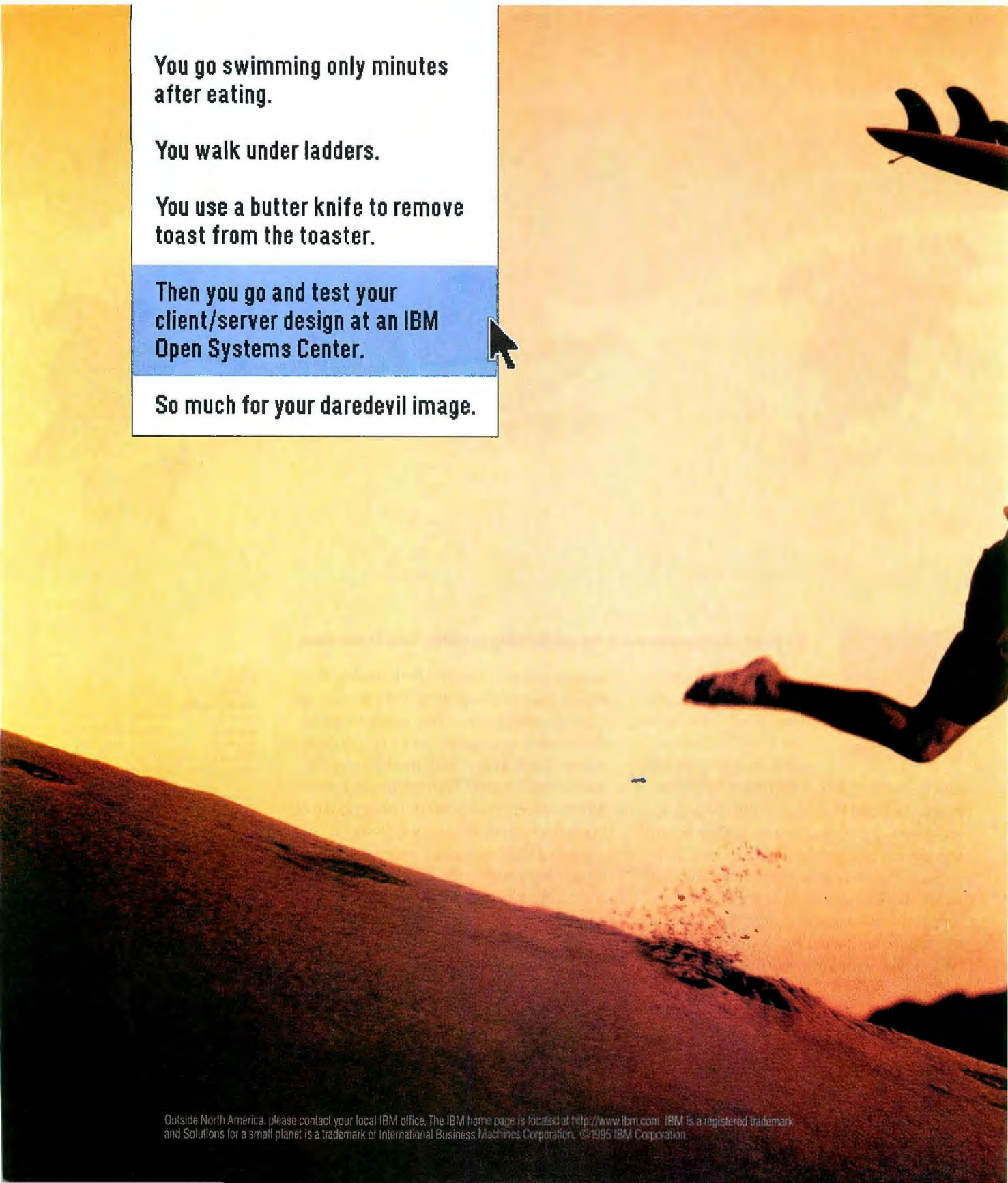

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the telephone—a computer with an adapter card that incorporates a jack for a phone handset, for example.

A common use of TSAPI is automatic call distribution (ACD), where a call can be routed based on the time of day, day of the week, information the caller enters in an interactive voice response system, or the caller's telephone number. Most ACD systems link calls to data that they make available on someone's PC. For example, in a bank's customer-service department, the ACD system would display the caller's account information on the PC screen as the bank employee picked up the phone.

To achieve such integration requires that the PBX and the LAN server (to which the PCs are connected) work closely together. The PBX must support the NetWare Telephone Services (NTS). Most major PBXes, such as those from AT&T, Fujitsu, Mitel, and NEC, do.

TSAPI also requires several software components on the server. Specifically, a NetWare file server must run a set of NetWare loadable modules (NLMs) that establish and maintain the logical connection between each phone and desktop computer. These NLMs include Novell's TServer, a PBX driver, and a PBX link driver. TServer is the TSAPI NLM. It defines how a PBX and a computer communicate. It's through this interface that a client sends requests to a PBX to do things like dial a telephone number.

The PBX driver takes client requests and translates them into the proprietary command language the PBX understands. It then passes the instructions to the PBX through the PBX link driver, which simply passes the commands across the link connecting the PBX and the server. The PBX vendor supplies these two drivers.

When you put it all together, it works like this: The client sends its requests for telephony services over the LAN to the TServer NLM using the SPX protocol. The TServer NLM talks to the PBX driver, which routes the TSAPI request to the PBX via the link driver. When the PBX receives a request, it carries out the action.

In the case of the customer-service department, for example, a TSAPI-enabled ACD application would direct an incoming call to the appropriate associate, ring that person's phone, and pop the caller's account information up on the associate's computer screen.

There are many third-party developers writing TSAPI-enabled applications. CallWare Technologies, for instance, offers several telephony NLMs that provide features such as voice mail, auto attendant, and audiotext (which allows a user to record frequently requested information). One NLM, VoiceView, allows users to manage all their voice messages through a simple PC-based graphical interface.

Another CallWare NLM supports NetWare Directory Services. It lets a network manager administer both the data network and the CallWare voice-messaging system from one point. For example, from a single NDS user object, an administrator can set access rights to all network files, enable CallWare to notify your pager when you receive voice mail, and add or change CallWare voice-mailbox assignments.

Applied Voice Technology offers a TSAPI-enabled interactive voice-response product called CallXpress3 Automated Agent. The system can use either caller ID or automatic number identification (ANI) to direct a call to a customer-service associate or order-entry agent. If caller ID or ANI are not available, Call-Xpress enables you to write automated agent scripts to ask the caller who they are and why they are calling. Regardless of the way it identifies a caller, CallXpress routes the call to an appropriate person and brings up the caller's files on that person's computer screen.

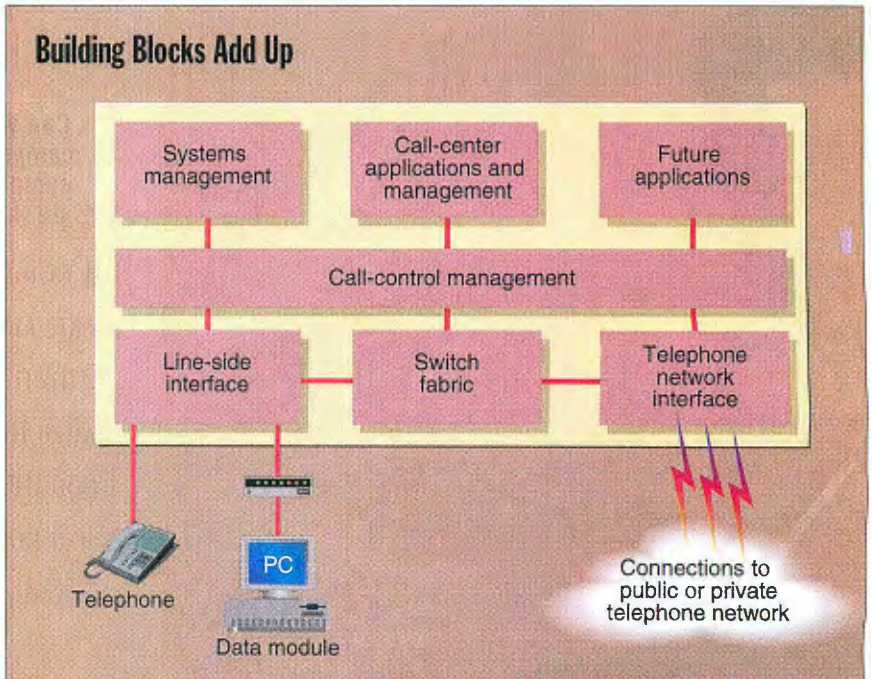
Aurora Systems offers TSAPI-based middleware tools to endow any Windows application, such as a database management or contact management program, with telephony capabilities. The tools let you route incoming calls based on caller ID or ANI and open an application screen displaying the calling customer's information. Users could transfer the call to another person, who would receive the customer's records along with the call. For outgoing calls, Aurora's software enables a user to access any telephone function with the computer's keyboard instead; for example, a user could set up conference calls by clicking on names in a database.

The TAPI Alternative

PBX vendors and developers of computer telephony integration (CTI) applications are also considering TAPI. TAPI's strength is its tight integration with Windows. A user can dial, forward, and transfer calls from any TAPI-enabled application. And any off-the-shelf application running on a Windows PC can access TAPI services. That means, for example, you can place calls from your existing customer database by double-clicking on a customer's phone number displayed on your screen.

Last year, many leading PBX vendors, such as Mitel, NEC, and Nortel, announced they'd support TAPI in their PBXes. However, unlike the case with TSAPI, most of the TAPI activity by third-party developers has focused on desktop applications and not on LAN-based TAPI-enabled applications. The reason is simple: The server part of TAPI is not available. (Sources at Microsoft tell us it should be by the time this issue is out.)

Last March, Microsoft announced it would port TAPI to Windows NT. And



Architecturally, PBXes use a modular hardware and software approach that allows you to quickly add support for new telephone services as they become available.

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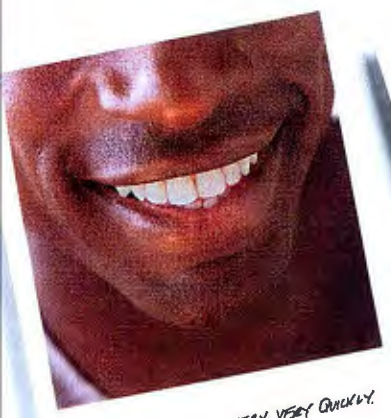

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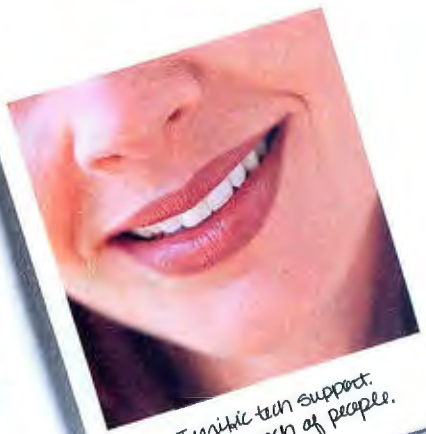

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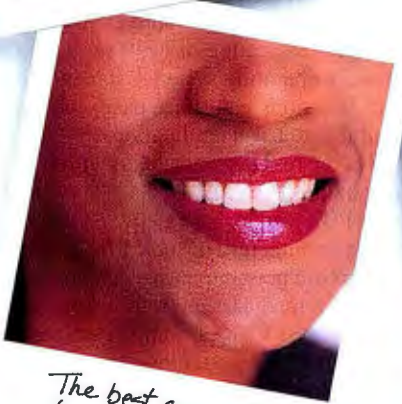

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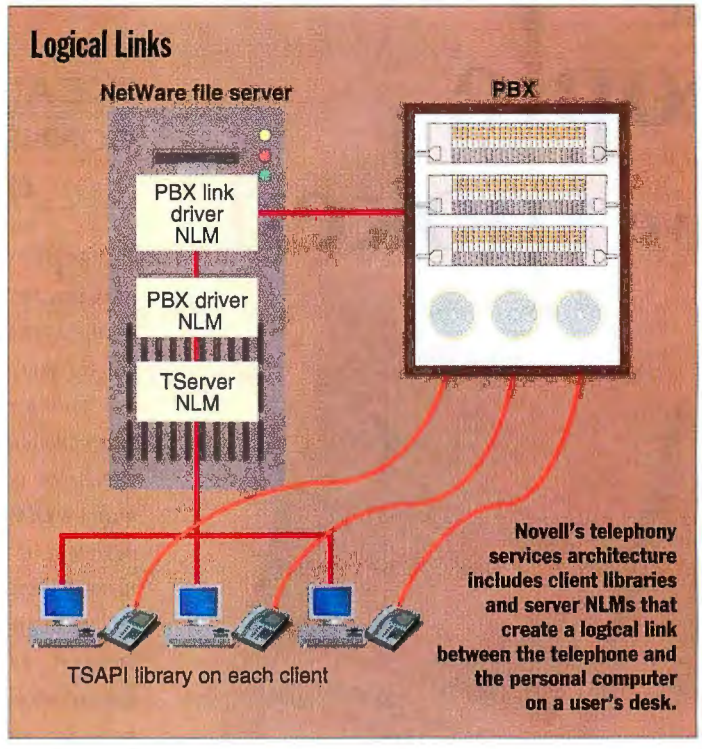
last fall, Microsoft said it would give vendors the necessary code to develop TAPI drivers. Such drivers, like the TSAPI drivers, would translate the TAPI commands and requests for services into the proprietary command language of each PBX vendor's switching system.

The anticipation of TAPI-enabled servers and PBXes has primed the CTI application pump. At last fall's Comdex, several vendors showed or announced LAN-based CTI applications built around TAPI. Nortel demonstrated its TAPI toolkit that offers many call-processing and routing utilities from which you can build LAN CTI applications. Dialogic late last year introduced a TAPI-based version of its CT-Connect software, which hooks a PBX to a LAN, providing applications with call-status information.



Faster Links

TSAPI and TAPI help open the software that talks to a PBX. PBX vendors are also adding support for standard interfaces, such as ISDN and Ethernet, to address the physical openness, and they're adding open network protocols to get PBXes talking to LANs. About two years ago, InteCom offered TCP/IP connectivity for its PBXes. Last year, AT&T and Mitel did, too.

Having TCP/IP is great, but enterprise network managers are not likely to add any device to their networks that doesn't appear on their management consoles. Easily done: Vendors are making PBXes so they can be managed by SNMP. PBXes have always had extensive diagnostic and management systems, but they've been proprietary: All the information about the system and call status has not been accessible from your standard network management platforms, such as HP OpenView or SunNet Manager.

SNMP changes that. AT&T's OneVision Definity Fault Management system, for example, employs SNMP to pass PBX status information to a network administrator. The system uses hardware and a software proxy agent to convert Definity's proprietary management data protocol into SNMP Management Information Base II (MIB II) data that is accessible through HP OpenView.

Bright Future

The efforts by PBX vendors in the last two years to make their products more data-friendly are starting to show results. We're seeing the first wave of standards-based CTI applications and a tighter integration between LANs and voice networks. The PBX is now a communications server in a LAN environment.

Some PBX vendors are adding server functions to their products. Basically, they're taking a processor in the PBX and running NT or NetWare on it. PBX features, such as call-forwarding, become available to data applications. With the tight integration of PBX services and network operating systems, standard telecom functions can more easily be made available to LAN applications.

But the real buzz has to do with the future of the PBX. ATM is a key part of most PBX vendor's strategy. By opening up the architecture of their PBXes, many vendors are poised to move quickly. In the process of modularizing software and hardware within PBXes, many vendors decoupled the switching functions from all other functions. That means today's circuit-switched PBX could, in theory, easily be modified by swapping in an ATM switching matrix. Of course, there's call-processing software that needs to be developed, but the point is this: Vendors do not have to start from ground zero.

Once ATM-based PBXes start to appear later this year or early next, it will be hard to tell the difference between a PBX and a switching hub. That's when the voice and data worlds will truly become one.

In the meantime, remember: Press the Conference button, then dial the new person's number, then press Conference again. ■

Salvatore Salamone is a BYTE editor based in New York City. You can reach him at ssalamone@bix.com.

Where to Find

PBX Vendors

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http://www.att.com

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(714) 630-7721
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http://www.fujitsu.com/FBCS/

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fax: (613) 592-4784

NEC America
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fax: (214) 518-5572
http://www.nec.com

Nortel
(formerly Northern Telecom)
Richardson, TX
(800) NORTHERN
(214) 684-1000
fax: (214) 684-3907

Siemens Rolm Communications
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TAPI Software Vendors

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MAKE MULTIMEDIA HAPPEN

From storyboard to development tools to network delivery, here's what you should know about multimedia development

Multimedia, long a star of the entertainment industry, is now auditioning as a supporting actor in the corporate world. Many companies see it as a way to increase revenues by delivering stronger messages about goods and services. Or they look to it to cut their training costs with interactive computer-based training programs.

The process of developing a multimedia application falls into five basic stages. The first is program design: The team discusses exactly what the application is going to do and what the user interface will look like. The second is storyboarding, in which you create a blueprint of the application. Third comes script development, in which writers create the words that a narrator will speak or that will appear on the screen. Fourth is production, when artists, directors, and actors take the storyboard and fill in its blanks, creating backgrounds and scenes. Finally comes authoring, when programmers put everything together.

Robert A. DelRossi explores the subject of multimedia authoring in "Learn the Lingo." In Salvatore Salamone's "What's the Story?," we look at the second stage, storyboarding, and some of the methods and tools you can use to ensure things run smoothly. In "Multimedia over the Network," Nathan J. Muller examines what it takes to run multimedia applications over existing networks and what networks you should be thinking about for your multimedia future.

Is It Worth It?

If you see multimedia development as a cost center, you may be right. The major issue isn't usually programmers; rather, it's the cost of licensing different forms of media to incorporate into presentations.

Companies seeking to add music and video clips to a multimedia presentation find that print, music, and film industries have vastly different ideas about selling the rights to their property. For example, there's no going price for a 1970s Top 10 song. The most common solution is extensive negotiation.

If you don't want to spend the time or effort in such negotiations, there's a solution: licensing-rights clearinghouses. One of the first firms to offer licensing services specifically for multimedia material is Total Clearance (Mill Valley, CA), a company with expertise garnered from the entertainment industry.

With the right contacts and experience, you might even be able to leverage your well-developed multimedia group into a profit center. That's what happened to the World Tutor Group (WTG), the multimedia training division of the AMR Training Group, itself a part of AMR, which operates American Airlines and the Sabre airline-reservation system. About six years ago, WTG turned to computer-based training and has since spun its talents into a service organization used by outside clients. ■

—Salvatore Salamone, News Editor

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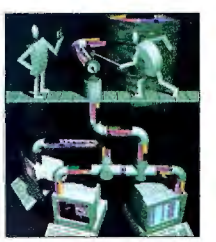

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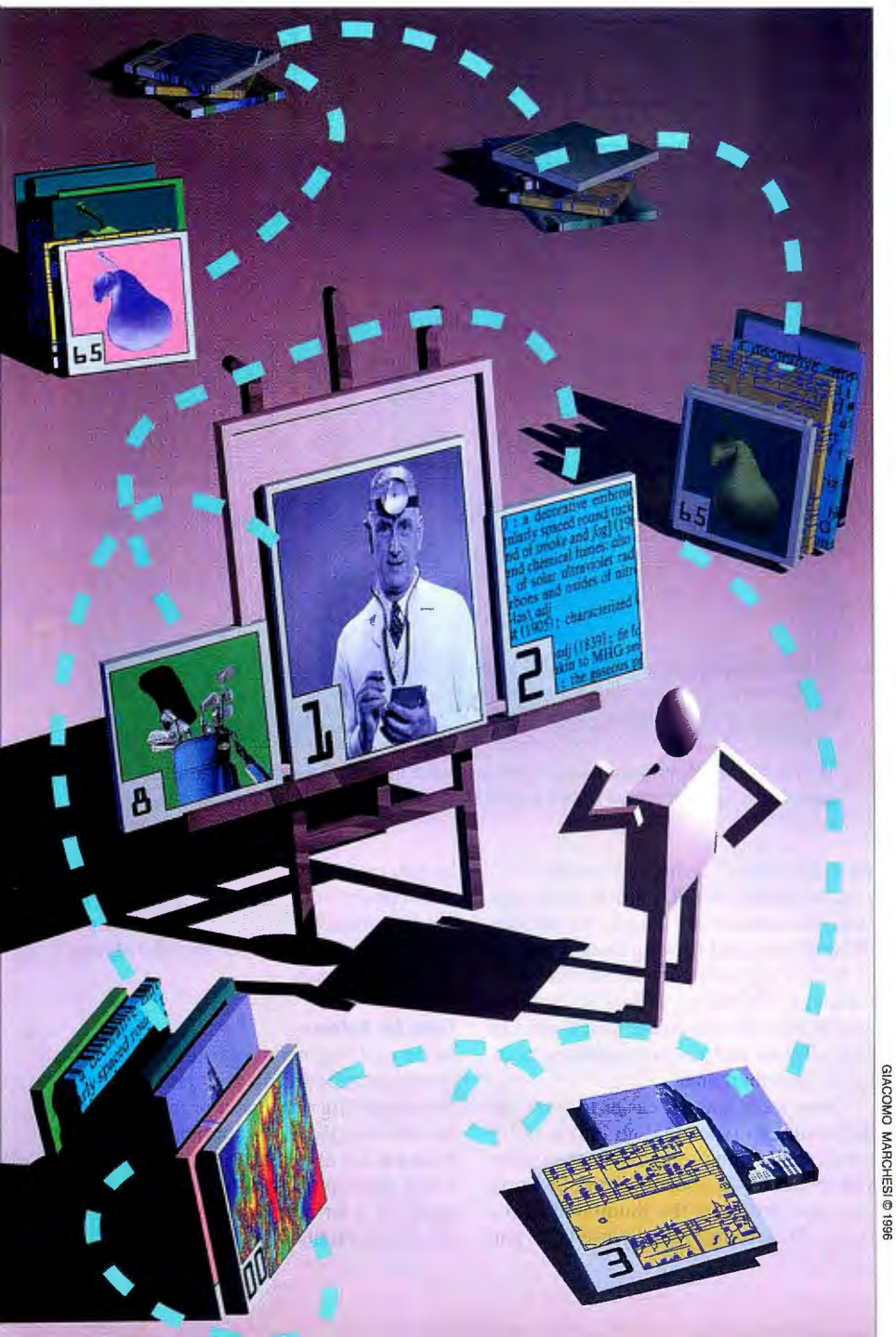
Storyboarding speeds development by organizing everything from concept to finished product

SALVATORE SALAMONE



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Every multimedia project is like a miniature United Nations summit. You have artists, actors, writers, directors, producers, and programmers. They all speak their own languages and have their own priorities. And somehow you need to get them all working together.

Take a hint from the motion picture industry: use a storyboard. Artists sketch every scene of a movie, and the director, costume designers, set designers, and cinematographer use the storyboards to set camera angles, figure out what costumes they need, design scenery, and make decisions about sound and lighting.

But there's a difference between a multimedia application and a movie: linearity. Movies are linear—one scene flows into another, the same way, every time you play the movie. Multimedia apps are often nonlinear—users may choose the path they take through the application. You could storyboard with pencil and paper, but charting multiple paths through an application will probably result in paper glut.

Multimedia developers use basically three types of tools to overcome paper's limitations: flow-charting and presentation software, simple storyboarding software, and tools that combine storyboarding with CASE-like functions.

Flowcharts and Presentations

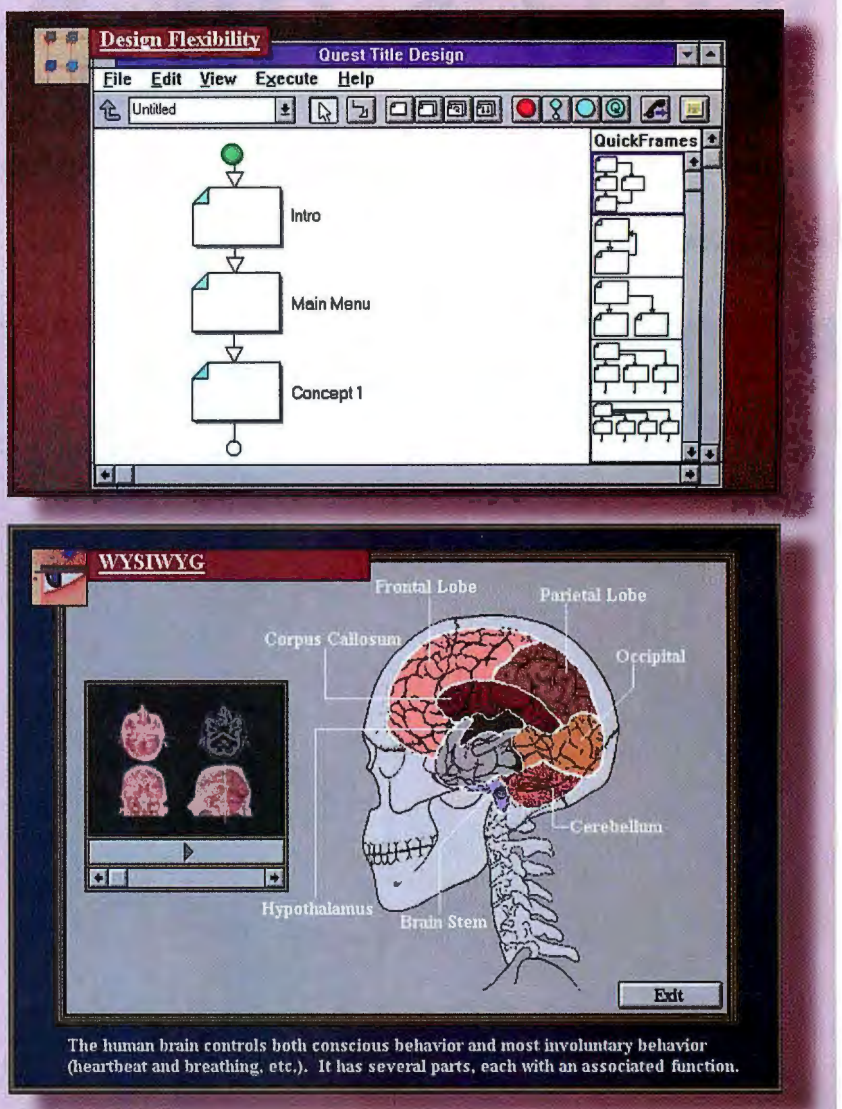
The very simplest solution is a flowcharting tool (such as the one in CorelDraw). A flowchart enables you to lay out processes, decisions, and endpoints. The main problem is that there's no link between the flowchart and the content you're putting together. The flowchart can represent what's going to happen, but not how it's going to look. Therefore, it's most useful for the project manager and the programmer who are trying to keep track of what the application is supposed to do when. By itself, a flowchart doesn't give an artist any sense of what graphics to create, nor does it give

the writers or actors any sense of what to do.

You can solve some of these deficiencies with multimedia presentation tools, which enable you to not only organize the flow of the application but to start creating the application's look and feel. For example, Adobe Persuasion lets you create relationships between multimedia objects by assigning them to different layers of a single presentation slide. With Persuasion, you bring text files, graphical elements (e.g., TIFFs or BMPs), audio tracks (e.g., MIDI files or WAV files), and animation clips (e.g., MPEG or AVI files) together in a single slide. The slide consists of views overlaid on each other. When you run the presentation, Persuasion fires up the various media players—a QuickTime viewer or a MIDI synthesizer, for instance—to play all these elements simultaneously.

Once you have thumbnails of what the main screens in your application are to look like, you can organize the content. You can even run a simple demo of the application. But there are two basic issues with this approach. First, presentation tools are usually best at *presenting*, not storyboarding. Consequently, they use templates and rules that work wonderfully for a presenter who drives the content, perhaps with occasional branches. A storyboard you create in a presentation tool will probably look more like a presentation than a storyboard. Second, you have little control over the individual elements in a presentation. For example, you typically cannot adjust the volume of an audio clip from within the presentation application. You'll have to adjust these functions in the individual players or content-building programs themselves.

Two Views Are Better than One



Allen Communication's Quest software lets you toggle between views so you can see the associations between various frames as well as all the elements in a particular frame.

Storyboard Software

You can use flowcharts and presentation tools to develop your storyboard, but they aren't specifically designed for that. You should consider some of the new programs that vendors have developed specifically for multimedia storyboarding.

"All the storyboarding tools came out of linear thinking," says Paul Clatworthy, a partner at PowerProduction Software. "We developed StoryBoard Artist to handle a nonlinear format." StoryBoard Artist for the Mac uses clip art and stock characters that you place into a storyboard frame, then manipulate, for example, by rotating them to represent a certain camera angle. You set the flow of the application by linking each frame to its destination frames. "We designed a tool for directors who can't draw," quips Clatworthy.

StoryBoard Artist's stock-item construction methods are unique, but the idea of combining and flowing images together isn't. Programs such as Media Commander for Windows, HiJaak 95, and Image'N'Bits let you create thumbnails of each element and assign an appropriate label to each thumbnail.

These tools make it easier to track the different data types that go into a multimedia application. Additionally, they allow you to create storyboard frames by dragging and dropping the thumbnail into a frame. Such tools typically use OLE and let you create OLE links from the presentation program to the data associated with the thumbnails. In that way, you might link a button on the screen with the playing of a video stream.

Tools for Authors

More sophisticated tools blur the line between storyboarding and development. Storyboarding with such programs often results directly in an application. These products are also authoring tools and typically rely on an icon-based design language or a scripting language. For example, PowerProduction's Digital BoxOffice

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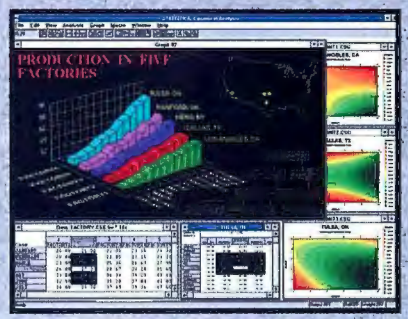

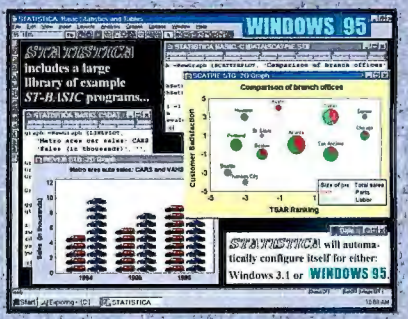

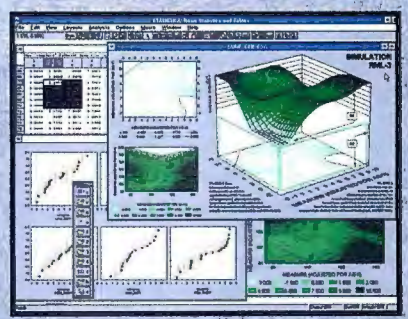

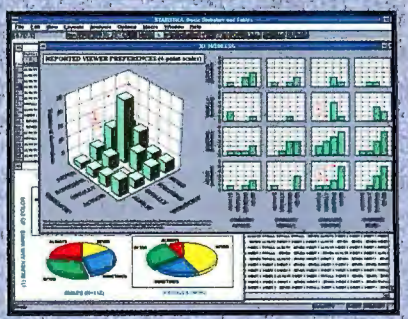

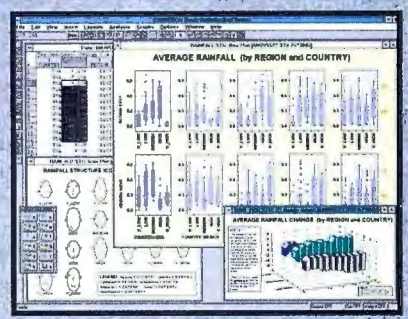

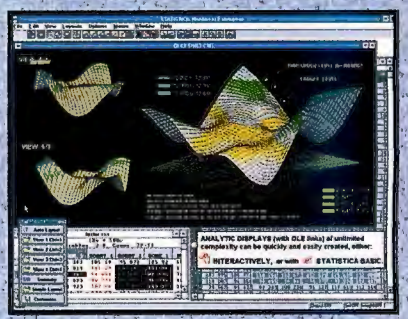

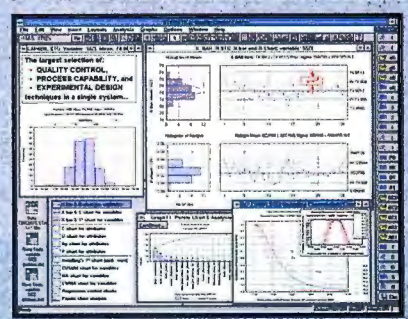

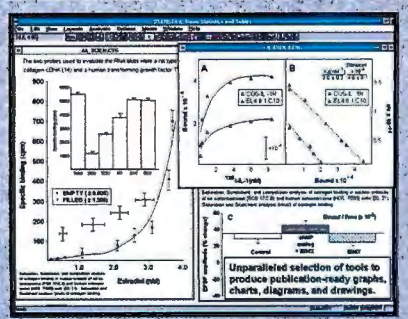

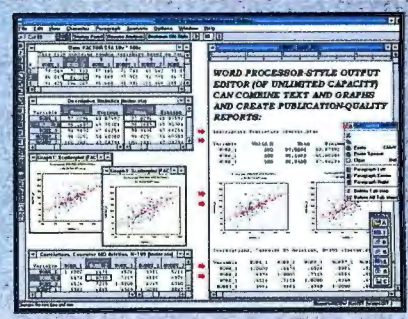

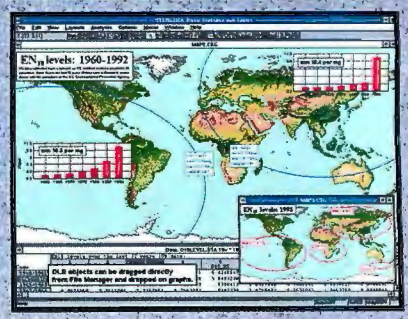

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is a storyboard-to-code tool—CASE for producers and artists. BoxOffice enables you to create a storyboard, then use menus to make English-syntax scripts to link frames. When you're done storyboarding, you have a multimedia application.

Allen Communication's Quest for Windows also has strong tools for developing individual frames and associating frames. For example, you can toggle between a view showing the relationship between frames and a view showing all the elements of a particular frame. Quest is particularly good for developing computer-based training (CBT) applications, especially when you couple it with the company's Designer's Edge program. This $2995 package includes a comprehensive checklist that helps you analyze your project's needs, identify your audience, develop an overview, assemble your instructional elements, and put together your storyboard. Designer's Edge borders on CASE: As you work through the checklist, the program creates your app's structure—all you need to do is add the content.

Other high-end authoring-and-more programs include Avid's editing tools within its Real Impact program and AimTech's CBT Express for Windows. One of Real Impact's key features is Dial-a-Quality, which changes the quality of images by balancing your distribution medium and system performance. It comes with a media library. CBT Express is frame-based and template-driven, and it enables you to create training applications quickly by using prefab backgrounds, buttons, and templates for just about every common CBT task (e.g., glossaries and tests). CBT Express has a big sibling called IconAuthor, which offers transition effects, sample applications, and database integration.

Database integration may seem an odd feature to add, but using a database as a central information repository can really ease development, especially when working on large projects. MicroMentor, a company that develops instructional multimedia applications, uses tools like the ones we've discussed but sometimes takes a different approach. Rather than pulling the multimedia pieces together in the application, developers, writers, and artists put them in a database, then write a Visual Basic application that pulls the files from the database.

During design, you use the database's forms to enter descriptions of the kinds of information you're going to need as well as how it's linked together. Then you can just generate reports for the different members of the project—for example, artists get a list of the graphics they need to produce. The team members go off and generate the content they need, and that, too, goes into the database. Then the programmer has to write a program to put it all together.

There are several reasons for creating an application this way. First, the database can generate reports tailored to each team member. Second, more programmers know Visual Basic than know scripting languages. Third, if you are creating a series of similar products, you can build one database and easily update the application to pull out slightly different material.

Looking for a Match

You can still do storyboarding with pencil and paper, but a computer-based tool will make the job much easier. If you simply need a way to quickly pull together different multimedia elements, a lower-end storyboarding tool might be all you need.

If you have to keep track of many data files, a tool that provides thumbnails and a way to archive the elements would be a good bet. If you're working on an interactive training presentation that requires handling lots of conditional branches and juggling many forms of multimedia data, a storyboarding tool that integrates tightly with the authoring software is essential. ■

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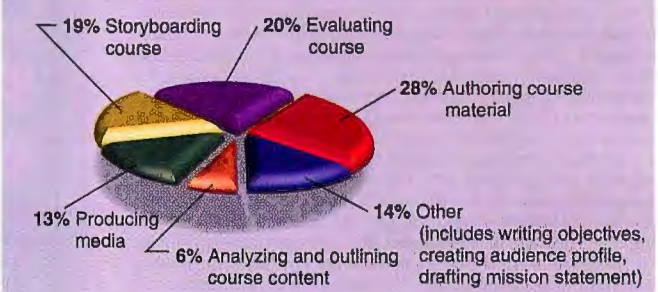
The Hierarchy of Storyboarding Tools

FUNCTION OF STORYBOARDING TOOL	ADVANTAGES	DISADVANTAGES	TYPE OF APPLICATION THIS TOOL IS GOOD FOR
Associates different multimedia elements in one frame	Easy to use	Limited control over elements	Simple multimedia presentations
Creates thumbnails and helps organize different multimedia data types	Visual depiction of various elements	A particular tool may support only a limited set of data types or formats	Simple and interactive multimedia presentations; some simple interactive training programs
Integrates with other tools including editing and authoring programs	Full control of content	Often requires high skill level to use	Interactive training programs

Storyboarding Takes Time



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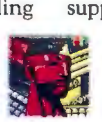

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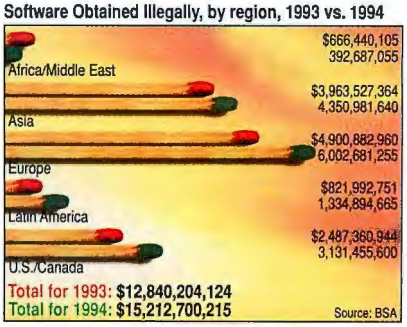

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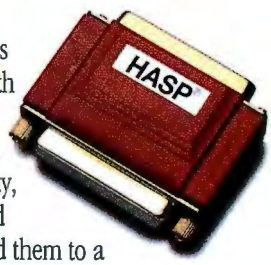

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MULTIMEDIA OVER THE NETWORK

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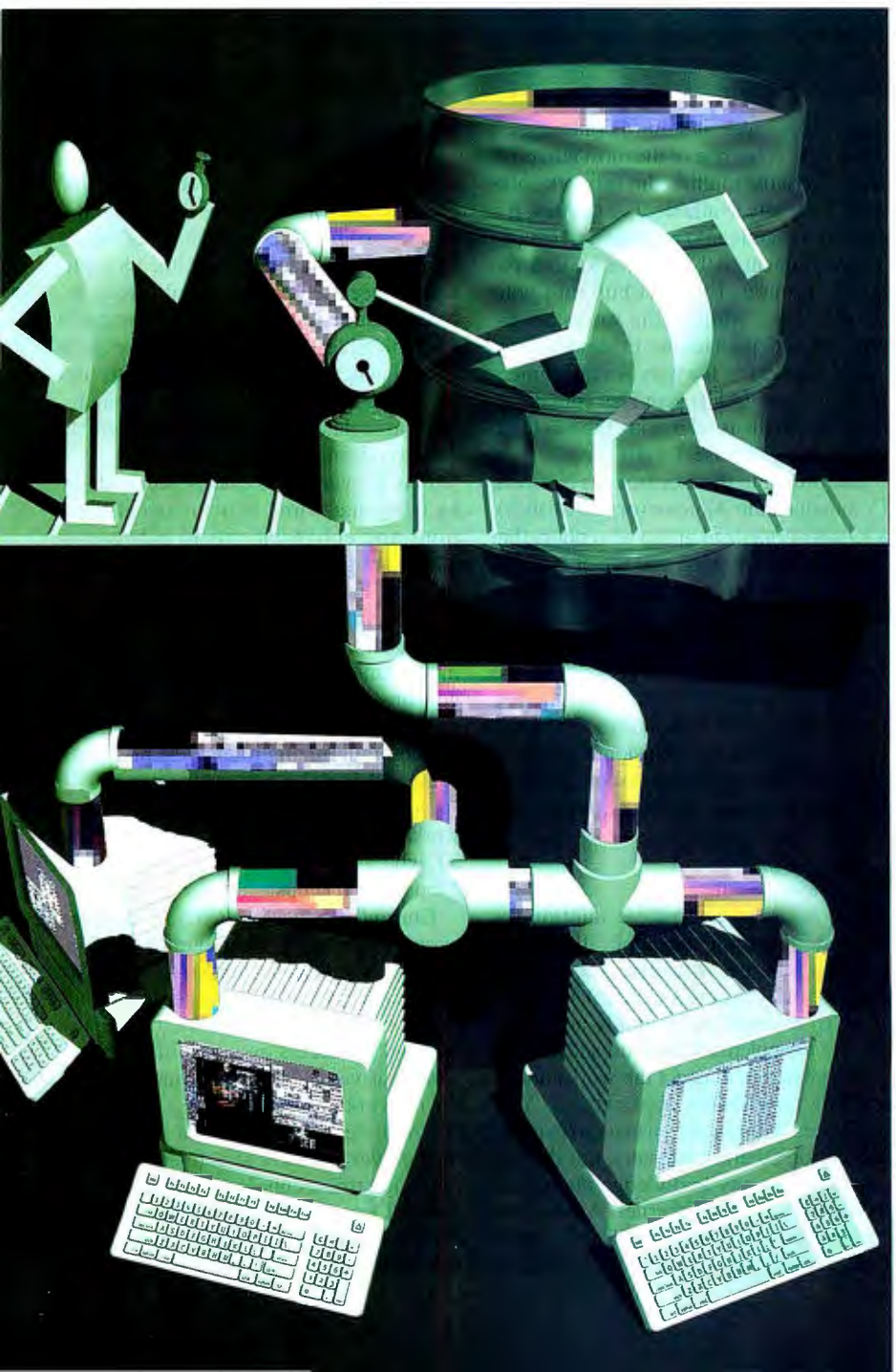
NATHAN J. MULLER



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Distance learning. Video interactive collaboration. Distributed simulations. Computer telephony integration (CTI). Under the rubric of multimedia, applications like these can propel us into a new way of working.

But before we can realize the potential of multimedia, we first have to address a more mundane challenge: how to effectively deliver multimedia applications over LANs and WANs.

Multimedia traffic has one distinguishing characteristic: It's time-sensitive. Different data types, especially voice, must arrive at their destination at the right time or the multimedia application loses its effectiveness. For example, if the audio portion of a videoconference is out of sync with the video components, you get "dubs disease," the illness that afflicts foreign actors when a producer decides to use dubbing instead of subtitles.

Vendors are addressing the problem of synchronization by assigning a quality of service (QoS) to a multimedia application. QoS identifies an application as time-sensitive and requiring priority over other, less time-sensitive ones. But where is the best place to handle QoS? The network (i.e., routers, hubs, and switches)? The OS? Or some combination of hardware and OS working together?

Leveraging Today's Infrastructure

If you already have an Ethernet LAN, it's impractical and expensive to replace it. Instead, you need an economical method of extending your network to accommodate multimedia applications. Enter isochronous Ethernet (aka IEEE 802.9a, ISLAN-16T, or isoEthernet).

The premise behind isochronous Ethernet is that voice—not audio or video—is the critical component in multimedia communications. During a conversation, even the slightest delay creates a major disruption. Echoes caused by delays can confuse

even the most articulate speakers. A split-second delay can disrupt a simple two-way conversation by causing one participant to repeat a question, only to interrupt the other's answer. If you've ever experienced a telephone conversation via a round-trip satellite link, you know the annoyance of delay.

Isochronous Ethernet adds multirate ISDN to standard Ethernet. The marriage of Ethernet and ISDN guarantees QoS for voice in networked multimedia applications. In addition, isochronous Ethernet works with H.320, T.120, and MPEG videoconferencing, document conferencing, and video-distribution standards.

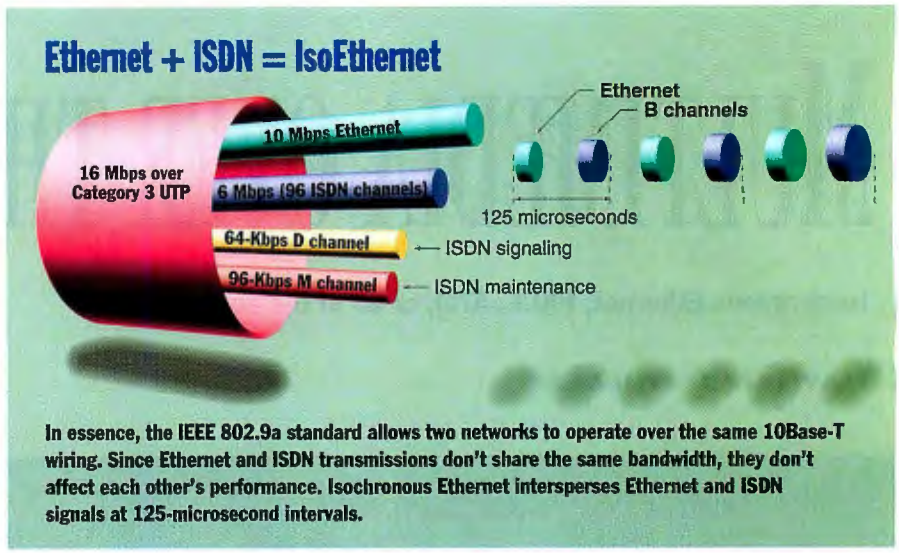
A network is isochronous when it operates in real time, with *time* defined by the worldwide-standard 8-kHz clock used for nearly all voice communications. Today's Ethernet networks are asynchronous and do not provide the 8-kHz clocking signal that the voice component of a multimedia application—delivered through an H.320 codec, for instance—requires.

The IEEE 802.9a standard is the only LAN technology that extends 8-kHz clocking to the desktop. All others, including 25-Mbps asynchronous transfer mode (ATM), require buffering to smooth out traffic bursts and adaptation techniques to transmit and receive synchronous traffic, such as H.320 voice and video.

Isochronous Ethernet is a hybrid network that integrates standard 10-Mbps Ethernet (IEEE 802.3 10Base-T) LAN technology with 6.144 Mbps of isochronous (ISDN) bandwidth, for a total of 16 Mbps available to any user (hence the IEEE designation of Integrated Services Local Area Network, or ISLAN 16-T). Isochronous Ethernet uses an encoding scheme, called 4B:5B, that enables the total bandwidth to be 16 Mbps using the same 20-MHz clock that provides only 10 Mbps with the Manchester encoding scheme of traditional Ethernet (see the figure "Ethernet + ISDN = IsoEthernet").

Isochronous Ethernet provides 96 64-Kbps ISDN B channels over the same ubiquitous Category 3, unshielded-twisted-pair wire that 10Base-T uses. That's enough bandwidth for a multipoint videoconference with six participants, each using 384-Kbps speeds, with room to spare for interactive whiteboarding and presentation graphics. And there's still enough bandwidth left over for the participants to receive Group 4 fax, E-mail, and voice-mail messages over separate channels.

If isochronous Ethernet is a power user's dream come true, it's an MIS manager's delight. It's also one of the most attractive and affordable multimedia network solutions currently available. For starters, it's easy to integrate into an existing 10Base-T environment: All you have to do is put an isochronous Ethernet hub into your wiring closet. Multimedia workstations, outfitted with isochronous Ethernet adapter cards, connect to the hub. An attachment unit interface (AUI) provides connectivity between the isochronous Ethernet hub and existing 10Base-T hubs.



In essence, the IEEE 802.9a standard allows two networks to operate over the same 10Base-T wiring. Since Ethernet and ISDN transmissions don't share the same bandwidth, they don't affect each other's performance. Isochronous Ethernet intersperses Ethernet and ISDN signals at 125-microsecond intervals.

According to the Isochronous Network Communication Alliance (or incAlliance), a loosely organized group of vendors that promotes the adoption and use of isochronous network technologies and products, about two dozen companies offer products that take advantage of isochronous Ethernet. National Semiconductor, the original developer of isochronous Ethernet, provides chip-level components and board-level subsystems for inclusion in products from such companies as Ascom Nexion, Ericsson Business Networks, Incite, and Luxcom.

A Proprietary Solution

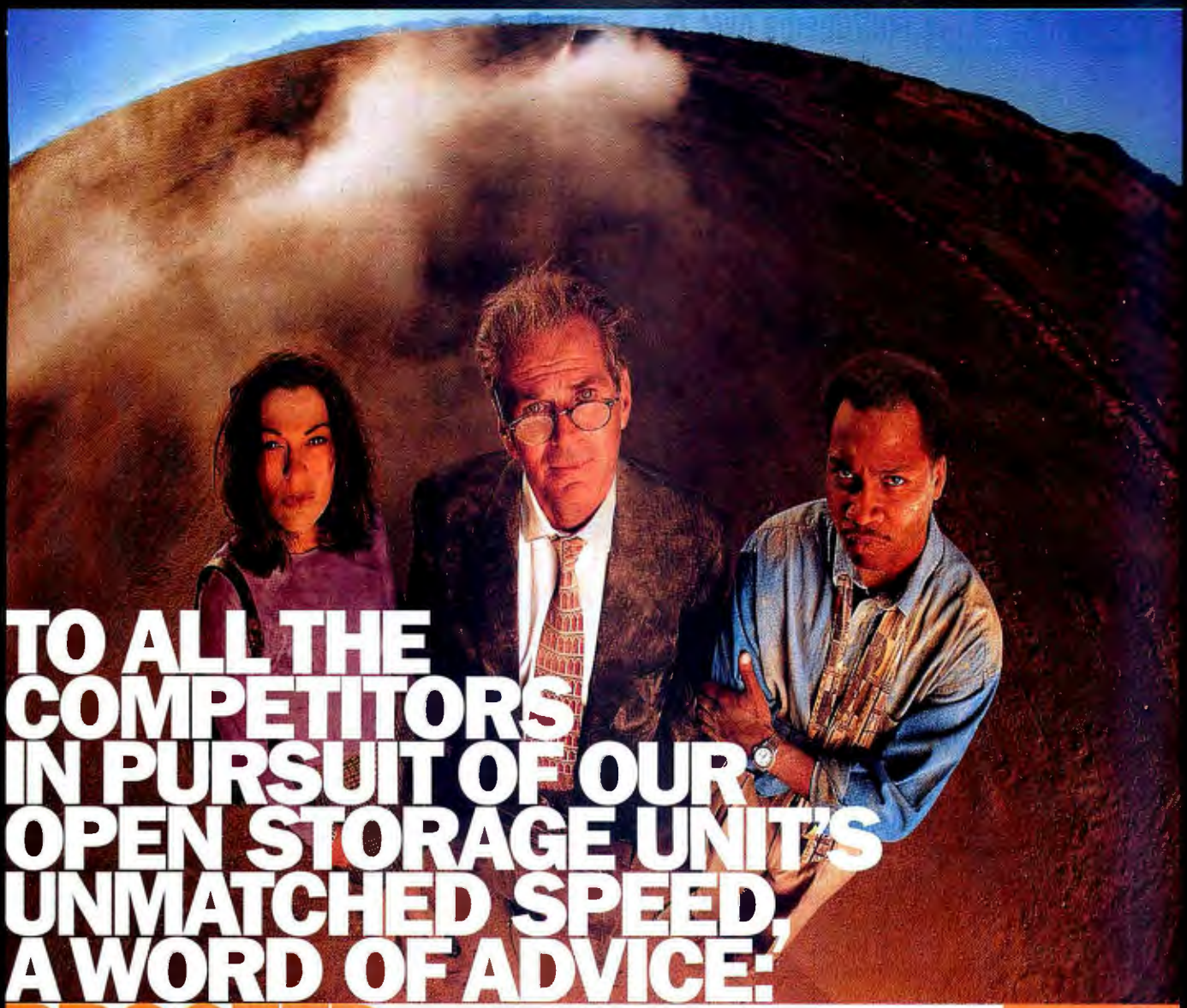
3Com offers an alternative solution for networking multimedia applications over existing Ethernet networks. The company's Priority Access Control Enabled (PACE) technology is simple and inexpensive to implement: You just add a workgroup switch to connect the workstations running multimedia applications. You don't need to make any changes to existing cabling or Ethernet adapters, nor do you need to have any knowledge about any technology except Ethernet. Among the companies supporting PACE are Apple, Dell, Novell, Oracle, Silicon Graphics, Starlight Networks, and Sun Microsystems.

While isochronous Ethernet adds a timed channel to Ethernet, PACE addresses Ethernet's delivery timing and priority. To produce integrated, high-quality graphics and sound, multimedia applications need regular, predictable data delivery. But Ethernet delivery timing is unpredictable; under a full load, it experiences latency and jitter. *Latency* is the delay between the time transmission and reception of data. *Jitter* is the uncertainty in the arrival time of a packet.

PACE overcomes excess packet delay by using star-wired switching configurations and enhancements to Ethernet—which are all backward-compatible with existing Ethernet adapters. The technology uses traffic-control algorithms that enable each Ethernet segment to operate at more than 98 percent efficiency. These algorithms provide predictable LAN transmission by regulating the flow of traffic, thereby minimizing jitter. Best of all, because IEEE 802.3 Ethernet is essentially speed independent, the same enhancements work at Fast Ethernet speed (i.e., 100Base-T), which allows you to migrate from 10 Mbps to 100 Mbps.

Currently, however, PACE stops short of applying true QoS to multimedia traffic. In other words, Ethernet isn't perfect for multimedia transmission because it offers no priority-access scheme. All traffic must contend for access on a best-effort basis, which can cause delays in getting data onto the network in the first place.

PACE defines a method of prioritizing traffic over Ethernet to deliver true QoS. Although this technology is already built into a 3Com workgroup switch—the LinkSwitch 1000—as this article went to press, it was not yet in use. By the time you read



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this, 3Com should be implementing PACE, but it won't include a standard prioritization method.

The IEEE 802.1 working group has only recently agreed to begin addressing QoS issues—specifically, the handling of prioritization in bridges—and it isn't expected to have anything for another 12 to 18 months. Meanwhile, 3Com will use—and publish—its own prioritization scheme, which offers two levels of service: high and low.

Multimedia over the Internet

Isochronous Ethernet and PACE deal with plumbing. That's fine if you have control over the hardware. But what if you don't? What if you're dealing with all sorts of physical media located all over the globe? In other words, what if you're dealing with multimedia applications running on the Internet, where the only thing you know for sure is TCP/IP?

One stumbling block for running multimedia applications over TCP/IP is the problem of delay. IP doesn't allocate a specific path or amount of bandwidth to a particular session. The resulting delay can vary wildly and unpredictably, wreaking havoc with real-time applications.

There are several proposed solutions to perform resource-setup functions similar to that of Q.93x signaling in a circuit-switched network. The most promising of these is the Resource Reservation Protocol, or RSVP, developed by the Internet Engineering Task Force (IETF).

RSVP runs on top of IP to provide receiver-initiated setup of resource reservations on behalf of an application data stream. In other words, when an application requests a specific QoS for its data stream, RSVP delivers the request to each router along the path(s) of the data stream and maintains router and host states to support the requested level of service. In sum, RSVP essentially allows a router-based network to mimic a circuit-switched network on a best-effort basis. It even provides transparent operation through routers that do not support it.

At each router, the RSVP program applies a local decision procedure, called *admission control*, to determine if it can supply the requested QoS. If it can, the RSVP program in each router passes incoming data packets to a packet classifier that determines the route and QoS class for each packet. The router then queues the packets in a packet scheduler that allocates resources for transmission on the link. If admission control fails at any node, the RSVP program returns an error to the application that originated the request.

The advantage of RSVP is that it works with *any* physical network architecture. It runs over Ethernet, token ring, ARCnet, or Fiber Distributed Data Interface (FDDI), as long as IP is the underlying network protocol. This makes RSVP suitable for use with compa-

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ATM's Touch of Class

CLASS OF SERVICE	APPLICATION	BANDWIDTH GUARANTEE	DELAY VARIATION	THROUGHPUT GUARANTEE	CONGESTION FEEDBACK
Constant bit rate (CBR)	Provides a fixed virtual circuit for applications that require a steady supply of bandwidth, such as voice and video traffic.	✔	✔	✔	—
Variable bit rate (VBR)	Provides enough bandwidth for bursty traffic, such as transaction processing and LAN interconnection, as long as rates do not exceed a specified average.	✔	✔	✔	—
Unspecified bit rate (UBR)	Uses any available bandwidth but doesn't guarantee when or if data will arrive at its intended destination.	—	—	—	—
Available bit rate (ABR)	Makes use of available bandwidth and minimizes data loss through congestion notification.	✔	—	✔	✔

✔ = yes; — = no.

nywide networks as well as for the Internet.

RSVP meshes well with IPv6 (previously known as IPng), so users can set up end-to-end connections with a specified amount of flow control for a given time. Time-sensitive services, such as real-time video and voice, get the special handling they require along the route path. How? IPv6 can label packets in traffic patterns, so applications can identify packets that belong to particular traffic flows for which the sender requests special handling.

Although IPv6 standards are nearing completion, it could take a few years for the technology to be widely implemented throughout the Internet. Major networking vendors, including Bay Networks, Cisco, and 3Com, have indicated they will add support for IPv6 to their products in the third or fourth quarter of this year.

Finally: ATM

Although all the resource management and flow-control techniques discussed thus far are implemented on a best-effort basis, if widely deployed they tie up lots of network bandwidth. In other words, we need more bandwidth. Enter ATM.

ATM uses 53-byte cells to carry voice, data, and video signals. By using a standard cell size, it can switch data via hardware, which is more efficient and less expensive than using software, the way X.25 and frame relay do. Hardware-based switching is also faster: ATM speeds are scalable and can exceed 2.5 Gbps over fiber.

In addition, ATM provides the features necessary for successful multimedia applications. Specifically, it has the ability to define different traffic types, with each traffic type delivering a different QoS.

The traffic type that supports multimedia applications (see the table "ATM's Touch of Class" on page 76) is called constant bit rate (CBR) service. CBR supplies a fixed-bandwidth virtual circuit that addresses the special handling needs of delay-sensitive multimedia applications—those that contain real-time video and voice, for example. In ideal circumstances, the application negotiates QoS with the network. Applications do the negotiation through native ATM interfaces. If an application can't do this, interfaces such as ATM LAN emulation and classic IP over ATM (RFC 1577) do it instead.

QoS guarantees a certain level of performance: maximum cell rate, available cell rate, cell-transfer delay, or cell-loss ratio. The network reserves the full bandwidth that the application requested. There

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are no data-rate limits for CBR connections, nor is there a limit on how long a connection can transmit at the maximum cell rate (technically called the *peak cell rate*, or PCR). The PCR is the maximum data rate the connection can support without risking data loss. Any traffic above the specified rate risks being dropped.

These and other advantages of ATM—including low latency, high throughput, and scalability—will one day make it the network of choice for supporting new, high-bandwidth multimedia applications, as well as legacy LAN and TCP/IP traffic. This realization has vendors and standards bodies looking to support upward migration to ATM networks.

National Semiconductor, for example, already offers an on-board segmentation and reassembly (SAR) component for isochronous Ethernet cards to support traffic over ATM links. 3Com plans to offer ATM connectivity through high-speed backbone switches—its own, or those of other vendors. However, when PACE traffic hits an ATM network, the advantages of PACE are left behind, leaving just ordinary Ethernet.

Multimedia OS?

With ATM looming as the dominant network architecture in the not-too-distant future, the next logical step is to develop an OS that allows applications to take full advantage of it. This is what First Virtual Corp. (Santa Clara, CA) is advocating.

FVC's Multimedia Operating Software is middleware that enables Windows applications to run over ATM. MOS runs invisibly under the application layer and above the network layer (see the figure "Middleware Simplifies Networked Multimedia" on page 80), bridging the gap between ATM and Microsoft Windows. Unlike other ATM solutions, which rely solely on LAN emulation, MOS brings ATM QoS directly to applications (resulting in high-quality voice, video, text, and images on the desktop) while leveraging the inherent management, security, and authentication features of the existing network OS (NOS).

Users running ATM-attached PCs still run the same applications and access the LAN server as before, except they can also run network multimedia. MOS automatically handles QoS, based on the type of traffic. MOS has predetermined delay and bandwidth parameters for applications according to their bandwidth and delay needs. For example, MPEG traffic gets

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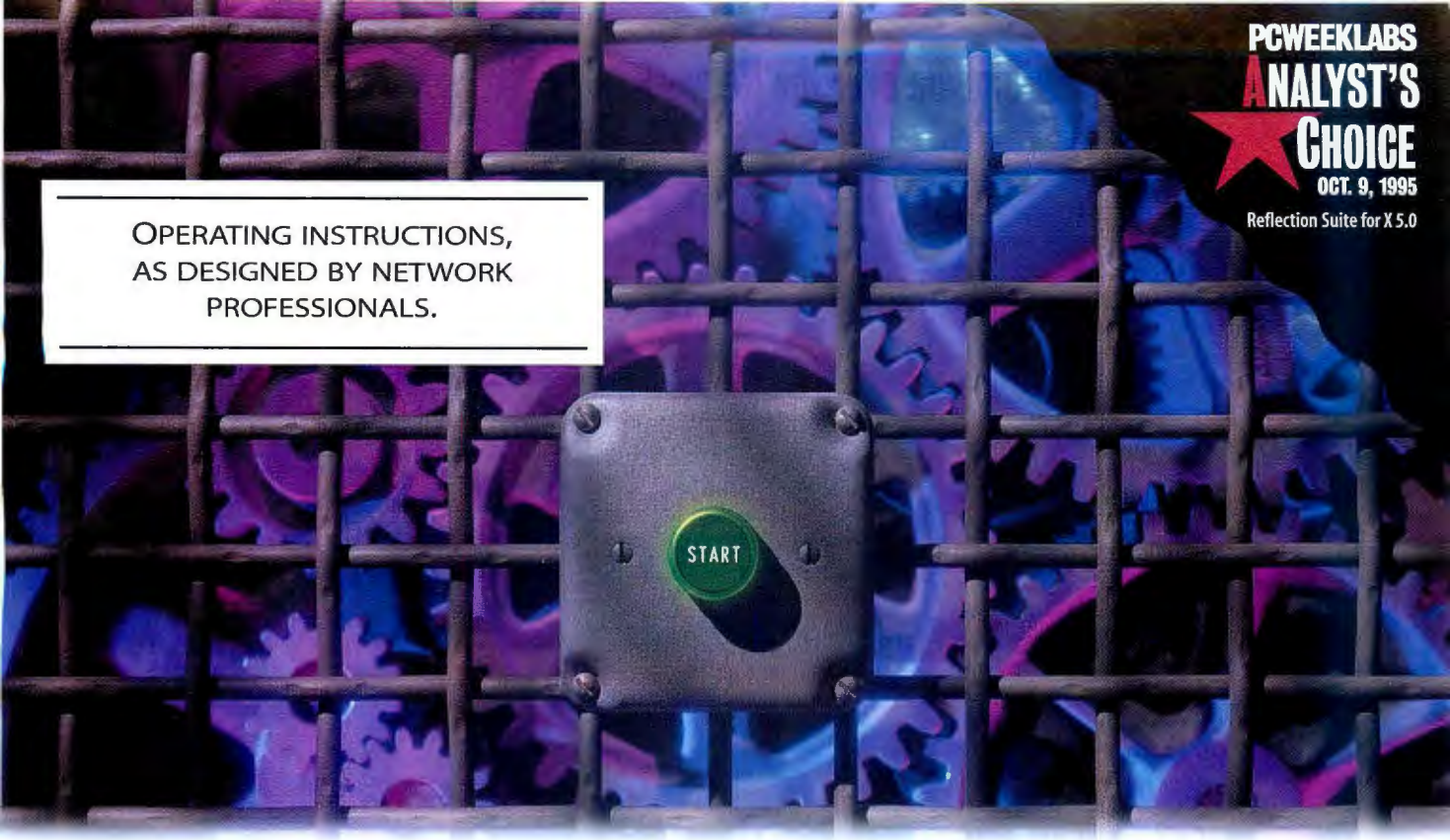

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1.5 Mbps of bandwidth, while an audio file gets 5 Mbps. H.320-based videoconferencing gets 384 Kbps, with a delay of 200 to 300 ms. All these services—including applications running over TCP/IP, IPX, and NetBIOS—can be delivered with guaranteed end-to-end quality using the existing desktop wiring infrastructure.

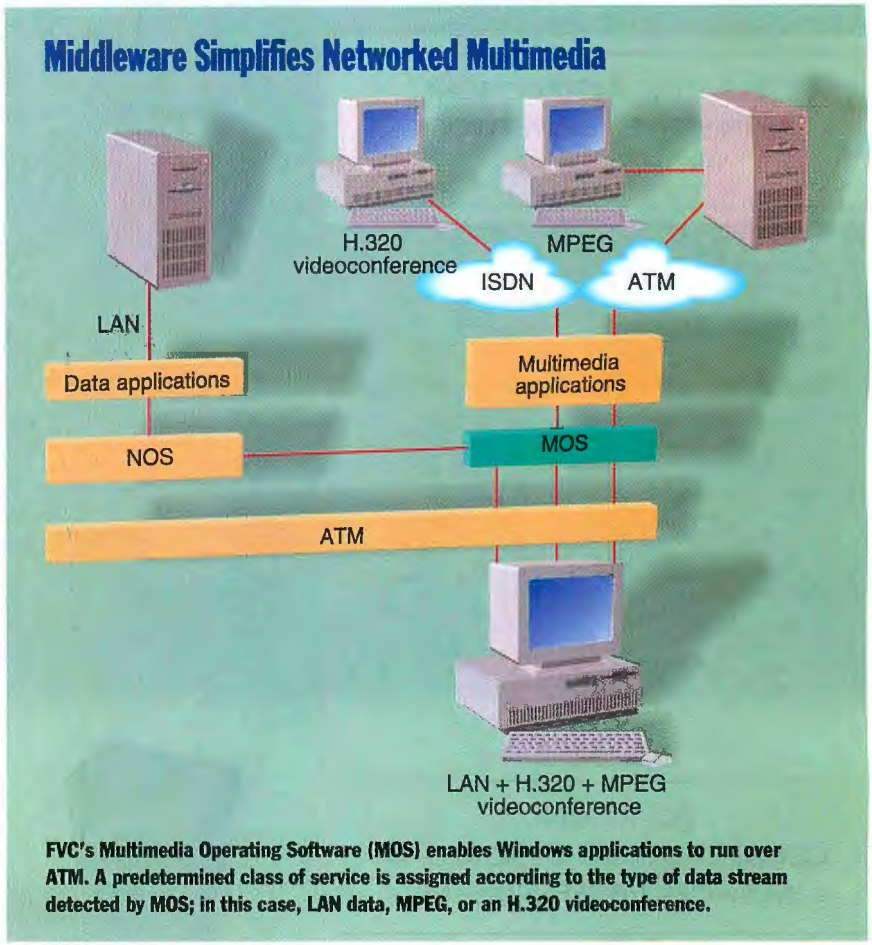
To implement videoconferencing, each PC must be equipped with a 25-Mbps ATM adapter with a direct connection to an H.320-based codec interface board. FVC's H.320-compliant Media Gateway Server (MGS) connects local ATM workgroups to remote sites via ISDN for videoconferencing across the WAN.

MGS is an integrated hardware and software package that upgrades a PC to an ATM/ISDN gateway with Basic Rate Interface (BRI) or Primary Rate Interface (PRI) connections. You make your ISDN connection via MGS, which initiates external calls over the WAN through ISDN's Q.931 call-setup and management-signaling protocol.

Videoconferencing PCs communicate with each other or with the gateway via a 25-Mbps ATM connection to FVC's Media Switch. The ATM adapter and MOS provide ISDN redirection, setting up calls from one computer to another for videoconferencing.

The portion of MOS that resides on the PC sits between the applications and the LAN-emulation software, where it sets up real-time calls for voice, video, and audio. The software redirects Windows applications' real-time data streams from the local drive to a destination across the ATM network. In essence, this redirection spoofs applications into thinking they're executing locally.

When a DOS or Windows program requests a file, MOS consults a map to determine whether the file is stored on the LAN server or on the media server. If it's stored on the LAN server, the request goes through the appropriate protocol stack normally. The LAN-emulation software on the adapter sets up an ATM call to the LAN server and segments the IP or IPX packets into 53-byte cells and sends them off. At the other end of the connection, the ATM-to-Ethernet adapter located at the remote port of the switch performs cell-to-packet resassembly and then passes the packets on to the local LAN server.



FVC's Multimedia Operating Software (MOS) enables Windows applications to run over ATM. A predetermined class of service is assigned according to the type of data stream detected by MOS; in this case, LAN data, MPEG, or an H.320 videoconference.

When the client requests a file that's stored on the media server, MOS sets up an ATM call and passes the request along to it. A component of MOS also resides on the media server, where its primary function is to handle client requests and retrieve data. At the core of this MOS component is a real-time kernel called the ATMOS, which performs call scheduling. This function enables the server to support up to 80 users simultaneously.

Do We Go to ATM from Here?

With the technologies, standards, and products for delivering multimedia solutions rapidly falling into place, ATM looks like the long-term winner. Technologies such as isochronous Ethernet and PACE are viable solutions designed to fulfill emerging requirements for the isochronous bandwidth required by multimedia applications without forcing too much change to existing networks. However, the extent to which ATM is finally accepted—and within what time frame—are topics of continuing debate.

While many industry analysts have pegged the time frame for widespread deployment of ATM at 3 to 5 years, Mike Sodergren, National Semiconductor's director of strategic marketing, offers a contrary view. Although he is highly supportive of the technology, based on the present course of events, he projects a 10-year scenario for ATM deployment.

According to Sodergren, ATM appears to be technology-focused instead of application-focused, with vendors offering various upgrades of voice, video, and data networks on a stand-alone basis. There doesn't seem to be a concerted effort in the industry to address QoS issues and the convergence of voice and data or to extend the massive investment in existing infrastructure.

"Until these things occur," says Sodergren, "lots of money will be spent without delivering to end users anything tangible in the networked enterprise. This accounts for the emphasis on isoEthernet, which blends wide bandwidth—Nx56/64-Kbps ISDN and Ethernet—in their native forms and offers future support for ATM for an integrated voice/data solution."

Sridhar Krishnaswamy, a senior architect at MCI's Intelligent Network Group,

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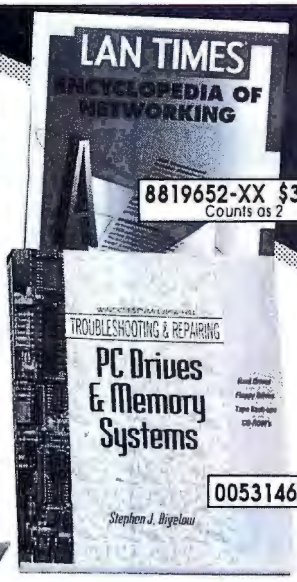

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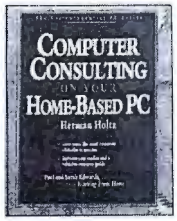

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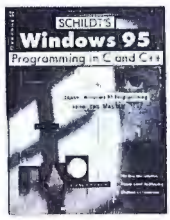

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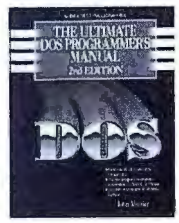

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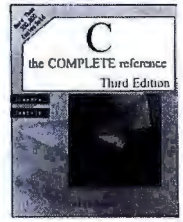

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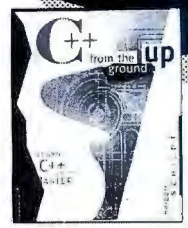

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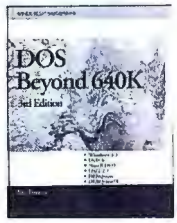

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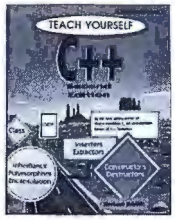

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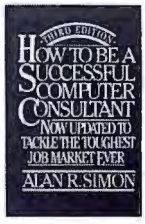

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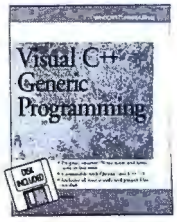

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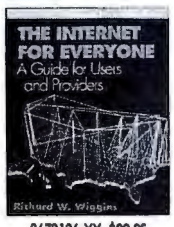

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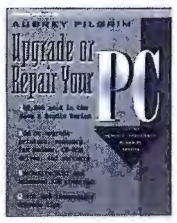

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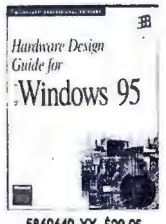

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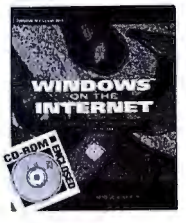

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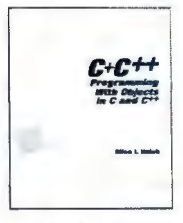

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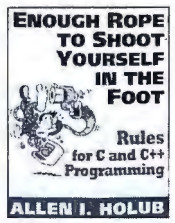

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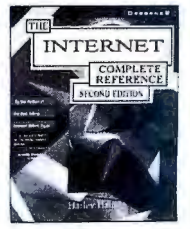

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notes that there are no new requirements that carriers have to meet for isochronous Ethernet. According to Krishnaswamy, "The carriers already support ISDN for high-quality isochronous transmission over digital circuits and employ Q.931 signaling for fast call setup. ATM, on the other hand, requires that major changes and additions be made to the network infrastructure. When it comes to developing and deploying multimedia applications, it would seem that isochronous-Ethernet-based solutions would be easier than those that require ATM end-to-end."

Two other developments support these views. The ATM Forum recently abandoned its plan to develop an API for ATM, making it unlikely that a single, commonly accepted interface for ATM applications will emerge anytime soon. In addition, the IEEE 802.9 working group will be asked in March to take up the development of a standard for a 100-Mbps version of isochronous Ethernet. This would not only elevate isochronous Ethernet into the "long-term solutions" category for multimedia applications but could put a chokehold on ATM.

As you can see, ATM will not be the ultimate solution that satisfies the needs of every organization or situation. In a way, that could be beneficial. It means there's no need to hold off deployment of multimedia applications until something like ATM becomes more widely available.

Of course, it also means that since ATM is not the nirvana that will satisfy all multimedia-delivery problems, managers will still have to use a combination of technologies to ensure the timely delivery of multimedia data streams over their corporate networks.

Fortunately, the combination of data-link and network-layer technologies, such as isochronous Ethernet and PACE, combined with OSes that take advantage of higher-layer services (like the QoS offered with ATM and ISDN), should give most companies enough leeway to design a total system for carrying their multimedia traffic. ■

Nathan J. Muller is a writer and author who lives in Huntsville, Alabama. He has written over 800 technical articles and 11 books on a variety of computer, communications, and management topics. Among his latest books is The Guide to Network Planning, Procurement and Management *(McGraw-Hill, 1996). He can be contacted on the Internet at nmuller@ddx.com or on BIX c/o "editors."*

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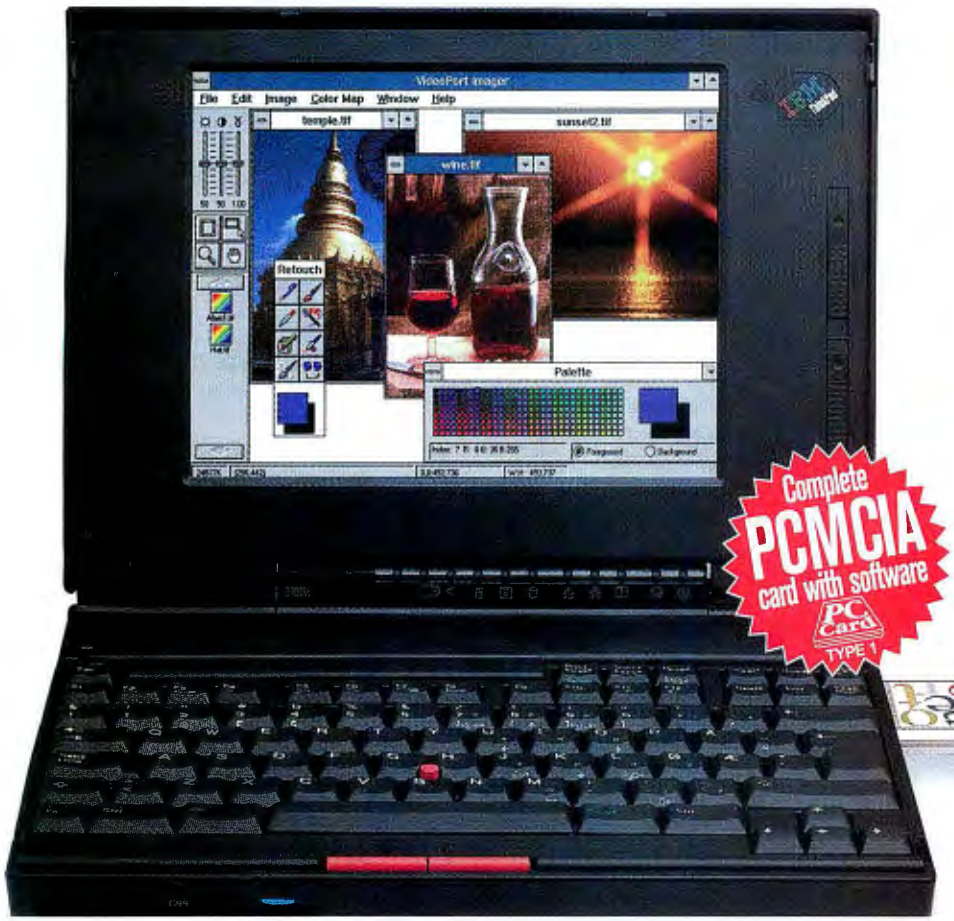

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LEARN THE LINGO

Whether you need a presentation program or an authoring toolkit depends on the type of project

ROBERT A. DELROSSI

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You stand poised at the edge of a 10-foot-long flexible board 50 feet above the pool. The water looks cold. And hard. People are behind you on the ladder, yelling for you to get going. You have two choices: Jump or figure out how to climb back down through all those people. You jump.

Now imagine that the water is multimedia development. The situation is still intimidating. The benefits of multimedia to education and recreation are innumerable. Nearly every personal computer sold today is multimedia-capable. Either you jump into the future, or you climb down and fight your way into the past.

Really, the only question is *how* you are going to jump. We're going to make your landing softer by describing the top multimedia-development tools, from simple to super, and some of the financial pitfalls you should watch out for.

From Presentation to Authoring

There are different tools for the different types of multimedia development (see "The Right Tool for the Job" on page 90). Simple, easy-to-learn tools include presentation-graphics programs, such as Adobe's Persuasion, Lotus's Freelance, Microsoft's PowerPoint, Gold Disk's Astound, and Asymetrix's Compel.

Such programs let you incorporate audio tracks and video clips into each frame of a presentation. When a frame displaying the company's logo appears, for example, the appropriate music plays simultaneously in the background.

The nice thing about these programs is that they are fairly easy to use. Typically, they include built-in audio and video players. And they include animation features so you can control when and where on the screen text or images appear.

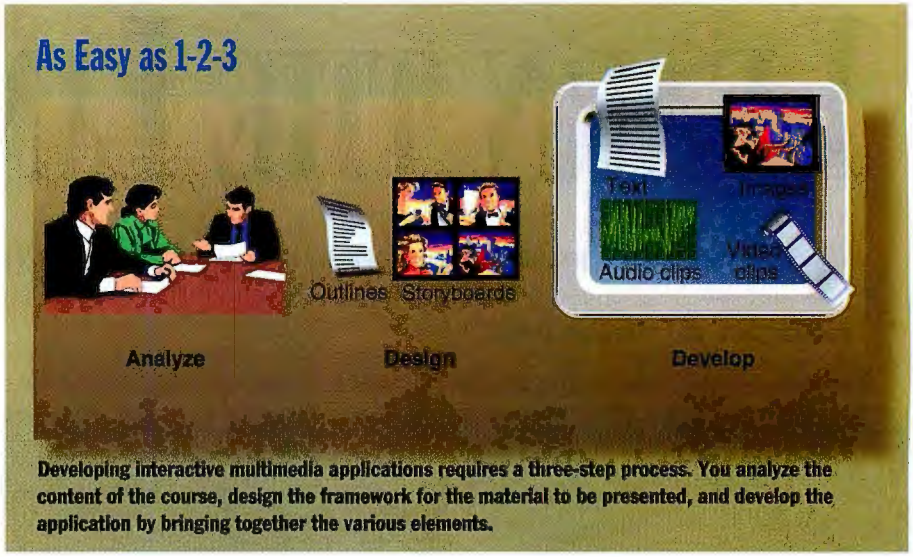
The downside is that these types of programs are limited when it comes to the type of multimedia presentations they help

you assemble. Basically, you can embed an object, such as an audio or video clip, within a single presentation frame, or you can give the appearance of animation by looping frames one after another. You can have an item in a frame—such as a bar in a graph that represents sales data—grow or shrink by playing successive frames with different-size bars.

Slightly more sophisticated are tools such as Stirling Technologies' DemoShield and HSC Software's InterActive. Like a presentation tool, they don't use a scripting language. Instead, they enable you to achieve much the same effect using menus, buttons, and dialog boxes. The advantage is that you don't have to learn a scripting language. The disadvantage is that the interface to achieve some effects can be obtuse, with references buried under several layers of menus or dialog boxes.

To develop truer animation and interactive presentations, you have to work with more powerful multimedia development tools. The most common higher-end programs include Macromedia's two products, Authorware and Director, and Allen Communication's Quest.

The general approach to constructing multimedia programs using these tools involves dragging content icons from a palette onto a *flowline* (see "Minimal Assembly Required" on page 88). The flowline is basically a timeline of events in your presentation. It determines the sequence in which different events will happen and includes such things as branching and loopbacks. The icons are objects for text, graphics, sound, and video.



Developing interactive multimedia applications requires a three-step process. You analyze the content of the course, design the framework for the material to be presented, and develop the application by bringing together the various elements.

You run the sequence to see if the presentation is working as you planned. You can put empty icons in place when developing the application, which enables you to develop a presentation before all the elements are available. For instance, you may be creating an interactive training program but have not yet filmed all the scenarios. Once you've finished developing the presentation, you generate a run-time version that is a stand-alone program for end-users.

That's the general method. Each of these higher-level tools takes its own approach to actually creating an application.

Macromedia's Authorware is probably the best-known of these tools. Macromedia originally designed it for creating interactive training and educational programs. The software uses an icon-based design approach that reduces the amount of manual scripting you need to do. The icons link to Authorware flowlines that show how the information moves and how different elements relate to one another.

By dragging different kinds of icons on to the flowline, you can arrange the various pieces of the presentation. You then customize what the icons do by clicking on them and changing their properties. For example, an icon that represents a picture will need the name of the picture file to display. One that plays music needs to know the name of the sound file, along with characteristics such as the speed at which you want the music to play and whether it should run once or continuously. The latest version, Authorware Professional 3.0, has a new framework icon that serves as a template, so you can specify that particular elements appear on every frame.

Asymetrix Multimedia Toolbook's approach is slightly different, relying instead on a book metaphor, where each page represents a slide in the finished product. On to each page you can drop the various objects that make up your presentation. Like Authorware, Multimedia Toolbook provides ways for you to include synchronized music, sound effects, and video. But unlike Authorware, Multimedia Toolbook has a simple programming language. To program in Authorware, you use specialized programming icons that you add to the timeline. Both packages offer a series of adjunct tools for modifying and otherwise refining the various source elements

CBT EXPERIENCE

Perhaps more than any other, it is the world of computer-based training (CBT) that has best seized upon the opportunities offered by multimedia. Just ask Robert Blalock, director of Technologies Research for the World Tutor Group (Fort Worth, TX).

World Tutor Group has an interesting heritage. It is the multimedia training arm of AMR Training Group. AMR, in turn, owns American Airlines. It was at the airline that the Group got its start. Faced with a mandate to train 30 percent more employees each year at no additional cost, WTG turned to CBT for relief. That was six years ago, when the state of the art for multimedia development was primitive compared to the software you can use today.

The development tool WTG used in 1990 was based on a C-like programming language. Creating materials with it, Blalock explains, required not only a specialist who knew the material to teach, but a programmer as well. So WTG set about finding software that could leverage the knowledge of its specialists in a way that empowered them to design some of the training products themselves.

WTG chose Macromedia's Authorware, one of several high-end tools for developing computer-based presentations that mix and match all types of media sources. Tools like Authorware and Asymetrix's Multimedia Toolbook make it possible to design screens that present text or graphics and let you add the punch of synchronized sound, animation, and video.

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that go into your multimedia presentation.

Allen Communication's Quest Multimedia Authoring System has a slightly different user interface. Like Authorware, it uses a timeline with content icons, but it also provides wizards that prompt you through the design process. An add-on product, Designer's Edge, helps developers who are new to multimedia authoring. Designer's Edge includes a set of wizards and built-in expert advice. Users we spoke with said they've found the Allen software particularly good for developing instructional programs.

Let's stop to consider some authoring tools of a different type. Visual Basic and V-Graph's O-Zone are examples of development environments that enable you to design content with OLE or OpenDoc and multimedia extensions. In other words, component-based multimedia development. With this kind of environment, you'll typically have a separate module for each multimedia function (i.e., video playback and audio playback will be separate modules, like OCXes) and you set the properties of these modules for each multimedia object (e.g., video or audio clip). The advantage to this kind of development, especially with a general-purpose tool, is versatility: You aren't limited to developing just multimedia applications.

The capability to program—no matter how you do it—is an essential element of multimedia tools and differentiates them from simpler business presentation packages such as Microsoft PowerPoint. Programmability is also the key to computer-based training (CBT) applications, which often must deliver not only course material but testing material, too. Powerful LAN-based CBT applications can present and grade tests right away, giving the user immediate feedback. They can also package the results and send them to a test administrator straightaway. What's more, administrators can monitor how far a student has progressed through the course material.

Minimal Assembly Required

Multimedia development tools like Quest let you pull content together by simply dragging icons of the various elements onto a frame.

The Future of Multimedia

Most people in the multimedia business agree with World Tutor Group's Robert Blalock (see "CBT Experience" on page 86) that the multimedia industry still has a big future. With increasing acceptance and demand, and better and faster computers, the tools for delivering high-quality multimedia presentations will improve, too.

One area that will change is the way multimedia is distributed. The Internet will be an explosive distribution tool for multimedia presentations, agrees Kevin Ellis, product marketing associate for Macromedia Director. With Director and an add-

KNOW THE PRICE

Though the tools for building multimedia applications are easier and more powerful to use than ever, prices can still be high. Besides the cost of the necessary software to develop a presentation, there is the issue of the hardware required to run the presentations you make. Fortunately, most multimedia software no longer requires royalties to the vendor, though you should check with the developer of the product you are using.

Since multimedia presentations often include large clips of video or animation, they tend to grow quite large. Distribution on CD-ROM is not uncommon for all but the most trivial applications, meaning development teams will need burners for creating distributable copies. For bulk copies, look to outside firms to handle duplications inexpensively.

A bigger cost you have to consider is that of developing the content itself, says Robert Blalock, director of Technologies Research at World Tutor Group. If, like WTG, you would like to develop computer-based training (CBT) material for your company, Blalock recommends finding a strategic partner, one that uses CBT itself as well as develops it for others. Especially for a first project, Blalock explains, "the magic behind success is not the computer but the rigorous design phase that precedes the project." Developing a coherent plan for any presentation, whether it's a pitch to a potential client or something as complex as a full CBT curriculum, can require extensive planning.

Yet another cost is associated with the materials you use for the content of your presentation or courseware. Some music, pictures, and video clips, for example, are copyrighted, meaning that you may have to pay royalties to their creator. This can be true even if you download the content from systems like CompuServe or America Online. You cannot simply assume that you can use someone else's material for free.

What's more, studies on multimedia development show it can take hundreds of person-hours to develop just one good hour of training material. Nevertheless, the payoff can be big in terms of savings over traditional instructional methods. But there's more to it, Blalock argues. Good CBT programs, he says, can actually be more effective, and cost-effective, than traditional training. And often users like them, too, embracing the idea of working at their own pace and having the flexibility to review at their leisure.

Even if you're not building training programs, using multimedia effectively even for simple business presentations can take time and practice. There are lessons from the desktop publishing craze of six or seven years ago that today's multimedia developers should study. Back then, companies spent thousands of dollars equipping PCs to handle resource-hungry DTP programs. Thousands more went toward high-quality output devices like color printers. The results were often little more than very expensive, garish documents.

Over time, of course, most desktop publishers developed design discipline as they learned what works and what doesn't. It's likely that today's multimedia-development neophytes will travel a similar costly road to success.

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on tool called Shockwave for Director, Ellis explains, developers can create multimedia objects that you can view on a World Wide Web page. Unlike the traditional multimedia distribution medium, CD-ROM, Web pages are far easier to customize and update.

Some progressive companies have already adopted multimedia strategies for advertising and attracting new customers. Multimedia catalogs of clothing and cars, for example, are already available. Online and CD-ROM-based magazines are out there, too.

Blalock says he expects the typical CBT program of the future will be smarter, evolving into an electronic performance support system (EPSS). An EPSS carries the utility of training software to new heights by tightly integrating with the application it is teaching you to use. With a well-designed EPSS, just about anyone should be able to sit down at an airline reservation terminal, for example, and step through the process of booking a flight. As your expertise grows, the system grows with you, watching how you work and suggesting ways to do things more efficiently. When the learning load is light, the user can start training on new materials or reviewing his job skills.

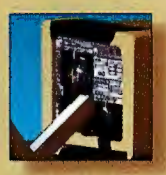
With the continued growth in the multimedia market, it's a good time to learn what it will take for you to add multimedia to what you do. Look into the software, know the costs, think about a strategic partner for your first big venture, and then get ready to make a big virtual splash. ■

Until recently, Robert A. DelRossi was director of technology for Boston-based Liberty Real Estate Group, Inc. His articles have appeared in several magazines. You can reach him by sending E-mail to 71510.1726@compuserve.com.

The Right Tool for the Job

TOOLS	PROS	CONS
Adobe Persuasion, Microsoft PowerPoint, Lotus Freelance	Easy to use; built-in media players for audio and video clips.	Limited functions allow development only of simple applications.
Stirling Technologies' DemoShield and HSC Software's InterActive	Geared to more sophisticated presentations; use buttons, menus, and dialog boxes to create presentations.	Interface sometimes too cluttered for power users.
Macromedia's Authorware and Director, and Allen Communication's Quest	Offer high-end features including scripting, built-in video editing, and use of C and C++ programming to develop applications.	Not for all users; require developer to have a certain level of sophistication.

INFORMATION, PLEASE



Multimedia is great for information kiosks. These interactive stations present information in a visually attractive way, sometimes using sound as well. A hotel, for example, could have a kiosk application that takes guests on a virtual tour of the property.

Tools like Macromedia's Authorware and Asymetrix's Multimedia Toolbook can generate applications that recognize "hot spots," so guests can touch the screen to punch up details on nearby attractions. The kiosk simply interprets the selections and branches to the part of the presentation that addresses the guest's request. TourGuide from American Training International goes one step further. It enables you to update a kiosk's software over a modem, making it easier to keep the application up to date. Just as voice mail hasn't replaced operators and office assistants, a kiosk is not likely to replace a hotel concierge, but it can address a guest's questions at all hours of the day or night.

Product Information

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Adobe Systems, Inc.
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(415) 961-4400
fax: (415) 961-3769
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Astound! for Windows . $250
Gold Disk, Inc.
Santa Clara, CA
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(408) 982-0200
fax: (408) 982-0298
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Authorware Professional for Windows $4995
Macromedia, Inc.
San Francisco, CA
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(415) 252-2000
fax: (415) 626-0554
http://www.macromedia.com
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Compel $295
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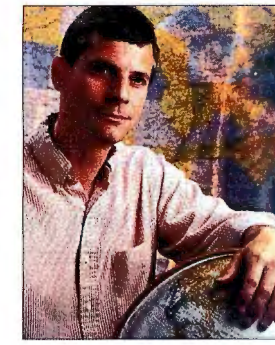
JON UDELL



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Lessons learned from The BYTE Site's first major redesign

During Fall Comdex we unveiled the first major redesign of The BYTE Site. Does it appeal to your sense of form and function? That's for you to decide, but either way, the lessons we learned might be useful to you. Our goal was to improve the look and feel of the site—easy to say, hard to do. Here are the six rules that guided us.

RULE 1:
Map the Site on Every Page

Like Ptolemaic minds at the dawn of the Copernican revolution, Web users often feel rootless and disoriented. Your own web, if it's woven to a consistent pattern, can offer comfort. We map The BYTE Site with a standard header made of a row of buttons that link to the site's main areas. Below that, we include the page's title, preceded by an icon that matches one of the buttons. The row of buttons is a standard device that says, "You can go to these places." The matching title adds an important fact that many sites omit. It says, "You are here."

Another way to achieve the same effect might be to show the button for the current area in an alternate, "pushed-in" state. That approach would eliminate the need to echo the area's icon in every title but would violate the semantics of buttons. On our site, clicking on an area's header button means, "Go to the root page of that area." If you're already deep inside that area, clicking on the header button produces the same action—bouncing you to the area's root—without changing the button's state. That classic user-interface no-no leads to Rule 2.

RULE 2:
Be Consistent

To achieve a consistent look, a Web site must appeal to the ancient traditions of publishing. Tables of contents and chapter heads remain as useful as they were in Gutenberg's day. But to achieve a consistent feel, a site must also embrace the modern traditions of interactive software. Whatever looks like a button should also act like one. Whatever doesn't, shouldn't.

Without a high level of automation, however, this kind of consistency is a luxury you simply can't afford. Life's too short to edit hundreds or thousands of Hypertext Markup Language (HTML) pages by hand, much less reedit them when you decide to reorganize your buttons. Our homegrown HTML generator solves that problem for the BYTE archive, which contains 99 percent of the site's 5000 pages. But standardizing the last 1 percent—a few dozen handcrafted and highly visible pages—became a burden.

One solution to standardizing the last 1 percent, called the *server-side include*, entails marking the places in your HTML files where the Web server should insert boilerplate text as it sends the files to browsers. Another solution, and the one I favor, also requires marking where to insert boilerplates, but instead it relies on a preprocessor to do the insertion. I prefer to use this method because not all Web servers support on-the-fly inclusion and because

Using small icons as data-type cues: Small icons that serve as list bullets can define the types of the list elements (above). They can also define the sources of data on a search-results page (below).

Tabbed indexes in HTML: Repeat a row of text links, varying the position of a single "dead link" to mark the location of the current page. We use this technique to manage a series of text boxes in an article (above) and to present views of vpr (below).

Intel Cyrix AMD **NexGen** DEC Mips Sun HP PowerPC

Next generation: Nx686

Dossier: Little is known about the Nx686, because the chip hasn't been announced yet and NexGen doesn't want to tip its hand to rivals AMD, Cyrix,

1 A B C D E F G H I J **K** L M N O P Q R S T U V W X Y Z

VPR KeySteps, Avening, Glos, GL8 8NT, UK, Fast use of new software, 95-10-20
VPR Kids Count Entertainment, Inc., Jack's House Special Edition CD-ROM, 95-11-06
VPR Kyocera Electronics, Inc., FS-1600A MAC printer bundle, 95-11-01

they already have enough work to do.

Our preprocessor is a Perl script (see http://www.byte.com/art/netcol/netproj.htm) that replaces what's between this pair of HTML comments:

```
<!- begin stdhdr ->
<!- end stdhdr ->
```

with boilerplate. It also expects a title—of the form `<h1><img src...`—and standardizes the border, alignment, and spacing applied to the title's icon. To use this system you have to enumerate the set of files it manages in another script, which doubles as an inventory list for the non-automatically generated part of the site.

RULE 3:
Use Small, Discrete Images

Small GIFs that introduce elements of bulleted lists, a common decorative enhancement, can also play a key functional role. Our table-of-contents pages use them to document relationships among articles, text boxes, figures, photos, and tables (see the figure on page 91). Our search-results page uses them to distinguish between two types of data—BYTE articles and vendor-supplied press releases—drawn from different areas of the site. These small GIFs load quickly and, once cached, reload instantly. Deployed consistently, they can create visual patterns that map underlying structures of data.

Full-screen image maps, on the other hand, are a disaster. Putting one of these on your home page invites entry yet repels it with a force inversely proportional to the speed of the visitor's link.

Bandwidth aside, the image map is a questionable device because it violates another convention of software behavior. In a hyperlinked environment, users rely on interactive feedback to distinguish among the sensitive regions of the screen. When you point to a textual or graphical link, your browser reacts with two kinds of feedback: It changes the cursor, and it reports the name of the link destination.

When you point to a spot on an image map, the cursor changes, but the browser can report only coordinates on the image map, not the link target that those coordinates imply. Some image maps delineate hot spots more clearly than others, but there's no getting around the absence of the crucial feedback that confirms transition from one hot spot to another. This glitch affects both the user-hostile full-screen image map and its friendlier cousin, the banner image map that appears in the header or footer position on many sites' pages.

What to do? The BYTE Site avoids image maps entirely; when we use images as links, each image refers unambiguously to a single link target. If we were to switch from the row of buttons to a banner style, we'd build the banner out of a series of discrete chunks.

There's yet another solution at hand: *client-side image maps*. With this technique, HTML tags define particular regions of an image and explicitly associate those regions with link targets. But while Netscape Navigator 2.0 and the Microsoft Internet Explorer both support this feature, the majority of the browsers visiting our site don't, yet.

RULE 4:
Create "Tabbed" Indexes

I've found a nifty way to emulate index tabs in HTML. We use this technique to manage a series of text boxes in an article (e.g., http://www.byte.com/art/special/9511sota/506023a.htm) and to index the company, product, and date views of the Virtual Press Room (`vpr`) (e.g., http://www.byte.com/vpr/compall1.htm). The device uses a repeating row of textual links that map a series of pages (or regions within a page). When you click on one of these links, it goes dead—that is, it becomes unhighlighted (and preferably font-enhanced) to announce, "You are here."

You can achieve this effect by hand for a small series, but the HTML coding is tedious. For `vpr`, I use a Perl script (http://www.byte.com/art/netcol/netproj.htm) to iterate over lists of index items—either letters of the alphabet or dates—and generate the necessary HTML.

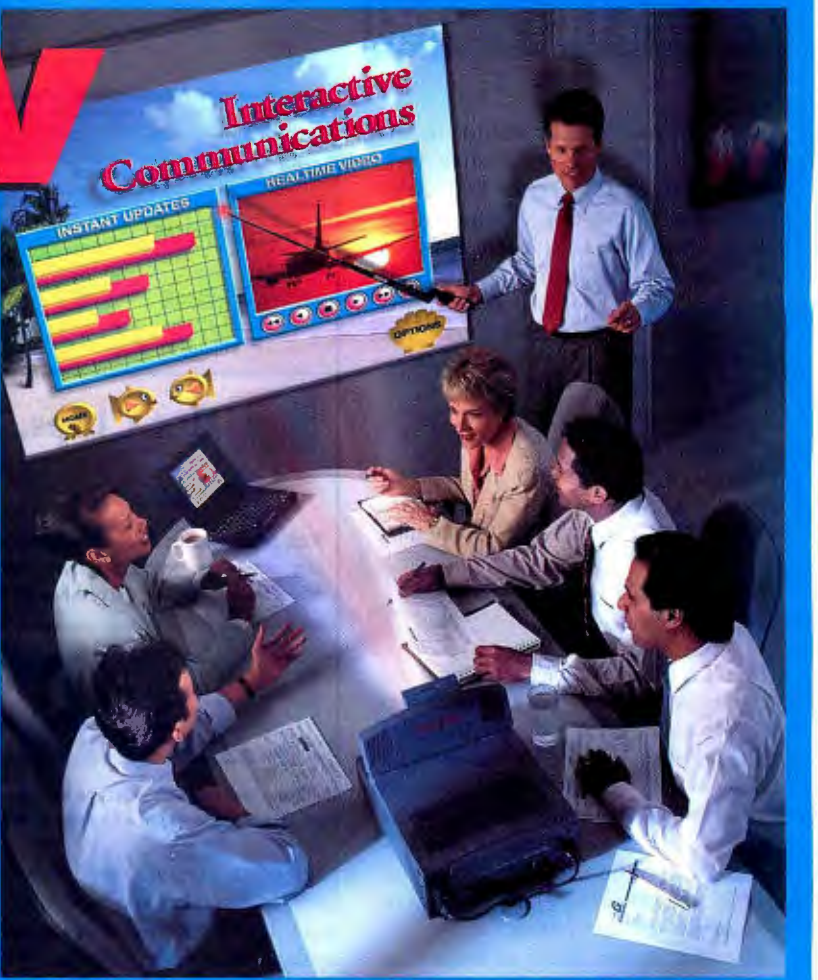
RULE 5:
Create Many Paths to Information

Each row of index tabs in a `vpr` view also carries an iconic link to a search screen. That's one of the ways in which The BYTE Site maximizes its internal interconnectedness. Here's another: On table-of-contents pages in the archive, references to figures and tables link to the locations in articles where these elements appear. Other links to these same elements occur in the text of the articles.

Why duplicate them? Magazine designers are always looking for ways to provide "multiple entry points" to information. On the Web you can literally do that.

continued

HOW TO KEEP YOUR AUDI-ENCE



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As usual, you need automation to implement this rule in a cost-effective manner. It was easy to make the Perl script that builds vpr views tack an iconic search link onto each row. For the table-of-contents links to elements inside articles, it was a bit trickier. The Epsilon Extension Language (EEL) program that generates the table-of-contents pages has to scan articles for link targets of the form

```
<a name=linktarget>
<h3>Title</h3>
```

and build matching link sources like this:

```
<a href=pathname#linktarget>
  Title</a>
```

Here's another example: an uplink from each table-of-contents page to its parent (the Web equivalent of `cd ..`). Initially I omitted these, relying on the native backtracking ability of browsers. If you start on the archive's main page and follow the path August 1995 -> News and Views -> Apple's New Multimedia Macs, you can climb back up the tree by clicking on your browser's "Go back" button.

But what if you arrive at the article "Apple's New Multimedia Macs" by way of a search, either from the BYTE search page or an external one? Now the "Go back" button takes you back to that search page. There's no easy way to explore the context surrounding "Apple's New Multimedia Macs"—that is, the other August 1995 News & Views articles. An uplink on every table-of-contents page supplies the crucial missing path.

Multipane browsing with Netscape Navigator 2.0 frames: With this exciting HTML extension you can consolidate large sets of pages—here a whole issue of BYTE—into a single multipane browser.

Rule 6: Degrade Gracefully

The tabbed indexes in vpr views rely on two visual cues to focus attention on the current tab: font enlargement and absence of highlighting. If your browser doesn't support the nonstandard `<font>` tag, the effect diminishes but still works. This is an example of graceful degradation. Other advanced HTML features, notably tables, degrade disastrously when they are viewed via Lynx or a first-generation GUI browser. For that reason, we use tables sparingly.

How much do you care about less-capable browsers? That's your call. Knowing how many Lynx or Mosaic 1.x users visit your site (see "Damn Lies," February BYTE, to learn how to collect that information) helps you to scope the problem. But remember that even a small share of the Web population can represent a lot of people. For example, the 3 percent of our visitors who use Lynx form a group that is 3500 strong—and growing. And some of those visitors, I was recently reminded, are blind.

To serve up tabular data to the full spectrum of browsers, the ultimate solution starts with cell-tagged data—in HTML or any other format that fully specifies rows and columns. Then it mechanically derives a plain, ASCII-formatted version. Finally, it delivers either the rich or plain version according to the capabilities of each incoming browser. I commend sites that do this. Ours doesn't—yet.

Practice What You Preach

As I wrote these rules, I found our site guilty of several violations. Buttons didn't always behave as buttons should (see Rule 2); archive pages didn't offer redundant access to the search function (Rule 5); and some graphical links lacked text alternates for Lynx users (Rule 6).

As I correct these flaws, I'm exploring the design opportunities—and the challenges—of Netscape Navigator 2.0. Using its `<frameset>` tag, I have prototyped a Smalltalk-style article viewer (see the figure above) that promises to vastly enrich navigation of the archive.

How will my six design rules play out in this environment? Beats me; I only know that somehow they must. Watch the site and let me know what you think. ■

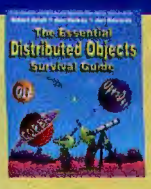
Jon Udell is BYTE's executive editor for new media. You can reach him on the Internet or BIX at judell@bix.com.

Toolwatch

MHonArc
(http://www.oac.uci.edu/indiv/ehood/mhonarc.html)

Point Earl Hood's masterful Perl script at a file of E-mail messages in Unix format, and it creates a threaded HTML archive, complete with decoded MIME attachments. There are other excellent mail-to-HTML converters (e.g., Kevin Hughes' hypermail, http://www.eit.com/software/hypermail). MHonArc doubles as a great Perl tutorial.

Booknote



The Essential Distributed Objects Survival Guide, $29.95
by Robert Orfali, Dan Harkey, and Jeri Edwards
John Wiley and Sons, 1995
ISBN 0-471-12993-3

This worthy sequel to *The Essential Client/Server Survival Guide* explores two competing distributed-object architectures—CORBA and OLE/COM. The authors prefer CORBA, but they frame the debate in ways useful to anyone curious about the technical underpinnings of a global computing fabric.

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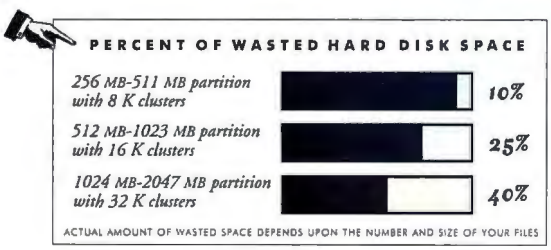

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Version 2.0

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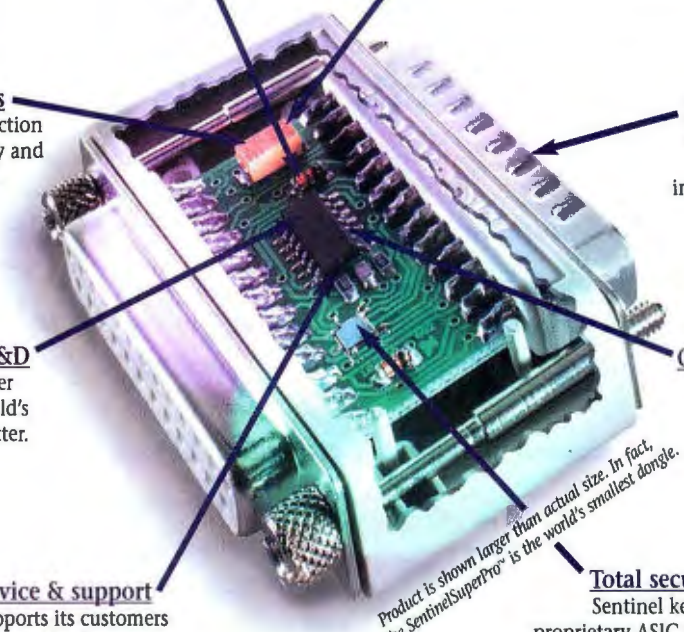

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BYTE EXTRA

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Applications Development

Edition

Track That Code

Configuration management packages keep big, sprawling development projects organized and manageable, even with multiple teams at multiple sites. PAGE 96DM 7

Net-Surfing with Notes

Want to have your cake and eat it, too? Here's how to use Notes as your Web development tool.

PAGE 96DM 13

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Pentium Performance Unlocked

A visual tool goes beyond profiling to provide instruction-level tuning tips for 486 or Pentium platforms

ROBERT L. HUMMEL

Rising user expectations of sizzling applications performance have put programmers back in the code-optimization hot seat. Fortunately, this doesn't mean you'll have to dust off your assembler. Intel has introduced VTune, a Windows-based visual-tuning environment for the x86 architecture.

The tool provides a visual display of the CPU resources being consumed by all active software on Windows 3.1 and Windows 95 systems. It identifies the sections of code that are using substantial CPU processing time, not only in the application being tuned, but in the OS and device drivers as well. Time spent in system and user modes and for 32-bit, 16-bit, and V86 applications is also displayed.

With VTune, you can identify and troubleshoot code hot spots. Double-clicking on a resource spike brings up the Hotspots window, a low-level view of the sections of code within that module. If you double-click again, the Source Viewer brings up your source code. The tool requires no source code changes. If source code isn't available, a built-in disassembler creates listings from object files.

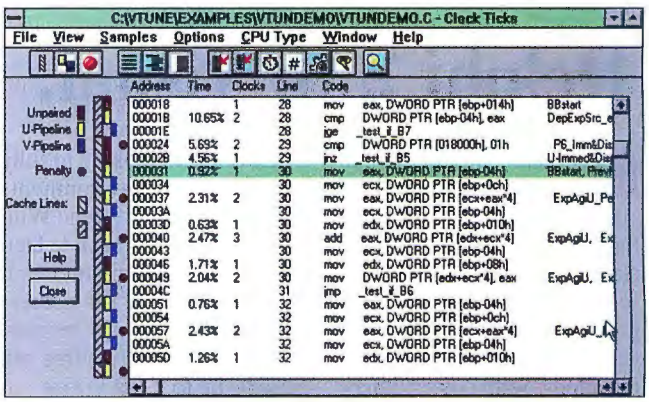
Regardless of the programming language, including assembly language, VTune displays the line numbers and percentage of CPU time spent executing each active code statement. VTune flags possible trouble, including instruction sequences that result in penalty conditions and poor instruction pairing.

VTune goes beyond simply reporting trouble. Context-sensitive tuning tips are available as on-line help. The program is language-independent and works with industry-standard compilers. But if you program in C, the C Tuning Coach identifies tuning opportunities in your source code and validates your current optimizations.

Improvements can be dramatic. "After two days of work with these tools, we were able to boost display performance [of our Windows application] 12 times higher," says Udi Noach, R&D Manager at Ampol Technologies, an Israeli company. "[VTune has] helped us detect precious idle system time that we could exploit."

Using the built-in scripting interface, you can perform automated performance analysis of all the software executing on your system.

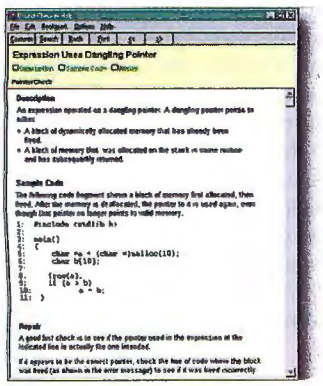
VTune supports 486 and Pentium processors. Intel plans support for the Pentium Pro (P6) processor.



VTune can display details of the Pentium's dual-pipeline architecture, showing actual instruction pairing and penalty information.

High-Tech Tool for Low-Down Bugs

The complexity of today's large applications seems destined to foil the attempt of even the most thorough development team to ship bug-free software. Seemingly small defects can ripple through a product, branding it with a reputation for being unreliable and bug-ridden. Ultimately, the cost of bugs to the developer and the company can far exceed their original impact.



Automatic testing of release candidates coupled with a large-scale beta-testing program will generally uncover a majority of the most common bugs. But what about those occasional bugs that occur only in odd configurations? Can you be sure you've gotten them all?

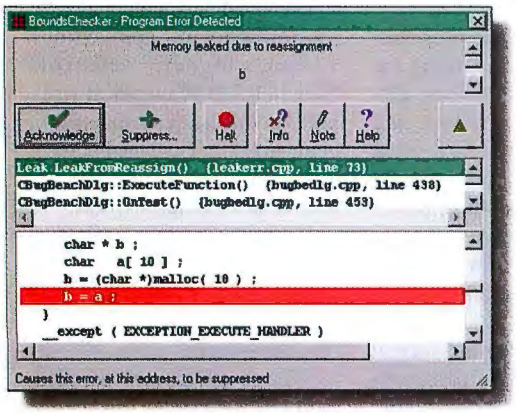
BoundsChecker Professional detects 72 types of Windows errors.

The cost of fixing bugs at a late stage of product development is high, requiring patches, updates, and technical support. The optimum and most cost-effective time to detect and correct bugs is as they're coded.

Well known for its Soft-ICE family of debugging products, NuMega recently announced a new edition of its BoundsChecker automated error-detection and analysis product for Windows 95 and Windows NT applications. BoundsChecker Professional automatically detects 72 categories of Windows errors—three times as many as the standard edition detects—while your program is running. These include dynamic memory overruns, resource leaks, pointer checks, and Windows API function failures. Along with flagging errors, the program provides comprehensive explanations and code examples of the errors, and instructions on how to correct them.

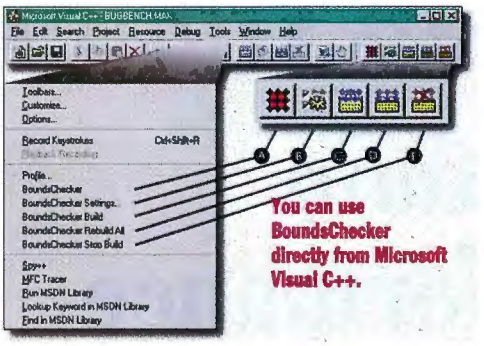
According to Jim Moskun, chairman of NuMega, "The

ability to 'check early, check often' will accelerate error detection and make it faster and easier to isolate and fix programming errors." NuMega claims that you can cut up to 20 percent of a project's development time by using BoundsChecker Professional to speed debugging.



Check early, often, and smartly. BoundsChecker's extensive help screens suggest bug fixes.

If you develop applications using Microsoft Visual C++, you can take advantage of BoundsChecker Professional without departing your integrated development environment (IDE). The program appears on the toolbar, in the pull-down menus, and as a folder tab. BoundsChecker Professional mimics the user interface of Visual C++, allowing you to use it as easily as the standard commands to build, run, and test your programs.



You can use BoundsChecker directly from Microsoft Visual C++.

The program also features NuMega's Compile-Time Integration technology, which enhances debugging while leaving your original source code unchanged. At compile time, BoundsChecker Professional automatically inserts error-checking code into your program, saving you hours of editing and recompiling and encouraging frequent bug-checking.

To meet the increased demand for software quality assurance, developers must assume a greater responsibility for thoroughly testing their code. With tools like BoundsChecker Professional, you can do so in a convenient and non-intrusive way.

—RLH

Delphi 2.0: Visual, Fast, and Now 32-bit

Borland's introduction of Delphi 2.0, the 32-bit version of its popular Windows rapid application development (RAD) tool, fans the flames of software's hottest tools category: visual applications development for client/server applications. With powerful new features, Delphi 2.0 deserves a close look from even the most dedicated users of Visual Basic 4.0 and other such tools.

OLE support in Delphi 2.0, for example, includes the ability to install and use OLE custom controls (OCXes) as well as create OLE automation controllers and servers. You can use the program to create both in-process and out-of-process servers. A 32-bit Delphi application can then control OLE applications.

Delphi automatically creates an object wrapper when you install an OCX, providing an object-oriented view of that control. This gives the programmer the ability to use existing third-party OCXes as well as the ability to customize OCXes through inheritance.

Developers looking to fully exploit 32-bit environments such as Windows 95 and Windows NT will appreciate Delphi's support for multithreading and its 32-bit flat address space. Arrays, strings, records, and other data structures can now be up to 2 GB in size.

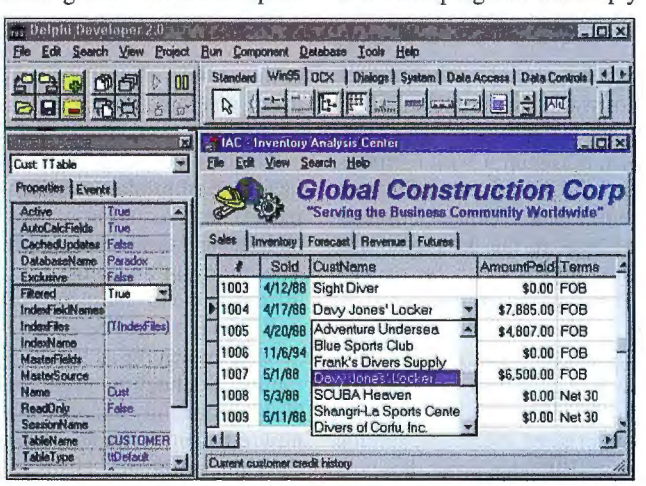
However, Delphi's most significant advantage over other environments, particularly Visual Basic, is its 32-bit optimizing native code compiler that capitalizes on the expertise developed for Borland's C++ compiler. Compiling offers developers some performance enhancements, including smaller EXE files, faster performance in code-bound applications, and the ability to share code using a common OBJ format.

Borland's advertising trumpets the fact that Delphi programs are compiled, while Visual Basic programs are simply interpreted p-code. Speed, says Lance Devin, who is the senior product manager for Delphi, is a critical advantage of Delphi. "In client/server applications," he notes, "people have an expectation that going to or from a server should be as fast as access on a local machine."

Christopher Flores, who is the director of technical marketing for Visual Basic, dismisses that claim. "Borland emphasizes compilation," he observes. "We say that [interpreting code] is not a bottleneck in client/server program operation."

Performance is an issue when you use these tools to develop enterprise and mission-critical applications. Delphi 2.0's compiler architecture offers easy access to important system features, such as multithreading, a flat-memory model, and OLE automation and controls. These features give developers a new way to maximize their development possibilities in such environments as Windows 95 and Windows NT.

—RLH



Delphi 2.0 supports OLE custom controls (OCXes) and 32-bit applications for Windows 95 and Windows NT.

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Industry standard BASIC language	Yes	Yes
Seamless scalability to Oracle 7 & SQL Server	Yes	No
Native Oracle 7 & SQL Server interfaces	Yes*	No
True object-oriented code reusability	Yes	No
OCX and OLE 2 support	Yes	Yes
Multiplatform: Windows, Macintosh, OS/2**	Yes	No

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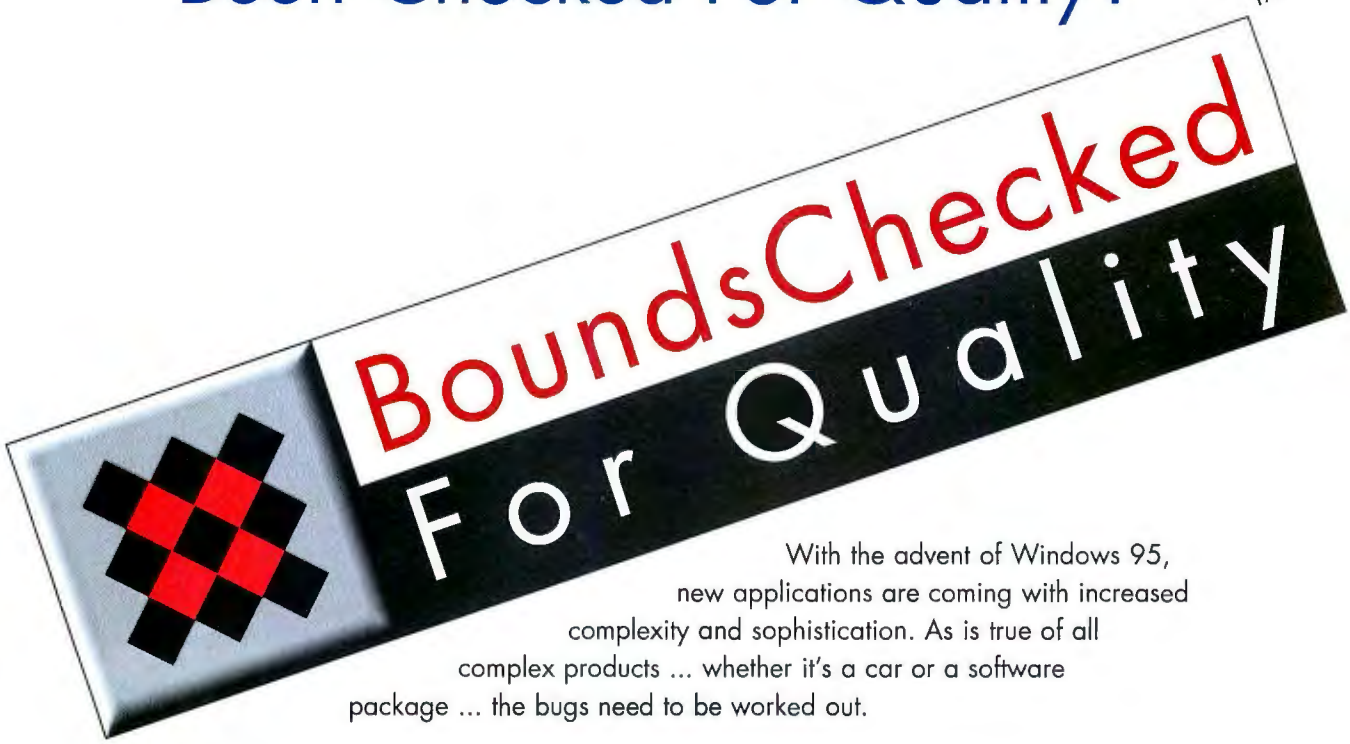

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Track That Code

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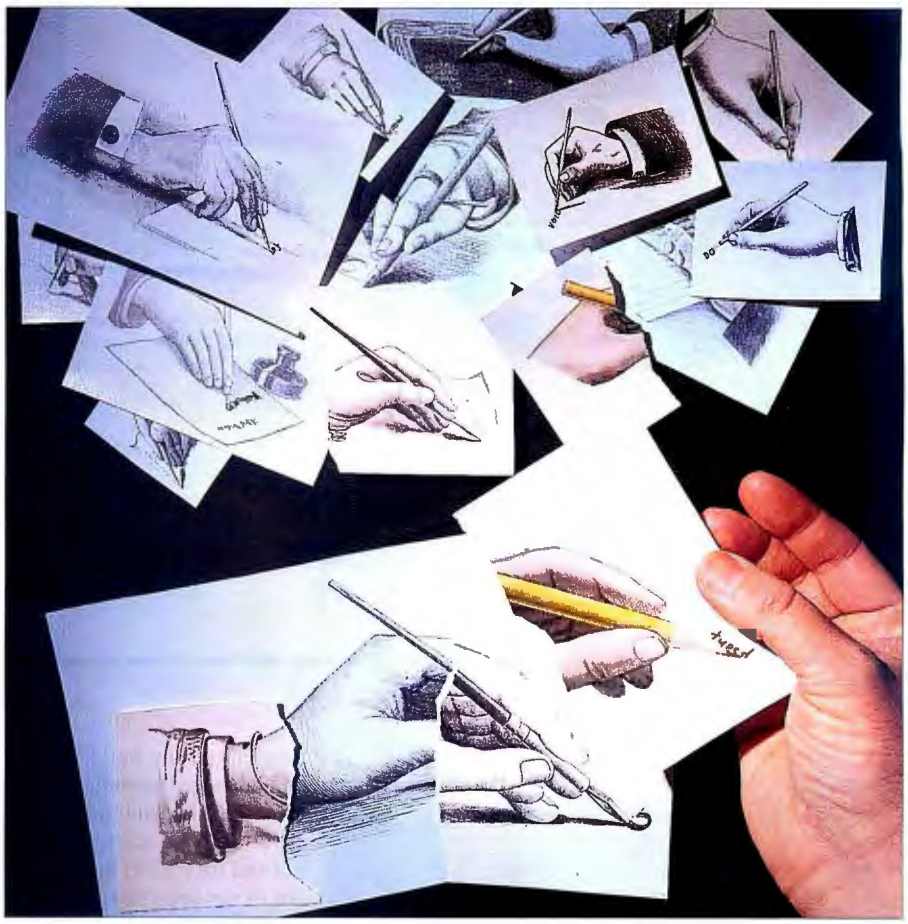


MICHAEL KRESSLEY © 1996

Complex development problems require powerful solutions. Modern version-control systems may be the answer you need.

If yelling, "Where's the floppy with the source code?" is your idea of version control, then you may be sacrificing productivity and quality. More rigorous version control is now available in several forms, ranging from utilities integrated into popular development environments to cross-platform, multitool, distributed configuration managers.

We're talking about tools that go beyond the traditional low-end version-control (VC) tools—such as the RCS (Revision Control System) and SCCS (Source Code Control System) packages—that were built around the concept of a vault. With these tools, an individual developer creates a work environment by extracting source files from a central repository and copying them to a private workspace outside the VC system. Typically, all source files must be copied—even those that the developer doesn't plan to change.

As he or she completes the changes, the developer checks the revised source code back into the vault. In an active project, this results in many copies of each source file. Because programmers change the files outside of the VC system, they cannot coordinate simultaneous updates to the sources. This limitation often results in such problems as developers overwriting each other's changes, and it limits the opportunities for concurrent development.

Contemporary development demands have put even more pressure on this older approach. For one, teams no longer work on a single source base; parallel development, where many development teams work on the same source base for both maintenance and future product development, is common.

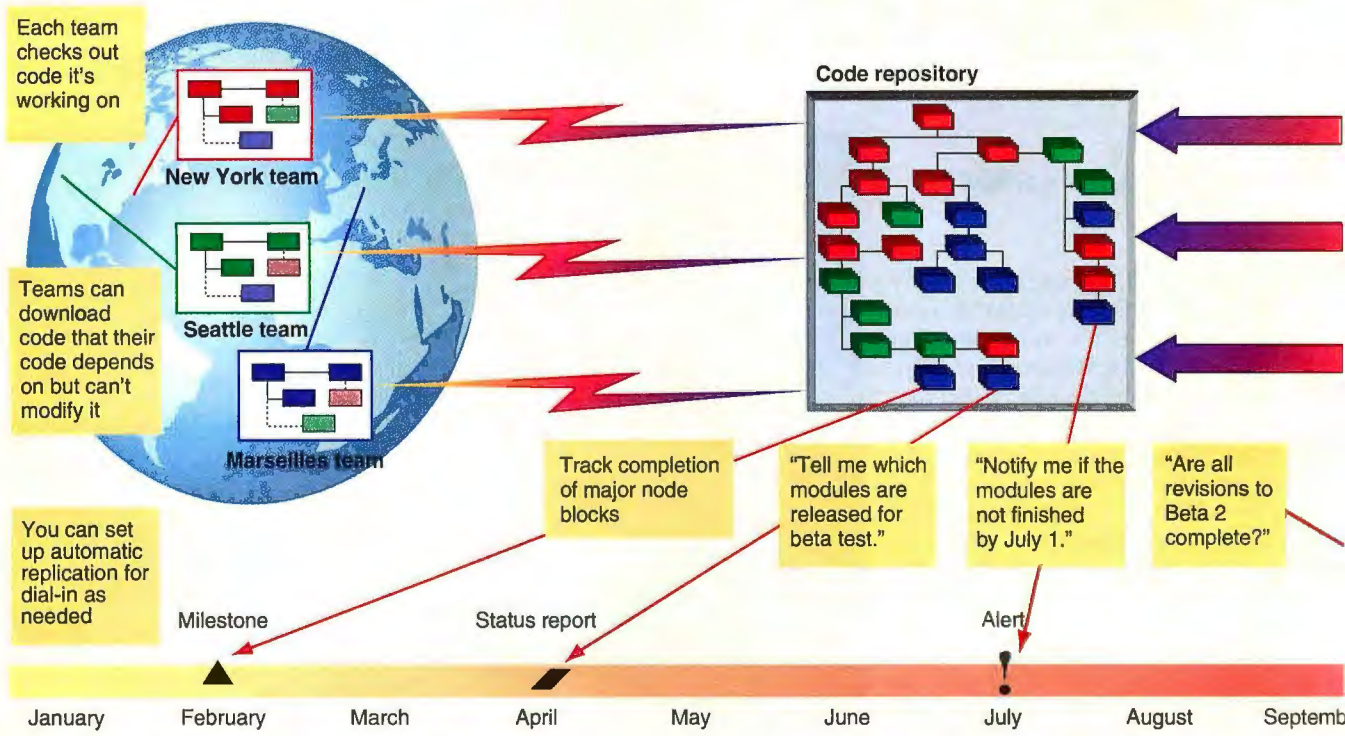
In addition, the chance of a single software manufacturer's producing products that can work together on Unix and PC platforms alike is much higher today. Similarly, the availability of scalable OSes that can run on RISC and Intel platforms alike, such as Windows NT, has encouraged manufacturers of high-end enterprise tools to produce versions that accommodate both types of platforms.

More robust VC tools allow developers to track all changes made to every file in a project. Furthermore, they manage access to different components of a project, enabling controlled sharing of code among the (possibly several) development teams that are involved. In a large-scale effort, where programming teams might be at different geographical sites, a comprehensive VC system enables each team to view the others' changes while maintaining control over access to the source files.

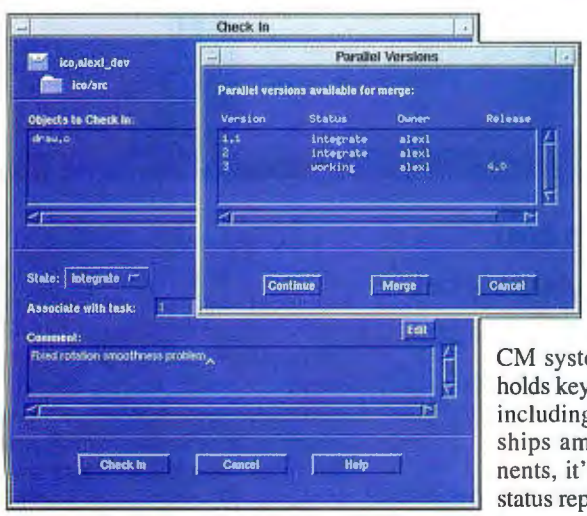
A configuration management (CM) system includes the functions of an advanced VC system and expands them in several important areas. Instead of simply allowing a developer to create a workspace by checking out source files, a CM system manages that workspace to the benefit of the entire project. A developer working on one section of code, for example, might want to test current changes for compatibility with the latest code revisions from one team while remaining isolated from the changes

How Version Control Works

Dispersed programmers get the code they need . . . **while team leaders manage complex project time lines . . .**



A successful VC/CM system might need to synchronize files at multiple remote sites among different development teams, create interim builds that can be replicated, and monitor work flow to ensure timely delivery of an end product.



Continuus/CM notifies a user that there are parallel versions of a particular file (here, draw.c) in existence. Any or all versions are available for merging with a user's current changes.

that are being implemented by another team.

In addition, a vigorous CM system includes such build management features as minimal rebuilding, documenting the components that make up each software build, and making available the entire file environment of any build. The reliability and reproducibility of the build environment are critical for quality control and for tracing the genesis of any bugs that are discovered later in the testing process.

Support and enforcement of organization-specific policies and procedures are the final tasks of a modern CM system. Because such a system holds key information about a project, including the status of and relationships among its individual components, it's uniquely able to generate status reports, identify and track problems early in the development cycle, and project forward to milestones.

The New Frontier

The importance of VC as a part of the software development process has evolved dramatically from the earliest "who's got the source floppy?" stage. Yet many software developers continue to use homegrown VC systems that grew along with their products. In a recent survey, only 5 percent of the software companies polled worldwide reported that they used a commercial VC/CM product.

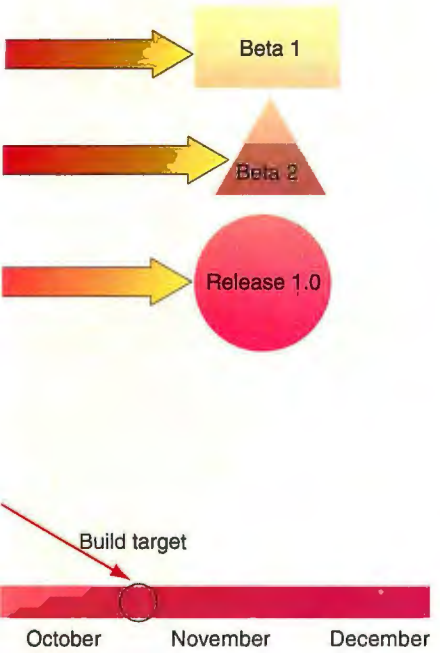
This may be in part because compilers and visual design environments, particularly in the Windows environment, increasingly include their own somewhat-limited VC capability. The simplicity of these built-in and add-on facilities makes them more approachable than full CM packages. However, simplicity comes at a price: lack of process control, lack of an automated workspace setup, and limited scalability.

Clearly, times have changed and the development process has evolved. Powerful new features are appearing in the current crop of VC/CM tools in an effort to keep pace with today's software development requirements. Although many features of VC/CM tools are touted by their providers, a few key areas of VC and CM products are crucial.

Development Environment Integration

Version control must be readily available and easy to use from the comfort of the

and can control multiple builds



Applications Development Issues

VC/CM solutions promise to help you overcome these common development problems:

- **Reduced time to market**
- **Increased application size and complexity**
- **Large numbers of development and delivery platforms**
- **Increased team size**
- **Geographical separation**
- **Quality-assurance requirements**
- **Emphasis on code reusability**
- **Impact of programmer turnover**

development environment. Nearly every VC/CM solution provides (or is scheduled to provide) integration with common development environments. Intersolv's PVCS and Mortice Kern Systems' Source Integrity, for example, support many of the popular integrated development environments (IDEs), including Delphi, Visual Basic, and Visual C/C++.

To encourage integration, many VC/CM providers publish a set of APIs that third-party applications can use to incorporate VC/CM features into their applications. If your development project intends to use, or could benefit from, such features, a published API should be high on your feature-set checklist. Xcc Software's RCE, for example, is delivered as a set of APIs in library (DLL or LIB) form.

Low-level integration of VC and CM opens up other doors that might move VC/CM tools into common usage. For instance, a developer charged with creating a VC system for software might leverage that work by developing a modified system to track drawings in a CAD/CAM system or documents in a marketing group. For these applications, an API-based system may provide the most flexibility. VC/CM manufacturers see this situation emerging. By building task flexibility into a system, they can market their tools as a single enterprise-wide management system.

High-End Watershed: Multisite Support

As software companies struggle to pump up their productivity on large-scale projects, it's becoming common for them to divide the responsibility for software development among several teams located at different sites. These teams might be in adjoining rooms, in different places across town, in neighboring states, or scattered over the globe.

Even if an infrastructure exists to support these teams, it's not necessarily available to contract programmers working from their own offices or offshore development shops. In some cases, a programmer might need to access source code while performing on-site support or customized development at a client's facility.

In each of these situations, version-control and configuration management (VC/CM) tools built around a single-server paradigm fail to deliver the needed capability. Changes made at remote sites must be merged into the sources at the main site. But performing this process manually is time-consuming and can be prone to error, especially if users at several sites are making changes to the same sources. Also, different sites might be in control of various software components, which makes it difficult to locate the master copy of a particular code component.

To be effective, a multisite VC/CM system should support the management of a distributed development environment. It must maintain parallel repositories at multiple sites without manual intervention. These sites should be synchronized automatically as determined by the project coordinator, either periodically or in response to such events as the release of code.

Of course, support should exist for distributing updates via an enterprise-wide network. But the use of other channels, including direct-dial, Internet transfer, and using such media as tape, should be supported as well. Brute-force methods of synchronization are wasteful. An efficient system minimizes the volume of data transfer by exchanging only changed files or even just the changes within files. And, finally, the system must be available on all platforms on which the development is taking place.

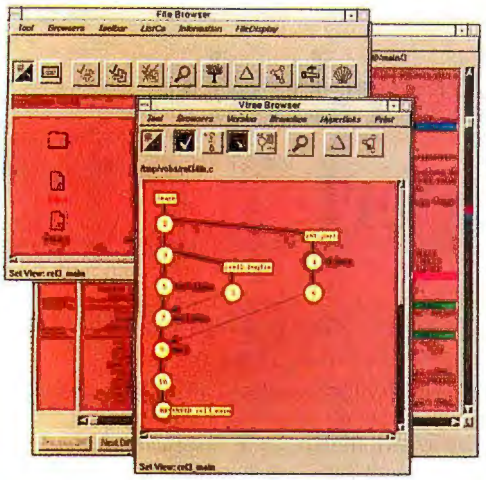
According to Van Simmons, product manager for VNP Software's DevMan, "Distributed development tools, combined with the widespread availability of affordable Internet connections, can produce very important gains in this regard. Scattered sites all over the world can work together as a team on one project."

Multisite VC/CM support will likely become a high priority for many VC/CM-solution providers. Before the widespread adoption of multisite support occurs, however, customers must demand that security issues and cross-platform limitations be addressed.

Cross-Platform Support

Now that PC compatibles, Macs, and Unix workstations can all serve as common development platforms within the same corporation, VC/CM solutions must address the needs of a heterogeneous environment.

continued



Atria's ClearCase displays detailed historical and change-tracking information for any particular file within a project.

Consider the range of computer systems attached to the Internet: For the most part, the hardware details are completely transparent to the user.

Although an enterprise network supports a number of heterogeneous platforms, cross-platform support for development tools is a relatively new concept. Whether a developer is using Windows, Windows 95, Windows NT, OS/2, DOS, Unix, or Mac OS, development tools should function in harmony.

Diverse platforms will increasingly have to interoperate. However, the different compilers, linkers, and OSes that are used in a heterogeneous development environment continue to make this an elusive goal—but one that is brought closer by advanced VC/CM systems. Atria's ClearCase and Continuus Software's Continuus/CM are two examples of VC/CM products that support a wide range of Unix and PC development environments alike. PVCS, from Intersolv, and Mortice Kern Systems' Source Integrity cover the PC domain thoroughly.

SIZING UP THE FEATURES

Advances in version-control and configuration management (VC/CM) software are currently concentrated in three important categories. Here's a brief description of what you should expect from products that claim to support these features.

DEVELOPMENT ENVIRONMENT INTEGRATION

This feature should give you seamless access to VC/CM features from within a common development environment, such as Delphi, PowerBuilder, Visual Basic, or Visual C/C++. VC/CM features should appear as icons or menu items within the integrated development environment (IDE). This way, you don't have to exit your IDE, check out a file, and then reload the IDE. Publication of APIs by the VC/CM program also allows other applications to integrate VC/CM features into their base functionality.

MULTISITE SUPPORT

This feature enables you to work on a particular project from different geographical locations. This implies intrinsic support and control for modem and network access to the project. Initially, you might want to have one central server that can be remotely accessed; ultimately, you might need multiple distributed servers that automatically synchronize with each other.

CROSS-PLATFORM SUPPORT

This feature should allow you to work on a project from a variety of heterogeneous platforms, including Windows, Windows 95, NT, OS/2, DOS, Unix, and Mac OS. True cross-platform support ensures that you can exchange and manipulate source code independently of your current platform.

The Future

VC/CM system providers are working diligently to deliver on their promise to provide increasingly flexible tools that integrate transparently into the software development process. Because of its inherently heterogeneous nature, the Internet will play an important role in removing barriers to VC/CM solutions by encouraging the development of tools for multisite and cross-platform environments. Indeed, the need to track and manage the rapid evolution of documents that are published on the World Wide Web may prove to be the next mainstream application for VC/CM systems.

The best VC/CM solution for your particular development environment depends on a number of factors: feature set, price, product support, future plans, and supported platforms. Soon—if not already—a successful VC/CM system will give your competitors an advantage in the development process. Thus, the time to consider VC/CM is now. ■

Kip McClanahan is a systems software designer for Motorola. He has been a PC programmer for 13 years. You can contact him on the Internet or BIX at editors@bix.com.

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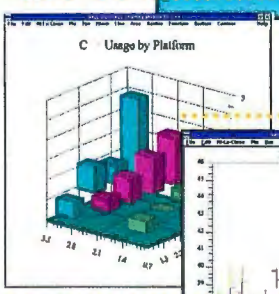

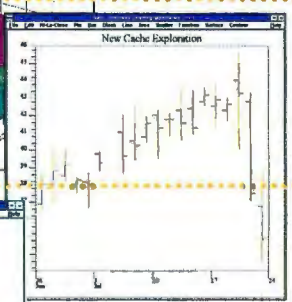

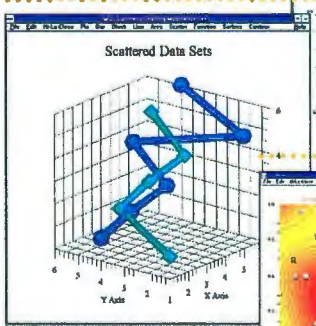

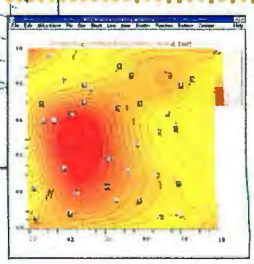

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Net-Surfing with Notes

ROBERT L. HUMMEL

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Put Notes and the World Wide Web together to overcome each technology's weaknesses

Lotus Notes advocates were the Young Turks of the early 1990s, unleashing the then-new technology of document-oriented groupware to deliver real benefits to business. Now the Younger Turks of the Internet have raised the question of whether Notes is a needlessly expensive and proprietary way of doing what the World Wide Web already does. Developers would do well to recognize the strengths of both approaches and to learn how to make them work together to maximum effect.

Like all traditional groupware platforms, Notes offers stability, maturity, and security in a single package. It supports a broad class of business-process applications that require ongoing action by participants. Notes is designed to enable enterprise-wide collaboration and the sharing of work-flow applications over LANs and WANs.

By its nature, Notes is an excellent vehicle for developing elaborate work-flow and controlled-distribution information systems. It provides multiple levels of security, an excellent model for interaction and response, add-in tools for extensive customization, and the ability to pass objects easily.

The broadcast nature of the Web, on the other hand, makes it a good arena for developing applications that involve the public publishing of documents. The Web has one unusual feature for a client/server system: The clients are extremely diverse and detached from the server development process.

It's tempting to view the document-publishing functions in Notes as being in competition with the Web. But Andrew Mahon, communications product marketing manager at Lotus, disagrees. "Notes doesn't compete with the Web," he says. "It competes with other application platforms that run on the Web." The latest version of Notes, release 4.0, has powerful features for integrating with the Internet. These are listed below.

InterNotes Server. This is a gateway to the Internet running on a Notes server. You gain two valuable capabilities by using it: Notes security limits inbound traffic from the Internet, and you don't have to run TCP/IP to each desktop—the InterNotes Server acts as a TCP/IP gateway.

InterNotes Publisher. This application translates Notes documents into Hypertext Markup Language (HTML), so a Notes application can produce Web documents as output.

InterNotes Web Navigator. A Web browser with a difference, this feature works within Notes. You can control it with the usual Notes macros and scripts.

With these tools, you can construct and manage applications that include unique features of both Notes and the Web. Thus, you can benefit from the integration of the two technologies.

The Web at a Glance

The Web works on a "pull" model of document management. That is, Web clients, or browsers, specify the uniform resource locator (URL) for a document name and request a copy of that HTML page. The page is transmitted across the network and then displayed on the client workstation.

Web information is document-based. The documents employ rich-media presentation, as well as a hypertext linking structure. The Web appears to be an ideal way to provide marketing, cor-

porate, and service/support information that is readily available for public access. In addition, the broadcast nature of Web publishing works well in a one-to-many situation.

The Web is also becoming increasingly popular as a means of enterprise-wide communications within organizations (the so-called intranet). The main appeal of the Web seems to be its apparent ease of use. Many organizations falter, however, when it comes to maintaining a Web server. As documents are produced, they must be prepared in HTML and linked. Each time you add or delete a document, you must update the links, as well as the pages that refer to those links.

The Notes System

Notes is a client/server platform for developing and deploying groupware applications. Like the Web, it's document-based. The basis of any Notes application is a database of documents that appear to the user as forms that can be viewed with a browser. Complex document topologies are structured using an outline-like expand-and-collapse metaphor.

Because documents can have arbitrarily structured or unstructured content, Notes is able to store and manage collections of data that do not readily lend themselves to relational or other database systems. Notes can easily support facilities that prove useful in a business environment, such as passing information as formatted text, tabular data, graphics, or linked or embedded objects. Multimedia objects, such as scanned images and faxes, voice, sound, and video, can be passed as well.

With Lotus's new InterNotes Web Navigator, users can access the World Wide Web from within Notes.

In addition, Notes incorporates a full-text search engine to allow users to index and search documents. It can also implement version control to track multiple changes that different users make to a single document.

Information Access

Both the Web and Notes have server environments designed for information distribution. However, to view data on a Notes server requires both a Notes client and permission to view the desired documents. This rigid control can make it difficult to create public domain documents or to share information with members of the general computer public, some of whom might not have the required client software.

The broadcast nature of the Web lends itself to the use of independent client and server applications. And the proliferation of free and shareware browsers has had the effect of making client software, and thus Web data, universally available.

But being an information provider on the Web is a good deal more demanding than being an information user. Setting up and maintaining an enterprise-level Web server requires a commitment to additional personnel and equipment that many companies might not wish to undertake. Collecting and translating documents manually into HTML is time-consuming. And you must update links to the documents or references to other Web sites.

One solution is to provide organizations with the ability to publish to the Web from within Notes. Lotus's InterNotes Publisher does exactly that by automatically converting Notes databases and documents into HTML. This solves the problem of managing HTML documents.

Putting information from Notes on the Web also solves the problem of giving access to non-Notes users. Anyone with a Web browser can access the Notes documents you choose to put on the Web. And as the content of the documents changes and new contributions are added, the InterNotes Publisher automatically updates the Notes overviews and Web home

NOTES AND WEB SYNERGY

FOR THIS WEB PROBLEM	NOTES OFFERS THIS SOLUTION
TCP/IP must be installed and supported on every desktop	Client access to the Web is via the Notes server
Unrestricted access can waste resources and sap productivity	Sites can be locked out using Notes' access-control features
Browsing requires an on-line connection	Internet database can be replicated and read off-line
Access to popular sites is often slowed by high traffic	Notes can cache popular Web sites and save pages as Notes documents
No notification of page updates, new sites, or other changes	New information or other changes in the Web can initiate a work-flow application
Interactivity is limited	Incoming Web information is easily channeled into work-flow applications
Custom applications require independent development and support for each platform	Notes applications run on all supported platforms
Exposure might compromise security	Server security extends to the Web
FOR THIS NOTES PROBLEM	**WEB OFFERS THIS SOLUTION**
Access to Notes database requires all users to have a Notes client	Web browsers offer access to HTML documents produced by Notes
Replication of large databases to many servers at remote sites can be slow and costly	Users can eliminate delays and the need for a server by viewing the latest documents published on the Web
Access to information outside of Notes databases requires leaving Notes	Notes' new integrated browser allows direct access to the Web via Notes server

pages, as well as all links that refer to the new documents, without manual intervention.

Interactivity

As mentioned earlier, an organization can publish information on the Web to capitalize on its graphical nature and ready public access. This increase in visibility can aid marketing, sales, and technical-support efforts. But the Web's ability to integrate itself into a company's core business applications is weak.

The Web is volatile in nature. Each day, for example, five firms that yours competes with might post new data on their Web pages. But tracking those updates manually might take more effort than it's worth. Also, on most Web pages, interactivity or feedback is limited to filling in a form to send an E-mail message back to a single contact. Integration of feedback and inquiries into a company's work flow can be a difficult, roll-your-own proposition.

On the other hand, you can easily program Notes to search for and retrieve data from a variety of sources. With Notes 4.0, that includes the use of the InterNotes Web Navigator with macros or scripts to create applications to monitor the Web. For example, you can monitor your favorite Web sites for changes and tell Notes to send you a daily summary as E-mail with links to altered pages. The InterNotes Web Navigator can also easily place information gleaned from the Internet into a Notes application. Responses from a help-wanted posting, for example, can be forwarded as mail messages within Notes to the company's hiring center.

You can translate into Notes all standard HTML documents on the Web, including forms, tables, photos, graphics, links, and URLs. You can also browse and retrieve information from other Internet sources, such as ftp, gopher, and Usenet.

Security and Access

No organization wants to expose its confidential information and internal systems to unauthorized viewing or possible tampering by persons or programs on the Internet. But techniques for implementing security on the Internet are still evolving, as the recent problem with Netscape's encryption system has demonstrated.

Notes, on the other hand, is known for its robust security. The InterNotes Web Navigator works through the Notes server and inherits all its password-authentica-

LOTUS NOTES RELEASE 4.0 IMPROVES PROGRAMMABILITY

Developers are certain to notice the new integrated development environment (IDE) in Notes 4.0. Its three-pane interface (Design, Action, and Properties) improves access to all programming facilities. Other enhancements include:

***Simple Actions,* which provide easy access to common document management functions, such as copying a document, changing a field value, or moving a document to a folder. Programming is reduced to simple point-and-click development.**

***Over a dozen new or enhanced @functions* have been added to Lotus's classic macro language. These include functions to interface with agents and manipulate uniform resource locators (URLs) on the Web.**

***Agents,* which are background macros, run application logic that's either expressed as Simple Actions or macros or written in LotusScript. They allow developers to automate tasks such as data handling, replication, and message services.**

***LotusScript 3.0,* a cross-platform, object-oriented superset of the BASIC programming language, gives you control structures, looping mechanisms, and data-structure management.**

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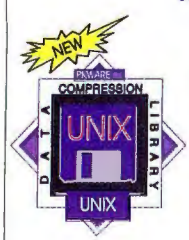

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tion and access-control procedures. Because direct client access to the Internet is eliminated, your security risk is reduced.

Conversely, not all access to Web sites is productive. By restricting Internet/Web access through a Notes server, administrators can deny access to specific sites using Notes' access-control features.

Replication Overhead

The need for prompt access to changing information can be critical. In some cases, Notes replication can introduce unacceptable delays. A remote office, for example, might need the latest price sheet immediately but not receive it until the next scheduled replication. In other cases, small offices or single workers might not be able to justify the expense of setting up a full-time server. Similarly, mobile or contract workers might need access to information on an unscheduled basis. But licensing and installing a personal server or having these workers constantly dialing in to a central site might not be time- or cost-efficient.

However, when an organization publishes documents on the Web, these workers can use readily available browsers to access the latest information. The need to acquire a Notes client for each user or to replicate entire sets of document databases on numerous servers is eliminated. In addition, the central site isn't forced to maintain a large inbound communications server to handle frequent and lengthy dial-up Notes access.

Room to Grow

The broadcast nature of Web publishing and its readily available client software make it popular with developers. But Notes remains a powerful platform for developing document management and work-flow applications.

Lotus's Mahon acknowledges that both Notes and the Web have room to grow. "We've already got the function; now our challenge is to get more open," he says. "They've got the openness and need to get the function."

It's important not to underestimate the impact of the Web and other developing on-line services on the way in which business will evolve in the next few years. The extensions and capabilities planned for Notes will ensure it remains an effective platform for managing information. ■

Robert L. Hummel is an electrical engineer, programmer, and consultant. He has written extensively on assembly language programming for Intel processors and on data and fax communications. You can reach him on the Internet or BIX at editors@bix.com.

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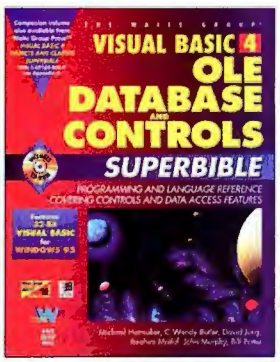

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SOFTWARE VIDEO COMPRESSOR/PLAYER

A software-based codec for Windows, the MP640/95 2.5 compressor/player and resource kit ($299) lets you add full-screen, full-motion video to your applications. The codec is asymmetric, handling the bulk of the work in the compression stage, letting the player program produce full-motion video on 486DX2 machines using a 4X CD-ROM drive. The program can compress video files captured at sizes of up to 640 by 480 pixels and provides full-screen resizing during playback at rates of up to 30 frames per second.

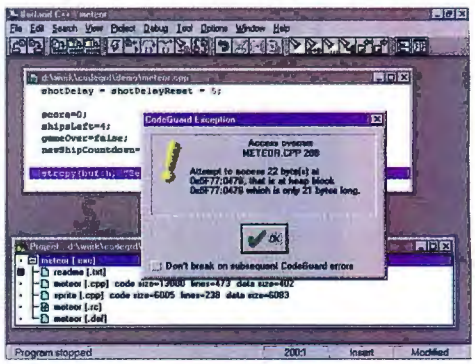
The P640/95 includes the APIs, header files, and documentation required to create and distribute video using Windows 3.x/95. Other versions are available for Windows NT on both Intel and non-Intel platforms. The program offers a royalty-free distribution license for the player when used with a fixed medium.

Contact: Motion Pixels, Inc., Scottsdale, AZ, (602) 951-3288; http://www.motionpixels.com.

Circle 1111 on Inquiry Card.

BUG-CHECKER FOR BORLAND C++ ▼

CodeGuard for Borland C++ 4.5 ($149.95) is a debugging tool that automatically locates and diagnoses memory bugs in 16-bit Windows applications developed in Borland C++. The program integrates into the Borland C++ 4.5 IDE and requires no source code changes. It eliminates the need for you to switch between tools or to rebuild your application while debugging. CodeGuard locates and reports memory leaks, invalid memory references, memory overruns, and access to uninitialized data. The program also validates API function arguments and returns values for those functions most often responsible for memory corruption.



Contact: Borland International, Inc., Scotts Valley, CA, (800) 233-2444 or (408) 431-1000; http://www.borland.com.

Circle 1113 on Inquiry Card.

MULTIPLE OSES ON A SINGLE PC

System Commander 2.2 ($99.95) makes it easy to install as many as 100 OSes on a single PC. The program, from V Communications, allows you to quickly test an application under a variety of OSes, provide simultaneous technical support for different environments, or protect your system integrity when working with beta software.

When you boot up, the program presents a menu from which you can select the desired OS. Switching OSes is as simple as rebooting and making another selection. When you install a new OS, the program automatically detects this, archives key files, and adds the new OS to the boot menu.

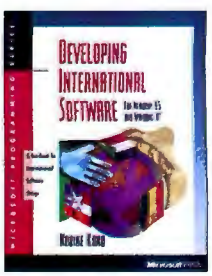
The program doesn't use resident memory or device drivers. It is compatible with DOS, NetWare, Windows, OS/2, Unix, and other Intel-compatible OSes.

Contact: V Communications, Inc., San Jose, CA, (800) 648-8266 or (408) 296-4224.

Circle 1107 on Inquiry Card.

INTERNATIONAL WINDOWS DEVELOPMENT

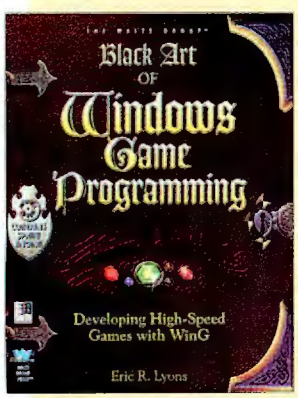
Containing critical reference material on international standards, *Developing International Software for Windows 95 and Windows NT* ($35) by Nadine Kano will help you write global code and localize applications. The book is meant for programmers and interface designers who have knowledge of Windows and C++. Programming issues covered include handling multilingual I/O, Far Eastern writing systems, and character-set encoding. Reference topics include DBCS/Unicode mapping tables, multilingual API functions and structures, and platform support for the Win32 NLSAPI.



Contact: Microsoft Press, Redmond, WA, (800) 677-7377 or (206) 882-8080; http://www.microsoft.com.

Circle 1108 on Inquiry Card.

GAME PROGRAMMING UNDER WINDOWS



The techniques and tricks of creating games under Windows are discussed in *Black Art of Windows Game Programming* ($34.95) by Eric R. Lyons. The book emphasizes using Microsoft C/C++ and the WinG toolkit to create high-performance games that run under Windows. Tutorials on managing memory, handling user input, using sprite bit maps, and synchronizing sound and graphics are included. A CD that comes with the book contains a sprite engine that you can use to develop arcade games from scratch along with bit maps and sound resources.

Contact: Waite Group Press, Corte Madera, CA, (800) 368-9369; 74754.1403@compuserve.com; http://www.waite.com.

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WHAT'S NEW

MASTERING NETSCAPE APPLICATIONS

Netscape and HTML Explorer **($39.99) by Urban A. LeJeune covers World Wide Web publishing design tips and techniques. The book provides a complete HTML guide that features the Netscape HTML extensions and step-by-step techniques for creating Web pages with HTML+ and CGI scripts. It also presents undocumented ways to configure and customize Netscape. An included CD contains a collection of images, icons, symbols, audio clips, and video clips.**

Contact: Coriolis Group Books, Scottsdale, AZ, (800) 410-0192 or (602) 483-0192; http://www.coriolis.com.

Circle 1114 on Inquiry card.

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With the Wise Installation System 4.0 (professional version, $129; developer version, $179), you can easily create professional-looking installation programs for Windows, Windows 95, and Windows NT. You create the installations as a single

self-extracting EXE file (one per disk for multiple-disk installations) using a high level of compression. The program's installation expert prompts you for key information. It then writes and edits your installation scripts.

The program's script language supports DLL calls, dependency checking, bit-map graphics, component-level installation, serialization, and editing of configuration files. The developer version supports password-protected installations and uninstall support. *Contact: Great Lakes Business Solutions, Inc., Canton, MI, (800) 554-8565 or (419) 433-4777; http://www.glbs.com.*

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OBJECT-ORIENTED COBOL FOR MULTIPLE PLATFORMS

COBOL developers can take advantage of object-oriented technology with IBM's VisualAge for COBOL for OS/2 ($895), COBOL Set for AIX ($895), and COBOL for MVS (price based on processor size). IBM plans a 32-bit Windows version. The availability of an object-oriented COBOL lets you leverage the huge installed base of COBOL code while creating advanced client/server applications for the desktop. Each product supports IBM's SOM, giving you the ability to reuse object classes among different SOM-compliant languages. These COBOL products adhere to a version of the emerging 1997 COBOL standard providing object-oriented extensions. *Contact: IBM Corp., Somers, NY, (800) 426-3333; http://www.software.ibm.com.*

Circle 1116 on Inquiry Card.

OS/2 DEVELOPER CONNECTION CD-PACK

The Developer Connection Volume 9 ($199 for a four-issue subscription) gives you an easy way to preview many of IBM's software technologies through prerelease programs and documentation. Notable software on the four-CD set includes toolkits for OS/2 and OpenDoc, the Smart Analysis and Reporting Tool, and the OS/2 Technical Library. You also get a limited license for OS/2 Warp 3 and the BonusPak. The set also includes Developer Connection for LAN Systems, a cross-platform three-CD set that contains information relevant to OS/2, Windows, DOS, and AIX workstations. *continued*

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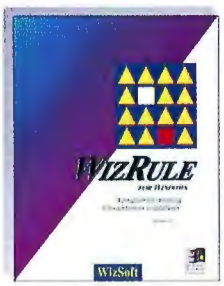

WizRule for Windows:

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WHAT'S NEW

Contact: IBM Corp., Boca Raton, FL, (800) 633-8266; http://www.austin.ibm.com/developer/programs/DevCon.html.

Circle 1119 on Inquiry Card.

CRAFTING MULTIMEDIA IN VISUAL C++

Visual C++ Multimedia Adventure Set ($39.99) by Peter Aitken and Scott Jarol describes the process of creating multimedia applications under Windows 95 using Visual C++. The book provides an explanation and tutorial

for the Windows Multimedia API.

The book includes such undocumented programming techniques as quickly displaying Hi-Color images and direct bit-map animation using the `CreateDIBSection()` function. An included CD contains a Visual C++ hypermedia engine with royalty-free source code, animation tools, a WAV-file editor, and other multimedia tools.

Contact: Coriolis Group Books, Scottsdale, AZ, (800) 410-0192 or (602) 483-0192; http://www.coriolis.com.

Circle 1118 on Inquiry Card.

PENTIUM PRO DISASSEMBLY

With the addition of full support for the Pentium Pro instruction set, Sourcer 6.5 ($149.95) lets you create commented source code and listings from memory and executable files for Intel's latest processor. The program's data analyzer and code simulator identify segments and resolve data across multiple segments.

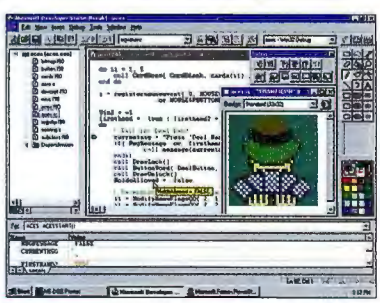
The Windows Source add-on ($129.95) gives you the ability to generate source code for Windows EXE files, DLLs, VxDs, device drivers, and OS/2 NE files. The BIOS Pre-Processor add-on ($49.95) generates commented listings for the main-system BIOS, video BIOS, and other BIOS ROMs. The program supports the entire Intel x86 family, including 32-bit protected-mode code for 386, 486, Pentium, and Pentium Pro processors.

Contact: V Communications, Inc., San Jose, CA, (800) 648-8266 or (408) 296-4224.

Circle 1117 on Inquiry Card.

32-BIT FORTRAN FOR WINDOWS 95

Microsoft FORTRAN PowerStation 4.0 (professional edition, $799; standard edition, $599) lets you create and run FORTRAN programs of virtually any size and degree of complexity on a PC running Windows 95 or Windows NT. The program's full support of ANSI FORTRAN 90 as well as many VAX, IBM, and MIL-STD-1753 extensions enables you to port applications from mainframes to PCs easily. The 32-bit flat-memory model lets applications access up to 4 GB of addressable memory. Mixed-language programming is possible because the code produced is compatible with both Visual C++ and Visual Basic,



letting you migrate legacy code.

The program can also create Windows 32-bit DLLs from FORTRAN source code. The professional edition includes the Microsoft International Mathematical and Statistical Libraries, which contain nearly 1000 coded and tested math, statistical, and special-function routines.

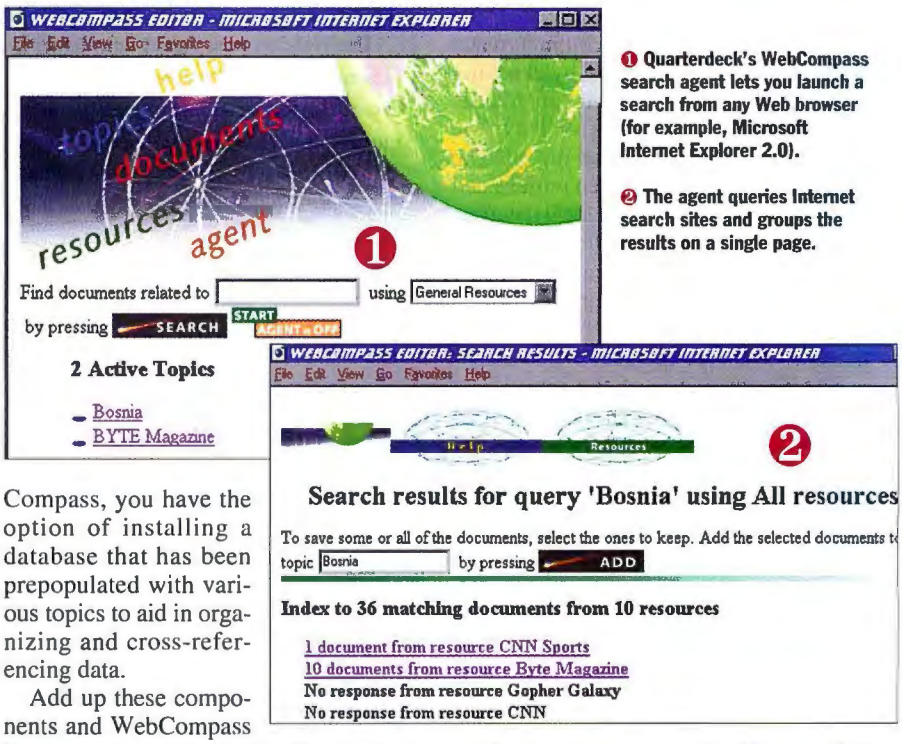
Contact: Microsoft Corp., Redmond, WA, (800) 426-9400 or (206) 882-8080; http://www.microsoft.com.

Circle 1115 on Inquiry Card.

Navigating with a Web Compass

Quarterdeck harnesses leading-edge "metasearch" technology to create a smart agent that searches the Web and organizes the results

REX BALDAZO



1 Quarterdeck's WebCompass search agent lets you launch a search from any Web browser (for example, Microsoft Internet Explorer 2.0).

2 The agent queries Internet search sites and groups the results on a single page.

Searching for a specific subject or topic on the Internet's World Wide Web is a lot like driving cross-country without a road map: You'd better enjoy the journey because you may never reach your destination. Index sites such as Lycos (www.lycos.com) and OpenText (www.opentext.com) are a good starting point. But no one index can cover everything, nor can any search site always be up to date; you often end up searching several of these services in turn. Quarterdeck's new Windows utility called WebCompass greatly simplifies the task of searching multiple indices.

Developed by Limbex Corp., WebCompass is actually not a search tool but a *metasearch* tool (see the Technology Focus on page 98). That's a fancy way of saying that WebCompass does not perform any searches itself. Rather, it runs other search resources such as Lycos and Yahoo (www.yahoo.com) and the BYTE Site (www.byte.com). When the editors of BYTE magazine saw WebCompass demonstrated at Comdex/Fall '95, we were so impressed we gave it our Best of Show award. And now that we've had a chance to give it an extended test drive, we are more impressed than ever.

Use Your Own Browser If You Want

The engine that runs WebCompass is a Common Gateway Interface (CGI) application, which means you must have a Web server running on your local machine (WebCompass includes a version of Quarterdeck's WebServer). You then use the Web browser of your choice to control WebCompass (see the top screen on this page). Though Quarterdeck's QMosaic is packaged with WebCompass, configuration problems with our Microsoft Network Internet connection prevented its use. So we tried the Microsoft Internet Explorer 2.0 as our interface, which proves just how remarkably flexible WebCompass is: It doesn't care which browser you run.

WebCompass also comes with a Microsoft Access 2.0-format database—as well as 32-bit ODBC drivers—to store and index search results. When you install WebCompass, you have the option of installing a database that has been prepopulated with various topics to aid in organizing and cross-referencing data.

Add up these components and WebCompass has an imposing footprint. Quarterdeck recommends around 30 MB of disk space for a typical installation, about half of which is the prepopulated database. Once you start storing and indexing your search results, the database will only get bigger.

Resource Management

The key to WebCompass is its ability to interact with various search engines, which it terms *resources*. The package comes with several resources configured, including CNN, CNN Sports, Yahoo, Lycos, and Excite. In turn, each resource is grouped into a category, such as General Resources or Technical Resources.

When you run a WebCompass search, you specify both the search terms and the resources you wish to use. WebCompass then goes out across the Web and runs those resources for you. Instead of you having to visit each search site in turn, WebCompass does the dirty work of querying the resources, collecting all the responses, and presenting them on a single page (see the bottom screen).

You can use resource categories to group similar resources. For example, if you're running a query on *Montana* but you want the quarterback and not the state, you can tell WebCompass to search only the Sports resources. If you want to search *all* the resources for Montana, you can do that as well. The search results would then include references to Joe Montana, the Big Sky conference, and perhaps Yellowstone National Park.

If the configured resources don't fit your bill, you can add new resources and reassign existing ones to different categories. Adding a new resource is a two-step process. You first enter the URL along with descriptive information and the desired category. Then, WebCompass reads in the search resource at that URL. You must then specify which field on the resource page will be used to enter search text, and you also have to set up the resource page by entering search criteria.

You set up the search page the way you would want to use it if you were running it directly. From then on, whenever you choose a WebCompass category that includes this new search resource, WebCompass can automatically run that search page for you.

continued

Undercover Agent

WebCompass has two search modes: interactive and agent-based. Interactive is the traditional mode: You type in your search terms, select a resource category, and activate the search. WebCompass then does the hunting and gathering and presents all the results, or *hits*, from the various resources on a single page.

You can investigate each hit in turn and add it to your local database by checking the box next to it. You then can add the hit to a topic that is usually related to the search term you used to find the hit. The WebCompass Agent will then retrieve and index the document in your local database so you have it for future reference. In fact, this local topic database is one of WebCompass' search categories, so you can search it just as you would any other resource category.

The Agent is one of the unique strengths of WebCompass. It runs as a separate application outside the browser, though you activate it from the main WebCompass page. The Agent has two roles: It retrieves and indexes articles you have selected as a result of a previous search, and it automatically performs searches for you.

Once you've specified which articles to add to the local database, the Agent can go off and retrieve them, index them, and organize the documents for later review. The indexing scheme is fairly reliable, usually getting related articles together. In our tests using WebCompass, the Agent sometimes put unrelated articles together, but the software generally took a reasonable first stab at grouping the articles it found.

When you run a search interactively, you can add it to a new or existing topic. We ran a search on the word *Bosnia* and created a new topic also called Bosnia. (Topics are keywords that help organize data in the local database.) If you specify a particular topic as active, the WebCompass Agent will automatically run the searches related to that topic. The software then adds these new search results to the local database for later review. Agent searches can run while you use your browser to view something else.

Product Information

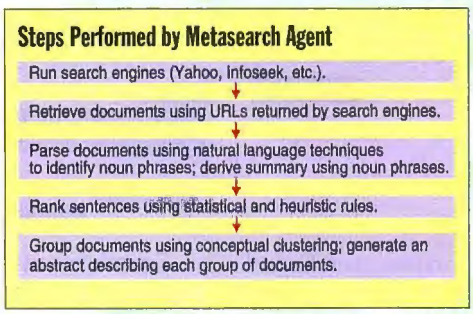
WebCompass 1.0 . . . . . $100
(anticipated street price)
Quarterdeck Corp.
Marina del Rey, CA
(310) 309-3700
(800) 683-6696
fax: (813) 523-2335
http://www.quarterdeck.com
Circle 1049 on Inquiry Card.

Searching from Among Searchers

WebCompass is a metasearch tool, which means it can pass requests to other search resources and then process the results. Thus WebCompass adds value to search engines, but it is not dependent on any particular one.

The first part of metasearching—interacting with search resources such as Yahoo—is straightforward. WebCompass does essentially what a human user of Yahoo would do: Enters a search term and submits the search to Yahoo. It's only in processing the search results that WebCompass gets complicated.

The WebCompass Agent downloads (as a background process, without human intervention) the documents whose URLs were returned by the search. It then uses a variety of AI techniques to analyze the documents, including natural-language parsing for extracting noun phrases. The Agent next uses a combination of statistical and heuristic rules to rank the noun phrases in the document. For example, it might note the frequency of a phrase (a statistical method) or promote a phrase because it falls in the first sentence of a paragraph (a heuristic method).



WebCompass uses AI techniques to massage Internet search results and group related hits.

The Agent uses the noun phrases to derive a summary, or abstract, of each document. This summary (not the whole document) is stored in the local database for future reference. You can remove the abstract from the database when it is no longer useful.

WebCompass employs the sentence rankings to group similar documents, another AI technique called conceptual clustering. Once the Agent has decided which documents are similar, it analyzes the similarities to produce a title that describes that group of documents. This title appears as a hyperlink that you can use to jump between related groups of documents.

An artificial intelligence that passes the Turing test may be some time in the future. But the efforts of AI researchers are clearly bearing fruit in agent-based products like WebCompass.

A Few Nits Found

Having the Agent repeatedly run the same query every day quickly adds up to a lot of articles indexed in the local database. Thankfully, WebCompass comes with tools for managing the database, but since these are also Web-based, they feel clunky at times. For example, you can delete a group of articles with a single click, but to delete a single article you have to jump to a separate form. And you can move articles from one topic to another, but since the interface is Web-based, no drag-and-drop commands are available. You have to step through a Hypertext Markup Language (HTML) form to accomplish the task. You also have to use HTML to configure new resources and set up the Agent.

Furthermore, while being able to use different browsers is a strength of WebCompass, it is also a weakness. The caching schemes of some browsers can cause a mismatch between what your browser shows and what WebCompass is actually doing. For instance, the browser might indicate that the Agent is inactive when in fact it is out there busily running an indexing task. You can fix this inconsistency by reloading your browser whenever you suspect it might be out of sync with WebCompass.

What's more annoying is that WebCompass is a single-user application, which means you can't set up an instance of WebCompass on your network and let different people maintain their own topic databases using the common installation.

These are minor flaws, some of which will no doubt be ironed out in the next release. What matters is that WebCompass has quickly made itself an invaluable part of our Internet tool set. ■

Rex Baldazo is a technical editor in BYTE's New Media department. You can reach him at rbaldazo@bix.com.

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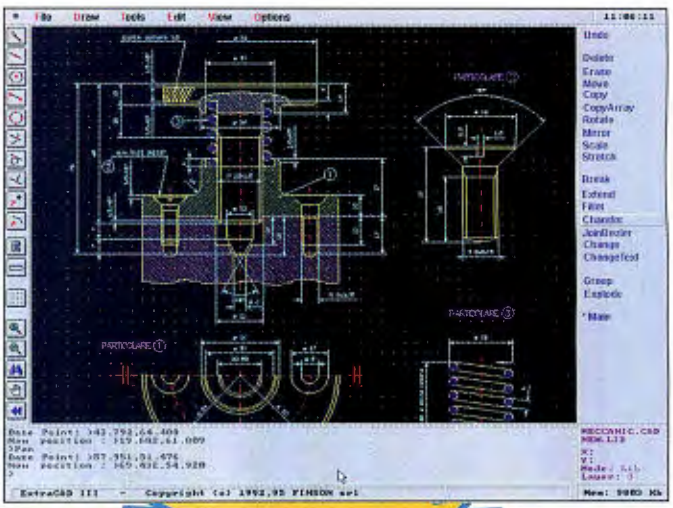

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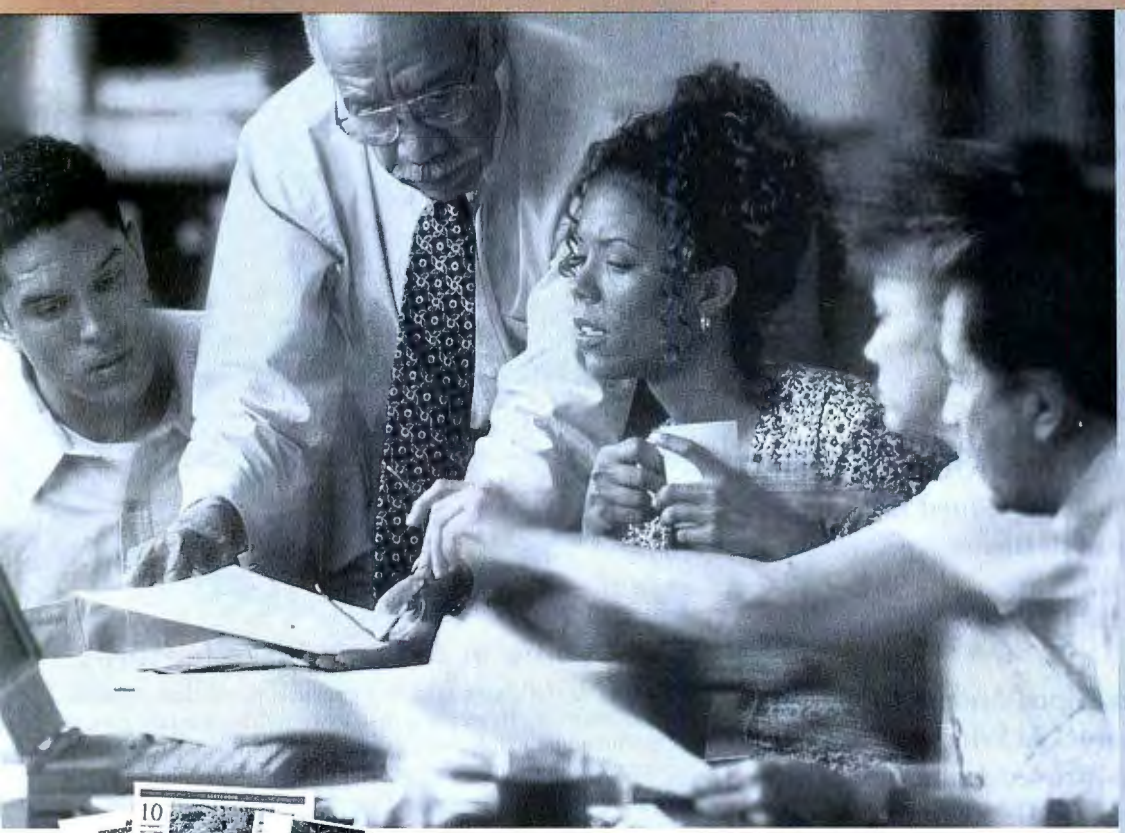

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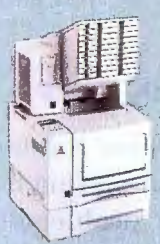
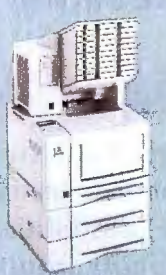


or add a lockable mailbox/collator



add another paper tray

add an envelope feeder

configure it for any need

Big, Bright, and Beautiful

IBM's latest top-of-the-line notebook has a display to die for. Who needs an external monitor?

RUSSELL KAY

What strikes you most about IBM's ThinkPad 760CD is its 12.1-inch active-matrix display. It's simply gorgeous. Bright and clear, the 800- by 600-pixel panel provides 16-bit color depth (65,536 colors) and the same viewing area as a standard 14-inch monitor. Since it sits closer to you than an external monitor usually does, the 12.1-inch LCD panel is at least equivalent to a 15-inch CRT. That makes the 760CD the first undisputed candidate for a true desktop-system replacement. The $7449 price tag ($8134 as tested) is also striking, but this is IBM's flagship notebook.

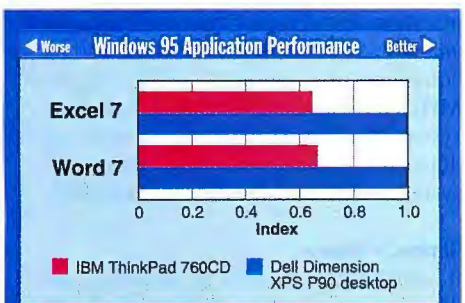
Once you tear your eyes away from the display, you realize this multimedia notebook has other goodies to enjoy. The CPU is a 90-MHz Pentium with a 256-KB external cache—powerful, if not state of the art. The non-CD 760 models can be had with a 120-MHz processor. The standard memory configuration is 8 MB of DRAM; our test unit came with 16 MB, and it can be expanded up to 40 MB with dual in-line memory modules (DIMMs).

The system comes with a quad-speed CD-ROM drive built in (it's swappable with the included 3½-inch floppy drive), a lithium-ion battery, a 1.2-GB EIDE hard drive, IBM's Mwave digital signal processing (DSP) system (which gives you a 28.8-Kbps fax modem with telephony features), and hardware-assisted, full-screen MPEG-2 video playback (half-horizontal resolution). The system has two PC Card slots.

The ThinkPad 760CD has more to offer than a 12.1-inch color screen. Lifting the keyboard reveals a quad-speed CD-ROM drive, a lithium-ion battery, a 1.2-GB EIDE hard drive, and a DSP subsystem that provides 28.8-Kbps communications and telephony.

AL KAREVY © 1996

When you press back the two locking buttons on the side of the unit and lift up the front of the keyboard, you get a lesson in laptop packaging. Take away the CD-ROM drive, battery, hard drive, and Mwave subsystems, and you're left with a package about 2 by ½ by 6 inches in size: That's the entire CPU, chip set, graphics controller, and I/O circuitry. With all these neat things, the ThinkPad is no lightweight at 7.4 pounds, but it's not a backbreaker, either.



Testing under Windows 95 with Microsoft Word 7 and Excel 7 scripts developed by NSTL shows that the ThinkPad 760CD doesn't match desktop performance. Less-than-desktop performance, which is typical for portables, stems from weaker graphics speed. The Wintach graphics test showed that the comparison Dell desktop system had 67 percent better graphics speed. We tested at 800- by 600-pixel resolutions with 256 colors. Both the Dell Dimension XPS P90 and the ThinkPad 760CD had 90-MHz Pentium processors and 16 MB of RAM. The XPS P90 had an STB Powergraph 64 Video graphics card.

Good Design, Bad Design

The ThinkPad 760CD is a curious mixture of thoughtful design and sometimes-awkward implementation. Our test system came with Windows 95 installed (OS/2 Warp is another option), but we still had to do a fair amount of configuration work. For example, the parallel and serial ports came turned off, which made initial attempts to use an external mouse frustrating. (Restarting Windows 95 became an all-too-common experience.)

The DSP-based 28.8-Kbps fax modem provides telephony functions and can detect incoming activity to awaken the 760CD from sleep mode, but again, the modem (and MPEG decoding) had to be specifically enabled in software. This isn't a machine we'd recommend to a novice.

Physically, the ThinkPad is well made. The keyboard elevates at the rear for a different typing angle or totally lifts up at the front to reveal the battery, hard drive, and what IBM calls the "ultrabay." This bay normally contains the CD-ROM drive, but it can instead hold the floppy drive, an extra battery, or a second hard drive.

That's a lot of flexibility, but the implementation of these exchangeable parts is awkward. You remove any of the existing installed batteries or drives by pulling up on flexible blue plastic tabs at each device's rear. Presumably strong enough for the job, they don't inspire confidence, and slippery hands complicate the task.

Worse is the bezel that you must install when you exchange the CD-ROM for the floppy drive. The bezel covers an opening in the front of the ThinkPad, but you cannot put it into place unless you first

remove the battery—something the instructions don't mention. There are actually two different bezels included with the computer, one for the floppy drive and one for the battery or hard drive, and they're an outright nuisance. We ended up omitting the bezel, which meant the floppy drive wasn't held in place as firmly as it should have been.

Frankly, the bezels seem like just more fiddly little plastic bits to get in the way, to lose, or to break. The creative folks at IBM who dreamed up the Butterfly's expanding keyboard can surely come up with a better solution to plugging a hole. In this regard, Toshiba laptops do a much better job of dealing with peripheral drives.

Considerably more thought went into the power-supply brick. To reduce weight and bulk, the AC power cable is only 6 inches long. The length is in the thin cable that carries the DC to the computer. The brick has a molded ramp where the cable exits so that it won't take a sharp bend, as well as a socket to hold the other end of the cable when you're packing it. You simply wrap the cable around the brick and then plug the end into the top. But now there's slack in the cable and it will unwind, right? No, IBM has thoughtfully attached a Velcro strap that lets you tighten and neaten things up.

A Multimedia Standout

With MPEG playback, on-screen video quality was excellent and smooth. We also enjoyed the internal quad-speed CD-ROM drive. You can play audio CDs using the front-panel button, and a sliding control lets you adjust the volume through headphones (not included) or the two front-mounted stereo speakers, which sound about as tinny as you'd expect with 1-inch transducers. The drive also reads Kodak Photo CDs and plays Philips CD Interactive (CD-I) game and instructional discs.

The test unit came with Windows 95, including the Microsoft Internet Explorer and Microsoft Network. Additional bundled software included Asymetrix Compel PE and Mind Path multimedia presentation software; a FaxWorks faxing package; TranXit file transfer software, which can use serial, parallel, or the built-in (two-port) infrared links; Digital Video Producer, for capturing video; a Video CD-I player; and a group of Lotus applications, including ScreenCam, cc:Mail Mobile, and Lotus Organizer 2.0.

Product Information

ThinkPad 760CD $8134
(with 90-MHz Pentium, 256-KB L2 cache, 16 MB of RAM, 12.1-inch active-matrix color display, 1.2-GB EIDE hard drive, and quad-speed CD-ROM drive)
IBM Personal Computer Co.
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fax: (919) 517-1101
http://www.pc.ibm.com
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On the Road Again

The unit's full-size notebook keyboard is good, though not remarkably so. The built-in TrackPoint III pointing device is by far the nicest implementation of this type we've yet encountered. It's reasonably fast and accurate yet unintrusive. Both mouse buttons, located at the base of the keyboard, can be physically locked in place to make drag operations easier.

In tests with BYTE's Thumper 2, a robotic device that simulates actual use, the ThinkPad's lithium-ion battery lasted 3.0 hours with the CD-ROM drive inactive. Heavy CD use would cut this time drastically. (With a freshly charged battery, the ThinkPad's battery-gauge program indicated that we had 2 hours, 30 minutes of processing time.)

IBM's literature claims battery life ranges from 3 to 9 hours, presumably with all power-saving options adjusted to their most economical (and most intrusive) settings. Installing a second battery doubles the run time. Nickel-metal-hydride batteries are also available.

This well-equipped machine is for the power user who wants to consolidate his or her activities into one computer. To measure performance, we ran Windows 95 application test scripts (Microsoft Excel 7 and Word 7) developed by NSTL. When compared to a similarly configured 90-MHz Dell Dimension XPS P90 desktop system, the ThinkPad performed only two-thirds as fast due to a slower graphics subsystem, a bottleneck with most portables.

Gimme, I Wanna

It's not easy being a BYTE reviewer. Although we get to play with the latest tools, we have to deal with products that are sometimes mysterious and dumb.

The ThinkPad 760CD is neither of those. It's a very nice unit. About the worst thing we can say of the 760CD is that, compared to the competition, it's somewhat overpriced. But the display really changes the way you think about a laptop. I don't want to give it back to IBM. ■

Russell Kay is a BYTE technical editor. He can be contacted on the Internet or BIX at russellk@bix.com.

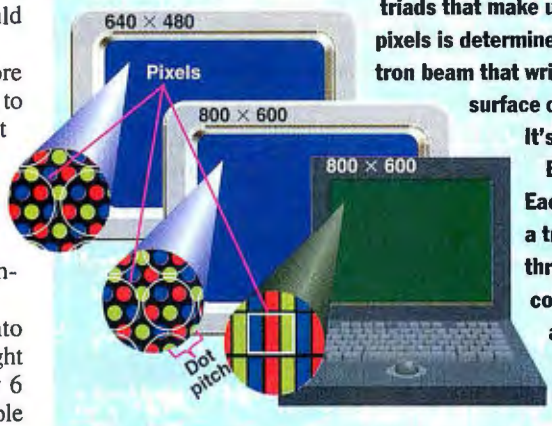
TECHNOLOGY FOCUS

What's the Resolution?

Now that notebooks like the ThinkPad 760CD support resolutions higher than standard VGA (640 by 480 pixels), there's a complication with DOS applications that still display at 640 by 480 on an LCD screen. On a desktop CRT display, there's no problem because there's no hard-and-fast connection between logical resolution and the red, green, and blue phosphor triads that make up the image. The spacing of pixels is determined by modulation of the electron beam that writes the image on the inside surface of the screen (see the figure). It's an analog system.

But LCD displays are digital. Each pixel is a physical element: a transistor-controlled set of three LCD cells, each with its own color filter (again, red, green, and blue). To get 640 by 480 resolution on an 800 by 600 screen, either you wind up with a smaller image that occupies only the center part of the display or the graphics processor tries to scale the image up to fit the screen. This process works adequately for video images, but it makes text look funny because the scaling can't be smooth. Some lines are doubled, but some aren't.

Pixels and Phosphor Dots



With a CRT display, the size and placement of pixels are not related to the array of colored phosphor dots that produce the image. With an LCD, each pixel is a physical structure.

NetWare Mirror with a Twist

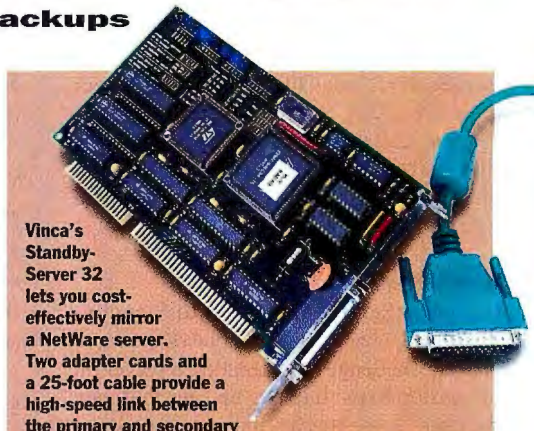
With its SnapShotServer option, Vinca's StandbyServer 32 provides inexpensive server mirroring and snapshot backups

BILL LAWRENCE

Your network users want increased performance and storage capacity, while management demands lower cost. Everyone wants 100 percent uptime. In the end, budget constraints may force you to sacrifice constant uptime for performance and capacity. In such a scenario, server reliability enhancers that require you to double your server hardware investment, such as NetWare SFT III and Compaq's Recovery Server Option, often don't make the financial cut.

Vinca's StandbyServer 32 allows you to mirror your NetWare server at a considerably lower cost than does NetWare SFT III, and its failure-recovery process gives you close to 100 percent uptime, which is good enough for many businesses. When you add Vinca's new SnapShotServer NetWare loadable module (NLM) to the mix, you get snapshot backups that don't affect server availability.

Testing on a small NetWare network, we found that both Vinca products work well, although installation and instructions are rough enough to require considerable NetWare expertise. We tested the $2599 version of StandbyServer 32, which comes with two ISA adapter cards. EISA and Micro Channel architecture versions cost $2999. A LAN Server version for OS/2 is also available. SnapShotServer costs an additional $1299.



Vinca's StandbyServer 32 lets you cost-effectively mirror a NetWare server. Two adapter cards and a 25-foot cable provide a high-speed link between the primary and secondary servers over which mirrored disks are synchronized. When the Sentry NetWare loadable module (NLM) running on the secondary server detects a server failure, its AutoSwitch feature reboots the secondary server and brings it up as the primary server.

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Disk Mirroring Goes the Distance

Unlike other server-mirroring solutions (see the Technology Focus on page 104), StandbyServer 32 doesn't require the secondary server to be an identical twin of the primary server. It requires only enough memory and CPU power to take over when the primary server fails and to limp along until it's fixed. You can use a less expensive server and disks to mirror the information on your primary server, and you can opt to mirror only those volumes storing critical information.

You also save money by not having to buy an additional NetWare license. However, if you install a separate NetWare license on the secondary server, it can mount volumes of its own and accept user connections while mirroring data on the primary server. The secondary server doesn't have to be dedicated to mirroring the primary server.

StandbyServer 32 achieves server mirroring simply but effectively. Two adapter cards (one each for the primary and secondary servers) provide a high-speed link over a 25-foot connecting cable (a 50-foot cable is optional). When you install and connect the cards and load Vinca's software, the disks in the secondary server appear as local disks to the primary server. You then use NetWare's disk-mirroring capability to duplicate information from the primary server's local disks to disks in the secondary server.

The secondary server uses a run-time version of NetWare (included with StandbyServer 32) with an NLM that manages the mirrored disks. A second NLM monitors the primary server. If the primary server fails, the secondary server reboots and mounts its copies of the mirrored primary-server volumes. In doing this, it assumes the name and internal IPX address of the failed primary server.

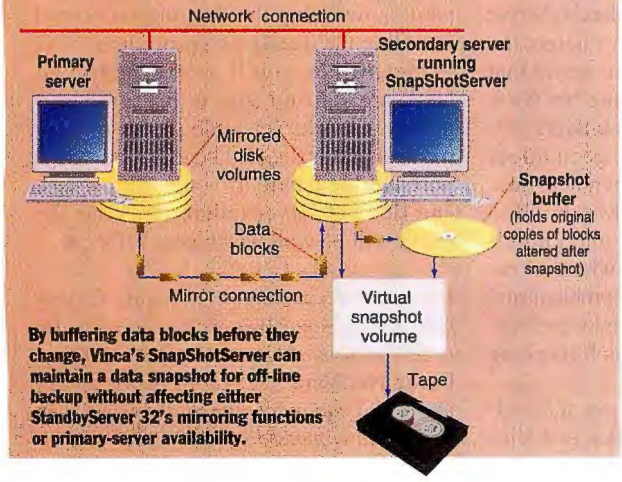
Users experience a brief interruption during the reboot, and they have to know how to reconnect once the secondary server is up. Thus, StandbyServer 32 doesn't match the seamless and nonstop fail-over service that NetWare SFT III provides (see the feature-comparison table on page 104). It also doesn't require two identical Novell-certified servers that are configured with equal amounts of RAM and disk storage, as does NetWare SFT III.

Not Idly Standing By

Vinca's use of NetWare's disk-mirroring capability has its pros and cons. Introduced in the mid-1980s, the technology is well established. Disk writes can take longer because they must be completed to two disks instead of one, but NetWare's caching insulates users from delays except in extremely write-intensive scenarios.

However, using an older secondary server can have performance drawbacks. To minimize performance consequences, the secondary server should have disks, a disk channel, and an I/O bus that compare favorably to the primary server. During normal operation, the CPU and memory performance of the secondary server matter little because the primary server handles all processing and disk caching. Obviously, when the secondary server takes over during a primary server's failure, its CPU speed and RAM quantity become significant. But if the secondary server needs to run only long enough to enable you to repair the primary server, you don't need to go first-class. *continued*

Recording a Point in Time



By buffering data blocks before they change, Vinca's SnapShotServer can maintain a data snapshot for off-line backup without affecting either StandbyServer 32's mirroring functions or primary-server availability.

While NetWare SFT III is truly fault-tolerant, and thus provides the best defense against hardware failure, it may provide less protection than StandbyServer 32 against software or OS failures. With NetWare SFT III, both servers run configurations that are duplicated. If an errant NLM causes the OS to fail and crash the server, both sides of the mirrored-server pair are likely to crash. With StandbyServer 32, the secondary server does not have to be configured to run the same drivers and NLMs when it reboots to become the primary server.

Freeze-Framing Your Data

SnapShotServer, an add-on to StandbyServer 32, elegantly solves one of the more vexing challenges of operating a server on a nonstop basis: backing up files that may be open. It does this by maintaining a snapshot of server data at a given moment.

The program is an NLM that runs on the secondary server. Once it takes a data snapshot of a mirrored-server volume, you can mount the snapshot as a regular NetWare volume and archive it using your regular backup software.

SnapShotServer doesn't interfere with Vinca's mirroring process. It tracks disk blocks that change after the snapshot and stores an unchanged copy of each changed block in a special buffer volume. The size of this buffer is typically 5 percent to 10 percent that of the volume you're backing up. A snapshot volume consists of the unchanged blocks from the original volume plus any blocks from the snapshot buffer. Because all the activity takes place on the secondary server, backing up doesn't impact performance, nor does it threaten the stability of the primary server with a software crash.

While Vinca's snapshot method is more reliable than backing up a live copy of open files directly from the primary server, it isn't risk-free. You could take the snapshot at the moment a database transaction is incomplete, for example. To reduce this risk, SnapShotServer will take snapshots only after there have been no disk writes for a specified number of seconds, so you can catch the volume at an idle moment when transactions are likely to be complete.

We found that SnapShotServer works well, but it whetted our appetite for more capability. There is no way, for example, to automatically keep multiple point-in-time snapshots of the same volume. You can configure SnapShotServer to make a snapshot at intervals of as short as every 15 minutes, but you must archive them with your backup software to preserve each iteration.

Not for Novices

Vinca's products worked as advertised in our tests, with one exception. StandbyServer 32 couldn't detect the failure of a server that was running NetWare 4.x unless bindery emulation was enabled. Vinca's technical-support staff responded promptly and knowledgeably when we reported this problem, and we received a preview copy of the next release, which fixes the problem.

Installation and configuration of StandbyServer 32 are complex tasks, and Vinca's attempts to automate the procedure with an installation utility caused more problems than the utility was worth. We resorted to manually installing Vinca's drivers and NLMs in the appropriate subdirectories and carefully configuring the AUTOEXEC.NCF and STARTUP.NCF files of the two servers ourselves. According to a Vinca spokesperson, the company is rewriting the documentation and retooling the installation procedure.

Meanwhile, you'll need expertise on NetWare start-up files to make Vinca's products work. Set aside plenty of time for trial and error, and keep Vinca's support number handy. If you need low-cost and flexible server failure recovery, the result will be well worth your effort. ■

Bill Lawrence manages LAN and PC computing for a major Western power utility. He is the author of Using NetWare 4.1 *and* Using NetWare 3.12 *(both published by Que). You can reach him on the Internet or BIX at blawrence@bix.com.*

Product Information

StandbyServer 32 . . . . .$2599 with ISA cards; $2999 with EISA or Micro Channel architecture cards
SnapShotServer $1299
Vinca Corp.
Orem, UT
(800) 934-9530
(801) 223-3100
fax: (801) 223-3107
info@vinca.com
http://www.vinca.com
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TECHNOLOGY FOCUS

Mirroring: Different Strokes

Each of the three available NetWare mirroring products deploys a unique mechanism to synchronize the mirrored servers and to start the secondary server when the primary server fails. StandbyServer 32 makes the disks in a secondary server appear as local disks to the primary server through two interface cards and a cable. NetWare's native disk mirroring duplicates primary-server data on the secondary server. When the secondary server senses primary-server failure over the network, it reboots and comes up as the primary server.

NetWare SFT III provides the only server mirroring that is nonstop fault-tolerant. You connect two identical servers by Mirrored Server Link (MSL) network adapters, which provide a dedicated high-speed communications channel between the servers. NetWare SFT III's Multi Server Engine module synchronizes the two servers so that the disk contents and memory image of each remain identical. The mirrored servers must be identical. When the primary server fails, the secondary server becomes the primary server without any interruption in handling user requests.

With Compaq's Recovery Server Option, two identical servers attach to the same SCSI disk array. If the primary server fails, the SCSI bus switches to the control of the secondary server, which reboots using the OS files and volumes found on the shared disk array. Users experience a brief interruption during the reboot and must reconnect to the server. Disk fault tolerance comes from the mirroring and RAID features provided by Compaq's SCSI controller.

FEATURE COMPARISON: SERVER-MIRRORING PRODUCTS

	VINCA STANDBY-SERVER 32	NETWARE SFT III	COMPAQ RECOVERY SERVER OPTION
Unattended fail-over	Yes	Yes	Yes
Nonstop fail-over (no user interruption)	No	Yes	No
Requires identical secondary server	No	Yes	Yes
Requires second NetWare license	No	Yes	No
Allows partial server mirroring (selected volumes)	Yes	No	Yes
NOS support	NetWare 4.x and 3.x	NetWare 4.x	NetWare 4.x and 3.x, Windows NT

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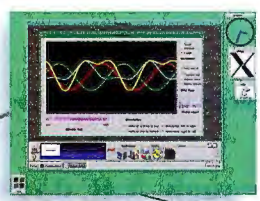

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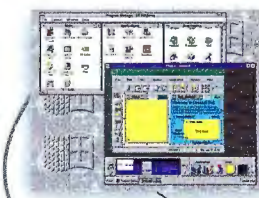

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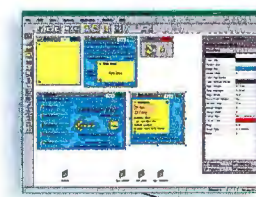

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If you're tired of waiting for the paperless office, you can at least create the paperless cubicle with a low-cost personal document scanner. A device category that was jump-started by Visioneer's innovative PaperPort, the personal document scanner doesn't require a radical revamp of corporate work flow, data-input systems, or cultural habits. Trim, inexpensive sheet-fed scanners sit on personal desktops, suck in reams of paper, and establish an efficient electronic filing system at a single workstation. Think of it as a grass-roots paperless revolution.

As BYTE editors, we go through piles of personal paper each day. By using personal scanners to manage our own paper crisis, we've gauged their strengths and weaknesses in handling paper overload. We evaluate the trailblazing PaperPort as a representative example. Visioneer recently released the PaperPort Vx upgrade.

Hewlett-Packard has a newer approach to the same problem: its unique HP ScanJet 4Si network scanner, which comes with an older edition (3.0) of the PaperPort software. An entire workgroup shares a single ScanJet 4Si, with each workstation running a local copy of the software.

If you want to include color elements in your document/image repository, consider Logitech's PageScan Color (see the text box "ScanMan Scans 24-bit Color" on page 108).

AL KAREVY © 1996

Personal document scanners should be easy to use and easy on precious desk space. Visioneer's upgraded PaperPort Vx (above) fits snugly between your keyboard and monitor. Hewlett-Packard's HP ScanJet 4Si doesn't sit on your desk at all. You plug it into your NetWare network and share the hardware across a workgroup.

Personal PaperPort

The Visioneer PaperPort is a simple, no-frills solution that does a specific job and does it well. It manages your *personal* paper. When you feed in a page, the scanner cranks up, pulls the page through, and scans it. The only mechanical adjustment is a sliding cover that changes the paper path from a loop (to drop the paper out in front) to a direct pass-through (to drop the paper out the back—good for business cards and other small items).

It takes about 6 seconds to scan in a full page. The image then appears on the PaperPort 3.5 desktop. You can drag the scanned image onto PaperPort links at the bottom of the screen. If you drop it on the Word icon, PaperPort transparently converts the image into a Word document using the bundled version of OmniPage Lite OCR and then fires up Word with the new file.

Also, you can drop the image on the cc:Mail link and send it to a coworker. The coworker will then need the PaperPort software, or a PaperPort Viewer utility, to read the document and add annotations. Annotations include sticky notes, highlighting, overlay text, freehand pencil, and straight lines.

From the desktop, you can drag the electronic documents (or images) into folders that live along the left side of the screen. Unfortunately, PaperPort doesn't support

TECHNOLOGY FOCUS

OCR: A Lomg Way fr@m the O!d Dajs

Over the past 10 years, OCR has come a long way. Early desktop-based OCR solutions required tedious user training. The software would build a database, assigning an ASCII value to the bit-map image of each character it came across. Once trained, the OCR engine compared scanned character images to the images in its database, returning an ASCII character that represented the best match. Besides consuming time and resources, trainable packages did not work well when faced with a variety of fonts.

Instead of bit-map matching, *omnifont* technology uses feature extraction to distinguish characters, breaking down a character into its component parts and recognizing an image based on its unique combination of shapes. Omnifont requires no training, consumes less disk space, and, because a character retains the same basic features regardless of the font, works well across a broad range of typefaces.

Technology developed by Caere (maker of OmniPage Pro 6.0, WordScan Plus 4.0, and OmniPage Lite OCR, which comes bundled with the PaperPort software) not only recognizes single characters but evaluates entire words to make better predictions. The technology is based on the hidden Markov model, a complex mathematical model used in predictive technologies such as speech recognition and DNA matching.

The OCR engine looks at all the pixels that make up a word and then uses probability algorithms, including contextual evidence and language rules, to select the most probable word. Trigram analysis and dictionaries further improve accuracy. Trigram algorithms consider the probabilities of three words appearing together and can adjust the prediction of a single word based on the trigram probabilities.

hierarchical organization (i.e., a folder within a folder). A single level of folders is a real drawback when it comes to organizing all that electronic paper.

Using PaperPort's 2.0 file format, the stored images are fairly compact. We found that an 8.5- by 11-inch text document typically consumed from 35 to 55 KB of disk space (turning on the SharpPage feature generates larger files but makes OCR more accurate). A 3- by 5-inch, 8-bit gray-scale photo took up about 40 KB, and a business card about 15 KB.

Visioneer's PaperPort Vx is a refreshingly simple idea done right. We intend to put it to good use clearing out our piles of personal paper. Now if it could only file boxes of software....

If you're familiar with PaperPort, here's what's new with Vx:

- 8-bit gray-scale images, for 256 levels of gray (up from 1-bit monochrome)
- OmniPage Lite, for transparent OCR
- CardScan SE Business Card Reader software, for scanning business cards
- PictureWorks Copy Machine software, for making PaperPort and a printer function as a copy machine
- New links and file types: Lotus Notes and cc:Mail, Microsoft Mail and Exchange, Novell InForms, Xerox TextBridge Pro, Corel Photopaint, Adobe Acrobat, JPEG, and GIF.

Workgroup Scanning

Hewlett-Packard's new network scanner, the HP ScanJet 4Si, extends the PaperPort model out to the workgroup. It connects directly to a NetWare network (3.1x and up) and includes a 20-seat user license for the PaperPort 3.0 software. It's a 15-page-per-minute, 300-dot-per-inch, 8-bit flatbed (8.5- by 11.7-inch scan area) scanner with a 50-page document feeder and a 10Base-T or Token Ring connection.

The ScanJet 4Si compresses scanned documents, using G4 and Packbits compression, to its own 135-MB hard drive before sending it over the network for temporary storage on a NetWare server. We confirmed HP's claimed performance of approximately 2½ minutes for a 15-page text-mode (1-bit) job.

HP's Windows 3.x software makes NetWare installation and administration easy. You run the installation program from any Windows client to install the NetWare loadable module (NLM) and administration utility on a server. From the administration utility, you configure the scanner, connect it to other servers, build user lists, and set up print queues to enable copying. Workstation users can download drivers, a client version of PaperPort, and a utility for monitoring the scanner's status.

To scan, you scroll to your workstation's name from the ScanJet 4Si's LCD panel, load up to 50 pages in the feeder, select a mode (text, photo, or mixed), hit the start button, and wait for the images to appear on your local PaperPort desktop. PaperPort loads if it's not already running, and the scanner remembers individual user settings. From that point, you can OCR, fax, print, or drop the image on application links. Version 3.0 of the PaperPort software does not include CardScan SE Business Card Reader, PictureWorks Copy Machine, or desktop folders.

That's right: This PaperPort version doesn't let you organize your images into folders. All the images share the same PaperPort desktop, so there is no way to organize your stuff beyond stacking pages on top of each other. It's sort of like selling a bookcase and charging extra for shelves. You'll want to upgrade to version 3.5 of PaperPort ($599 for a 20-user upgrade) for any serious archiving needs.

With a network scanner, your entire workgroup requires only a single hardware device, saving hardware costs and centralizing maintenance. And best of all, you can load up to 50 pages at once. All the scanned pages will appear on the PaperPort desktop as a single stack, so you may need to perform the time-consuming task of separating the stack into individual documents.

The ScanJet 4Si lets your entire workgroup easily standardize on the PaperPort software. Once standardized, the workgroup can share PaperPort documents, route them across the network or as E-mail attachments, annotate them, and establish a work flow by way of PaperPort.

Solutions for a Small Cubicle

We think the PaperPort Vx is the best general solution for personal paper management. For the scanning of smaller documents scattered throughout the day, it proved most convenient.

However, for batch jobs and large documents, the ScanJet 4Si's 50-sheet feeder is well worth the walk to the scanner. Price and number of users will then drive your buying decision. The combination of a ScanJet 4Si with a 20-user upgrade to PaperPort 3.5 software costs about the same as 10 PaperPort Vx units. So, if your installation requires more than 10 users, you should choose the ScanJet 4Si. ■

Stanford Diehl is a director of BYTE reviews. Currently, he consults, writes, and works as an administrator of color prepress systems. You can reach him on the Internet or BIX at sdiehl@bix.com.

SCANMAN SCANS 24-BIT COLOR

Once you have a personal scanner on your desktop, you'll probably find yourself needing an occasional color scan: a color photo or a color-coded graphic. Logitech's new PageScan Color adds some solid features to the sheet-fed personal-scanning category, including 24-bit color. Also, you can remove the PageScan Color from its base to hand-scan larger items or bound material without removing pages. The estimated street price is $399.

The PageScan Color comes with Xerox TextBridge OCR, PaperMaster SE document management software, a low-end image editor, fax and copier components, and a TWAIN driver, so you can scan into almost any Windows imaging application. PaperMaster SE supports file drawers as well as file folders for an extra level of organization. However, because it uses a proprietary file format, you can't get electronic documents into or out of PaperMaster SE. To get import/export capability, you'll need to upgrade to the full version of PaperMaster for $49.

Product Information

HP ScanJet 4Si
Ethernet, $2999;
Token Ring, $3199
Hewlett-Packard Co.
Santa Clara, CA
(800) 722-6538
(208) 396-2551
http://www.hp.com
Circle 1130 on Inquiry Card.

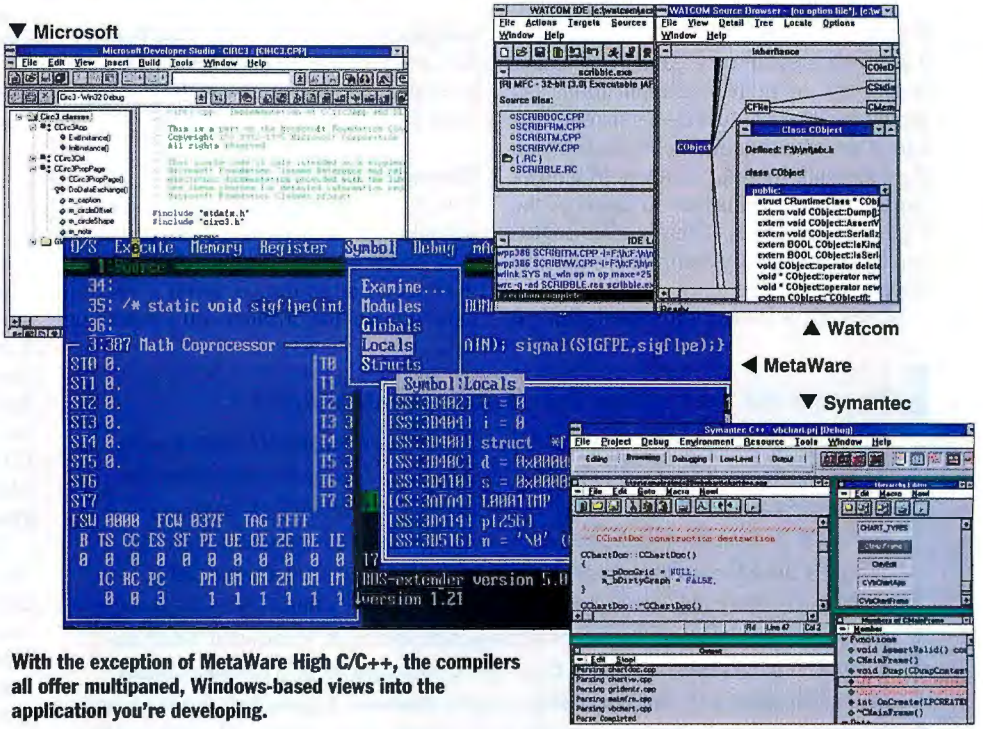
PageScan Color $399
(estimated street price)
Logitech, Inc.
Fremont, CA
(800) 231-7717
(510) 795-8500
fax: (800) 245-0000 (fax back)
Circle 1131 on Inquiry Card.

PaperPort Vx for Windows or **PaperPort Vx for Macintosh** $369
(estimated street price)
Visioneer, Inc.
Palo Alto, CA
(800) 787-7007
(415) 812-6400
fax: (415) 855-9750
http://www.visioneer.com
Circle 1132 on Inquiry Card.

Compiling Convenience +

We rounded up DOS/Windows-based C++ compilers and found Microsoft and Watcom are tops, but where's Borland's upgrade?

RICK GREHAN



With the exception of MetaWare High C/C++, the compilers all offer multipaned, Windows-based views into the application you're developing.

You don't just buy a C++ compiler anymore. Well, you can, but in these days of rampantly spreading windowing operating systems, you wouldn't want to. The actual compilation of C or C++ source code into a final application is just one in a series of operations, some of which can be more complicated than the compilation itself. Hence, the C++ compiler becomes just one piece of an *environment*, a coordinated collection of tools that can include text editor, browser, debugger, profiler, resource editor, and so many others that all the icons barely fit on even the biggest screen.

In this roundup, we examine five C++ environments targeted for the Windows platform: Microsoft's Visual C++ 4.0, Watcom's C/C++ 10.5, Symantec's C++ 7.2, and MetaWare's High C/C++ 3.31. We also look briefly at Borland's C++ 4.53; briefly because this article went to press at a cusp in Borland compiler development. Borland 5.0 was just around the corner but not shipping in time for us to review it (the package will likely be available by the time you read this).

Common Ground

Hard as the designers try to differentiate their products, most everyone (except for MetaWare) provides a browser. Visual C++'s browser, ClassView, employs the expandable-tree format common to Windows 95 and is only one "view" into the application under construction. (Another view provides a similar tree whose leaves are the source code files.)

Symantec's browser arises out of the teamwork of the hierarchy editor and the class editor. The former is a tree-like view into class hierarchy, the latter is a Smalltalkish three-pane editor. Both Symantec and Visual C++ do parsing work in the background even before you've done any compilation, which means that once source files are in your Symantec project, you can begin using the hierarchy editor and the class editor.

Watcom's browser is more sedate. It's a separate application that you can nonetheless launch from within the integrated development environment (IDE). It reads a browse database created during compilation—provided you've set the appropriate option in the project. Watcom's browser is like Symantec's hierarchy editor: It lets you go from an element in the browser window to the location in the source files where that element is defined. However, this requires the Watcom system to call the editor up; Symantec and Visual C++ are better integrated in this regard.

MetaWare High C/C++ 3.31

Advantages:

- Consumes only 15 MB of disk space (actually comes on floppies)
- Compiler is synchronized with the latest ANSI specifications
- Free technical support

Disadvantages:

- A command-line product, it lacks an integrated development environment
- Limited platform support; e.g., it can't create a Windows NT target
- Needs additional components to make a complete development system

MetaWare High C/C++ 3.31

When it comes to the High C compiler, everything we've said so far about IDEs goes out the window. High C is purely a set of command-line tools. Admittedly, the editor is window-based, as is the debugger, but it's window with a small *w*—character graphics only. We'd like to call it charmingly primitive, but it doesn't take long for the charm to evaporate. High C doesn't even come with its own linker, for crying out loud. MetaWare offers an optional one for free, but it creates only Windows 3.x-compatible executables.

Can you build a 32-bit Windows application with High C? Certainly you can, but you can also use a shovel instead of a snow blower to clear your driveway. Furthermore, the 32-bit application you'll build will not be a Win32 app. MetaWare supplies its own "supervisor," a program that acts as an intermediary between the 32-bit code of your program and 16-bit Windows. Therefore, the target is really

Windows 3.x, not Windows NT or 95.

High C/C++ does have some positive attributes. MetaWare has worked to keep the compiler up to the latest ANSI C++ standards, including exception handling, run-time type information, namespaces, and so on. And MetaWare bundles in Rogue Wave Software's impressive Tools.h++ class library. This library easily supports multithreaded applications and provides classes to handle persistent storage, a set of collections classes built on the Smalltalk model, and even Windows support with I/O classes to manage the clipboard and DDE. There's also a DLL version of the library that reduces the size of your executable.

High C/C++ comes with free technical support. And it's no small accomplishment that the compiler arrives on six high-density floppy disks and doesn't consume hundreds of megabytes of disk space. The glamour of this economy fades, however, when you realize that you have to get a linker separately to have a complete development system. Though MetaWare offers a somewhat limited one for free, we used the linker that comes with Phar Lap's TNT DOS Extender ($595).

Microsoft Visual C++ 4.0

You may be wondering what happened to Visual C++ 3.0. Microsoft skipped from 2.0 (which we reviewed last April) to 4.0 in order to align the compiler's version number with that of Microsoft Foundation Classes (MFC) 4.0 class library. MFC 4.0 comes with Visual C++ 4.0 and carries such new features as support for Windows Common Controls (supplied with Windows 95 and NT), integration with the OLE controls developer kit, and classes to encapsulate Data Access Objects (DAO). The Technology Focus at left explains the role of DAO and the Borland Database Engine (BDE).

In Microsoft's IDE, the emphasis is on the word *integrated*. Called the Developer Studio, this IDE can serve as a docking station for not only Visual C++ but also Visual Test and Visual FORTRAN Powerstation. As capable as the Developer Studio's user interface is, we worry about its density. Obviously, Microsoft's engineers labored to cram as much functionality onto the screen as possible.

Visual C++ 4.0 introduces the Component Gallery object repository, which is useful on several levels. In one sense, it provides a way to manage classes more as objects than as conglomerates of source code, making it a kind of source-code-management system. To place a class into an application, you just withdraw a copy of it from the Component Gallery and place it in your application; you don't have to cut and paste from header files, `.cpp` files, and so on. Furthermore, using the gallery to insert a class does more than simply move source code. You can, for example, associate a resource with the class, and the resource will be automatically added to your source code.

You can easily store third-party OCXes in the gallery. It took us only a few mouse clicks to quickly install an OCX in the Component Gallery and insert it into a sample application. Visual C++ did the dirty work by reading the OCX and generating the source code for a C++ "wrapper" class. This class included prebuilt methods that are associated with each OCX's functions, and

Microsoft Visual C++ 4.0

Advantages:

- Is a complete, tightly integrated development environment
- Component Gallery provides reuse and software management
- Just-in-time debugging finds bugs before program crashes

Disadvantages:

- Easy to get lost in the IDE
- 16-bit development requires separate (though included) compiler

TECHNOLOGY FOCUS

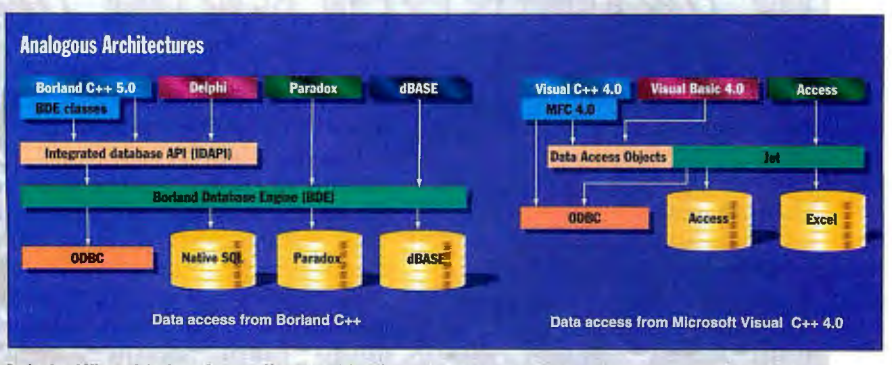
Keys to the Enterprise: Data Access Technologies

Data access methods like Microsoft's Open Database Connectivity (ODBC) or Apple's Data Access Language provide a common layer over small local databases and server-based SQL engines, but integrating these low-level technologies into a high-level development environment requires additional components. Enter Microsoft's Data Access Objects (DAO) and the Borland Database Engine (BDE).

DAO consists of objects that make up the programmer's interface to Microsoft's Jet engine, the database manager that underlies Microsoft Access and Visual Basic. DAO 3.0, bundled with Visual C++ 4.0, is implemented as a Common Object Model-compliant DLL and works only in 32-bit Windows. It gives fast 32-bit access via Jet to native Access data using the same simple, abstract data objects found in VB. Microsoft Foundation Classes (MFC) 4.0, included in Visual C++ 4.0, wraps DAO objects into C++ classes similar in structure to those that encapsulate ODBC, giving MFC programmers a more-or-less consistent path to both technologies.

Like Jet, BDE is a high-speed database engine and COM object that underlies a collection of development tools and commercial packages (Borland's Delphi, Paradox, dBase, and Quattro Pro), simplifying data sharing. BDE provides access to ODBC and native access to a few SQL databases through Borland's SQL Links.

Using Borland C++ 4.5x, programmers reach these data sources via BDE through C API calls into the BDE DLL (Borland's integrated database API, or IDAPI). Borland C++ 5.0 integrates BDE by wrapping IDAPI calls into C++ classes designed using Delphi's data object model. Watcom and Symantec provide direct ODBC support through the 16- and 32-bit versions of MFC included with their packages. —Steve Apiki



Borland and Microsoft both use Common Object Model (COM)-compliant components to access their high-speed database engines.

public member variables associated with the object's properties.

Visual C++ 4.0 includes just-in-time debugging. If you're running a debug release of your application and a run-time error occurs, the system presents a dialog box that gives you the choice of either terminating the application or dropping into the debugger (with the source window aligned at the location of the offense).

Visual C++ 4.0 is above all a 32-bit product: It can target Win32s, NT, and Windows 95. A separate CD-ROM that comes in the box carries a copy of Visual C++ 1.52c, which supports 16-bit MS-DOS, Windows 3.1, and Windows for Workgroups 3.11. Microsoft promises a RISC version of C++ 4.0 on NT for PowerPC, Mips, and Alpha platforms. A cross-development edition is available for PowerPC and 68K-based Macintosh systems.

Symantec C++ 7.2

Our recent review of Symantec C++ 7.2 (see "Symantec C++ Differences," December '95 BYTE) aptly pointed out that Symantec has always been the "other" C++ vendor behind Microsoft and Borland—despite Symantec's knack for producing significant innovations in its compiler's integrated development and debugging environment (IDDE).

Netbuild is one such innovation. It's a distributed compilation environment that allows you to turn other machines on your network into compilation servers. It's particularly useful in large projects or when you can run the build during off hours.

Symantec C++'s IDDE preparses your application's source code when you first load the project with source files. This preparser can tell if source code has changed, automatically reparsing in that event. Like `make`, it parses only those files that have changed.

The preparsed results feed into the text-handling components of the IDDE, which makes possible a Smalltalk-like three-pane browser and editor combination. The editing capabilities of this three-pane system are complete: When you seek a member function within a class, a lower-level editing window opens. If you make changes, the proper source-code file gets updated.

The preparsing works in the background, but it can get annoying if you've just started working with an MFC application and you're running the software off a CD. Depending on the speed of your system, the preparser can take a while to read all the MFC Include files. (Yes, Symantec provides support for MFC: Versions 2.53 and 3.2 are bundled with the package.)

Symantec is also innovative in providing a scripting language, Symantec BASIC, that lets you automate many of the features of the IDDE (particularly the editor) that are otherwise activated via menus and toolbars. Also, just as the Microsoft Component Gallery provides a "wrapping service" for automatically constructing a C++ class interface to OCXes, Symantec's VBXExpress will automatically construct a C++ wrapper class around a VBX.

Symantec's target coverage is nearly as broad as Watcom's. From the IDDE, you can produce executables and DLLs for 16- and 32-bit DOS, as well as for Windows 3.1, Windows for Workgroups 3.11, Windows 95, and Windows NT. Symantec shares a spot with Microsoft as one of only two vendors in this roundup that also provide a Macintosh product (though Microsoft's is a cross-development system, while Symantec's is native on the Mac).

Symantec C++ 7.2

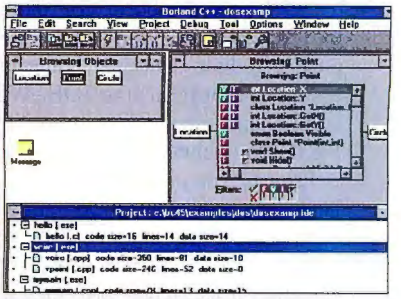
Advantages:

- Tightly integrated development environment with extensive drag-and-drop capabilities
- Netbuild allows distributed compilation

Disadvantages:

- Full installation takes nearly 300 MB
- Below-average performance of generated executables

Borland's 5.0



The upcoming version 5.0 of Borland C++ will incorporate more executables into the integrated development environment, making it more competitive with Microsoft and Symantec compilers.

Borland C++ 5.0 was warming up on the launchpad as we labored on this roundup. Though Borland 4.53 ($499.95; (800) 233-2444) was available—and we used it in our benchmarking—we chose not to perform an official review of either. Instead, here's a preview of version 5.0, based on our hands-on experience with the beta. We'll take a closer look at 5.0 when the final release ships.

The new Borland C++ 5.0 promises to move in the direction of the more integrated development environments (such as Symantec and Microsoft) and away from the approach of separate executables orbiting the IDE. It will also move more components into the IDE and will provide true background compilation.

Unlike Visual C++, the Borland C++ 5.0 compiler will still let you target 16-bit platforms (Windows and DOS) from a single host. Borland chose this backward compatibility (rather than including a separate compiler, as does Microsoft) because of research showing that users are not jumping to 32-bit environments all at once.

Borland's ObjectWindows Library (OWL) will leap from version 2.5 (the current version bundled with the 4.53 compiler) to version 5.0, bolstered with a variety of Windows 95-type controls. OWL will not, however, be the only application framework recognized by the 5.0 compiler. Borland C++ 5.0 will support the latest version of MFC and will include the Rogue Wave standard C++ library, which includes the standard template library.

Borland C++ 5.0's IDE will also be outfitted with a scripting language. Borland describes ObjectScripting as being very C++-like, which means that a C++ programmer will already have a leg up on the language rather than being forced to switch mental gears to deal with a BASIC clone. Borland promises that the language will provide access to most of the IDE's internals, beyond the capabilities of the scripting language found in Symantec C++. For example, you could create a script that automatically locates all the source files in a particular directory, gathers them into a project, then builds the project.

With its C++ 5.0, Borland will incorporate the database package as part of the compiler package. Compiler developers will thus have access to the Borland database engine, which is explained in the Technology Focus on page 110.

Watcom C/C++ 10.5

Watcom's greatest strength is its cross-platform capabilities. From a single IDE, you can generate targets for DOS (16-bit and extended), all the Windows platforms, OS/2 (16- and 32-bit), and NetWare. Its support for host platforms is equally broad; you can run the Watcom IDE from 16-bit Windows, Windows NT and 95, and OS/2. Watcom C/C++ has been the base platform for our BYTEmark benchmarks since their inception.

The Watcom box arrives with the usual entourage of support tools: debugger, profiler, heap walker, spy, and a post-mortem debugger called Dr. Watcom. There are also image and dialog editors that can be launched on their own or shepherded by the resource editor. Watcom's philosophy

is distinct from Microsoft's and Symantec's. Where the latter companies have moved to pull the main development components (editor, debugger, compiler) under a single, umbrella-like IDE, Watcom's components are separate executables that the IDE launches as required.

Prior to version 10.5, Watcom C/C++ lacked a visual application builder; it now has Blue Sky's Visual Programmer. Not as robust as, say, Visual Basic, Visual Programmer nonetheless provides a graphical mechanism for populating your application with resource-type objects—buttons, bit maps, menus, etc.—all the while constructing source code (built atop MFC, which ships with the compiler) as you specify the components' functions. We particularly like the menu and dialog-box capture feature, which is a kind of reusability tool. Activate dialog box capture, then launch another application: Whenever you move the pointer over a dialog box, the cursor turns into a stylized hand with pointing finger. Double-click, and a copy of the dialog box moves into the Visual Programmer's dialog-box editor, ready for inclusion in your application.

Watcom C/C++ 10.5

Advantages:

- Supports a variety of host and target platforms
- High-quality compiler output

Disadvantages:

- Comes with few wizards or expert tools
- Browser and some other tools are not tightly integrated with development environment

Watcom gets high marks for its multiplatform support. And the quality of floating-point math produced by the compiler is a cut above average.

What to Test?—and How?

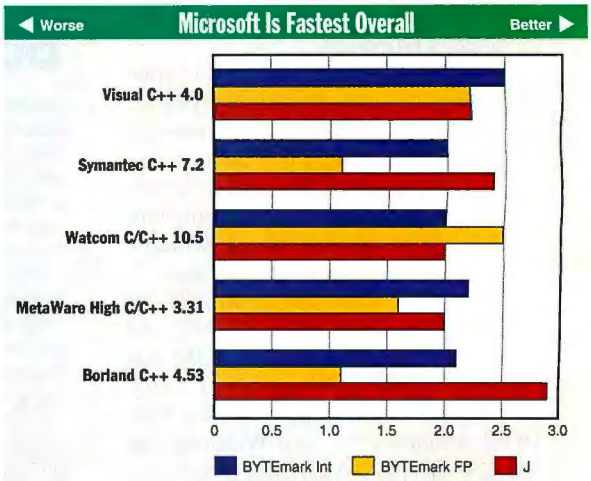
Actual compilation comprises a smaller part of building an application today, and one that's increasingly difficult to time. New technologies such as Symantec's Netbuild make comparisons even more difficult.

Consequently, we chose to focus our benchmark testing on the quality of code that each compiler produced. We selected two programs: our own BYTEmark and the public-domain version 7 of the J programming language. BYTEmark is a collection of 10 tests that exercises the CPU, FPU, cache, and system memory; J is a complete interpreter that is the last public-domain release of the J language's source code prior to J's becoming a commercial package. (For details, see "The Joy of J" by Dick Pountain in the September '95 BYTE.)

We shipped BYTEmark source code to each vendor and asked them to determine the best optimization settings for the program. We compiled the test according to their recipes and ran the resulting executable on an Intergraph system running Windows NT 3.51 with dual 150-MHz Pentium Pro processors. (No benchmark we tested was multithreaded, so the additional processor had no effect.)

The results of the tests appear in the graphs above. The BYTEmark index figures are automatically calculated by the program. For the J test, we entered a short linear programming script (short by J standards, that is) that performs the simplex algorithm. We also entered a script to calculate the determinant of matrix and turned it loose on an 8x8 matrix. (Note that although we did not formally review Borland's product for this article, we include the results from their version 4.53 compiler for comparison purposes.)

If we were to base our conclusions on BYTEmark results alone, then Microsoft is the clear winner, with Watcom close behind. The J benchmark, however, provides a different perspective. Ironically, Borland fared better than the rest. The difference in performance of the two tests is likely due to the different code models they present. Tests within the BYTEmark tend to be small routines executed repeatedly; execution flow in the J interpreter will be less localized.



C++ compilers perform differently depending on the code model. Microsoft Visual C++ 4.0 is fastest in the algorithm-based Native-Mode BYTEmark tests. Borland C++ 4.53 is tops in compiling two scripts written in the public-domain J language, a code flow that is less localized. Indexes are based on the performance of a 90-MHz Dell XPS P90 Pentium system (which scores a 1.0 in all the tests).

If-Else Statement

Deciding which C++ environment to buy depends largely on your target. If you're going for platform coverage within the Intel family, we recommend Watcom. Though its integer performance has slipped compared to other compilers, it continues to do well with floating-point code. The new Visual Programmer makes Windows development with the Watcom package a less strenuous challenge. Close behind Watcom is Symantec, which covers nearly as many target platforms, provides a well-thought-out development system, and is designed by a crew of engineers who continue to amaze us with their imaginative extensions to the IDE.

For people who know they're going to be working on 32-bit Windows platforms, Microsoft's Visual C++ is our top recommendation. Its overall performance (combining all benchmark scores) takes first place. Plus, the Component Gallery—already a useful mechanism for rapidly incorporating OCXes into a C++ application—will evolve into a more robust object-management system. ■

Rick Grehan (rick_g@bix.com), a BYTE senior technical editor, developed the BYTE benchmark suite and writes the monthly CodeTalk column. He has an M.S. in mathematics/computer science.

Product Information

High C/C++ 3.31 . . . . . $795
($995 with Phar Lap TNT DOS Extender)
MetaWare
Santa Cruz, CA
(408) 429-6382
fax: (408) 429-9273
techsales@metaware.com
Circle 1133 on Inquiry Card.

Microsoft Visual C++ 4.0. . $499
Microsoft Corp.
Redmond, WA
(800) 426-9400
(206) 882-8080
fax: (206) 936-7329
http://www.microsoft.com
Circle 1134 on Inquiry Card.

Symantec C++ 7.2 . . . . . $399
Symantec Corp.
Cupertino, CA
(800) 441-7234
(503) 465-8470
fax: (503) 334-7400
http://www.symantec.com
Circle 1135 on Inquiry Card.

Watcom C/C++ 10.5. . . . . $350
Powersoft
Waterloo, Ontario, Canada
(519) 747-4971
fax: (519) 886-3700
http://www.watcom.com
Circle 1136 on Inquiry Card.

CD-ROM Changers: The Inside Story

Upgrade to one of these internal quad-speed CD-ROM drives from Alps or NEC and put four discs on-line instead of one

CHRIS O'MALLEY

Anyone with even a small handful of favorite CD-ROMs can easily see the value of a CD-ROM player that holds several discs at once. That goes double if you depend on a CD-ROM-based reference work or phone directory. But until recently, CD-ROM changers were available only as bulky, external, and often pricey "jukeboxes."

New internal changers from NEC and Alps put four discs at your disposal. The NEC MultiSpin 4x4 CD-ROM Changer and the Alps 4X Internal CD-ROM Changer are both quad-speed CD-ROM players that hold four discs yet fit into a standard half-height drive bay. They come with Windows software and handle regular CD-ROMs as well as audio CD, Enhanced CD (or CD+), Photo CD, CD Interactive (CD-I), and Video CD discs. Most important, neither will break the bank: The Alps 4X lists for $410 and is likely to be substantially discounted, while NEC gives the MultiSpin 4x4 an estimated street price of just $279.

Nakamichi makes the MultiSpin 4x4 drive for NEC and is also supplying it to a number of major PC companies to include in their systems. By the time you read this, Nakamichi will be selling its own version, called the MJ-4.4, in a retail package for the same $279 estimated street price.

Not to be outdone, Panasonic just introduced—too late for this review—a half-height internal CD-ROM drive that holds five disks. The $399 Big 5 quad-speed drive has a multitray mechanism that you load with bare discs. Panasonic claims a disc-switching time of less than 5 seconds.

Two Loading Approaches

Both the Alps and NEC drives reviewed here come with the same short, L-shaped Enhanced IDE (EIDE) interface card made by Future Domain, as well as an IDE ribbon cable to connect them and audio cables (for linking the CD-ROM drive with a sound board). Both drives also have a headphone jack and a volume-control wheel on the front plate. You can install either drive horizontally or vertically.

For all the similarities between the two drives, they approach disc storing and swapping quite differently (see the Technology Focus box on page 114). Like many car audio players, the Alps 4X uses a magazine mechanism (derived from the mechanism used in the car stereos made by Alps' Alpine division). The NEC MultiSpin, on the other hand, uses a direct-feed mechanism in which there are no trays, caddies, or magazines. This mechanism has also been proven in audio CD players from Nakamichi and in an external seven-disc changer.

AL KAREVY © 1996

Both the Alps 4X (bottom) and the NEC MultiSpin pack four discs into a half-height 5¼-inch form factor. The Alps unit uses a cartridge (shown), while the NEC drive feeds in bare discs. Other similarities are quad speed (600 KBps) and an EIDE interface (adapter card included).

You can configure each drive to handle its multiple discs in either of two ways: as a single drive letter, where you select which disc is active, or with multiple drive letters (e.g., D, E, F, and G). The single-drive mode makes it easier to run multidisc games and other titles that you must install and run from one drive letter. With the Alps 4X, you select the active disc by pressing a button on the drive. With the NEC MultiSpin, you do it through the provided Windows utility program.

Treating a multidisc drive as four separate drives, on the other hand, means you can launch programs without selecting a slot. But it also means that the programs must be in the same drive-letter slot in which you installed them and that multidisc programs designed to work with only one drive letter (as many are) must all use the same slot—forcing you back into a manual disc swap. Also, audio CDs can be played only in the first slot in this mode.

Either way, these two drives function best as a convenient place to store and play single-disc titles. That gives the less-expensive NEC MultiSpin the advantage, because you can easily insert or remove one disc at a time. Unless Microsoft endows Windows with the ability to fluidly direct CD-ROM changers, the best hope for simplifying multidisc games is the recently announced digital videodisc standard, which promises enough capacity to eliminate the need for multiple discs in most cases.

MultiSpin Eats Naked Discs

As it has done with its other products, NEC takes extraordinary steps to make the installation process painless with a "getting started" poster and, if you prefer visual instructions, a videotape. Still, installation isn't a no-brainer. The procedure varies, depending on whether you already have an available secondary IDE connector (and therefore don't need the interface card) and whether you're running Windows 3.1 or Windows 95. There are also DIP switches involved. The NEC manual outlines the steps, but it does a relatively poor job of putting the if/then choices into perspective.

NEC's setup software in-

Feature	Alps 4x Internal CD-ROM Changer	NEC MultiSpin 4x4 CD-ROM Changer
Price	$410	$279 (estimated street price)
Data transfer rate (KBps)	600	600
Average access time (ms)	210	250
Buffer size (KB)	128	128
Interface	EIDE	EIDE
Disc loading	Four-slot magazine	Single-feed
IDE burst transfer	PIO mode 3 (11.1 MBps)	PIO mode 3 (11.1 MBps)

TECHNOLOGY FOCUS

Changing of the Discs

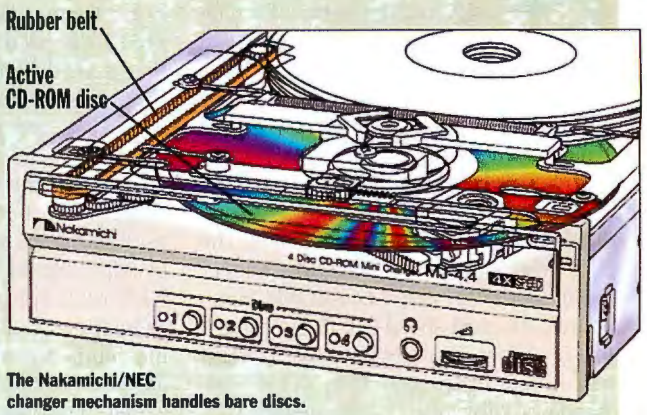
How do you fit a CD-ROM reader and four discs into a half-height drive? Alps' 4X uses a four-tray magazine. Once you insert the magazine into the drive, the disc-picking/reading mechanism rises or lowers to the level of the disc you want to play. An arm hooks the appropriate disc tray and pulls it partially out of the magazine stack. Each tray has a large opening on the bottom, providing room for the spindle to clamp it, for the motor to spin it, and for the pickup to read it. The overlapping storage and play areas enable the mechanism to fit within a standard half-height drive.

The NEC MultiSpin 4x4, designed by Nakamichi, tackles the task by eliminating disc caddies, trays, and magazines. The insertion of a bare disc trips an optical sensor that activates a drive belt. The rubber belt contacts the disc at its outermost rim (to avoid damaging data areas) and pulls it into the drive.

The disc stops first at the play position, and the drive's motor, turntable, spindle, and pickup head all rise to clamp, spin, and read the disc. The disc's table of contents is stored in static RAM (SRAM), so the drive knows what's loaded without having to reread each disc every time you power up.

The disc then either continues to play or moves backward to the "stocker," which is a slotted disc-storage area. The elevator-like stocker uses threaded gears to go up and down so that the proper disc can play without being fully ejected from its storage spot. Again, overlapping play and storage areas save space.

Despite their differences, the timings for these two mechanisms are similar. Both drives take about 8 seconds to go from reading one disc to reading another.



The Nakamichi/NEC changer mechanism handles bare discs.

stalls the device drivers and a utility program that lets you control the drive. The ability to treat the MultiSpin as a single drive broken into subdrives (e.g., D:1, D:2, D:3, and D:4, so you can see what's in each slot) currently works only under Windows 3.x. Windows 95 support is promised for the first quarter of this year. Current users will be able to get the Windows 95 driver via NEC's World Wide Web site (http://www.nec.com) or fulfillment center ((800) 820-1230).

The MultiSpin drive is a pleasure to use. Loading the discs is as easy as pressing one of the four numbered buttons on the front bezel, which opens the drive door, and inserting a naked disc (label side up) about halfway into the opening. The drive draws the disc inside automatically, as a cassette-tape player does, closing the door as it does so. You can tell which slots are occupied by the small lights next to each slot number. You eject the discs by pressing the same slot buttons or by using the eject button in the utility software.

The buttons and the loading slot have special seals to prevent dust from being sucked into your PC's fan. We had no troubles in inserting and ejecting more than 100 discs. However, there's a way to manually rotate the gears to eject a disc should one become jammed, although it requires partially removing the drive.

Alps Reads Magazines

Like many other audio and CD-ROM products, the Alps 4X uses a magazine. Depending on how you like to work (or play), that makes it a little more or less convenient than using the MultiSpin. The downside is that you must fit discs into trays that slide into the magazine and then load the magazine into the drive—a fairly tedious procedure. The advantage is that you can buy extra magazines (for about $20 apiece) and keep separate four-disc sets ready to quickly pop into your drive. The MultiSpin comes with one magazine.

There's no poster or video bundled with the Alps 4X, but the installation process is similar to that of the MultiSpin. By default, the Alps setup software handles the four slots as separate drive letters. However, you can choose to assign them all to a single letter by configuring the Alps device driver with a software switch in the CONFIG.SYS file. You can then use the stop/change button on the drive's front panel to cycle through the discs and make one active. This works under Windows 3.1 or Windows 95. The pros and cons of these arrangements are basically the same as with the MultiSpin.

As befits its Alpine heritage, the controls on the Alps 4X drive's bezel follow the model of a CD audio player, with reverse, play/pause, forward, stop/change, and eject buttons. LEDs on the right show which disc you have selected, and a busy LED shows activity. Alps' MultiPlayer Windows program closely resembles the controls on a car stereo player, giving you full control of the changer.

For software that you tend to operate by set or category, such as CD-ROM telephone directories or a group of favorite audio CDs, the magazine approach makes a lot of sense. But if you frequently change single discs, the direct-load approach of the NEC MultiSpin is much more convenient. And, at less than $300, it's a convenience you can afford. ■

Chris O'Malley (Boynton Beach, FL) is a freelance writer who covers computers and software. He can be contacted on the Internet at 4312323@mcimail.com or on BIX c/o "editors."

Product Information

Alps 4X Internal CD-ROM Changer $410
Alps Electric (USA), Inc.
San Jose, CA
(800) 825-2577
(408) 432-6000
fax: (408) 432-8337
http://www.alpsusa.com
Circle 1128 on Inquiry Card.

MultiSpin 4x4 CD-ROM Changer . . . $279 (est. street price)
NEC Technologies, Inc.
Boxborough, MA
(800) 632-4630
(508) 264-8000
fax: (800) 366-0476
http://www.nec.com
Circle 1129 on Inquiry Card.

Windows-Built for Unix Power

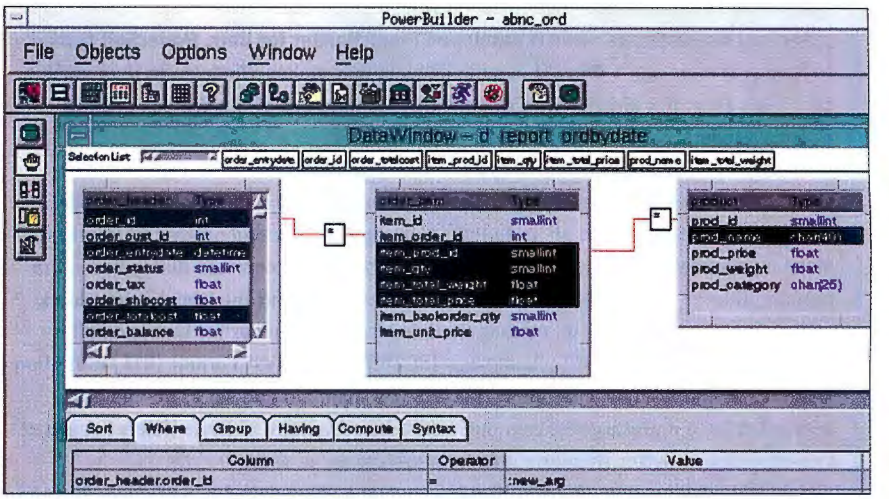
PowerBuilder, the leading client/server programming environment for Windows, moves to Unix so your apps can, too

TOM YAGER

PowerBuilder, the database front-end programming system from Sybase's PowerSoft division, has earned a place as a leading choice among corporate developers. Running under Windows, and more recently the Macintosh, PowerBuilder simplifies the task of creating robust applications that browse, update, administer, and report on data in remote databases.

Now PowerSoft has given PowerBuilder a Unix personality. The latest major release, called PowerBuilder for Unix, runs on Sun (and cloned) Sparc workstations under Solaris 2.4 and OSF/Motif. It's a full port of PowerBuilder 4.0 and does virtually everything its small-iron counterparts will do.

Perhaps the greatest appeal of PowerBuilder for Unix is that it runs (as the documentation says) "mostly unmodified" applications developed with PowerBuilder for Windows or Macintosh. It's a graphical database client tool that maintains source-level compatibility across those three platforms.



A central feature of PowerBuilder, regardless of platform, is the DataWindow, which abstracts server-based SQL functions to make them available on client machines.

Starting Out, We Hit a Bump

We tested PowerBuilder on a Sun SparcStation 10 with 64 MB of RAM. PowerBuilder does not include its own database server, but it does support Oracle 7, both Sybase and Microsoft SQL Servers, and Sybase System 10. We used System 10.

PowerBuilder for Unix is a native Sparc/Solaris application, but its Windows roots are obvious. PowerSoft deserves credit for not following the trend of forsaking printed documentation in favor of hypertext, but the bulk of this package's manuals depicts the Windows version of PowerBuilder. Only a few thin guides, an installation guide among them, speak specifically to the Unix release.

The first problem we encountered was getting the server configured. Sybase System 10 is virtually self-installing, but the PowerBuilder documentation fails to state clearly that you need a piece of optional software—Sybase's Open Client/Open Server. This is a set of libraries and header files that allows C and FORTRAN programmers to build Sybase database access into their applications. PowerSoft should have bundled the libraries with its products. We wasted considerable time trying to identify the missing piece. And while Sybase System 10 automates most of its initialization process, PowerBuilder's startup requires considerably more manual labor; you have to hack user profiles and set environment variables.

Once PowerBuilder is installed, your first task is to connect to a database server. We ran the server on the same machine as PowerBuilder—still a fair test because PowerBuilder uses TCP/IP to communicate with the server even if the server is on the same box.

Each application gets its own database profile. While you cannot create databases in PowerBuilder, you can perform most other functions (including defining new tables) from within it.

PowerSoft provides an excellent Unix-specific tutorial that walks you through creating an application from scratch. As you begin to work with the tutorial, you will gain appreciation for the role Bristol Technology's Wind/U plays (see the Technology Focus box on page 116). Even fairly advanced interface elements, like floating toolbars, have successfully made the transition from Windows to Unix. To its credit, Bristol didn't try to recreate Windows under Unix; every basic interface element is native OSF/Motif. But Windows users will still feel at home because both layout and feel, right down to tabbed controls and common dialog boxes like File Open, are decidedly Windows-like. Such fidelity to Windows makes it easier for Windows PowerBuilder developers to target and test their applications for Unix.

Paint Your Application

PowerBuilder's environment consists of a set of *painters*. With the application painter, you pull together the application's elements and preferences. With the database painter, you manage table layouts, validation rules, and other related elements. With the DataWindow painter (see the screen above), you design the user interface. There are also painters for menus, reports, and all the other elements that form a PowerBuilder application.

PowerBuilder maintains a hidden table called a *repository* that holds data-entry validation rules and initial values, among other things. By making these and other elements part of a database and not part of the application, PowerBuilder lets you reuse rules and other elements across tables. PowerBuilder makes objects of the application elements you create. You can transfer these objects from one application to another and create objects that inherit elements from other objects.

Anyone who thinks PowerBuilder is too expensive need only spend a few minutes with it. The software is loaded with the kind of grace notes and thoughtful turns

TECHNOLOGY FOCUS

Wind/U Opens Windows to Unix

Porting a Windows application to Unix is never fun. Core code is usually easy to port because commercial Windows C++ compilers have Unix-compatible functions in their standard libraries. What takes time is translating user-interface code from Windows to Motif, a process made more challenging the more you use low-level calls to the Windows API.

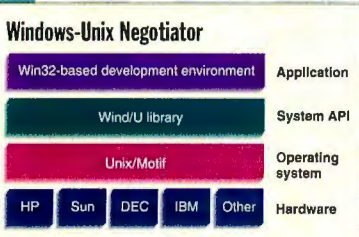
Facing this challenge when it developed PowerBuilder for Unix, PowerSoft turned to Bristol Technology's Wind/U, a suite of tools that makes Windows-to-Unix porting laughably easy. Put simply, Wind/U delivers the functions of the Windows API to Unix developers.

With Wind/U, virtually everything you create in the Windows development environment of your choice simply "walks" over to Unix and runs after a recompile. Wind/U's not an emulator; all its functions are native Unix and native OSF/Motif. Its Motif approximations of standard Windows elements like common dialog boxes are perfect. They're recognizably Motif in their appearance, but the layout is Windows.

HyperHelp, another Bristol module included in PowerBuilder for Unix, compiles Standard Generalized Markup Language (SGML) or Rich Text Format (RTF) definition files into Windows-style .HLP files. This lets you maintain one set of on-line documentation for a multitargeted app and also take advantage of HyperHelp's hypertext viewer, which is better than any Unix help system we've seen.

Bristol's XPrinter module simplifies the task of getting data from an application to a printer. Unix developers well know how hard it can be to "talk" to a printer. XPrinter provides the hooks that create a very elegant Windows-like connection between your application and your printer.

Of the 1.5 million lines of C/C++ code in PowerBuilder, PowerSoft says it had to modify only 3 to 6 percent for the Windows-to-Unix port—an astonishingly low number. The upshot is that one person can handle the porting work for an application that may have taken a building-full of engineers to create.



PowerBuilder recompiles Windows apps in Unix and links them to Bristol Technology's Wind/U library to generate native Motif code. This maintains identical functionality between Windows and Motif versions.

that most software designers leave out. The validation-rules dialog box, for example, has a button that inserts the current column's variable name into the rule you're writing. The display-format dialog box not only lets you define a format for a column, it even tests your format within the dialog box itself. You just enter a value and click a button to see it displayed as you requested. We expected to have to pull up a database view to see if our format definition worked.

Windows-Centric Not a Bad Thing

Motif purists might chafe a little at the extent to which Microsoft Windows paradigms are applied to PowerBuilder for Unix. The Windows version of PowerBuilder is notable for, among other things, allowing developers access to low-level elements like the attributes for window styles. But when you pull up the dialog box for altering a custom window's style, you'll see a set of checkboxes detailing Windows-type attributes, not Motif-type attributes. Users running your application won't be able to tell because the look is still native Motif.

This Windows-centric approach is entirely appropriate. By choosing Windows as its base, PowerSoft made it possible to create gorgeous Motif database apps that port effortlessly to Windows, and vice versa. Were you restricted to Motif's capabilities, the Windows version of the ported application would suffer. For that matter, so would the Motif version.

If you're expecting PowerBuilder to shield you from having to learn SQL, you'll be disappointed. It doesn't reduce *everything* to drag-and-drop. If you're familiar with Windows tools, you might find PowerBuilder's approach similar to Visual Basic's. The interface helps you manage data elements, paint the interface, and perform basic procedures like field validation. But for virtually everything else, you'll need a strong foundation in both SQL and PowerBuilder's scripting language, PowerScript, a structured language that reads somewhat like BASIC. As with other operations in PowerBuilder, you're never flying blind when you're writing scripts. The package provides a debugger, and within the editor are powerful browsers. Database structures, interface objects, and other application elements are a few clicks away.

Delivery Time

Perhaps the best thing about PowerBuilder is what you get when you're finished building: a stand-alone executable program. PC snobs will bristle at being forced to keep the .EXE extension PowerBuilder requires, but that doesn't diminish the joyful simplicity of entering a single command to launch your program.

Virtually everything you create in PowerBuilder for Unix will move, unchanged, to PowerBuilder running in a Windows or Macintosh environment. Load your application into PowerBuilder for Windows and select the Generate EXE option to produce a native Windows program that acts just like its Motif counterpart. But if you tie C code into your program or call out to external Unix commands, you'll have more trouble porting: The executable files PowerBuilder creates are not directly portable.

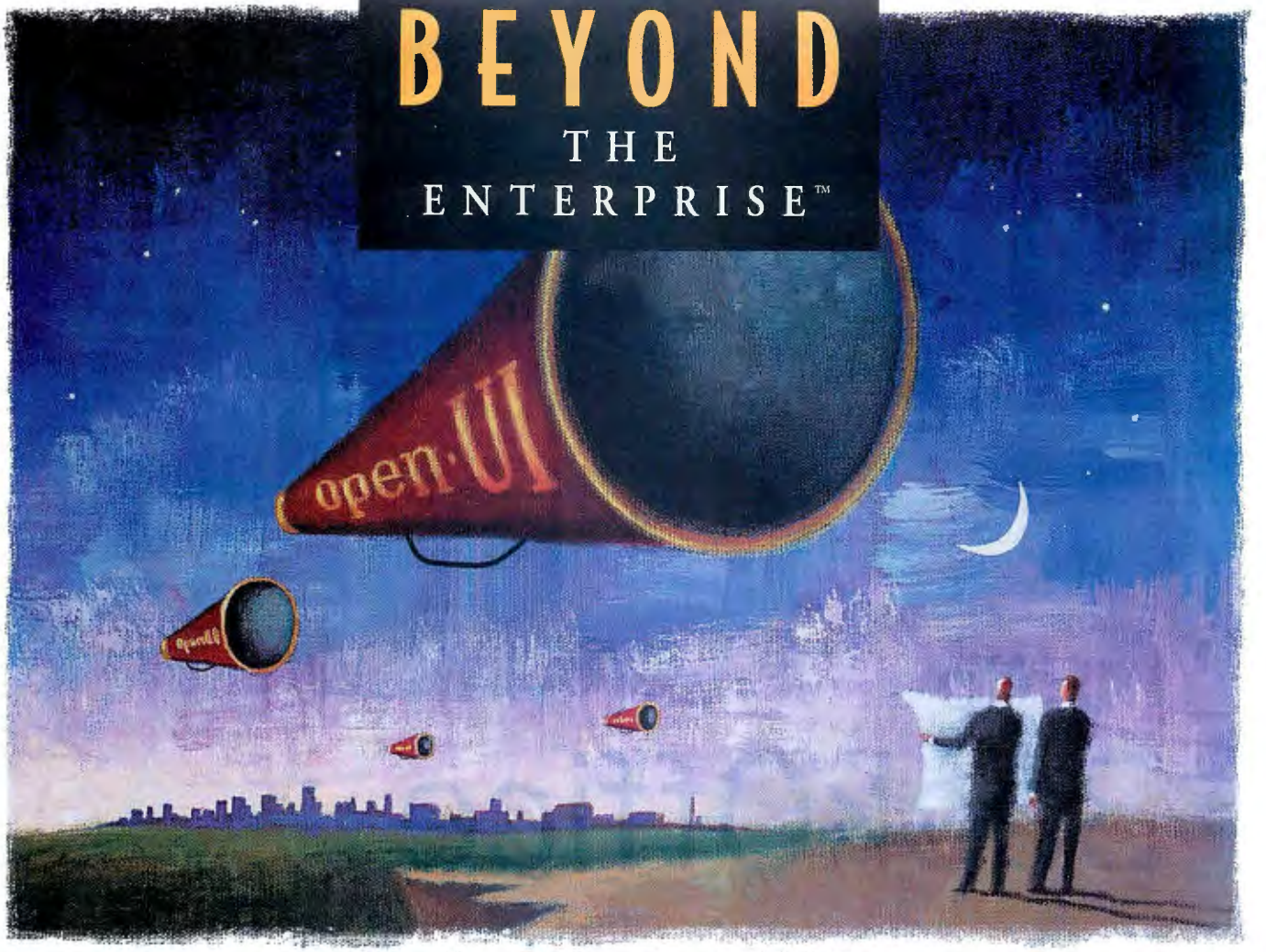
It's disappointing that PowerSoft didn't also target Solaris x86. SunSoft touts source-level compatibility between its Sparc and x86 releases. If that's true, then PowerSoft could have targeted Solaris x86 with naught but a recompile. But things are rarely simple; at the very least it would have meant support and documentation requirements. PowerSoft does plan to target HP/UX and AIX but won't say when.

If you're delivering a critical client/server database application, you'd do well to consider PowerBuilder. We can't think of another tool that blends seamless cross-platform compatibility, high-level conveniences, and low-level access. ■

Product Information

PowerBuilder for Unix 1.0 . . . . .$3295
PowerSoft Corp.
Concord, MA
(508) 287-1500
http://www.powersoft.com
Circle 1105 on Inquiry Card.

Tom Yager is a writer and former BYTE editor who operates a research lab in Texas. You can reach him at tyager@maxx.net.



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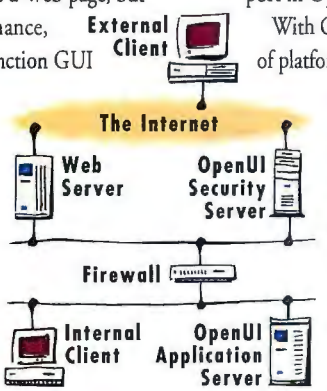

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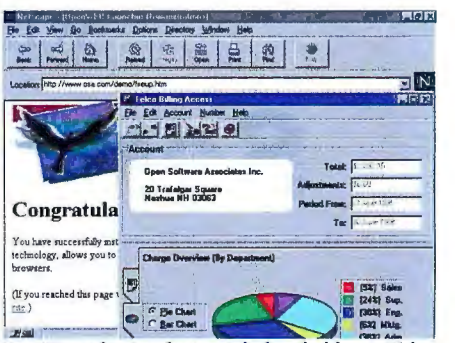

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Smart Forms for the Enterprise

Your company's forms should be more than an afterthought. Four programs can turn forms into a medium for groupware.

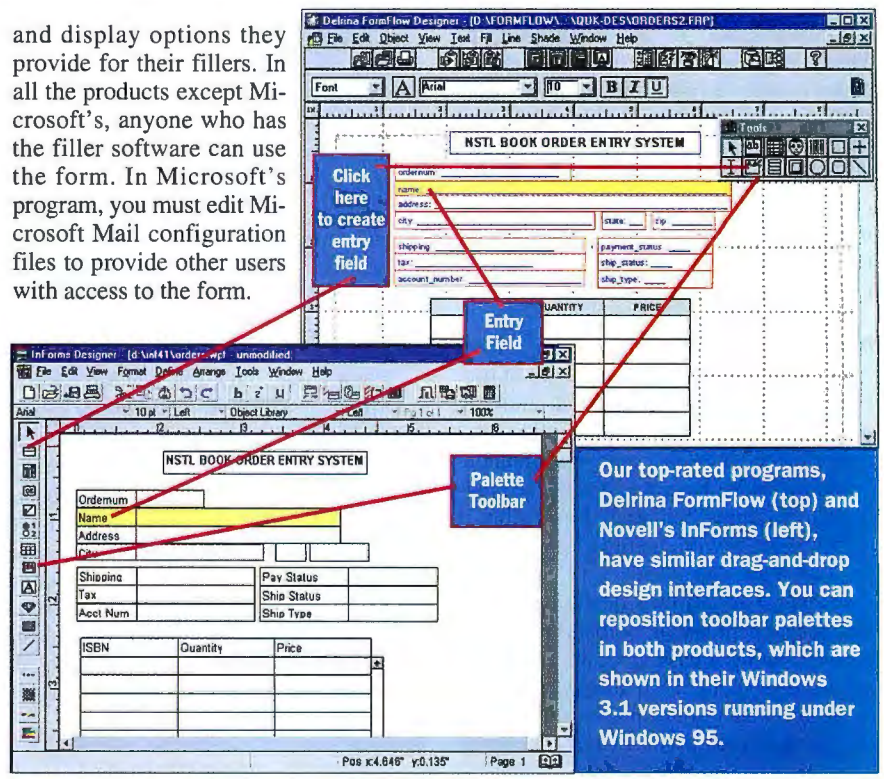
MARK HETTLER

In theory, replacing paper with electrons can improve an organization's efficiency. This is most true for forms, which make up a huge part of most companies' paper volume, carry mission-critical data, and contain a structure that lends itself to computerization. Today's leading forms programs are up to the challenge, providing windows onto corporate databases while using E-mail to intelligently route data around the enterprise.

In this roundup, NSTL evaluates four electronic-forms management packages for Windows: Delrina FormFlow 1.1, Novell's InForms 4.1, JetForm's JetForm 4.1, and Microsoft Electronic Forms Designer 1.0. (Lotus was upgrading Lotus Forms during our testing and didn't participate.)

To be included in the testing, a program must be able to act as a database front end, complete with field-level database lookups and validation. It must provide such design features as drawing tools, listboxes, radio buttons, and check boxes as well as standard text-entry fields and labels. And it must support routing over standard E-mail systems.

Delrina FormFlow and InForms are the best of the field. Although both are extremely versatile and easy to use, Delrina FormFlow comes out slightly ahead of InForms, primarily due to its slightly faster performance and InForms' reliance on Novell's GroupWise for E-mail functions.



Our top-rated programs, Delrina FormFlow (top) and Novell's InForms (left), have similar drag-and-drop design interfaces. You can reposition toolbar palettes in both products, which are shown in their Windows 3.1 versions running under Windows 95.

Form Functions

Forms programs do four things: design, filling, database access, and E-mail-enabled functions (e.g., routing, work flow, and tracking). Design features include the controls we've come to expect in graphical packages (e.g., color selection, grids, rulers, and the ability to import logos). Filling, database access, and E-mail features tend to vary more across products.

Filler modules help you work with previously created forms. The programs vary widely in the number of database access and display options they provide for their fillers. In all the products except Microsoft's, anyone who has the filler software can use the form. In Microsoft's program, you must edit Microsoft Mail configuration files to provide other users with access to the form.

Forms programs also provide access to databases for data entry and retrieval. You can use the forms to retrieve data, distribute it, collect it, and update the database (see the Technology Focus on page 120).

The programs let you address and send a form by E-mail while viewing the form; recipients use the same form to view the associated data. Thus, you can electronically mail blank or partially filled forms to recipients, who fill them out on-line. To do this, a forms program must provide more than a window to the database. It must store the data as part of the form or in a temporary database attached to the form.

While all the tested products produce forms that can browse through large data sets, each incorporates a single record (the one it is reading when it is sent) for transmission to recipients. Alternatively, if all the recipients and the database share the same network, you can send a form with links to the original database rather than embedding a single record. *continued*

OVERVIEW

NSTL RATING		VERSION	PERFORMANCE	VERSATILITY	EASE OF LEARNING	EASE OF USE	PRICE
★★★	Delrina FormFlow	1.1	■	▲	▲	▲	$399
★★★	InForms	4.1	■	▲	▲	▲	$495
★★	JetForm	4.1	▲	■	■	▲	$495
★★	Microsoft Electronic Forms Designer	1.0	■	■	▼	■	$469

KEY

★★★★★	Outstanding
★★★★	Excellent
★★★	Average
★★	Below average
★	Poor
▲	Good
■	Fair
▼	Unacceptable

E-mail offers more than just data sharing. Work-flow mechanisms in these programs provide a level of control over document flow that is inconceivable with paper forms. JetForm and Delrina FormFlow have sophisticated work-flow options built into their design and filler modules. InForms does, too, but the features are available only if you're using GroupWise. Microsoft Electronic Forms Designer doesn't have built-in work-flow features, and programming them in Visual Basic can be difficult.

Finally, one of the most powerful benefits of electronic forms is the ability to track the progress of a form through the routing process. Only Microsoft Electronic Forms Designer lacks this ability.

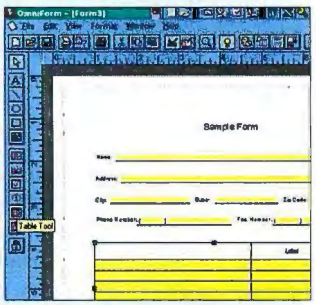
Delrina FormFlow

An ideal balance of power and ease of use, Delrina FormFlow combines an intuitive interface with a powerful scripting language, which lets you create distributable forms-based applications. It is the second-fastest program (behind JetForm), but it is the program with the broadest range of useful features.

Delrina FormFlow's design interface makes excellent use of toolbars and dialog boxes. Routing is easy to set up, and tracking is independent of the mail system. Data retrieval is easy, but updating data after receiving a form involves unpacking the

Scanning Forms with Caere

A fifth product that might have met the criteria for this roundup is OmniForm 2.0 from Caere, a leader in OCR. BYTE was unable to examine OmniForm soon enough to qualify it for formal testing.



Caere's OmniForm emphasizes forms scanning more than database access and forms routing. Shown here is a bit map of a scanned form being modified in OmniForm's design module.

Unlike the other packages, OmniForm combines forms management with Caere's OCR expertise. Though it comes with forms-design tools, OmniForm also lets you scan in your existing paper forms and use them as the basis for new electronic forms. It attempts to recognize form objects, such as tables and fill-in fields. You can correct misrecognized characters and reuse unconverted bit-map objects from the original using point-and-click commands.

While the other products allow direct access to a variety of database formats, OmniForm uses its own format and exchanges data only via Open Database Connectivity (ODBC). You can't, for example, use a form to find a record in a dBase or SQL Server database or to add data to such a database. You can use OLE automation scripts to program these functions, however. It does allow browsing, adding, and deleting of individual records.

We got some inconsistently reproduced fonts and corrupted logos when we used OmniForm 1.0, a result typical of all OCR programs. Caere says that OmniForm 2.0, which came out last December, has an improved recognition engine. The new version is compatible with both Windows 95 and Windows NT Workstation 3.51. New connectivity with Microsoft Exchange provides additional E-mail capabilities such as routing. Also new are OLE 2 client, server, and automation features.

If you have many paper forms to convert to electronic format, OmniForm will do the job faster than the other packages. It is probably best used as a complement to Delrina FormFlow or InForms.

TECHNOLOGY FOCUS

Forms and Data: An Uneasy Marriage

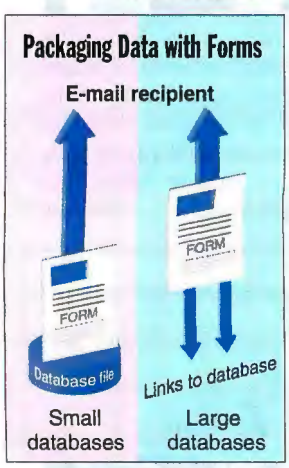
Dedicated forms programs maintain strong links to databases. The relationship poses numerous problems in data integrity, database access, and display, especially when the forms and data are routed across networks.

Delrina FormFlow and InForms link each form to an underlying data source, which users of the form can search, retrieve, and modify. Microsoft Electronic Forms Designer offers similar access using Visual Basic's data controls. JetForm requires you to set up select rules—essentially, SQL select statements that are passed to the database.

When sending a form containing database links by E-mail, users will want to send the data currently being displayed. Delrina FormFlow copies the displayed record to dBase format and sends the dBase file with the form. InForms handles the current record similarly but stores it in a proprietary format. InForms also lets you send the file without the form, which saves overhead when the sender and recipient have the same form.

Sometimes, however, the sender will want recipients to use the form to browse through all the records in the underlying database. Sending the entire database through the mail is generally not feasible for large databases, but it can be useful for small ones. Delrina FormFlow offers that option. In addition, both Delrina FormFlow and InForms allow sending a form complete with its database links by E-mail. This is useful if the recipients are on the same LAN as the sender and all have access to a shared network database.

JetForm does not maintain database links once the data has been retrieved; it sends the currently displayed data as part of the form. In addition, because SQL-based select rules are already built into the form, recipients may reselect records. Microsoft Electronic Forms Designer also sends the currently displayed data as part of the form, but letting recipients refresh the form's data control requires Visual Basic programming.



You can package Delrina FormFlow forms for E-mail transmission with their underlying databases attached (typical if they're small) or with links to the databases if they are too big to be sent whole.

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AD_BYTE0296

DESIGN AND FILLER FEATURES

	DELRINA FORMFLOW	INFORMS	JETFORM	MICROSOFT ELECTRONIC FORMS DESIGNER [1]
DESIGN TOOLS				
Push buttons	●	●	●	●
Check boxes	●	●	●	●
Radio buttons	●	●	●	●
Scale/zoom	●	●	●	○
Customize program menus	●	○	○	●
Resize object proportionally	●	●	●	●
Automatically align objects with grid	●	●	●	●
Group/ungroup form objects	●	●	●	●
Trace from scanned-in form	●	●	●	○
TEXT				
Precise text placement	●	●	●	●
Create tables	●	●	●	●
Rotate text	●	●	●	○
Spelling checker	●	●	●	○
GRAPHICS IMPORTING				
Windows bit maps	●	●	●	●
Windows metafile	●	●	●	●
Encapsulated PostScript	●	●	●	○
PCX	●	●	●	○
TIFF	●	●	●	○
AutoCAD	○	●	○	○
Macintosh PICT	○	●	○	○
FORM FILLER				
Scale/zoom	●	②	●	③
Zoom selected area	○	○	●	③
Undo/redo command	○	○	○	③
Search for record	●	●	●	③
Search using multifield criteria	●	●	○	③
Add annotations	○	○	●	③

[1] Some features are programmable in the required Visual Basic or available from third-party vendors.

② Three view sizes: actual, full-page, and page-width.

③ Form filler is not required because forms are executable.

Yes = ● No = ○; features available in future upgrades or optional packages are marked ○.

form contents and performing a complicated merge operation.

The tutorials are excellent, though you probably won't need them for design and filling, thanks to the program's intuitive layout. More complex operations, such as scripts for conditional routing, are not well explained, however. Delrina plans to release a Windows 95 upgrade sometime in the middle of this year. Delrina FormFlow is one of our recommended buys.

InForms

Novell's entry, which has extensive links to GroupWise—and, unfortunately, depends on it for E-mail—is the easiest program to use, though its interface is somewhat less intuitive than Delrina FormFlow's. It is better at complex operations, such as updating a database using information in a form sent as E-mail. In addition, InForms' serial-routing and form-tracking features are the easiest to set up.

InForms' filler module has the best database query and search facilities. Forms design is easy, as well, although InForms makes you fiddle with too many menus to set attributes.

InForms uses GroupWise's tracking mechanisms, so you won't have tracking if you use a different messaging system. GroupWise has its own facilities for tracking mail messages throughout an enterprise. InForms provides an interface to these facilities from within the form filler, and it filters out everything except information about forms sent using InForms' work-flow option. You can select an item to track, and the system displays a list of all recipients of the form, indicating whether a recipient has received, accepted, and completed working with the form. You can use this feature to identify bottlenecks.

InForms ranks close to Delrina FormFlow in richness of features, though there are slight differences in some categories. For example, InForms is slightly better in design categories such as graphics handling. Delrina FormFlow offers stronger cross-platform support, though InForms offers more data formats.

Other than its dependence on GroupWise for work-flow and routing features, InForms' weakest feature is performance, where it came in last. It is slow at opening and closing forms, though it beats the rest at data retrieval. Along with Delrina FormFlow, we can recommend InForms as a smart purchase for most applications.

JetForm

JetForm offers powerful features for enterprise-wide forms management. However, with this power comes intimidating complexity. Tracking is difficult to understand and set up. Even JetForm's basic design interface and procedures lack the intuitiveness of those in Delrina FormFlow and InForms. What's more, setting up a form to access a database is more difficult than in any of the other products.

Even so, JetForm is the best of the four at forms management and performance. It employs a hybrid of E-mail and a server-based tracking database to track forms flowing through the network. JetForm's print server allows you to dedicate a single printer to forms printing and give all forms

Product Information

Delrina FormFlow 1.1 .$399
(starter kit; Filler only, $129)
Delrina Group/Symantec
Toronto, Ontario, Canada
(800) 268-6082
fax: (408) 363-2340
http://www.delrina.com
Circle 986 on Inquiry Card.

InForms 4.1 .....$495
(Designer/Filler; Filler only, $199)
Novell, Inc.
Orem, UT
(801) 226-6000
fax: (801) 228-5178
http://www.novell.com
Circle 987 on Inquiry Card.

JetForm 4.1 .....$495
(Filler only, $149; JetForm Server for Windows 4.0, $835)
JetForm Corp.
Falls Church, VA
(800) 538-3676
fax: (703) 448-9543
http://www.jetform.com
Circle 988 on Inquiry Card.

Microsoft Electronic Forms Designer 1.0 .....$469
(bundled with Microsoft Mail Server 3.5; requires Visual Basic Professional Edition 2.0 or higher)
Microsoft Corp.
Redmond, WA
(206) 882-8080
fax: (206) 936-7329
http://www.microsoft.com
Circle 989 on Inquiry Card.

OmniForm 2.0 .....$349
Caere Corp.
Los Gatos, CA
(800) 535-7226
(408) 395-7000
fax: (408) 354-2743
Circle 990 on Inquiry Card.

users access to it. It also has a Fax Director add-on for sending forms by fax.

JetForm nudges slightly ahead of Delrina FormFlow in the overall performance ratings. It is the fastest at sending a form and inserting data, but the slowest at data retrieval. JetForm isn't as easy to use as Delrina FormFlow or InForms, and it isn't nearly as feature-rich, though it does offer good cross-platform support, routing, and filler and printing options.

Microsoft Electronic Forms Designer

Microsoft's entry barely meets our selection criteria. It requires Visual Basic and is sold only as part of Microsoft Mail Server 3.5; essentially, it is an add-on. You work in the Visual Basic design interface. Then you copy the Visual Basic project files for the template form to a new directory and modify the existing form.

Apparently, Microsoft regards the real McCoy to be the forms designer in the Exchange Server, Microsoft's new E-mail and workgroup program, which was not shipping in time for our testing. We tried a beta version, however, and found that while Exchange Server Forms offers a more typical forms-design interface than its predecessor, it still leans too heavily on Visual Basic for functions that are built into competing products.

Microsoft Electronic Forms Designer has far fewer features than its competitors. It is the only one lacking true WYSIWYG forms printing. Its filler software requires editing of Microsoft Mail configuration files to provide shared access.

Many work-flow features, such as simple serial routing and forms tracking, simply aren't there, though you could use Visual Basic to create them. Also, Microsoft Electronic Forms Designer is the only product lacking cross-platform features. The others all come with filler software for the Mac environment. Delrina FormFlow also has fillers for DOS and Unix. JetForm has them for DOS and OS/2.

Besides its extensive programmability, Microsoft Electronic Forms Designer gets one other major benefit from its reliance on Visual Basic: The forms it creates are executable, so they don't require separate filler software to be used by recipients.

This product is not competitive with such well-rounded packages as Delrina FormFlow and InForms. It finishes last in our four major criteria.

According to Form

Delrina FormFlow and InForms are our recommended purchases, although we give the top position to Delrina FormFlow. The two programs finish close in our overall ratings and tend to match each other's functions. The programs' key differences are Delrina FormFlow's slightly faster performance and InForms' reliance on Novell's GroupWise for its E-mail and workflow features. ■

A five-year veteran of NSTL software roundups, Mark Hettler pioneered NSTL's coverage of SQL servers and multiuser databases. You can contact him by E-mail at editors@nstl.com.

DATABASE AND WORKGROUP FEATURES

	DELRINA FORMFLOW	INFORMS	JETFORM	MICROSOFT ELECTRONIC FORMS DESIGNER
DATA VALIDATION				
Set up required fields	●	●	●	①
Floating-point	●	●	●	①
Fixed-point or money	●	●	①	①
Date	●	●	①	①
Lookup validation using foreign-key method	●	●	●	○
Validation by formula	●	●	●	①
APPLICATION CONTROL AND EVENT HANDLING				
Pop-up windows	●	●	○	●
Specifiy action after record is updated	●	●	○	●
Specify action after field is updated	●	●	○	●
Insert/delete records	●	●	○	●
CONCURRENCY CONTROL AND SECURITY				
Explicit record lock command	○	○	○	●
Automatically lock related records	●	○	○	○
Signature authorization	●	●	●	○
Lock fields after signature	●	●	●	○
DATA EXCHANGE				
DDE client capability	●	●	●	●
DDE server capability	●	●	●	●
OLE client capability	●	○	●	●
OLE server capability	●	●	●	●
Store link to external OLE object	●	○	●	●
Run OLE application	○	○	●	●
Supports ODBC	●	●	●	●
Supports Notes Field Exchange	○	●	●	○
Multiple database support on a single form	●	●	●	●
ROUTING AND E-MAIL				
Routing in forms design	●	●	●	●
Form can have variable views en route	●	●	●	●
Conditional routing	●	●	●	●
Tracking	●	②	●	○
Can E-mail data only (recipient loads form)	●	●	●	●
Choice of sending pointers to data or attaching data	●	●	○	●
Works with cc:Mail	●	●	●	○
Works with Microsoft Mail	●	●	●	●
Supports MAPI	●	●	●	●
Supports VIM	●	●	●	○
Works with Lotus Notes	●	●	●	○

① Not built in but can be achieved using the included programming tools.
② Tracking handled by required GroupWise program.
Yes = ● No = ○; features available in future upgrades or optional packages are marked ○.

This report contains the partial results of a recent issue of Software Digest, a monthly publication of NSTL, Inc. To purchase a complete copy of the report, contact NSTL at 625 Ridge Pike, Conshohocken, PA 19428, (610) 941-9600; fax (610) 941-9950; on the Internet, editors@nstl.com. For a subscription, call (800) 257-9402. BYTE magazine and NSTL are both operating units of the McGraw-Hill Companies, Inc.

HANDS-ON TESTING

6 SERVERS TANGLE

Make your presence known on the Web with these powerful turnkey server solutions. We saturate the systems with request loads that simulate TCP/IP traffic jams on the Internet.

CHANDRIKA MYSORE AND BRENT MELSON

If your company isn't on the Internet yet, then take a look at the six Web servers we've tested and see just how easy it is to get your message on-line. In the past year, more big-name systems vendors have joined the Web fray with RISC- and Pentium-based servers that are bundled with Web software—you don't have to be a Unix guru to create and maintain a home page. We tested five RISC-based systems (with Alpha, PowerPC, and Sparc processors) and a dual-processor Pentium system to see which one best handles the different FTP and HTTP request loads you will encounter once you open shop in cyberspace.

For this Lab Report, we requested that manufacturers supply us with turnkey systems that have their choice of Web software installed and configured for testing; thus, we could see how easy it is to set up each system as a Web server with minimal end-user intervention. We wanted to test how close each of the systems comes to actually being a turnkey solution.

The six servers all came with a high-end processor, such as a SuperSparc, MicroSparc, Alpha, PowerPC, or dual Pentiums, with speeds ranging from 75 to 266 MHz. We also had a mix of OSes: Solaris 5.4, Irix 5.3, Windows NT Server 3.51, and Apple System 7.5. Three of the vendors—Silicon Graphics, Sun Microsystems, and Intergraph—selected Netscape Communications' Server 1.22 for their Web software. Digital Equipment provided Process Software's Purveyor 1.1, and Apple selected StarNine Technologies' WebStar 1.2.4.

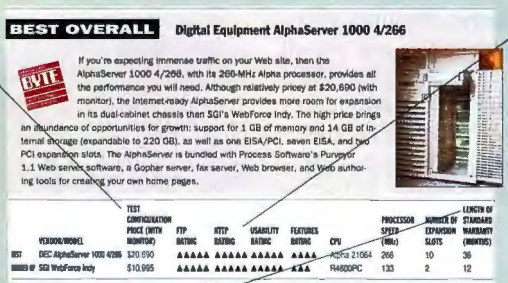
In terms of price, Tatung's MicroCompstation 5/11 is the least expensive server here; it costs $8635 with monitor. The next least-expensive server we tested is Apple's Workgroup Server 9150 at $8799, which targets small businesses. The Digital Equipment Internet AlphaServer 1000 4/266 is the highest at $20,690. All the prices listed here are for the configurations as we tested them and the software bundled with the systems.

We tested the servers under TCP/IP in two scenarios that most likely represent real-world use. The first scenario stresses the FTP aspect of the server, using 88 percent of FTP requests and 6 percent each of HTTP and Wide Area Information Service (WAIS) requests. The second scenario represents the most common usage pattern of HTTP services, stressing the servers with 97 percent of HTTP, 2 percent of FTP, and 1 percent of WAIS requests. These scenarios simulate the differ-

How to use this guide

We ranked the best Web servers based on their performance scores, features, and ease of use.

PRICE (WITHOUT MONITOR)
Check the Roll Call on pages 132 to 133 to see if the system is available without the monitor. Buying a high-resolution monitor is overkill if you're going to be using the system as a dedicated server.



PERFORMANCE RATINGS
These ratings are calculated from the individual performance scores generated from FTP and HTTP transactions. We varied the number of client sessions that access the server, ranging from eight to 48 virtual clients.

LENGTH OF STANDARD WARRANTY
Warranty and support policies vary from one to three years. Check the Roll Call under this heading to see if the vendor offers extended warranties and how long technical support lasts.

PHOTOGRAPHY: STEVE BELKOWITZ © 1996

ON THE WEB

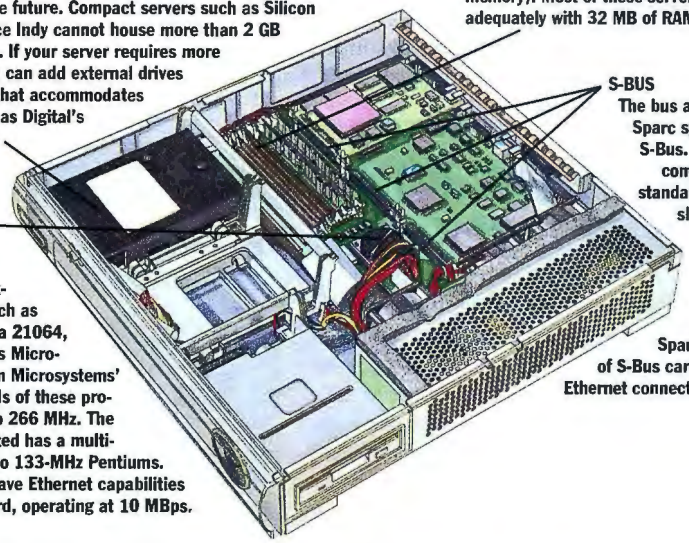
Unraveling the Web

HARD DRIVE STORAGE
All the servers we tested came with at least 1 GB of hard drive space and a SCSI connection. It's almost always less expensive to buy a server with a higher-capacity hard drive than to add another drive in the future. Compact servers such as Silicon Graphics' WebForce Indy cannot house more than 2 GB of internal storage. If your server requires more storage space, you can add external drives or select a model that accommodates up to 20 GB, such as Digital's AlphaServer 1000.

SIMM BANKS
Most of the RISC-based Web servers are capable of accepting up to 512 MB of memory (Digital's AlphaServer 1000 supports up to 1 GB of memory). Most of these servers function adequately with 32 MB of RAM.

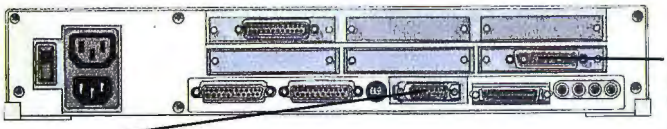
S-BUS
The bus architecture used in Sparc systems is known as S-Bus. The Sparc systems come with a number of standard S-Bus expansion slots. Optional S-Bus cards are used to connect external devices such as printers and monitors to a Sparc system. A variety of S-Bus cards are available for Ethernet connections, SCSI devices, and printers.

CPU
A server processing thousands of hits a day requires a high-end workhorse RISC processor such as Digital Equipment's Alpha 21064, Mips' R4600PC, Tatung's MicroSparc II STP1012, or Sun Microsystems' SuperSparc II. The speeds of these processors range from 75 to 266 MHz. The Intergraph TD-40 we tested has a multiprocessor design with two 133-MHz Pentiums. Four servers we tested have Ethernet capabilities built into the motherboard, operating at 10 MBps.



I/O PORTS

Web servers come with several I/O ports such as RS-232 serial, Macintosh 8-pin serial, AUI, 10Base-T, DB-15 video, 13W3 video, SCSI, SCSI-2, FDDI/ATM, Centronics parallel, 16-bit sound, digital video input, ISDN interface, microphone, and headphone connectors. Check out the types and number of ports available for the base price of the server. You can always upgrade with additional ports later.



13W3 VIDEO PORT
Some of the servers (e.g., Tatung's MicroCompstation 5/11) come with a 13W3 connector for the monitor. To hook up a monitor, you need a specially designed video cable that usually comes standard. Many of these servers come with a monitor and can't be purchased in any other configuration.

AUI PORT
Most of the servers provide the attachment unit interface (AUI) port as a standard way to connect to a thick Ethernet network. The AUI requires a twisted-pair Ethernet adapter to connect to the twisted-pair Ethernet network. An optional 10Base-T port lets you use the twisted-pair cable to connect to an Ethernet network. Look for systems that provide both AUI and 10Base-T ports as standard.

BEST OVERALL

Digital Equipment AlphaServer 1000 4/266

Digital's AlphaServer 1000 4/266 is the best Internet-server solution we tested. When you combine its fast RISC-based performance and expandability, it's worth the huge price tag ($20,690). The AlphaServer maintains excellent performance in both our FTP and HTTP Internet traffic jams, even as we pile on the load from client-side users. With Process Software's Purveyor 1.1, a 266-MHz 21064 Alpha processor, 64 MB of RAM, a 2.1-GB removable drive, and a quad-speed CD-ROM, the AlphaServer is hard to beat.
PAGE 127

RUNNER-UP

Silicon Graphics WebForce Indy

Running on the heels of Digital's AlphaServer, the SGI WebForce Indy ($10,995) speeds through our FTP and HTTP tests, and yet it costs almost half the price of the Digital machine. With its tightly packed desktop chassis that comes bundled with Netscape's Netsite Communications Server software, the Indy offers a powerful Mips R4600 processor and many cool features (such as a video camera) that are worth checking out.
PAGE 127

RUNNER-UP

Intergraph TD-40

With two 133-MHz Pentiums, the Intergraph TD-40 holds its own against the RISC boxes. With its fast response time and price tag of $10,640, the TD-40 stands out as a nicely priced alternative.
PAGE 127

ent traffic patterns that Web servers have to handle over the Internet.

Web servers can be used by small businesses (e.g., ad agencies, marketing firms, or consultants) or by large corporations as in-house servers. The server loads differ for small and large sites. If you are looking for a server to handle thousands or tens of thousands of hits a day, then you need a system capable of listening to all the requests and responding to them in an orderly fashion, while not missing any requests; this solution is not inexpensive. Sites facing lower levels of traffic require less horsepower and could get by with a lower-cost server. The amount of expected traffic is the key to your buying decision. Virtually any advanced PC can act as a Web server, but it takes some muscle to handle a really cool site on the Web.

ILLUSTRATION: BRUCE SANDERS © 1996

EASE THE INTERNET LOAD

HEAVY-DUTY WEB SERVERS

Companies big and small are setting up Web servers to showcase their wares. Corporations are also using Web servers internally to distribute central information throughout vast geographic infrastructures. Picking the right Web server depends on how popular you think your home page will be and consequently how much firepower you will need to handle requests from users.

Out of the six servers we tested, Digital Equipment's AlphaServer 1000 4/266 won best overall. Silicon Graphics' WebForce Indy and Intergraph's TD-40 came in second and third, respectively. To test these servers, we had to consider two factors that affect server performance.

The server's hardware, of course, is the primary bottleneck. The second factor is the design of the Web page itself. The server has to transfer each element on the page—graphics, text, buttons, and so on—from its hard drive to each user's system. For example, if you've designed your Web page to contain one graphical element, four buttons, and one block of text, then every time a user browses your page, he or she generates six transactions to completely display your page. If the subsequent pages use the same buttons and graphics, then most client browsers will have cached those items to each user's hard drive, which speeds up the process by eliminating unneeded transactions.

You could end up negating the fast performance of your hardware by implementing an inefficient page design, reducing the amount of traffic the site can handle. It is better to reuse graphics and buttons and lower the number of pages that vary. With this strategy, each page generates fewer transactions, using cached items to increase the server's throughput.

FTP Performance

Beyond E-mail, FTP is the most commonly used Internet service. It is an effective way to transfer files to other Internet machines because it supports all file formats. FTP sites, however, don't offer the more glamorous interface of Web sites, and it can take a long time to browse through lengthy FTP directories to find a file. Many FTP sites offer Hypertext Markup Language (HTML) fronends on their Web site so that users may more easily browse through and download files.

Digital's AlphaServer 1000 4/266 performs best in our first test scenario, where the server load pattern simulates heavy FTP traffic with limited Web support. SGI's WebForce Indy and Digital's AlphaServer start with similar performance at the lower number of test sessions (from 8 to 24 sessions), but the Digital server slightly tops the SGI server when there are 32 to 48 test sessions.

Intergraph's TD-40 is a dual-processor, 133-MHz Pentium server that matches up admirably against the top-performing RISC boxes in both test scenarios. The TD-40 costs $10,640 with a 17-inch monitor, which makes it a cost-effective alternative to some of the RISC boxes. The TD-40's strong scores show that the system fully exploits Windows NT's support for

NETSCAPE'S NAVIGATOR 2.0 ADDS SECURITY AND INTERACTIVE MULTIMEDIA

Over the past few months, Internet navigators have been busy downloading the latest version of Netscape's Navigator—the world's most popular Web browser—to take advantage of version 2.0's E-mail security, performance upgrades, and interactive multimedia capabilities. Netscape (Mountain View, CA; (415) 254-1900; http://home.netscape.com) also released Navigator Gold 2.0 late last year, which adds WYSIWYG document creation and publishing capabilities.

The most intriguing feature of Navigator 2.0, which sells for $49 per individual license, may be its support for the Java programming language (see "Wired on the Web," January BYTE). But users concerned with security holes in the Internet may find immediate comfort from version 2.0's safety features. Navigator 2.0 users can secure their E-mail messages by getting a Digital ID from Verisign (for $6), which proves on-line identities. With a Digital ID, Navigator 2.0 users can positively identify other users, be authorized to access information, and enable digital signatures. The Web browser also lets you conduct on-line financial transactions through the Secure Courier open protocol, which creates a secure digital packet for transit on the Internet.

Although not many Web sites support it yet, one of the best new features of Navigator 2.0 is *frames*. This technology lets you display multiple, independently scrollable frames on a single screen—each with its own distinct URL. By having multiple frames open, you don't have to click the back

In Netscape Navigator 2.0, you can view multiple frames instead of just having one window open (as in the earlier version of Navigator).

or forward buttons to get to another page, and queries executed in one frame can generate results in another frame (see "Web Design," this month's Network Project, on page 91).

Netscape's browser upgrade also introduces performance-enhancing features such as support for the Progressive JPEG file format, which loads images up to three times faster than the GIF format. Version 2.0 also adds client-side image mapping and multiple simultaneous streaming of video, audio, and other data formats. A Shockwave plug-in for Navigator 2.0 (initially available only for Windows) makes it possible for Web designers to integrate interactive multimedia presentations that are created with Macromedia's Director program. These Director titles play within the same window as the Web browser.

—John McDonough

dual-processor computers.

Sun Microsystems' Netra i625 and Tatung's MicroCompstation 5/11 have similar hardware, but the Sun system raced past the Tatung due to the combination of OS and Web software. The Netra i625 used Netscape Communications Server software, and the MicroCompstation used the Internet Gateway for Solaris. At $8635, the MicroCompstation is almost half the cost of the Netra, but the Netra provides more systems security features.

HTTP Performance

SGI's WebForce Indy server excelled, outperforming all the other systems in the HTTP stress test. Digital's AlphaServer followed closely behind the Indy at a heavy load of 48 test sessions. At $10,995, the Indy server costs almost half the price of the AlphaServer and comes with a 133-MHz R4600PC Mips processor and Netscape Communications Server software.

All the systems we tested, except Tatung's MicroCompstation and Apple's WorkGroup Server 9150/120, increased in performance when handling requests between eight and 32 test sessions, then leveled off between 32 and 48 test sessions. The MicroCompstation's performance remained the same throughout our HTTP testing between eight and 48 sessions.

We found Apple's WorkGroup Server 9150/120 easy to set up. Priced at $8799, it's relatively affordable compared to all the other Web servers tested here; only the Tatung costs less. In our tests, however, the WorkGroup Server demonstrated an unacceptable amount (more than 5 percent) of failures in FTP and HTTP file transfers. The 9150/120 could not serve the thousands of simultaneous requests from 16 to 48 client sessions that we heaped on top of it, but with eight client sessions in the HTTP test, it was able to complete the test.

Although we couldn't really compare its performance against the other servers, Apple's offering has all the makings of a strong Web server for small businesses that don't anticipate thousands of hits a day. It has a 120-MHz PowerPC 601 processor, 32 MB of RAM, two internal 1-GB hard drives, a quad-speed CD-ROM, and a built-in DAT backup. It comes with StarNine Technologies' WebStar 1.2.4, Netscape's Navigator Web browser, AppleSearch information search engine, and Adobe Acrobat Pro publishing software. Apple is expected to introduce servers that have the PCI-bus interface similar to the PowerMac desktops that are shipping today. *continued*

BEST OVERALL — Digital Equipment AlphaServer 1000 4/266

If you're expecting immense traffic on your Web site, then the AlphaServer 1000 4/266, with its 266-MHz Alpha processor, provides all the performance you will need. Although relatively pricey at $20,690 (with monitor), the Internet-ready AlphaServer provides more room for expansion in its dual-cabinet chassis than SGI's WebForce Indy. The high price brings an abundance of opportunities for growth: support for 1 GB of memory and 14 GB of internal storage (expandable to 220 GB), as well as one EISA/PCI, seven EISA, and two PCI expansion slots. The AlphaServer is bundled with Process Software's Purveyor 1.1 Web server software, a Gopher server, fax server, Web browser, and Web authoring tools for creating your own home pages.

RUNNER-UP — Silicon Graphics WebForce Indy

The Indy races through our FTP and HTTP server load tests neck and neck with Digital Equipment's AlphaServer 1000 4/266. It's an outstanding price/performance value at $10,995 (with monitor). The Indy server comes bundled with the Netscape Communications Server software from Netscape Communications. The RISC-based Indy handles all transactions with a R4600PC CPU from Mips Technologies. You can swap the CPU motherboard module to upgrade the system to more powerful R4600SC or R4400SC processors. The system also comes with a cool IndyCam color digital-video camera, microphone, and speaker for those people interested in desktop videoconferencing.

RUNNER-UP — Intergraph TD-40

The Intergraph TD-40 costs $10,640 and utilizes two 133-MHz Pentium processors to give impatient Web browsers a speedy response time—almost fast enough to keep up with SGI's and Digital's RISC machines. The NT-based server's FTP performance is twice as fast as that of the Sun Microsystems' 75-MHz Netra i625. This indicates that the TD-40 fully exploits Windows NT's support for multiprocessor configurations and makes it the clear winner over the Netra. The TD-40 we tested had 512 KB of zero-wait-state cache, 64 MB of memory, a 10-slot PCI/ISA bus, and a 2-GB hard drive with Netscape Communications Server software. Intergraph ships the TD-40 with a three-year warranty for parts and labor, while most vendors provide just a one-year warranty.

	VENDOR/MODEL	TEST CONFIGURATION PRICE (WITH MONITOR)	FTP RATING	HTTP RATING	USABILITY RATING	FEATURES RATING	CPU	PROCESSOR SPEED (MHz)	NUMBER OF EXPANSION SLOTS	LENGTH OF STANDARD WARRANTY (MONTHS)
BEST	DEC AlphaServer 1000 4/266	$20,690	▲▲▲▲▲	▲▲▲▲▲	▲▲▲▲▲	▲▲▲▲	Alpha 21064	266	10	36
RUNNER-UP	SGI WebForce Indy	$10,995	▲▲▲▲▲	▲▲▲▲▲	▲▲▲▲▲	▲▲▲	R4600PC	133	2	12
RUNNER-UP	Intergraph TD-40	$10,640	▲▲▲▲▲	▲▲▲▲	▲▲▲▲▲	▲▲▲	Pentium	133	10	36
RUNNER-UP	Sun Netra i625	$15,995	▲▲	▲▲▲▲▲	▲▲▲▲▲	▲▲▲	SuperSparc II	75	4	12

KEY

Ratings from 1 to 5: ▲ is the lowest; ▲▲▲▲▲ is the highest.

SERVICE INSTEAD OF SERVER?

What can you do if you can't afford to buy your very own Internet server? You can rent one. While many Internet service providers (ISPs) will gladly rent you space on their servers for hosting Web pages, NaviSoft (Vienna, VA; (800) 879-6882; (703) 918-2329; http://www.navisoft.com), a subsidiary of America Online, offers an integrated package that includes site housing (NaviService) and Web-authoring tools (NaviPress). NaviSoft offers rates starting at $14.95 per month for a personal home page. (For a list of more sophisticated services, see the table "NaviSoft's Service Features" below.)

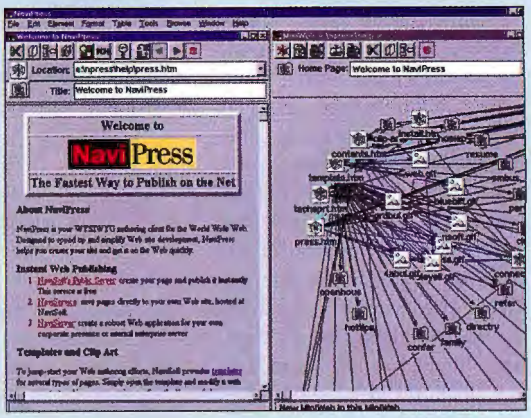
Many local ISPs also offer Web-page hosting services. NaviService's main competitors, however, will likely include companies such as BBSPlanet and UUNet in the commercial arena and Prodigy and CompuServe in the consumer market. NaviService offers advantages in two areas, according to Lydia Dobyns, vice president and general manager of NaviSoft: the robustness of the service's backbone (through the facilities of AOL) and the ease of use of the Web publishing tools found in NaviPress, a Web browser and Web-page editor.

What makes this particular solution interesting is the remote-authoring capabilities of NaviPress (the client software). Users can edit pages in the browser but they can't save those changes unless they have registered permission with the server. This is important in the realm of client/server Web sites because the user often won't have physical access to the server hardware housing his or her pages. A key ease-of-use factor for NaviPress page creators is that they can edit their Web pages remotely and publish them to the NaviService server at AOL using a special "put" command directly from NaviPress. NaviService subscribers may use other page-creation tools but must use more complicated FTP services to publish the pages they make.

NaviSoft does not offer Internet connectivity. NaviService users must make connections to the Internet via SLIP, PPP, or on-line service providers (e.g., AOL or GNN). This adds to the cost of maintaining a site, of course. Both AOL and GNN offer limited Web-page hosting to members at no additional charge. The two services use the NaviServer and NaviPress software. For AOL users, the content must be limited to personal rather than commercial use and a 10-MB storage capacity per account (because each account can have five screen names, you can link multiple pages). The GNN user can post personal and business-oriented material and has available a total storage capacity of 20 MB.

Early last December, NaviSoft's four levels of service had somewhere between 500 and 1000 clients combined. Dobyns said she expects the service will most benefit personal and commercial-level clients who can now create a Web presence without the expense of dedicated hardware and maintenance that an in-house Web server would require.

— Andrew Froning



NaviSoft's Web-page creation tool, NaviPress, and its mini-Web graphics function showing pages and links.

NAVISOFT'S SERVICE FEATURES

NaviSoft's four levels of service. The company provides technical support, Web-site consulting, and other Internet services, such as FTP and mail-domain aliases.

SERVICE	BASIC	DOMAIN*	COMMERCIAL*	DEDICATED
Start-up fee	$99	$199	$199	$999
Monthly fee	$14.95	$99	$199	$1999 (minimum of 6 months)
Server space	20 MB	50 MB	100 MB	1 GB
Hits per day	1000	5000	10,000	50,000

* Gives you a unique personal-domain name

HONORABLE MENTIONS

Silicon Graphics' WebForce Indy has an IndyCam color digital-video camera that captures video images for users interested in creating media-rich home pages. To activate the camera, you click on an icon on the Indigo Magic Desktop. This gives you a panoramic mirror in a window on the screen. You can then record a movie of yourself in .mv format, which you can save for Web navigators to download and view at their sites. The WebForce also has CD-quality audio, which makes it the hottest multimedia server that we tested.

To improve performance, you can add optional 100-Mbps network interface cards to most of the Web servers that we tested. This is important because poor network I/O throughput and a slow CPU can degrade a Web server's performance more than any other factors. The server must be connected by a high-speed network (i.e., Fast Ethernet, fiber optic, or T3 level) to fully exploit a 100-Mbps card.

The Digital Equipment AlphaServer 1000 4/266 provides 14 GB of hot-swappable disk storage inside its rackmountable cabinet. The entire right side of the server's chassis is reserved for disk storage, and you can slide in and out up to seven 2.1-GB StorageWorks drives. The drives are incredibly light, which enhances their portability.

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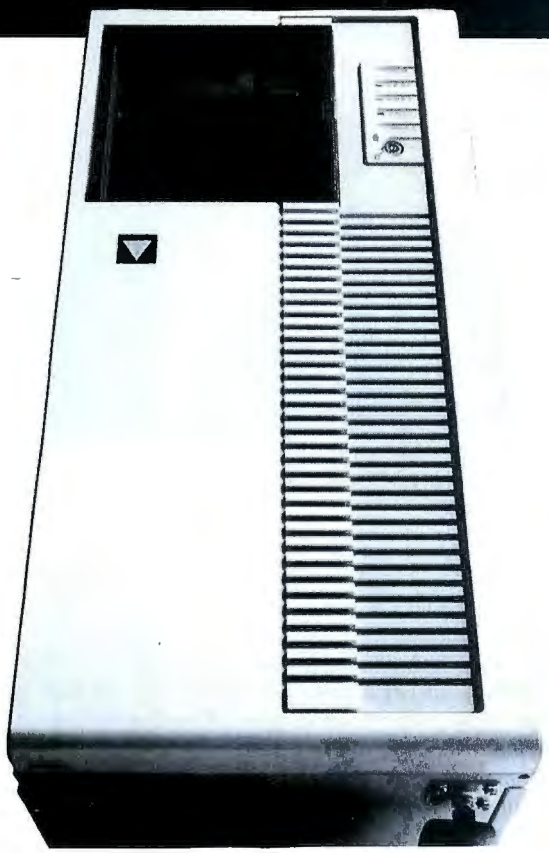

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How We Tested

The six servers we tested for this Lab Report included three Unix-based systems, two Windows NT-based systems, and one running the Apple OS, powered by RISC, Pentium, and PowerPC processors, respectively. Each vendor installed the Web server communications software that comes with their systems. The combination of hardware, OS, and Web server software was different on each of the systems.

The test-bed configuration was the same for all six servers. For our FTP tests, we configured all the systems as FTP servers performing anonymous FTP transfers. We requested the systems vendors to install or provide us with their choice of Web software that handles HTTP and FTP requests. The HTTP software transfers hypertext files from server hosts across the Web. We configured the InterMark test program to perform some percentage of FTP, HTTP, and Wide Area Information Service (WAIS) transfers simultaneously for our two test scenarios. These scenarios represent the real-world tasks Internet servers commonly face.

TEST CONFIGURATION

The server system hardware included a minimum of 32 MB of system RAM, at least 2 GB of SCSI disk storage, and a single 10Base-T Ethernet port. The client network included eight Dell Dimension/P75 systems, each of which was equipped with a 75-MHz Pentium and configured with 24 MB of RAM and Intel 10-Mbps Ethernet adapters.

We installed Windows NT Workstation 3.51 on each client, which, in turn, was connected to the Web server's 10Base-T port over twisted-pair cable. Each workstation was capable of running multiple Windows NT processes to simulate a much larger test-bed (up to 48 test sessions).

WEB SERVER TESTS

In our first scenario, we stress-tested the Web servers with 88 percent FTP traffic and the rest with HTTP and WAIS traffic, thus simulating the real-world dedicated FTP server used for archiving purposes. The average file size of FTP transfers we used was approximately 128 KB. In our second scenario, we tested with 97 percent HTTP traffic and the rest with FTP and WAIS. This simulates the most common use of a Web server, transferring the Hypertext Markup Language (HTML) files. Differing from the FTP tests, the HTTP tests transfer smaller files, about 15 KB. The WAIS traffic stresses the server CPU by searching for records in an on-line database (resident on the server) matching the keyword request.

Chandrika Mysore and Brent Melson evaluate all six servers using a test-bed of eight Dell P75 workstations connected on an Ethernet network.

In each scenario, we presented the server requests simultaneously from a range of eight to 48 clients, stressing the FTP, HTTP, and WAIS services at various demand levels. Each test client pounds on the server with heavy loads of requests, simulating the loads placed on it by 100 to 150 users accessing the server simultaneously. We tested the performance of these servers with a total of 48 virtual client sessions running from eight workstations. We stepped the load by adding virtual clients on each workstation, starting with eight clients and moving to 48. The FTP and HTTP tests stress the network components, disk I/O, and memory more than the CPU. The WAIS test stresses the server CPU and disk I/O.

Apple's Workgroup Server system comes with proprietary WAIS software called AppleSearch, which integrates with the Web server via AppleSearch ACGI. Digital offers a Unix-based server, and it originally sent us one to test; however, we were unable to complete the testing on this machine as it did not support the freeware WAIS software.

We developed our set of test files based on statistics from the National Center for Supercomputer Applications (Urbana, IL). The data summarizes the usage patterns at the NCSA's Web/FTP site, including average file sizes of various types, ranges of sizes, ratios of binary-to-text data, and patterns of file requests from the directory tree (e.g., HTTP gets many documents from the top of the tree and few from the bottom).

To create the file sources for our tests, we constructed three separate directory trees on each server to be benchmarked. The FTP tree consisted of 3100 files in eight directories (for a total of 356 MB of data); the HTTP tree had 4356 files in 12 directories (109 MB of data); and the WAIS tree included 6195 files with indexes in one directory (9 MB of data to be searched in a separate directory).

Testing the Web server systems in these scenarios represents a small subset group of server usage patterns. Every network setup varies, and different ways of organizing data place varying load patterns on a server. Our results can guide you to different types of server performance. For example, if you need a server for setting up a Web presence, the HTTP server performance is the most critical indicator. If you need an intracompany distribution system, FTP performance is more critical.

For the final performance score, we weight the HTTP test results twice as much as the FTP tests. The usability score is our subjective evaluation of the systems software and the available utilities that come with the servers. We surveyed the list of hardware and software features for each of the Web servers. We weight the features that are considered important for a Web server and generate a features score for every server. The overall score is weighted 70 percent for performance, 20 percent for usability, and 10 percent for features.

Contributors

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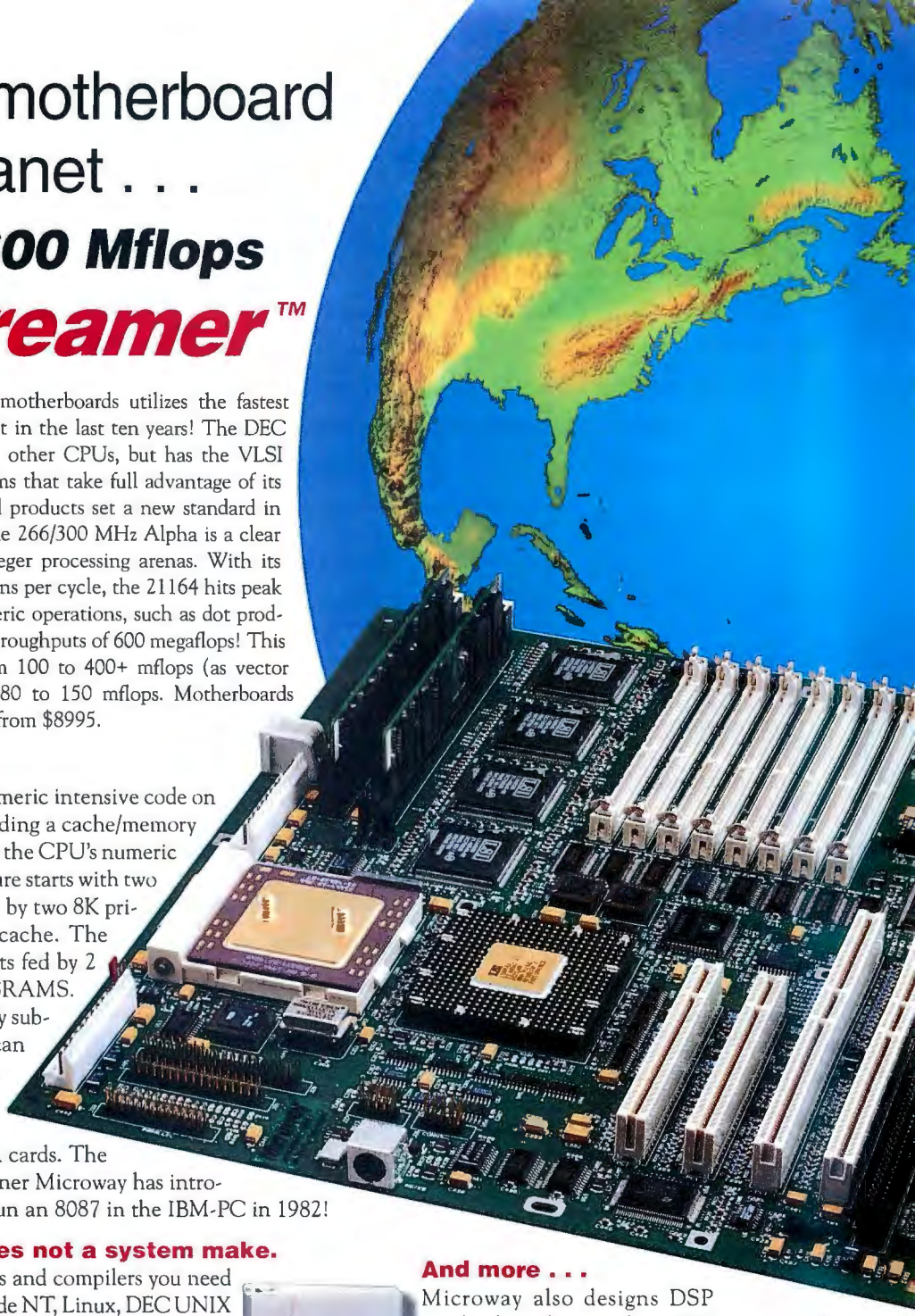

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NT, Excel and Word TM Microsoft. AutoCad TM Auto Desk.
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ROLL CALL

FEATURES CONTINUE ON NEXT PAGE

	APPLE COMPUTER WORKGROUP SERVER 9150/120	DIGITAL EQUIPMENT ALPHASERVER 1000 4/266	INTERGRAPH TD-40	SILICON GRAPHICS WEBFORCE INDY	SUN MICROSYSTEMS NETRA i625	TATUNG SCIENCE & TECHNOLOGY MICROCOMPSTATION 5/11
Test configuration price without monitor	$8399*	$19,995	$9440	N/A	N/A	$7705
Test configuration price with monitor	$8799*	$20,690	$10,640	$10,995	$15,995	$8635
FTP rating	**	10.0	9.2	9.9	4.5	3.2
HTTP rating	**	9.6	8.4	10.0	9.2	3.5
PROCESSOR						
Model	PowerPC 601	Digital Equipment Alpha 21064	Intel Pentium	Mips R4600PC	Sun SuperSparc II	Sparc Technology Group MicroSparc II
Speed (MHz)	120	266	133	133	75	110
Cache bus speed (MHz)	40	528 MBps	66	N/A	75	55
Memory bus speed (MHz)	40	33	66	50	50	55
Instruction cache (KB)	32	16	512	16	16	16
Instruction cache associativity	Four-way	Direct-mapped	Two-way	One- or two-way set	Five-way set	Four-way set
Data cache (KB)	1024	16	512	16	20	8
Maximum number of processors	1	1	2	1	1	1
Number of processors in test system	1	1	2	1	1	1
SECONDARY PROCESSOR CACHE						
Standard (MB per processor)	1	2	512 KB***	N/A	1	N/A
Maximum (MB per processor)	1	2	512 KB***	N/A	1	N/A
Total installed in test system (MB)	1	2	512 KB	N/A	1	N/A
Speed (ns)	11	15	N/A	N/A	N/A	N/A
Associativity	N/A	Direct-mapped	Two-way	N/A	N/A	N/A
SYSTEM RAM						
Standard amount (MB)	16	64	32	32	32	16
Amount in test system (MB)	32	64	64	32	84	64
Maximum amount (MB)	264	1024	256	256	512	256
Speed (ns)	70	70	70	60	60	60
EXPANSION BUS/SLOTS						
Bus architecture	NuBus	PCI/EISA	PCI/ISA	GIO32-bis	S-Bus	S-Bus
Number of slots	4	10	10	2	4	3
I/O PORTS						
Number of 9-pin serial	0	2	2	2	0	0
Number of 25-pin serial	0	0	0	0	2	2
UART type	N/A	Intel 8642	16550	Sipex 85C230 equiv.	Zilog 8530 equivalent	RS-232C, RS-423
AUI or 10Base-T	AUI	Both	Both	Both	Both	Both
SCSI-2	●	●	●	●	●	●
FDDI/ATM	Optional	Optional	Optional	Optional	Fast Ethernet, Token-Ring, and ISDN optional	●
Macintosh 8-pin serial	2	0	0	2	0	0
Video port	DB-15	0	0	SGI digital video input, NTSC/PAL composite and S-video inputs	0	0
INPUT DEVICES						
Keyboard type	Apple Desktop Bus	Enhanced PS/2 style	Multimedia IBM-compatible	PS/2	Sun Type 5	Sun Type 5
Three-button mouse	ADB Mouse II	●	●	PS/2	●	●
Optical mouse	○	○	○	Optional	●	Optional
NETWORK ADAPTER						
Ethernet adapter manufacturer	N/A	Digital Equipment	AMD	Silicon Graphics	Sun	N/A
Ethernet adapter model	N/A	DE435	PC Net PCI chip set	Integrated	Integrated	Integrated
Ethernet adapter location	Built-in	PCI slot	Motherboard	P-Bus	Motherboard	Motherboard
Ethernet connectors	EtherTalk	10Base-T, 10Base-2, 10Base-5	10Base-T/AUI	Twisted-pair	Twisted-pair	AUI
ISDN interface	○	○	○	●	○	○
DRIVE BAYS						
Total 3½-inch drive bays	5	7	4	1	2	3
Total 5¼-inch drive bays	0	2	4	0	0	0
CD-ROM						
Drive manufacturer	Various	Sony	Various	N/A	Various	N/A
Drive model	Internal	N/A	N/A	N/A	Various	N/A
Speed	4x	4x	4x	N/A	2x	N/A
Interface	SCSI	SCSI	SCSI	N/A	SCSI	N/A
Integrated speakers	●	○	●	N/A	●	N/A

= BYTE Best

● = yes; ○ = no; N/A = not applicable

* Street price

** The Apple server demonstrated an unacceptable amount (more than 5 percent) of failures in FTP and HTTP file transfers; however, with eight client sessions, it was able to complete the HTTP test (see page 127).

*** Shared by both processors

	APPLE COMPUTER WORKGROUP SERVER 9150/120	DIGITAL EQUIPMENT ALPHASERVER 1000 4/266	INTERGRAPH TD-40	SILICON GRAPHICS WEBFORCE INDY	SUN MICROSYSTEMS NETRA i625	TATUNG SCIENCE & TECHNOLOGY MICROCOMPSTATION 5/11
HARD/FLOPPY DRIVE						
Standard number of hard drives	1 or 2 internal	1	1	1	1	3
Manufacturer(s)	Various	Various	Conner or Quantum	Seagate	Various	Seagate or Fujitsu
Hard drive model(s)	1 GB, 2 GB, 4 GB	1 GB, 2 GB, 4 GB	540 MB, 1 GB, 2 GB	535 MB, 1.05-GB internal	535 MB, 1 GB, 2.1 GB	Seagate 1-GB Model ST3123ON; Seagate 2-GB Model ST3243ON; Fujitsu 4-GB Model N2934
Total hard drive storage capacity	20 GB	28-GB internal, 440-GB external	2-GB internal	2-GB internal	4.2-GB internal, 339-GB external	4 GB with two drive bays holding two 3½-inch drives
Interface	SCSI	SCSI	SCSI	SCSI-2	SCSI	SCSI
Number of drives installed in test system	2	1	1	2	1	1
Total hard drive capacity in test system	2 GB	2.1 GB	2 GB	2 GB	1 GB	1 GB
Standard 3½-inch 1.44-MB floppy drive	●	●	●	Optional	●	Optional
SECURITY						
Power-on password	Optional	●	○	●	●	●
Keyboard password	○	●	○	●	●	○
Setup utility password	Optional	●	●	●	●	●
Chassis lock	●	●	●	●	●	○
Keyboard lock	○	●	○	○	○	○
Support for SSL security	Optional	●	○	●	●	○
Secure remote log-in	Optional	●	○	●	●	●
Administer FTP access filter	Optional	●	○	●	●	●
DIMENSIONS						
Height (inches)	18.6	23.8	39.6	3	3.07	3
Width (inches)	8.9	16.9	178.2	16	16.4	16.5
Depth (inches)	20.6	25.6	186	14	16.1	17
Weight (pounds)	36.8	85	33	16	27	32
INSTALLED SOFTWARE						
Web software	StarNine Technologies WebStar 1.2.4	Process Software Purveyor 1.1	Netscape Communications Server 1.22	Netscape Communications Server 1.22	Netscape Communications Server 1.22	Internet Gateway for Solaris 1
Windowing system	Mac OS	Windows NT Server 3.5.1	Windows NT	OSF/Motif Toolkit 1.2, X11R5	OpenWindows	OpenWindows
Networking component	MacTCP	Windows NT Server 3.5.1	Windows NT	Iris NetWorker	ONC	Open Network Computing
FTP server	○	●	●	●	●	●
HTTP server	●	●	●	●	●	●
WAIS server	AppleSearch	Freeware kit—EMWAC	●	○	○	○
Programming languages	○	Freeware Perl, TCP	○	ANSI C, C++, Fortran77, Ada, Pascal	○	○
HTML development tools	PageMill and BBEdit	Freeware versions of HotMeTal, HTMLed, HTMLasst, HyperEdit, Hyped, CU-HTML	MS Word Internet Assistant	WebMagic Pro, WebSpace Author	○	○
Gopher server	○	●	○	○ (download from Silicon Surf)	○	○
Graphics editor	○	○	○	Adobe Photoshop 3.0, Illustrator 5.5	Photoshop	○
General publishing tools	Adobe Acrobat	Freeware EMAC	○	Iris ShowCase&trade 3.0	Illustrator, Photoshop, RAD, Cyberleaf	○
E-mail software	Apple Internet Mail Server	Freeware Vancemail	○	MediaMail Pro, IRIX	POP2, POP3, IMAP	Internet Gateway Server 1.0
Supports IPX/SPX for Internet access	○	Optional	○	○	●	○
IPX gateway software	○	Available	○	○	Solamet PPS	○
NetWare connectivity software	○	Optional	○	○	Solamet PPS	○
Other included software not listed above	Netscape Navigator	Mosaic, Finger, NNTP News Server	○	Developer Magic, ProDev, OpenGL, Iris GL	○	○
SALES AND SUPPORT						
Length of standard warranty (years)/ coverage	1/P, 2-day on-site	3 (on-site), 3 (next-day response), 90 days (help desk on software)	3/P, L	1/P	1/P	1/P
Extended warranty available	●	●	●	●	●	●
Sales and distribution channels	Direct, resellers	VARs	Direct, resellers	VARS, direct	SunService	Direct, VARS, OEMs
On-line support available	●	●	●	●	●	●
Free technical support after purchase	●	●	●	○	●	○
On-site service available	●	●	●	●	●	●
On-site service cost (first year)	Free	Free	Free	Varies depending on maintenance contract	$120	$700
Phone	(408) 996-1010	(508) 493-5111	(205) 730-2000	(415) 960-1980	(415) 960-1300	(406) 383-0988
Toll-free phone	(800) 776-2333	(800) 354-4825	(800) 345-4856	(800) 800-7441	(800) 821-4643	(800) 659-5902
Toll-free support number	(800) 767-2775	(800) 356-9000	(800) 633-7248	(800) 800-4744	(800) 872-4766	(800) 927-7880
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Warranty: P = parts; L = labor ● = yes; ○ = no

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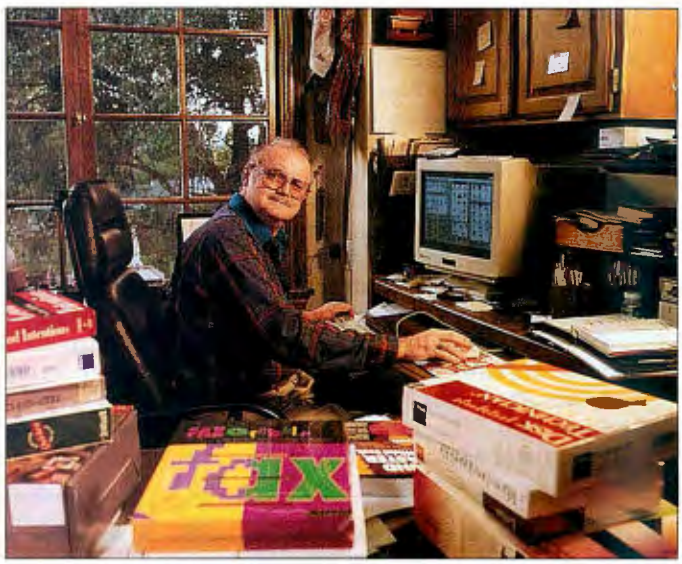

AMY ETRA © 1996

Big Cheetah's departure casts a pall over Chaos Manor—but the show goes on—and Roberta gets a Win 95 machine

The legend says the cobbler's children go barefoot. In our case, it's Mrs. Pournelle. Since 1990, Roberta has been using a Gateway 386DX with Desqview.

In fairness to me, Roberta has been doing most of her work on Mac systems, and I've got her the latest, including a hot PowerBook and a Power Mac 8100. She's more than happy with the Mac for developing her educational software. On the other hand, there's a larger market in the PC world, and she needs to stay familiar with it, although she uses the DOS system mostly for communications.

She operates a big network of home-schooling teachers, as well as other educational conferences, and much of that uses automated software that runs only in DOS. Still, as Richard observes, she may be the last person in the U.S. running Desqview. Moreover, while she's been able to connect to the Internet through BIX, it's time for her to get on the World Wide Web itself, and for that she wants Windows. Clearly, it was time to upgrade.

Incidentally, BYTE founded BIX, and although BYTE no longer has any ownership—BIX is part of the Delphi conferencing system—the BYTE editors have BIX accounts, and we use it for a lot of our official conferencing work. BIX doesn't have the fancy graphical interfaces of other information utilities, but it does have the largest signal-to-noise ratio of any system I know.

Anyway, we have two elderly—anything three years old is elderly—Gateway 2000 486DX2/66 systems. One, SuperCow, which has VL-Bus video, has been our experimental system and test-bed for a long time. The other is even older, being essentially the same machine without VL-Bus video. It has a Diamond Stealth video card, which is a lot faster than whatever VGA/EGA card is in Roberta's present system. For some years, that machine served as a NetWare network server, and it worked fine.

Recently, we took down the NetWare network because we weren't using it. For my purposes, OS/2 Warp Connect, Microsoft Windows for Workgroups, and Microsoft Windows 95 (W95) network nicely and provide all the network I need. That left the Gateway machine for Roberta; another hand-me-down, but it's a darned good one, and a lot faster than what she was using.

My first decision was what to put on it. I had three realistic choices: OS/2 Warp Connect, Windows for Workgroups 3.11, and W95. I went on-line and asked for advice. A major advantage of BIX is that I get useful information rather than Spam. I had a lively discussion with many knowledgeable people.

First, because Roberta uses many DOS programs and does communications, OS/2 Warp Connect looked good: it is, after all, what I use for most of my communications, including Web crawling. OS/2 is a better DOS than DOS by a lot, and it's very reliable for multitasking communications.

The problem was multimedia. OS/2 can't run Microsoft Audio Video Interleave (AVI) files—Microsoft won't license it to IBM—and while there's a shareware version of QuickTime that runs with OS/2, there's no supported version. Since one of the reasons Roberta wants an upgrade is to be able to work with Windows education software—there's a lot, and most of it is multimedia—OS/2 just isn't going to do it. That's a bit sad, but there it is.

The next consensus was that W95 is preferable to Windows for Workgroups 3.11. It's easier to learn, you can do more with it, and, in my experience, it works with DOS multimedia a lot better than Windows.

That decided, I dug out my DOS 6.22 disks and started removing NetWare by deleting its partition. I used FDISK. Version 2.0 of Partition Magic gets rid of FDISK, and I should have used that, but I was in a hurry, and after all, I was creating only one bootable partition. An hour later, I had the disk formatted and

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DOS 6.22 installed. Next we needed a CD-ROM drive.

Last week, Ron Sartore, president of the late and, by me, much lamented Cheetah International, came for a visit, and I let him take Big Cheetah away. It was a sad moment, but for some reason, Big Cheetah had been experiencing *mysterious* errors. Since there's a lot of pressure for me to test and use machines from companies still in business, it seemed pointless to spend much time troubleshooting what would never be more than a very fast 486DX2/66; so Ron took him away. Before he did, I removed the two-year-old Creative Labs Sound Blaster 16 card and its double-speed CD-ROM drive.

It took about 10 minutes to get that installed in Roberta's machine. Then the trouble started. It all worked "breadboarded," but now I had to find mounting hardware for both the CD-ROM drive and a big new hard drive.

When I was entering college, I must have done well on spatial-relations test questions. I recall a number of items where I had to choose what a figure would look like if rotated 60 degrees, and I got decent scores on my college entrance exams. Since then, I must have lost that ability: getting those silly rails on in the right place took four times as long as I had expected.

Then I found that the 5¼-inch floppy drive wasn't working properly. These things do wear out. Since I had to get a new drive anyway, I took out both floppy drives and installed a Teac FD-505 combination 3½-/5¼-inch drive. It's a half-height drive, so it takes no more room than a single drive, and it costs little more than a single floppy drive. You don't need a 5¼-inch floppy drive very often, but it's handy to have one. I can recommend the Teac FD-505; we've got one on about half the machines here.

The trick is connecting the cable: on a flat floppy cable, one of the connectors has a section of the cable twisted. On the other connector, the cable remains flat. If you connect the one with the twist, the 3½-inch drive will be A. If you want A to be the 5¼-inch drive, connect the one without the twist.

Installing the drive took no time at all except for those pesky mounting rails. We've really simplified the electronics in these machines, but the mechanical stuff leaves a lot to be desired. Eventually, I got it done while removing the skin from three knuckles.

Testing the 3½-inch drive was no problem, since that's what I booted from. I then looked around for a 5¼-inch floppy disk, and what came up was Alien Names, a shareware program written years ago by science fiction author and publisher Ralph Roberts. It efficiently generates a random assortment of alien-sounding names according to vowel/consonant schemes you input. It also generates insults.

I'd forgotten just how good this program is, and I'm glad I rediscovered it. Some programs are nearly perfect at what they do, and this is one of them. You can find a copy in my BIX conference.

The floppy drive worked fine. Now for W95. I had four choices. First, I could install

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Windows for Workgroups, get that running, test that the machine worked on the network, and finally install an upgrade version of W95 from a CD-ROM.

Second, I could skip W95 and install the upgrade CD-ROM version directly. As many readers have pointed out since my December column, the upgrade versions of W95 don't require that Windows be previously installed; they merely demand that you insert disk one of the Windows installation set at the proper time. I'd vaguely known that, but the December column was about tracking bugs, and I generally try to do that systematically. I wanted Windows for Workgroups 3.11 running so I could test things, including the network, before installing W95.

My third choice would have been a bit illegal. I have acquired an OEM CD-ROM copy of W95 to be installed on new machines. Microsoft doesn't sell original-installation CD-ROM versions of W95 except for OEM installations, probably because of the problem of supporting CD-ROM drives.

My fourth choice was to install W95 from floppy disks. Alas, that's what I did, largely to see what it would be like; and I learned that it's worth almost *anything* not to install W95 from floppy disks. It would have been easier to install Windows for Workgroups 3.11, get that running, and upgrade to W95 from a CD-ROM.

It takes forever—4½ hours—just to get W95 running directly from floppy disks, and when you think you are done and try to configure, or install W95 Plus, you find yourself feeding from one to seven floppy disks into the system again. And again. It is bad enough, in fact, that I am going to reinstall W95 from an upgrade CD-ROM so that in the future when the system wants something, it will ask for that rather than the floppy disks.

Aside from the near-terminal tedium, though, everything went swimmingly. W95 recognized the Diamond Stealth video card, the ViewSonic 17-inch monitor, the Creative Labs Sound Blaster 16 card, the CD-ROM drive, and the Intel EtherExpress network card. For reasons I don't understand, when I upgraded Pentafluge from Windows for Workgroups 3.11, I had to manually tell W95 that the EtherExpress card was set at interrupt request (IRQ) 10. Not this time.

The bottom line is that Roberta has W95 and is connected to the Chaos Manor internal network; and I can say that it's possible to install W95 from floppy disks, although you really don't want to do it.

It was worth the work. For years, I have used an old Hewlett-Packard LaserJet III

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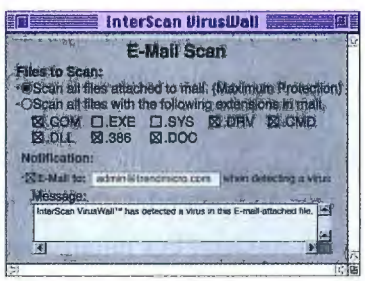

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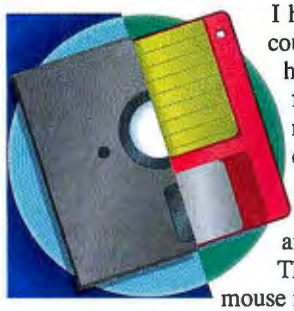
printer. It isn't fast or fancy, but for my limited printing, it has been good enough. Roberta, on the other hand, has a gorgeous 600-dot-per-inch Lexmark printer, which is faster and fancier. So now that she's connected to the Chaos Manor network, I can use her printer when I have a big or fancy job.



Once I had her system running, I got a nasty surprise. I had installed W95 with the Microsoft "Dove soap bar" Home Mouse plugged into serial port 1. Her older machine had a mouse port and PS/2 mouse, with the modem connected to COM1, so her software expected the modem to be on COM1. No problem, I figured. Just plug the mouse into COM2.

That didn't work. W95 said it could find no mouse. Since COM2 on Gateway machines is a 25-pin port, and the mouse uses a nine-pin plug, I thought I had a bad 25-to-nine-pin adapter, but that turned out not to be the case. Moreover, when I took that rig upstairs and tried it on SuperCow, which has an identical serial-port arrangement, I got the same result: the mouse wasn't found on COM2, this time by the Microsoft Mouse DOS software. I know I have had systems and software able to find a mouse on either COM1 or COM2 without problems, but not this time.

I had several choices. First, I could find the documents. Perhaps there's a configuration file created when you install mouse software, and once it expects to find that mouse on COM1, you must reinstall to change ports. I could find out and take care of it that way.

The simpler way was to put the mouse in COM1 and use COM2 for communications; which is what I did. I then discovered that Procomm 1 must be the dumbest program on earth. If you invoke it and it expects to find a modem on COM1 but none is present there, it will sit there blinking "Initializing" until doomsday. Moreover, the only way to tell it to look on COM2 is to get into the program, only of course it won't load.

I solved that by booting up with the mouse in COM1, invoking Procomm, unplugging the mouse from COM1, and plugging in the modem. Then when Procomm came up, I told it to look in future at COM2 and plugged the modem in there. That worked. I replaced Procomm 1 with Procomm 2, which has much the same interface as Procomm 1 but doesn't have that stupid trick.

On mice: I like the Microsoft "Big Teardrop" Mouse 2.0, but Logitech's newest TrackMan Marble trackball is terrific: the pointing is precise, the software is compatible with all flavors of Windows and OS/2, and the feel is excellent.

If you do a lot of mousing, a trackball is kinder to your wrist because you can rest your hand on it; and Logitech's TrackMan Marble stays cleaner than most upside-down mice. Recommended.

I installed Procomm 2 on Roberta's machine because she was used to Procomm 1, but it won't be permanent. I've recently converted to HyperAccess 2.1 for Windows. For years, my colleagues Wayne Rash and Hugh Kenner have recommended it.

I limped along with Procomm 2 until W95, when I made an awful discovery: while I can upload with ZMODEM in Procomm 2 and W95, I can't download with ZMODEM from BIX. Any attempts to download produce the message that the

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download was canceled at user request. Apparently, the Procomm 2/W95 combination sends some spurious character that BIX interprets as an abort order.

There's also HyperAccess 6.0 for OS/2; it's not a converted Windows version but a real OS/2 program. A "lite" version comes with one of the OS/2 Warp Connect upgrade packages, but get the "full" pack if you're going to use it much.

HyperAccess comes with log-in scripts for a number of services, including BIX, and it's easy to generate others. You can mark, cut, and paste without difficulty, making it easy to transfer stuff on-line to other files. The capture system is intuitive. It sends files easily. I like HyperAccess 2.1 for Windows a lot. Recommended.

The newest gadget at Chaos Manor is a 4-GB Micropolis MicroDisk 3243. This is an external model. It has its own power supply and can be carried from one machine to another.

The MicroDisk 3243 comes with an ingenious case system that lets you stack several drives into a tower. The base unit contains the power supply and the SCSI connection to the external world; if you add drives, they'll be connected internally. You can use a stack of these to build a RAID system or simply to add several new drives to your system.

Installation was a snap. It took a few minutes to unpack the drives and accessories—Micropolis believes in *secure* packaging—and another 15 or 20 minutes to be sure we understood the instructions for assembling the external housing. Once that was done, we connected the drive to the external SCSI connection of the Advansys SCSI controller on the Windows NT machine and rebooted. NT saw the drive at once and offered to format it. Half an hour later, we had a perfectly good 4-GB drive that's visible all over the network. Over the next few days, I let a batch file write a zillion little files and a couple of big ones, erase some of the files, run an optimization program, erase the disk, and start over. This is a good stress test.

I didn't expect any problems, and there weren't any. The MicroDisk 3243 is fast and rugged. This particular model is said to be optimized for audiovisual data transfer, meaning that it's better at delivering a high sustained rate over time than really fast short bursts. I'm not sure what any of that means; there comes a point when things are fast enough, and this drive certainly is that. It's quiet, and it runs cool.

I recall vividly when a 10-MB hard drive was about the size of a small washing machine. Now we have 4 GB, complete with a power supply, in something smaller than a shoe box. Micropolis makes good drives. Recommended.

Upgrading the wife—as Roberta puts it— delayed completing the setup of our new dual-Pentium system. This fire-eater is built up from a PC Power & Cooling case and power supply, a Micronix motherboard, a Peripheral Component Interconnect (PCI) fast SCSI controller, Century Micro memory, a Digital Equipment hard drive, and a Matrox video board.

We'll probably substitute a Micropolis 9-GB hard drive for the 4-GB Digital hard drive before we're done, if for no other reason than that the Micropolis drive is quieter; there's a mildly annoying hum from the Digital drive. If the system were closed up, I doubt we'd notice the sound, but one reason for this system is to use it as a test-bed, which means it's lying on a workbench with the case open much of the time.

We intend to use V Communications' System Commander 2.2 and PowerQuest's

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Partition Magic 2.0 to install a whole bunch of OSes on this machine: both MS-DOS and PC-DOS, W95, Windows NT, OS/2, and Linux. System Commander lets you boot up with whichever OS you like; Partition Magic lets you change the disk partition allocated to each OS without reformatting the disk. The programs together are a godsend.

The only OS that takes real advantage of the dual processors is NT, and that hasn't been installed yet because I had some problems with the CD-ROM drive. We recently got a new six-speed Plextor 6PleX CD-ROM drive, and I first fired up the new machine with a QLogic SCSI controller that didn't have the right drivers. Then I took the Qlogic controller out and installed the Adaptec PCI fast SCSI controller that ships with the 6PleX drive.

I expected some trouble, but there was none: the system fired up, recognized the hard drive, recognized the 6PleX CD-ROM drive, and waited for instructions. Alas, I'm out of time, so I didn't get NT installed yet. Next month for sure. Meanwhile, that 6PleX drive sure is fast.

The CD-ROM revolution continues. Writable CD-ROM drives now cost less than read-only units did just a couple of years ago, meaning that nearly anyone can get into the CD-ROM business now—and a great many people have. I get new CD-ROMs almost every day.

The trend is toward interactive multimedia. Some are educational. Others are a bit different. I suppose when CD-ROMs first came out, I should have been able to predict that there would be hundreds of discs with titles like Samurai Pervert Interactive, but I didn't.

I did foresee that the CD-ROM would be a major boon to scholarship. Logos Research Systems' Bible software is a great example. Their Logos CD Word Library 2.0, Level Four CD-ROM contains seven English Bible translations, including King James, American Standard, Revised Standard, and New Revised Standard; the Old Testament in Hebrew and Greek; the New Testament in Greek, with Byzantine and Alexandrian versions; the Latin Vulgate; translation tools, including several dictionaries and grammar expositions; major Bible commentaries; maps; and a lot of other scholarly and devotional tools.

It's all searchable, left to right for English and Latin, right to left for Hebrew. You can set up split screens with the original text and several translations side by side. There's an editor for attaching notes. You can extract and print texts. It comes with a short instructional video. They've even preserved the original fonts and text formats of works such as Jerome's and Matthew Henry's commentaries. In a word, they've done this right.

They've set the standard for scholarly works on CD-ROM. If you have any interest in Bible studies, you need it. Highly recommended.

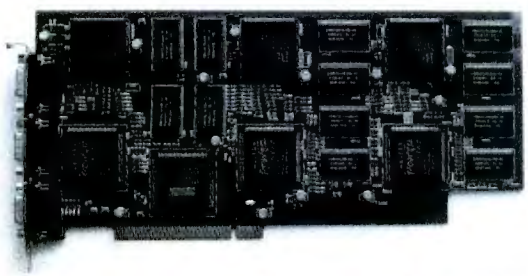
I long resisted 21-inch monitors, and now I wonder why I did. Yesterday, I installed a ViewSonic Professional Series PT810 at my main station. It took about 10 minutes, most of that devoted to carrying this 80-pound beauty up the stairs. W95 recognized it instantly. Changing to 1280 by 1024 pixels took a few minutes.

Then I sat down to it. John Carr, my

12-screen X Window terminal

uses up to 4 boards in PCI bus

The DX-Wall12 is a high performance PC based X terminal which connects directly to the PC's PCI bus and controls up to 12 monitor screens. The product consists of single and multi channel graphics add-on boards and X Window server software.



The DX-Wall12 server software can handle one large coherent virtual X Window screen with a resolution of 5120x3072 as an example. Windows can cover parts of more monitor screens.

Window movements and cursor handlings are automatic.

Custom X Window server developments, portings, and X application systems' development are available.

Compatibility	X Window X11R5
Software platforms	DDS & SCO UNIX systems
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Number of boards	from 1 up to 4 in one system
Number of screens	from 1 up to 12 monitor screens in one system
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DEXON Systems Ltd.
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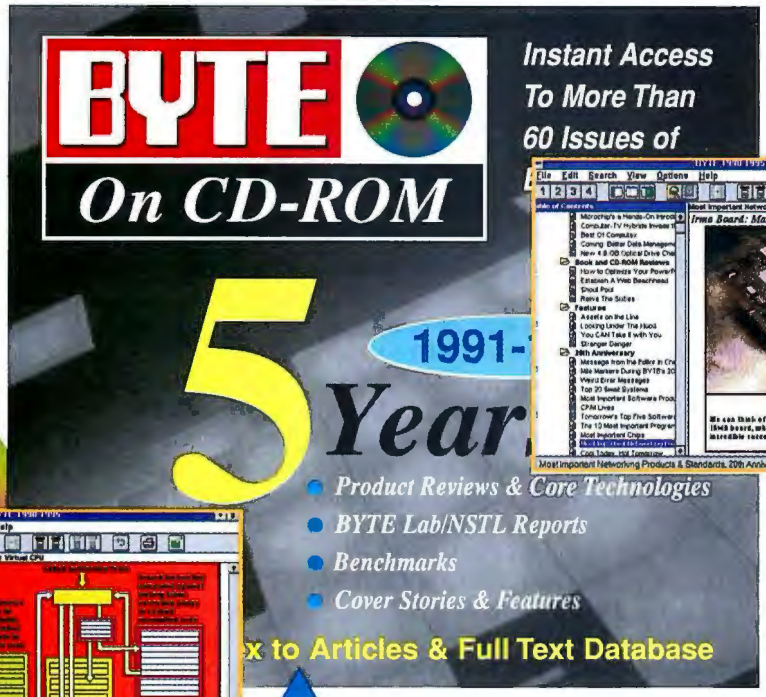

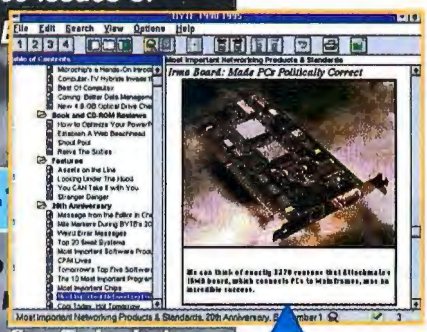

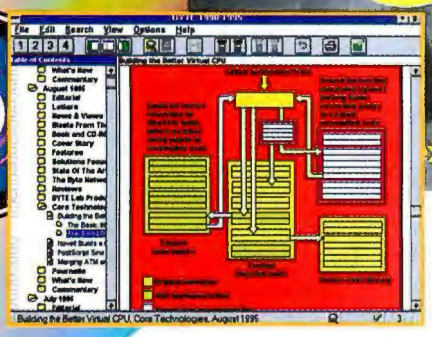

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HyperAccess 2.1 for Windows ($99.95), **HyperAccess 6.0 for OS/2** ($129), Hilgraeve, Inc., Monroe, MI, (800) 826-2760 or (313) 243-0576, fax (313) 243-0645, http://www.hilgraeve.com. **Circle 1138 on Inquiry Card.**

Logos CD Word Library 2.0, Level Four ($599.95), Logos Research Systems, Inc., Oak Harbor, WA, (800) 875-6467 or (360) 679-6575, fax (360) 675-8169, http://islander.whidbey.net/~logos. **Circle 1139 on Inquiry Card.**

MicroDisk 3243 External Drive ($2190), **Capricorn 3243 Internal Drive** ($1750), Micropolis Corp., Chatsworth, CA, (800) 395-3748 or (818) 709-3300, fax (818) 718-5312, http://www.micropolis.com. **Circle 1140 on Inquiry Card.**

Mission Critical ($59.95), Legend Entertainment Co., Chantilly, VA, (800) 658-8891 or (703) 222-8500, fax (703) 222-3471, 72662,1021@compuserve.com. **Circle 1141 on Inquiry Card.**

Partition Magic 2.0: DOS/Windows 95 ($49.95), DOS/OS/2 Personal License ($69.95), DOS/Windows/OS/2 Professional License ($495.95), PowerQuest Corp., Orem, UT, (800) 379-2566 or (801) 226-8977, fax (801) 226-8941, http://www.powerquest.com. **Circle 1142 on Inquiry Card.**

6PleX CD-ROM Drive: 63CS internal ($359), 65CS external ($449), Plextor Corp., Santa Clara, CA, (800) 886-3935 or (408) 980-1838, fax (408) 986-1010. **Circle 1143 on Inquiry Card.**

System Commander 2.2 ($99.95), V Communications, Inc., San Jose, CA, (800) 648-8266 or (408) 296-4224, fax (408) 296-4441, http://www.v-com.com. **Circle 1144 on Inquiry Card.**

TrackMan Marble ($99.95), Logitech, Inc., Fremont, CA, (800) 231-7717 or (510) 795-8500, fax (800) 245-0000, on CompuServe, go logitech. **Circle 1145 on Inquiry Card.**

ViewSonic Professional Series PT810 ($2495), ViewSonic, Walnut, CA, (800) 888-8583 or (909) 444-8843, fax (909) 869-7958, http://www.viewsonic.com. **Circle 1146 on Inquiry Card.**

long-suffering assistant, was raving about how great the color was and how sharp the icons looked. I put up some text. "It's maybe a little fuzzy?," I said. Then I realized: I was still wearing my street glasses. Of course it looked fuzzy. I changed to my computer glasses with 28-inch focal length, and you'll have to fight me to get this monitor away from me.

I'll bet that 5 minutes after Larry Niven sees it, he will order one. I am literally sitting here wondering how I got along without this all these years. I can read this comfortably from any position. When I switch to the desktop, I can have all kinds of stuff lying around on-screen, and I don't have to lean forward to see the icons.

Modern video boards and W95 can take advantage of a big screen. If you spend a good part of your time staring at a computer monitor, get a good one. Why go blind? I love this ViewSonic Professional Series PT810. Highly recommended.

The game of the month, and probably the year, is Legend Entertainment's Mission Critical. It starts fast: you are alone aboard a U.S. battle cruiser in a war zone in space. Your captain and all the crew are dead, but the skipper and his executive officer arranged for you to survive to carry out the crucial mission of the ship. No one but the skipper and the executive officer knew what that mission was. Meanwhile, the ship has been damaged and needs repair.

When you get the repairs made, your real trouble starts: the enemy is coming, and you have to fight this ship with no crew. That's barely possible, because the combat system is pretty realistic: you give orders to drones, and they do the fighting.

The graphics and sound effects are great, there are lots of movie action sequences with good human actors saying intelligent things, and, in general, they did this right. It has a realistic feel. I had no trouble installing and running this on Pentafluge under W95. Highly recommended.

The CD-ROM of the month is Microsoft Windows 95 Plus. You don't have to have this, but you'll like it. Be sure to install the pinball game: it's the most realistic computer pinball simulation I have seen.

The book of the month is John December's *Presenting Java* (Sam's Net, ISBN 1-57521-039-8). Java is Sun Microsystems' animation programming language for the Web. Since Microsoft has licensed Java, it has become the de facto standard Web language. Hot Java is a Web browser written in Java and available from http://www.java.sun.com/. They're described in clear language in this book. Recommended.

Next month: I give Chaos Manor User's Choice Awards for the most useful hardware and software of 1995, along with the annual Orchid and Onion parade; and, of course, Windows NT and the new dual-processor machine. ■

Jerry Pournelle is a science fiction writer and BYTE senior contributing editor. You can write to Jerry c/o BYTE, One Phoenix Mill Lane, Peterborough, NH 03458. Please include a self-addressed, stamped envelope and 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 the Internet or BIX at jerryp@bix.com.

Plan 9: Feature Film to Feature-Rich OS

A new OS, not from outer space but from venerable Bell Labs, treats all objects as files or file systems

BY PAUL FILLINICH

In a tongue-in-cheek salute to Ed Wood's sci-fi cult classic *Plan 9 from Outer Space*, researchers from AT&T Bell Laboratories named their ground-breaking operating system Plan 9. The new OS was created by an all-star cast including Rob Pike, Dave Presotto, Ken Thompson, Howard Trickey, and Phil Winterbottom, with support from Unix co-creator Dennis Ritchie.

The story opens with the scientists discussing their unhappiness with trends in commercial operating systems. Calling on their Unix experience, they and their colleagues on the Bell Labs computer-science research team begin to design a system that could adapt well to changes in hardware. In particular, they want to build an operating system that could profit from continuing improvements in personal machines, such as bit-map graphics, medium- and high-speed networks, and high-performance microprocessors. Thompson and Pike want the OS to be a general-purpose, multiuser, portable distributed system that could be implemented on a variety of computers and networks.

Thus Plan 9 was born. It's less than 600 KB in size and currently has several reference ports, including the Motorola 68020 and above, Sparc, Mips, the Intel 386/486/Pentium family, and Hobbit architectures. Plan 9 is client/server-oriented but with a major difference: Everything is a client, and everything is a server.

Building the Perfect Distributed OS

Plan 9 is predicated on several principles. The first is that all objects in the system are either files or file systems. Everything the program can talk to fits into this abstraction. An extension of a goal within the Unix design, Plan 9 takes this idea to its logical end.

In Plan 9, all communication with files is expressed in a protocol that can be transmitted over a wire. Thus everything can be made to be a remote file system. No longer do you have to know where a particular file resides.

Plan 9 also implements some new ideas in how it handles its namespace. The namespace—the set of objects visible to a program—is dynamically and individually adjustable. This is a new idea and has many interesting effects. Essentially it means the set of files the OS can see can be adjusted per process. Therefore, application programs do not need to know where they are running; where, and on what kind of machine, is an economic decision that does not affect the construction of the application itself.

The Plan 9 operating system can run stand-alone or distributed over separate machines acting as CPU servers, file servers, and terminals. The pieces are connected by a single file-oriented protocol and local namespace operations. Plan 9 is built from distinct, specialized components rather than from similar general-purpose components.

The Old Distributed Days

Until now, it has been common to connect a group of personal time-sharing systems—workstations—with a medium-speed network. But this has a number of shortcomings. Each workstation has private data, so each must be administered separately; maintenance is difficult to centralize. The machines are replaced every couple years to take advantage of technological improvements, rendering the hardware obsolete, often before it has been paid for.

Most telling, though, is that a workstation is largely a self-contained system, not specialized for any particular task, too slow and I/O-bound for fast compilation and too expensive to be used just to run a window system. To the Plan 9 team, concerned primarily with software development, it seemed that an approach based on distributed specialization rather than compromise could better address issues of cost-effectiveness, maintenance, performance, reliability, and security. The Bell Labs team decided to build a completely new system and terminal. This gave them an opportunity to rethink and perhaps even replace most of the utilities they had accumulated over the years.

Plan 9 is based on three principles:

1. **All objects are either files or file systems.**
2. **All file communication is expressed in a protocol that can be transmitted over a wire.**
3. **The namespace is dynamically and individually adjustable.**

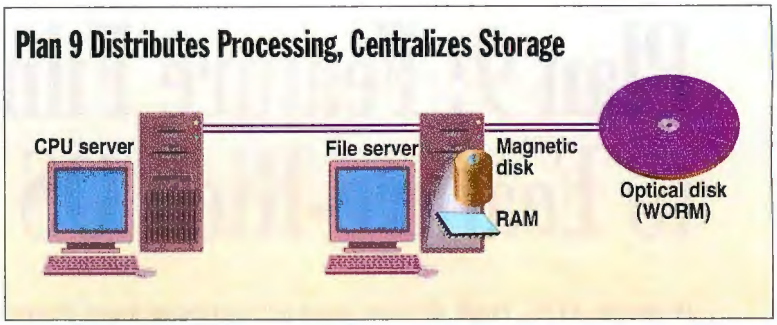
At Your Service

Plan 9 is divided along lines of service function. CPU servers concentrate computing power into large (not overloaded) multiprocessors; file servers provide repositories for storage; and terminals give each user of the system a dedicated computer, with bit-map screen and mouse, on which to run a window system. The sharing of computing and file-storage services provides a sense of community for a group of

programmers, amortizes costs, and centralizes and simplifies administration. This architecture is reminiscent of the centralized terminal-to-CPU time-sharing structure of the '70s. However, Plan 9 has some new and striking differences.

Plan 9 accommodates a variety of different networks. The service pieces communicate by a single protocol, built above a reliable data-transport layer offered by an appropriate network that defines each service as a rooted tree of files. Even for services not usually considered as files, the unified design permits some noteworthy simplification. Each process has a local file namespace that contains attachments to all services the process is using and thereby to the files in those services. One of the most important jobs of a terminal is to support its user's customized view of the entire system as represented by the services visible in the namespace.

Here's how some of the major Plan 9 components work:



Under Plan 9, a single file server maintains the data store for multiple CPU servers. The operating system moves data from RAM to disk to RAM based on frequency of use.

CPU servers: The CPU server performs compilation, text processing, and other applications. It has no local storage; all the permanent files it accesses are provided by remote servers. Transient parts of the namespace, such as the collected images of active processes or services provided by user processes, may reside locally, but these disappear when the CPU server is rebooted. Plan 9 CPU servers are as interchangeable for their task—computation—as are ordinary terminals for theirs.

A multiprocessor CPU server has several advantages. The most important is its ability to absorb load. If the machine is not saturated, there is usually a free processor ready to run a new process. This is similar to the notion of free disk blocks in which to store new files on a file system. The comparison extends further: Just as you might buy a new disk when a file system gets full, you can add processors when the system gets busy, without needing to replace or duplicate the entire system. Of course, you can add new CPU servers and share the file servers.

File servers: Plan 9 file servers hold all permanent files. The file server presents to its clients a file system rather than an array of disks or blocks of files. The files are named by slash-separated components that label branches of a tree and may be addressed for I/O at the byte level. The location of a file in the server is invisible to the client.

An example of how this separation of file services works is how the Plan 9 developers themselves actually use the concept. Their true file system resides on a WORM, an optical disk that can be recorded only once, and is accessed through a two-level cache of magnetic disk and RAM. The contents of the recently used files reside in RAM and are sent to the CPU server rapidly by DMA over a high-speed link, which is much faster than a regular disk although not as fast as local memory. The magnetic disk acts as a cache for the WORM and simultaneously as a backup medium for the RAM. With the high-speed links, it is unnecessary for clients to cache data. Instead, the file server centralizes the caching for all its clients, avoiding the problems of distributed caches.

Namespaces: The protocol for communication with Plan 9 services is file-oriented; all services must implement a file system. That is, each service is arranged into a set of file-like objects collected into a hierarchy called the namespace of the service. When a program calls a Plan 9 service, the program is connected to the root of the namespace of the service. Using the protocol, the program accesses the service by opening, creating, removing, reading, and writing files in the namespace.

From the services available on the network, a Plan 9 user selects those desired: a file server where personal files reside, other servers where data is kept, or a departmental file server where the software for a group project is being written. The namespaces of these various services are collected and joined to the user's own private namespace by a fundamental Plan 9 operator (called `attach`) that joins a service's namespace to a user's. The user's namespace is formed by the union of the spaces of the services being used. The local namespace is assembled by the local operating system for each user, typically by the terminal. The namespace is modifiable on a per-process level, although in practice much of the namespace is assembled at log-in time and shared by all that user's processes.

One of Plan 9's fundamental operations is attaching network services to the local namespace on a per-process basis. This fine-grained control of the local namespace is used to address issues of customizability, transparency, and heterogeneity.

Applications for Plan 9

An advantage of Plan 9's close relationship with Unix is that many of the applications that run on Unix can be ported to Plan 9. Much of what is delivered as part of the Plan 9 source-code product will be familiar to Unix developers. Not only have Unix applications been ported to Plan 9, but much of the standard command set looks similar to that of Unix.

Where to Find

Plan 9 Resources:

Anonymous FTP: plan9.att.com

University of Toronto site:

http://www.ecf.toronto.edu/plan9

But does the world need another operating system? It depends on the niche being addressed. AT&T sees a niche for Plan 9 in embedded systems and massively parallel systems. Each of these segments has adequate operating systems. However, there is not a consistent standard OS that cohesively connects these systems. Thus Plan 9 may find its place in applications that depend on low-end, single-use devices that must communicate with large-scale application servers.

Plan 9 is available today. Many leading-edge companies are looking to see how they can use it in their businesses and products. Some companies have already found a niche for it. Plan 9 from Bell Labs could be playing soon at a computer near you. ■

Paul Fillinich is a marketing manager at AT&T. His software career includes a long-running role as the original product manager for C++ (produced by Bjarne Stroustrup). He is an avid fan of software technology, not bad B-movies. You can reach him by sending E-mail to editors@bix.com.

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Bringing Benchmarks up to SPEC

A suite of respected CPU benchmarks gets a face-lift

TOM YAGER

Computer systems keep getting faster. That's the way we like it. Unfortunately, this also creates a challenge: As systems evolve, so must the benchmarks that we use to compare them.

The last time the Standard Performance Evaluation Corp. (SPEC) released a new version of its performance tests was in 1992. Since then, the SPECint92 (integer) and SPECfp92 (floating-point) benchmarks have become industry standards. However, SPEC's membership—which comprises system vendors, educational institutions, and consultants—has been busy finding fault with its own work. The result of all this soul-searching is a new benchmark, known as SPEC95. Thanks to new test programs and a new baseline machine, SPEC95 creates a more level playing field for comparing different systems and microprocessors.

Of course, you should view any benchmarks with a skeptical eye. Nobody has yet invented a canned benchmark test that precisely measures how *your* system will perform when running *your* software. For some users, the only worthwhile benchmarks are the ones that they create and run themselves using real applications. But standardized benchmarks such as SPEC95 are nevertheless useful for obtaining ballpark estimates of how different systems will perform under actual conditions. At the very least, you can use them as a broad, initial screen.

Rocketing Ratios

SPEC95 includes two test suites. One, written in C, measures integer performance; another, written in FORTRAN, measures floating-point performance. These programs deliver their results indexed to a standardized baseline system (a 40-MHz Sun SparcStation 10) scoring 1.0. In other words, if the SPECint95 result is 5.0, then the tested system is five times faster at integer tasks than the baseline system.

SPEC92's baseline system was a Digital VAX-11/780. This system was also the baseline for another, more dubious, benchmark: Dhrystone MIPS. This benchmark fell into disrepute over the years and is sometimes defined as "meaningless indicator of performance" or "marketing's idea of performance."

Actually, MIPS and SPEC92 were tolerable benchmarks until some CPUs began scoring ratios in the hundreds. For example, Digital Equipment estimates that its Alpha 21164 processor scores greater than 500 SPECint92 and 750 SPECfp92. Digital predicts that a next-generation Alpha processor, which is scheduled for introduction in 1997, will attain 1000 SPECint92. Sky-high ratios like these obscure the differences between systems and might indicate that some tests ran too fast to permit accurate measurement.

To keep the test ratios from soaring out of control (at least for a while), SPEC95 adopted the new SparcStation 10 baseline system. As a result, Digital says that the same Alpha 21164 chip that was estimated at 500 SPECint92 and 750 SPECfp92 now achieves 11 SPECint95 and 17 SPECfp95.

Another problem SPEC tackled was optimized compilers. SPEC had to abandon one floating-point test entirely when a new FORTRAN compiler knocked performance ratios right out of the park. The combination of faster systems and smarter compilers creates a problem for all types of benchmark programs.

How do you write a program that's complex enough to test a system acceptably well under all conditions but that also runs in a reasonable amount of time? SPEC's latest answer is that you can't. That's why if you run the full suite of SPEC95 tests on the new baseline machine, you won't get your results for two days.

New Requirements

The SPEC95 benchmark suite consists of programs culled from various sources, primarily academic and scientific.

continued

THE SPEC95 BENCHMARK

It's based on a new suite of programs.

SPEC95 INTEGER TESTS	
Game of Go	099.go
Motorola 88000 RISC CPU simulator	124.m88ksim
GNU C compiler	126.gcc
File compression/decompression	129.compress
LISP interpreter	130.li
JPEG compression/decompression	132.ijpeg
String and integer manipulations in the Perl language	134.perl
Database	147.vortex

SPEC95 FLOATING-POINT TESTS	
Mesh generator	101.tomcatv
Shallow-water model	102.swim
Quantum physics	103.su2cor
Astrophysics	104.hydro2d
Multigrid solver in 3-D potential field	107.mgrid
Differential equations	110.applu
Simulated turbulence in a cube	125.turb3d
Weather conditions and distribution of pollutants	141.apsi
Quantum chemistry	145.fpppp
Plasma physics	146.wave5

SPEC's first alteration was to replace some of SPEC92's small programs with more demanding ones. The goal was not only to create longer run times but also to present a more accurate picture of true performance by using larger, more resource-intensive programs. The SPEC95 code is portable and runs on just about any flavor of Unix. Soon there will also be a version available for Windows NT.

Of course, compiled programs measure the efficiency of a compiler as much as they measure the performance of a system. SPEC answers this criticism in two ways. First, SPEC acknowledges that compilers and optimizers can have a significant impact on the results. Second, SPEC now requires vendors to run the benchmarks with limited optimizations—no more than four optimization flags. Vendors must use the same flags for all tests and report their optimizations.

SPEC never intended for SPEC92 to measure I/O performance, but sometimes the larger tests overflowed a system's main memory, forcing it to use virtual memory. As a result, machines with faster disk I/O performed much better. To avoid this situation, SPEC95 requires the test system to have at least 64 MB of RAM (Windows NT systems, too).

By changing the test code and defining a new baseline, SPEC has made it almost impossible to devise a conversion formula that translates SPEC92 results into SPEC95 numbers. SPEC wisely discourages this because the two tests are not comparable. Major elements of the SPEC92 suite don't exist in SPEC95. The new benchmarks place less emphasis on floating-point math, because integer operations are more typical in real-world applications. And some tests in the SPEC95 suite run for a given period of time rather than for a given number of iterations, making comparisons with SPEC92 still more difficult.

Therefore, to obtain SPEC95 results for older systems, you have to run the SPEC95 suite on those machines. Unfortunately, many of them can't meet the minimum RAM requirement of 64 MB. That's why you won't see SPEC benchmarks for all six generations of the Intel x86 architecture going back to 1978. For those kinds of historical comparisons, we're still stuck with MIPS.

Where to Find

Standard Performance Evaluation Corp.
National Computer Graphics Association
Fairfax, VA
(703) 698-9604
spec-ncga@cup.portal.com

Looking for Respect

One of the best things about SPEC is that it's unbiased. Even though vendors such as IBM and Intel help define the benchmarks, SPEC is a nonprofit organization that makes everybody play by the same rules.

Limiting the compiler optimizations is just one example. There's also a whole set of "run rules" that govern compilation, testing, and system configuration. Vendors must follow yet another set of rules when publishing their test results.

Official SPEC95 test reports will have at least two numbers. SPECint_base95 measures integer performance with minimal compiler optimizations; SPECfp_base95 does the same for floating-point performance. These are probably the most trustworthy numbers because they obey the most stringent rules. However, it's likely that you'll see two additional results: SPECint95 and SPECfp95. These tests allow maximum compiler optimizations, which brings the compiler's performance into the mix.

However, some system vendors prefer to report SPECint_rate95, which is an entirely different result; it measures throughput ratios. Instead of measuring a machine's performance while running a single program, SPECint_rate95 is based on repeated tests that count how many iterations that a machine performs within a fixed amount of time. Here, factors such as cache efficiency make a difference.

Vendors are free to use any compiler optimization that they want for the SPECint_rate95 test. If they decide to use minimal optimizations, then they can report the result as SPECint_rate_base95. The parallel floating-point equivalents for these two tests are SPECfp_rate95 and SPECfp_rate_base95.

How to Use SPEC95

Anyone can purchase the SPEC benchmark suite on CD-ROM for $600. It includes all the tools you need to compile and run the programs. Vendors can submit results to SPEC, which reviews them. If vendors don't conform to all the run rules, they don't get published in the SPEC newsletter. Of course, SPEC can't stop anyone from publishing numbers elsewhere.

When interpreting SPEC results, it's important to keep a few things in mind. First, although SPEC has attempted to devise a suite that closely mimics system behavior when running real applications, these are still synthetic benchmarks. Your mileage may vary.

Second, remember that SPEC95 does not test I/O performance. If your application is I/O-intensive—on-line transaction processing, for instance—SPEC95 probably won't be as meaningful as a disk-I/O benchmark. If the responsiveness of a GUI is important to you, SPEC95 isn't the best choice for that, either.

Finally, don't attempt to map specific SPEC95 test programs to your real-world applications. SPEC95 is a collection of programs that lets you compare one system's basic performance to another's. There's still no substitute for running real programs on the system you're trying to evaluate.

If you're going to base a major purchasing decision on SPEC results, you might want to compile and run the tests yourself. At the very least, obtain the benchmark results directly from SPEC. If these results are markedly worse than the vendor's published numbers, demand an explanation from the vendor. SPEC's new rules should make it more difficult for vendors to rig the tests with their own benchmark-specific optimizations. SPEC has put the world on notice that if it uncovers any such optimizations, it will change the suite to close the loophole.

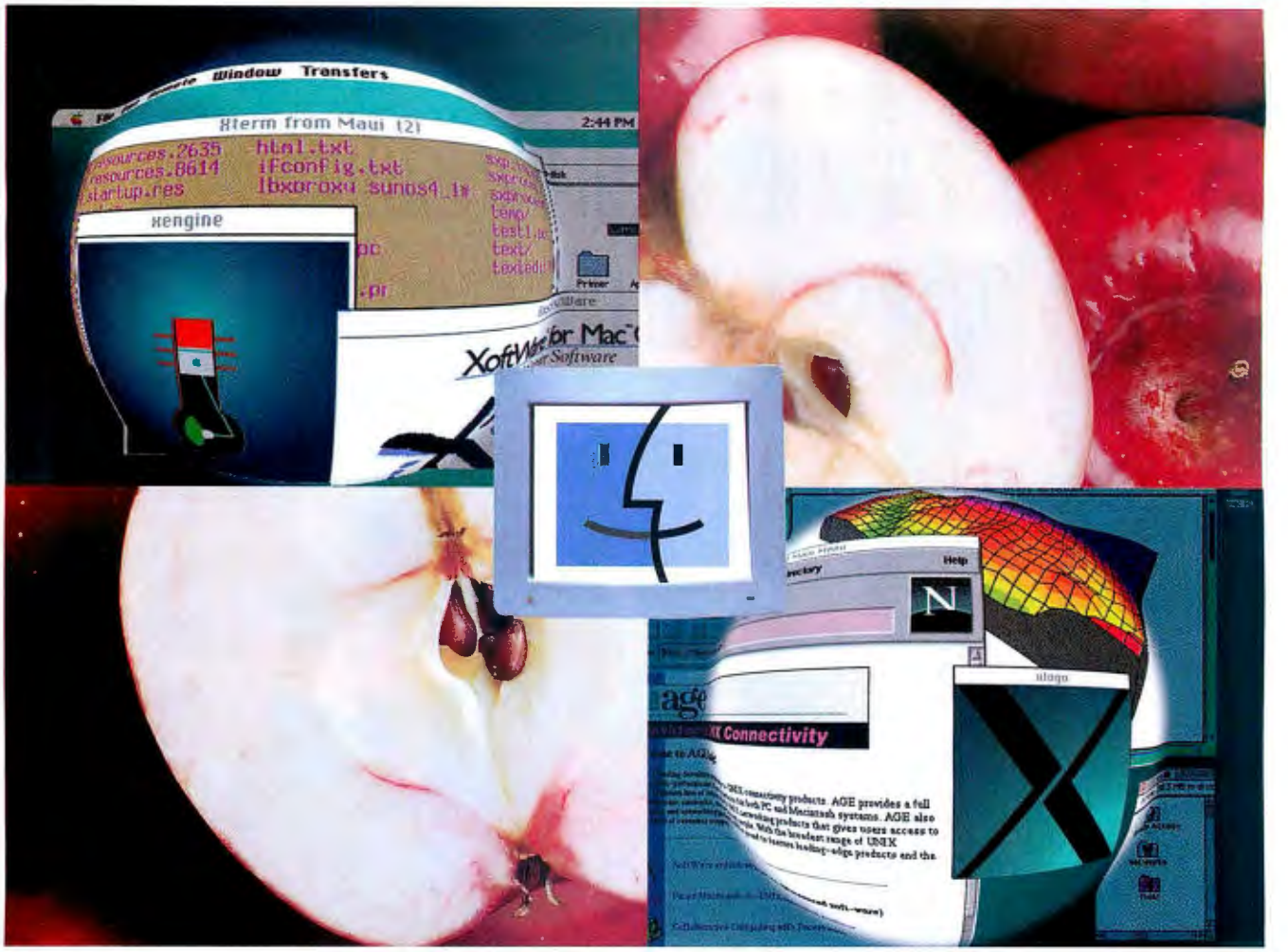
SPEC deserves praise for its dedication to providing reliable test data. SPEC95 is a definite improvement over SPEC92. ■

Tom Yager is a freelance writer and an evangelist for the Matrox Video Products Group. He works from his research lab in North Texas. You can reach him on the Internet at tyager@maxx.net or on BIX c/o "editors."

SPEC95: No Comparison to SPEC92

Because SPEC95 numbers are indexed to a different baseline system, they can't be compared directly to SPEC92 values. (Values shown are for a 150-MHz Pentium Pro.) Even the ratio of floating-point to integer performance might vary from the old benchmark, as this example for the Pentium Pro 150 shows.

	SPEC95	SPEC92
Floating-point	5.41	220
Integer	6.08	276.3
SPECint/SPECfp	1.12	1.26



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Bug-Free Benchmarks

Investigation into the erratic behavior of a benchmark leads to an unsettling discovery about memory allocation

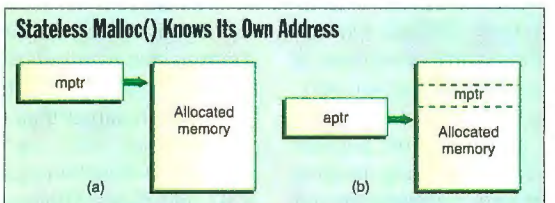
RICK GREHAN

If you've ever had a perfectly good machine go haywire on you—perhaps a new car that breaks down as you exit the dealer's lot—then you'll understand this. The BYTEmark, a program that we had worked on for better than a year—which had successfully run on CPUs ranging from PowerPCs to 286s, and on OSes from Unix to DOS—began cracking up. We were perturbed; Intel wasn't pleased, either, because the problem caused us to report erroneous numbers on the P6 processor in "BYTEmark Bug Bashed" (December 1995 BYTE).

The Patient

The specific benchmark component involved was LU Decomposition, one of the three members of the floating-point portion of the BYTEmark. This benchmark test gets its name from the algorithm it uses, which breaks a single matrix into two matrices: one lower-triangular (all elements above and to the right of the diagonal are zero), the other upper-triangular (all elements below and to the right of the diagonal are zero).

The algorithm might sound odd—and even a little pointless—but as it turns out, this is an effective technique for solving linear equations. You will find the details of the algorithm in many texts on numerical algorithms, such as *Numerical Recipes in Pascal*, by Press, Flannery, Teukolsky, and Vetterling (Cambridge University Press, 1989). What's important for our purposes is the fact that LU Decomposition does a great deal of array manipulation. Furthermore, the elements of the arrays are floating-point double values. Remember that.



A "stateless" malloc() wrapper. In (a), malloc() returns a pointer (mptr) to a block, the size of which is purposefully set longer than needed. In (b), the wrapper locates the first aligned address within the block and stores the original pointer just "behind" it. The aligned pointer (aptr) is returned to the application. Later, a wrapper around free() can retrieve the original pointer by looking behind aptr.

The Symptoms

Each of the tests in the benchmark suite is run multiple times (at least five) so that the system can form a collection of results to calculate an average. This also allows the system to verify that the results are reasonably close to one another. If the results vary wildly, then either the benchmark has a problem or there's some outside force (say, a background task) running on the system that's affecting the program.

Such was the case with the LU Decomposition test. The test results exhibited a *bimodal* distribution: The score was either an unreasonably low number or a reasonably high number—never anything in between. We were frustrated in our attempts to locate the cause of this effect. For example, on one Windows NT–based system, we found that running the Performance Monitor in the background always produced low numbers. On another system, if we ran one of the other benchmark tests—Numeric Sort—prior to running LU Decomposition, regardless of how many intervening tests we ran, LU Decomposition yielded low numbers.

Furthermore, this behavior appeared only on Intel machines running Windows 95 or NT. We couldn't make it happen on these machines running a 32-bit DOS extender, nor would it occur on a PowerPC machine running NT.

Early Diagnosis

The first suspect was a temporary memory buffer allocated and released within the LU Decomposition test. This was the only case of an OS call within a timing routine, so we moved it outside the timing loop. The results were negative.

Next we investigated the possibility of a memory leak. Fortunately, Mike Spertus of Geodesic Systems was here at BYTE demonstrating his company's product, Great Circle (see "Code Talk: A Programmer Needs a Maid," January BYTE), which detects and corrects memory leaks. He came into the lab and linked his library into the benchmark code. Great Circle gave the benchmarks a clean bill of health—no memory leaks.

We were getting closer, however. Although Great Circle found no leaks, it made the problem disappear. It had something to do with memory, but what?

Proper Diagnosis

The answer came in an E-mail message from Rob Barris of QuickSilver Software. He suggested that it might be a problem with the alignment of memory allocated by `malloc()`. Sure enough, a quick patch to the program allowed us to see that the test returned a low score whenever the allocated memory was *not* aligned to an address evenly divisible by 8. (Returned addresses were always divisible by 4.)

It was all clear now. The LU Decomposition test used 8-byte floating-point doubles. Whenever `malloc()` re-

turned an unaligned memory block, all fetches and stores were consequently much slower. Great Circle had cured the problem because it takes over `malloc()`, and its `malloc()` replacement always returns data aligned to 8-byte boundaries.

The Cure

The solution was apparent: Write a *wrapper* (an enclosing routine) around `malloc()` that provides aligned memory. Fortunately, the benchmark was written in the days when there was still a need to test 16-bit systems and all memory allocation went through a single routine, `AllocateMemory()`. In a sense, we already had our wrapper; we just had to make it smarter.

Do performance implications play a part in the definition of "suitably aligned"?

So, `malloc()` returns a memory-block pointer, which the wrapper routine examines and simply increments until the address is properly aligned, right? Well, not so fast. First, if you advance the memory block's pointer, you run the risk that a routine might overstep the block's end somewhere down the road. By advancing the address, you effectively shave bytes off the front of the memory block.

Second, when the program finishes with the memory block, the address is passed to the `free()` routine so that the C library can release the memory. Given that the wrapper has advanced the address of that pointer, what is returned to `free()` is not what was given to the application by `malloc()`. The program will crash.

You can eliminate the first problem by having the `malloc()` wrapper allocate slightly more memory than originally requested. This additional "buffer" lets the program advance the pointer with no danger of returning a memory block that's too short.

The fix for the second problem is a bit more difficult. One approach is to allocate an additional pointer's worth of memory at the front of the block. Once the pointer is adjusted appropriately, the real pointer is stored a pointer's distance back in the block. (We say "pointer's distance" because, although most pointers are 32 bits wide, 64-bit machines are already appearing on some desktops.) When it's time to free the memory, a wrapper around `free()` backs up to locate the original pointer. With this scheme, the `malloc()` and `free()` wrappers are *stateless*: They don't have to remember anything about the memory they've allocated; all the information they need is in the memory block. (See the figure "Stateless Malloc( ) Knows Its Own Address" on page 153.)

Nevertheless, we chose a simpler way out. We set up a global array that associates the pointer returned by `malloc()` with the adjusted pointer passed to the routine. We could get away with this because the algorithms of the benchmarks tend to allocate a few big blocks rather than many smaller blocks, so we had no fear of overruning the global array.

The Vector

Now that we have our fix, it's time to ask a few rhetorical questions. Should we have had to do this in the first place? Are we simply bellyaching if we complain that a low-level detail such as the alignment of memory returned by `malloc()` is an issue we really shouldn't be concerned with? Or are we justified in complaining that the compiler vendors—who are, after all, providing products that are supposed to save programmers from the perils of dealing too closely with OS APIs and hardware details—should make better `malloc()`s?

Our copy of *Standard C Programmer's Quick Reference Manual*, by Plauger and Brodie (Microsoft Press, 1989), simply says of `malloc()` that "you can safely convert the return value to a data object pointer of any type" whose size is no bigger than the maximum allowed by `malloc()` (the maximum being implementation dependent). No mention is made of performance requirements.

However, in *C: A Reference Manual*, by Harbison and Steele (Prentice-Hall, 1995), we find a section on alignment restrictions: "The C programmer is not normally aware of alignment restrictions, because the compiler takes care to place data on the appropriate address boundaries." Just what is meant by "appropriate" here is unclear. We know that on some machines, inappropriate alignment can cause a crash. Is a 4-byte alignment appropriate for an Intel machine? Or is that merely sufficient? Is sufficient enough?

Daniel Boulet of Boulet Fermat Associates sent us Internet mail on this matter. He told us that the Unix System V Interface Definition (the third edition of SVR4) `man` page on `malloc()` reads: "The function `malloc()` returns a pointer to a block suitably aligned for any purpose." Then Boulet makes this point: If performance implications don't play a part in the definition of "suitably aligned," then why not just implement `malloc()` to return arbitrarily aligned data on architectures that support it?

The Release

Boulet's question is a good one, but we're still unsure of where the blame—if you can call it that—lies. Should we have known better? If so, shame on us. Should the compiler vendors have known better? If so, shame on them.

For yourself, if your current programming project includes algorithms that manipulate large arrays, be warned—particularly if you're working with Intel machines and you deal with data types that are larger than the bit size of the OS. (We suspect that the reason `malloc()` on Windows 95 and NT returned memory aligned to 4-byte boundaries is that those OSes are being touted as 32-bit OSes.) Although our experience was with an array of floating-point doubles, we suspect that an array of data structures might experience similar problems if one of the structure's elements fell on an inappropriate address boundary.

For ourselves, we've "fixed" the BYTEmark. And although it may cause us to sigh over our unnecessary work, we hope that the next release of our favorite 32-bit C++ compilers from Microsoft and Watcom will include a slightly modified version of the runtime library routine `malloc()`. ■

Editor's note: *As of this writing, the source to the updated BYTEmark suite is available for downloading from the BYTE Web Site (http://www.byte.com).*

ACKNOWLEDGMENTS

Thanks to Mike Spertus, Rob Barris, and Daniel Boulet. Also, the compilers whose `malloc()` *routine exhibited the behavior described were Visual C++ 2.0 from Microsoft and Watcom C++ 10.5 from Watcom. Other compilers may or may not produce similar results.*

Rick Grehan, who developed the BYTEmark benchmark suite, is a senior technical editor for BYTE reviews. You can reach him on the Internet or BIX at rick_g@bix.com.

Internet-Aware Applications

Modified products are in the works that will let companies further exploit the Internet-as-backbone phenomenon

SALVATORE SALAMONE

Businesses have been struggling for at least a decade to extend their corporate backbone networks to corporate partners and the public. With 37 million U.S. and Canadian users now on the Internet (according to a fall 1995 CommerceNet/Nielsen survey), companies no longer have to wonder which network to bet on.

Yet the Internet is still underexploited by most companies, used mainly for E-mail and file transfer. And the problem isn't just security. Internet-aware, packaged applications have been rare, but not for long. Remember when LAN-aware applications transformed PC-based computing in the early 1990s? A flood of Internet- and World Wide Web–aware applications will soon do the same for networking beyond the company walls. Whether it's a beauty parlor scheduling its customers or a chip maker publishing real-time part-availability data from corporate databases, many more firms will soon be doing it with shrink-wrapped software and on the Internet.

Opening the Floodgates

Internet phone applications, introduced last year, were the first products that exploited the "free" bandwidth of the Internet (see "Dial 1-800-Internet," February BYTE). These products take an analog voice signal, compress and digitize it, and send it out over the Internet. The reverse process occurs at the other end of the connection, allowing two people to hold a phone conversation. Such products have algorithms that buffer incoming packets to help smooth out the unpredictable delays packets may experience while traversing the Internet.

The next type of product we're likely to see modified to run over the Internet is group-scheduling software. Campbell Services is modifying its OnTime Enterprise so that you can use it for intercompany scheduling running over the Internet. The new product is called OnTime Web Server, which is implemented as a Common Gateway Interface (CGI) application that will run on Windows 3.x, Windows 95, and Windows NT Web servers that support CGI.

Such intercompany group scheduling would, for example, help coordinate meetings between an advertising agency and the marketing department of a corporation. It could also be used by an industry consortium to plan its meetings.

Group scheduling over the Internet would work this way: A company would maintain a Web server running a modified version of OnTime Enterprise. Users pointing their browsers at that site would be able to view schedules in the form of Hypertext Markup Language (HTML) pages (see the screen below).

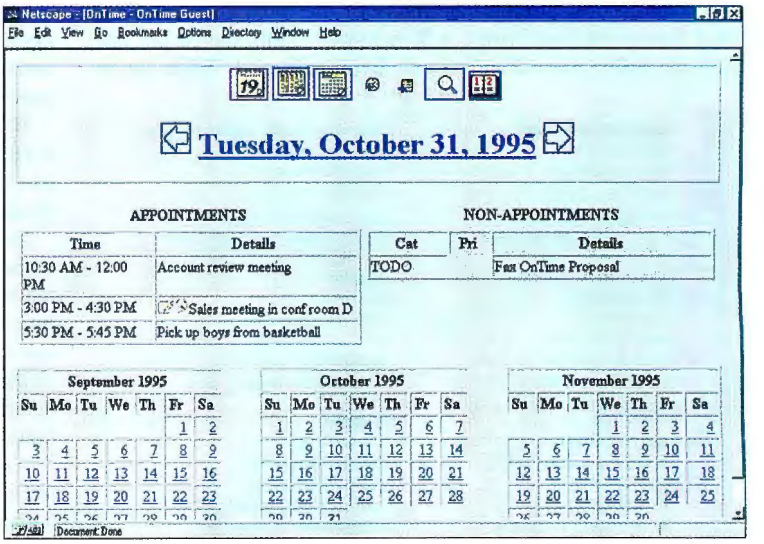
Security issues are a concern when using such a system. Imagine what the stock market would do if someone got to a scheduling Web site and saw that Bill Gates and Lou Gerstner were meeting for lunch five days in a row.

For this reason, Campbell Services will use the existing security and access-control features of OnTime Enterprise to prevent such abuse. These features include management tools for adding, modifying, and deleting users. Any part of the user community that's also on NetWare can be easily added through OnTime's NetWare Bindery integration capabilities.

Microsystems Software has slightly different plans for its enterprise group-scheduling product called CaLANdar. One idea that Microsystems has is aimed at intracompany scheduling, where users could pick up a revised schedule from any place they have Internet access. A salesperson could dial into a Web site from a hotel room and get a list of the next day's appointments that incorporates any last-minute changes entered in the home office.

Such access to group scheduling could be useful for a virtual corporation. For example, a consortium of vendors might use it to post its meeting schedule on one vendor's Web site for all to see.

continued



Need a publicly accessible calendar? Campbell Services' group scheduler will let anyone with a Web browser view the latest updates to his or her schedule.

Nigel Spicer, president and COO of Microsystems, sees scheduling programs being used in another way. "When it comes to getting a haircut or your oil changed, these programs used over the Internet could replace what you do on the telephone," says Spicer.

Internet service providers might offer this type of group-scheduling service for communities. The idea would be to let people browse through the local Jiffy Lube's or beauty salon's schedule of appointments. A user can then make an appointment from his or her PC.

Privacy issues are involved in a plan like this. For instance, you probably wouldn't want any person with a browser to see that you spend three afternoons a week at your psychiatrist's office. Similarly, you wouldn't necessarily want everyone to know that you'll be out of your home for 2 hours tomorrow afternoon getting your brakes repaired.

CaLANdar, like many group-scheduling products, has built-in security features that deal with these potential problems. For example, it lets an administrator import an E-mail user directory into CaLANdar, where he or she can then determine who has access to the group-scheduling system (rather than building such a list from scratch). CaLANdar also lets you hide a message or note. In that way, you can reserve a time slot so others can see that the slot is taken, but no one knows it's taken by you.

Microsystems has one large corporate client (which does not want to be identified) interested in a different scheduling-over-the-Internet project. The client is a greeting card company, and its plan is to offer a calendaring host service for its customers. Each person reaching the company's Web site would enter such information as the birthdays and anniversaries of friends and relatives. The system would send early-warning E-mail to give you enough time to buy a card and present. The company would also send you an on-line version of its catalog of gifts. This company sees the Internet used in this way as a free, global communications channel.

Come Together

It's one thing to give users a view at meeting schedules over the Internet, but how about setting up the meetings in the first place? You would need a contact management program to pull the meetings off.

Elan Software's latest version of GoldMine, a contact manager for workgroups, already has many of the tools you'll need. A new feature in GoldMine for Windows 95 (introduced last fall) was the ability to send and receive Internet E-mail. When you receive a message from one of your contacts, the message is automatically linked to the contact's GoldMine record.

You can compose messages off-line. These messages are queued up to be sent automatically when the next Internet connection is made.

Additionally, users can now synchronize databases over the Internet. Originally, GoldMine allowed point-to-point synchronization, a feature that was typically used by one person with a laptop and a desktop system. That concept evolved into a many-to-one product, called GoldSync, which allowed groups of users to synchronize databases of client contacts, conversation history, and appointments.

GoldSync works with dial-up phone lines or over a corporation's WAN. A natural extension was to modify the program to run over the Internet. The result is GoldMine for Windows 95's Internet-connectivity features, which let users send database updates over the Internet.

Get That Data

For many corporate users, the real impact of Internet-enabled applications will come in the DBMS arena. Larry Ellison, Oracle's chairman and CEO, has made it clear that the Internet is the way to go for accessing corporate data. He is one of the major proponents of the stripped-down, networked PC that's geared toward retrieving information over the Internet.

Oracle's product line already includes Web-server software and a browser. The company is also developing a server-based applications suite that will include database and Web-server technology, systems management tools, and a messaging server with text search tools and E-mail.

Last fall, Computer Associates announced CA-Unicenter/ICE (Internet Commerce Enabled). This set of products, once available, will be the foundation for a Web-centric database that lets you build Web pages incorporating company data and that makes this information available to anyone with a Web browser.

Computer Associates plans to offer a tightly integrated set of products under the CA-Unicenter/ICE architecture. Using the tools, a company might set up a Web-based catalog of its products. When a customer places an order over the Internet, the inventory database would be updated and an E-mail message could be sent to the customer when the order is shipped.

The point is to make existing information available without having to do much extra work. Along those lines, Sybase has announced a database application that dynamically generates Web pages from an existing database.

Basically, we're about to see the first wave of products that have been modified to run over the Internet. And some organizations, like the greeting card company mentioned earlier, are already thinking about new ways to use this capability.

Security seems to be the only obstacle standing in the way of an explosion in the use of Internet-enabled applications. Many of the vendors who are modifying their programs to run over the Internet are addressing security up front by linking access control and user rights to existing security systems, such as user rights assigned for LAN access. How well a job vendors do in this area will determine whether these Internet-enabled applications are embraced by large corporations. ■

Salvatore Salamone is a BYTE news editor based in New York and author of Reducing the Cost of LAN Ownership *(Van Nostrand Reinhold, 1995). You can contact him on the Internet or BIX at ssalamone@bix.com.*

Where to Find

Campbell Services
Southfield, MI
(800) 559-5955
(810) 559-5955
fax: (810) 559-1034
http://www.ontime.com

Computer Associates International
Islandia, NY
(800) 225-5224
(516) 342-5224
fax: (516) 342-5734
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Elan Software
Pacific Palisades, CA
(800) 654-3526
(310) 454-6800
fax: (310) 454-4848
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Microsystems Software, Inc.
Framingham, MA
(800) 489-2001
(508) 879-9000
fax: (508) 626-8515
http://www.microsys.com

Oracle
Redwood Shores, CA
(800) 633-0596
(415) 506-7000
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http://www.oracle.com

Sybase
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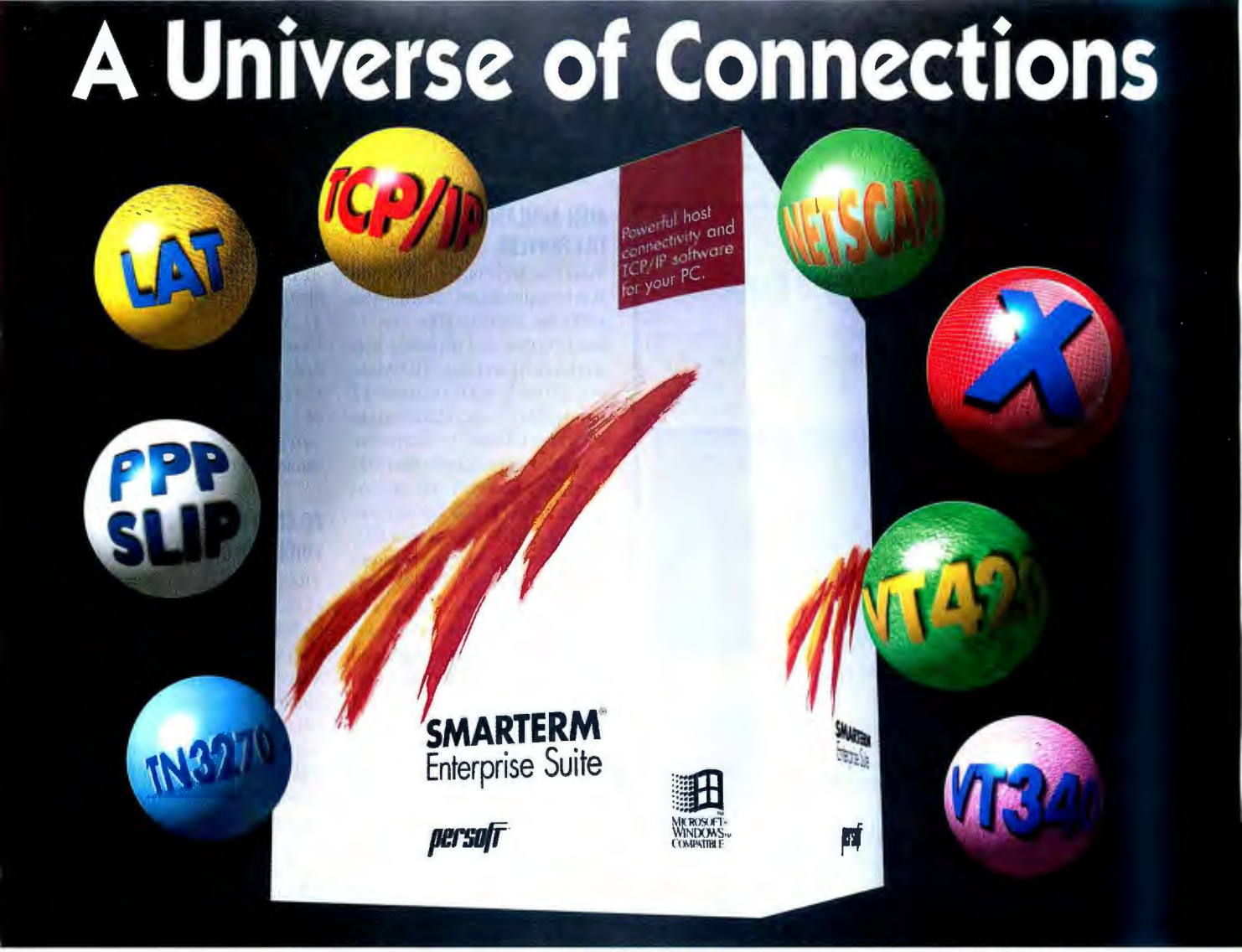
A Universe of Connections



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Circle 124 on Inquiry Card.

WHAT'S NEW Hardware

PREVIEW 3-D ACCELERATOR CARDS

PCI Card Accelerates Mac 3-D Graphics

Late last year Apple introduced QuickDraw 3D, its Mac OS component that provides an API for manipulating and storing 3-D objects as well as managing how they're displayed. However, 3-D manipulation and rendering are computationally expensive processes. A Power Mac running QuickDraw 3D can work in real time with simple models only. To obtain real-time rendering with complex models, hardware support is necessary.

QuickDraw 3D Accelerator Card $399
Apple Computer, Inc.
Cupertino, CA
(800) 776-2333
(408) 974-1010
http://www.apple.com/
Circle 1031 on Inquiry Card.

Enter the QuickDraw 3D Accelerator Card, a Peripheral Component Interconnect (PCI) card that comes equipped with 128 KB of cache static RAM (SRAM) and 512 KB of high-speed SRAM for storing texture maps. Two custom ASICs implement the rendering engine, which can render up to 120,000 triangles per second and up to 10 million trilinearly filtered, mip-mapped texture pixels per second. The card boosts Gouraud shading, texture-mapping, transparency, and constructive-solid-geometry operations.

It took just a matter of minutes to install the card and load the software in a Power Mac 9500. I had only a few sample applications to play with, but the results were spectacular. Sample 3-D objects created with Specular Graphics' Infini-D 3.1 had complex texture maps, and I set the objects rotating and mousing about the screen effortlessly. Another sample application, a game from Reality Bytes called Havoc, features real-time animation of a vehicle that's traveling across a convulsed and rocky landscape.

The QuickDraw 3D Accelerator Card promises to promote ever-more-realistic 3-D imagery, whether it's for next-generation games or serious workstation applications. And check out the card's unworkstation-like price: $399.

—Tom Thompson

120-MHZ PENTIUM TRAVELMATE

The TravelMate 5200 (about $5199) combines an Intel 120-MHz Pentium processor with a 32-bit 30-MHz synchronous PCI bus architecture and 256-KB Level 2 cache. The notebook also comes with 8 MB of RAM, expandable to 32 MB (or to 104 MB with 64-Mb DRAM memory); a 1.2-GB hard drive; a 1.44-MB floppy drive; a 10.4-inch 800- by 600-pixel active-matrix SVGA color display with 65,000 colors and 2 MB of video memory; one PC Card slot, supporting one Type III or two Type I/II cards; a 16-bit sound card; an internal speaker; a dual-mode microphone; interfaces for audio I/O and real-time video with Intel Indeo software; a serial infrared port; and two lithium-ion battery packs.

Contact: Texas Instruments, Inc., Temple, TX, (800) 848-3927 or (817) 774-6001; http://www.ti.com.

Circle 1036 on Inquiry Card.

HIGH-AVAILABILITY PENTIUM FILE SERVERS

Two file servers for LAN and WAN applications, the MaxPro 1500 and MaxPro 800, support most NOSes and differing network configurations. The MaxPro 1500 ($7600) features 12 removable 5¼-inch half-height and three internal 3½-inch drive bays. You can configure the fault-tolerant MaxPro 1500 unit as an integrated RAID server (supporting RAID 0–5) or as a CD-ROM-based server. The compact MaxPro 800 unit ($6600) features six 5¼-inch half-height and two internal 3½-inch drive bays. Both file servers come equipped with 90- to 166-MHz Pentium-based motherboards; support for EISA, ISA, and PCI add-in boards; IDE and floppy drive controllers; 16 MB of on-board SIMMs, expandable to 384 MB; 256 or 512 KB of secondary cache memory; a dual, hot-swappable 300-W power supply; and error-detection and reporting capabilities.

Contact: CSS Laboratories, Inc., Irvine, CA, (714) 852-8161.

Circle 1034 on Inquiry Card.

MULTIFUNCTION ETHERNET HUB

The M208 Workgroup Print Server (US$895) lets you connect up to three printers to your workgroup. A high-speed IEEE 1284–compliant parallel port provides load balancing, autosensing and switching, ASCII-to-PostScript conversion, header and trailer strings, banner/trailer page generation, monitoring and status reporting via SNMP and SMTP E-mail, multilevel password security, and data scrambling. The hub component provides eight 10Base-T UTP ports and one AUI port that, with an optional transceiver, allows you to connect to 10Base-5, 10Base-2, and 10Base-F Ethernet networks. The M208 provides simultaneous support for TCP/IP, IPX/SPX, AppleTalk, and NetBIOS over TCP/IP. Through the M208's support for SLIP and PPP, the server can also connect a remote office to a LAN.

Contact: Microplex Systems, Ltd., Burnaby, British Columbia, Canada, (800) 665-7798 or (604) 444-4232; info@microplex.com.

Circle 1037 on Inquiry Card.

PC CARD MODEM WITH VOICE AND CELLULAR ▼

The DataVoice 3400 PC Card ($399) features Direct Connect Cellular support for popular cellular phones and Radish Voice View technology, which enables you to alternate quickly between talking on the telephone and using a modem during the same call. Compatible with IBM PC laptops and Macintosh PowerBooks, the PC Card modem supports V.34 28.8-Kbps data transfer, 14.4-Kbps send-and-receive fax, and data compression and error correction. The DataVoice 3400 also has the ability to answer a telephone, play a prerecorded message, and record a caller's message and store it on the hard drive.

Contact: TDK Systems, Nevada City, CA, (800) 999-4835 or (916) 478-8421; answers@tsd.ssi1.com.

Circle 1035 on Inquiry Card.

28.8 MODEM/FAX/ETHERNET LAN PC CARD

Mariner ($599) offers connectivity to popular cellular phones and wireless messaging for one-way alphanumeric and Tango two-way paging systems, plus 10Base-T and 10Base-2 LAN connectivity. Mariner provides increased throughput, along with V.42bis/MNP 5 data compression, V.42/MNP 2–4 error correction, 14.4-Kbps fax operation, and Group 3 Class 1 and 2 fax-machine compatibility. A dual RJ-11 connector lets a PC and a telephone share a single telephone line.

Contact: Motorola, Inc., Schaumburg, IL, (800) 427-2624 or (708) 538-5200; http://www.mot.com/mims/isg/.

Circle 1047 on Inquiry Card.

BUSINESS-CARD READER ▲

The Smart Card Business Reader ($299) can read business cards in landscape or portrait form at speeds up to 4 cards per minute at a resolution of 400 dpi in 8-bit gray scale (256 shades of gray). You can view images of the cards on your PC monitor, view the contacts in database format or as a list, and add notes to the cards and search for contacts based on the notes.

Contact: Seiko Instruments USA, Inc., San Jose, CA, (800) 688-0817 or (408) 922-5800; rajeed_venkatapuram@seikosj.com.

Circle 1040 on Inquiry Card.

1200-DPI COLOR LASER PRINTER

At 5 ppm in color and 14 ppm in monochrome, the Phaser 550 (from $6995) provides printing at 1200 by 1200 dpi. It offers workgroup shareability with its large toner capacities, three media trays, and Tektronix's PhaserLink World Wide Web–based printer management tool. The printer comes with a 32-MHz AMD 29040 processor, a memory-compression coprocessor, a plug-and-play bidirectional parallel port, and a SCSI port. Optional network cards support EtherTalk, Novell NetWare, TCP/IP, TokenTalk, and LocalTalk protocols. In addition to offering Adobe PostScript Level 2 support, the Phaser 550 includes HPGL and optional PCL 5 emulation, with automatic sensing and switching among printer languages.

Contact: Tektronix, Inc., Wilsonville, OR, (800) 835-6100 or (503) 682-7377; http://www.tek.com/color_printers/.

Circle 1032 on Inquiry Card.

MULTIFUNCTION DOCUMENT SYSTEM

The Konica 7050 (from $24,950) is a 50-copy-per-minute digital laser copier that, with the optional Konica IP-201 Image Processor and KN-101 NIC (call company for prices), becomes a copier/network printer capable of printing 400 or 600 dpi. Its bidirectional parallel or serial ports or optional KN-101 NIC support TCP/IP, Ethernet, EtherTalk, Ethernet SNAP, or OS/2 LAN Manager/LANServe protocols. The unit's standard 16 MB of RAM is upgradable to 128 MB, and its five paper sources hold a maximum of 3650 sheets.

Contact: Konica Business Machines U.S.A., Inc., Windsor, CT, (800) 256-6422 or (203) 683-2222.

Circle 1041 on Inquiry Card.

120-MHZ PENTIUM NOTEBOOK

Combining a 120-MHz Pentium processor, multimedia capability, and modularity (with its NEC VersaBay II slot), the NEC Versa 4080H notebook ($5499) lets you design a system tailored to your needs. The notebook comes with a 1-GB hard drive; 8 MB of user-upgradable memory; a recessed, full-size keyboard with a palm rest and a VersaGlide touchpad pointing device; a lithium-ion battery that provides up to 5 hours of computing time; two infrared ports; two stacked PC Card slots to accommodate one Type III or two Type II cards; and docking options. Multimedia features include two stereo speakers, a microphone, a Sound Blaster Pro–compatible 16-bit sound card, four audio ports, a volume-control dial, full-motion video support, and a 10.4-inch 800- by 600-pixel TFT color display. The VersaBay II slot allows you to choose a floppy drive or optional CD-ROM drive, a second battery, or a second hard drive.

Contact: NEC Technologies, Inc., Mountain View, CA, (800) 632-8377 or (415) 528-6000; http://www.nec.com.

Circle 1042 on Inquiry Card.

3-D VR GRAPHICS ACCELERATOR

With 3D SymphonicVision ($299), you get a 64-bit Windows graphics accelerator, stereoscopic 3-D glasses, and Spatializer surround-sound technology. For 486 and Pentium PCs, the 3D SymphonicVision comes with a PCI burst-mode graphics accelerator that delivers resolutions from 640 by 480 pixels with 16 colors up to 1280 by 1024 with 256 colors. The eyeglasses come with high-speed LCD lenses that you can synchronize with your monitor. The Spatializer audio technology has the capability of delivering a 3-D sound experience from two standard speakers.

Contact: Ahead Systems, Inc., Fremont, CA, (800) 997-7711 or (510) 623-0900; ahead@ix.netcom.com.

Circle 1043 on Inquiry Card.

HIGH-END 3½-INCH DISK DRIVES ▼

Available in 4- and 8-GB versions and in a variety of Ultra SCSI-3 and SSA configurations, the 7200-rpm Conner Filepro Performance drives offer magnetoresistive heads, PRML read-channel electronics, and Conner Peripherals' proprietary media to increase data density to more than 850 MB per disk. The CFP4217 (about $999), which includes five disks and 4.29 GB of storage capacity, and the CFP8717 (about $1799), which includes 10 disks and 8.77 GB of storage capacity, provide data rates up to 110 Mbps, Tagged Command Queuing, Rotational Positioning Optimization, and average seek times of 8 ms.

Contact: Conner Peripherals, Inc., San Jose, CA, (800) 426-6637 or (408) 456-4500; http://www.conner.com.

Circle 1044 on Inquiry Card.

WHAT'S NEW Hardware

PC CARD-BASED SPEECH RECOGNITION ▼

The Phonetic Engine 1000 is a PC Card that allows mobile computers to run speech-driven applications using Speech Systems' continuous-speech, speaker-independent, speech-recognition technology. The PE1000 ($595) is a Type II Extended PC Card that receives incoming speech through a microphone and converts it to speaker-independent phonetic codes that it uses for recognizing speech. The VoiceMatch SDK software ($595), a set of programming tools, helps you develop speech applications under Windows. SpeechWizard ($295) is a software tool that lets you attach speech-input features to existing Windows-based applications.

Contact: Speech Systems, Inc., Boulder, CO, (303) 938-1110; http://www.speechsys.com.

Circle 1048 on Inquiry Card.

28.8 FAX MODEM FOR THE MAC

A data communications solution that incorporates the V.34 standard to enable communications speeds up to 28.8 Kbps, the SupraExpress 288 (about $200) provides maximum throughput speeds of 115.2 Kbps, fax-transmission speeds up to 14.4 Kbps, and FAXcilitate fax software. The software includes Smart Phonebooks, which make it easy to fax from a variety of locations and allow you to juggle multiple area and country codes and credit-card numbers; SmartIcons, which show you fax-software status; and Fax Broadcast, which lets you send hundreds of faxes with a single transmission.

Contact: Supra Corp., Vancouver, WA, (360) 604-1400; http://www.supra.com/.

Circle 1045 on Inquiry Card.

1700- AND 2550-MB DESKTOP DRIVES

The Quantum Sirocco 1700 ($265) and 2550 ($395) drives offer 1700 and 2550 MB of storage, respectively. The 3½-inch drives combine magneto-resistive head technology and PRML. The ATA-2 interface supports local-bus AT programmed-I/O mode 4 and multiword DMA mode 2 data transfers at speeds up to 16.6 MBps with a rotational speed of 4500 rpm, as well as fast SCSI-3 data transfer rates up to 10 MBps.

Contact: Quantum Corp., Milpitas, CA, (800) 624-5545 or (408) 894-4000; http://www.quantum.com.

Circle 1039 on Inquiry Card.

6.7-SPEED CD-ROM DRIVES

The Toshiba XM-3701 Series of 6.7-speed CD-ROM drives support a data transfer rate of 1000 KBps. The XM-3701B internal ($415) and TXM-3701D external ($515) drives employ the variable-speed playback system, which allows the drives to read data before the disk reaches a specific rotational speed of 1, 2, or 6.7 times the standard rotational speeds. You can use either of the drives as a CD-audio player independent of your PC. The drives support CD-DA transfers over the SCSI bus for maximum bandwidth utilization and feature a 256-KB data buffer.

Contact: Toshiba America Information Systems, Inc., Irvine, CA, (714) 457-0777; http://www.toshiba.com.

Circle 1046 on Inquiry Card.

ID CARD PRINTER

Using dye-sublimation technology, Fargo's Persona II ID Card Printer ($6995) prints directly onto both sides of blank PVC or polyester cards. Options include

a magnetic stripe encoder for high or low coercivity on Tracks 1–3 ($495) and a smart card encoder ($495). Fargo's CardMaker Software for Windows 2.5 ($995) helps you design and print photo-ID cards and badges.

Contact: Fargo Electronics, Inc., Eden Prairie, MN, (612) 941-9470; http://www.fargo.com.

Circle 1038 on Inquiry Card.

300-DPI COLOR INK-JET PLOTTER

The DesignJet 750C large-format color plotter has new modes to create smooth area fills and images for renderings or presentations with virtually no banding. The plotter (D-size, $6495; E-size, $7495) can queue vector plots for overnight plotting or for network use, and it can nest those plots to make optimal use of media space. The DesignJet 750C comes with 4 MB of memory, upgradable to 68 MB. SIMMs are available in increments of 4, 8, 16, or 32 MB.

Contact: Hewlett-Packard Co., Santa Clara, CA, (800) 851-1170 or (208) 323-2551; http://www.hp.com.

Circle 1120 on Inquiry Card.

ISDN TERMINAL ADAPTER

The Sportster ISDN 128K is a PC-based terminal adapter that provides connectivity to ISDN-based services. The $549 unit includes TurboPPP, which enhances the data transmission of PPP applications, negotiating the use of two B channels (64 Kbps each) via Multilink PPP for an aggregate throughput of 128 Kbps. It supports multiple forms of data compression for ISDN transmission. The Sportster ISDN 128K also supports NDIS, ODI, Packet Driver, and TAPI interfaces for use with popular Internet, remote LAN access, and data communications packages.

Contact: U.S. Robotics, Inc., Skokie, IL, (800) 877-2677 or (708) 676-7010.

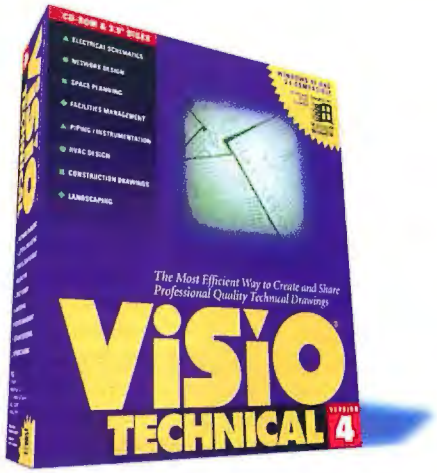
Circle 1121 on Inquiry Card.

HP'S HAND-HELD ORGANIZER

Small enough to fit into a coat pocket, the HP OmniGo 100 (about $349) combines the convenience of a pen and the familiarity of a keyboard with a rotatable screen that allows horizontal or vertical display. The unit comes with 1 MB of RAM, 3 MB of ROM, one PC Card Type II slot, and a serial port; it runs on two AA batteries. Available solutions include Pocket Quicken; HP OmniGo 100 Connectivity Pack, for automated file management, backup, and synchronization between the OmniGo 100 and a desktop PC; HP OmniGo 100 Clip & Go, for data transfer to a desktop PC's spreadsheet, word processing, or paint programs; and six strategy games.

Contact: Hewlett-Packard Co., Corvallis, OR, (800) 443-1254 or call local HP dealer; http://www.hp.com.

Circle 1033 on Inquiry Card.



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If you're looking for a fast, easy and flexible way to do technical drawings at your office or in the field, you have two choices. You could try to make CAD software fit your needs. Or, you can draw from Johnson Controls' experience and use new Visio® Technical 4.0.

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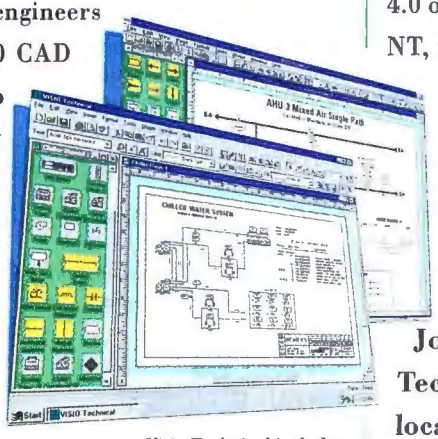
Johnson Controls® discovered that by standardizing on Visio Technical as part of their Windows® desktop, they could save millions per year in engineering costs. With Visio Technical, engineers went from using 4,000 CAD symbols to just 200 Visio SmartShapes® — greatly simplifying the drawing process and dramatically increasing productivity. Visio Technical also enabled Johnson Controls' sales force to create and modify technical drawings on-site with their laptops — something they couldn't do with CAD.



Visio Technical includes over 2,000 SmartShapes for engineering, architecture, and design. Simply drag SmartShapes from stencil to page. It's that easy.

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Johnson Controls' engineers found Visio's OLE 2.0 connectivity makes it easy to integrate Visio Technical drawings into their documents, presentations and proposals. The capability to import and export DWG and DXF formats allows them to work with existing CAD files. Plus, Visio Technical 4.0 offers Windows 95, Windows NT, and Windows 3.1 versions in one box.

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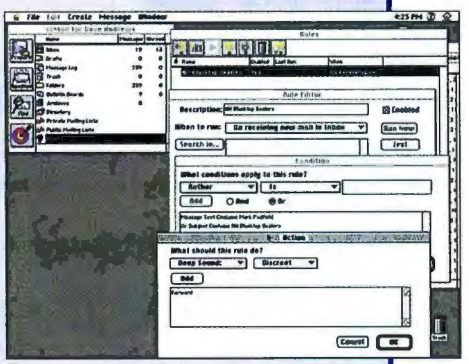
WHAT'S NEW Software

PREVIEW E-MAIL FOR THE MACINTOSH

Efficiently Rule Your Inbox

Good news, Mac cc:Mail users: Release 3 makes your wishes for more control over the ever-increasing number of messages in your E-mail inbox come true. The new Mac client for cc:Mail, Lotus's LAN-based E-mail program, takes the advanced-rules technology from the Windows cc:Mail client and improves it. As you can with the Windows version, you can set up your cc:Mail for Macintosh E-mail inbox to automatically delete junk mail, place messages in specific folders (depending on criteria ranging from subjects to specific text strings in the message's body text), or forward messages when you are away.



But I find the current Windows version's interface too cumbersome to automate anything but the most basic messages without spending an inordinate amount of time programming a given rule. I found the new Mac version's approach to rules easier and more intuitive. Within 5 minutes, I had written several complex rules to forward and archive messages based on subject header, author, and content.

Lotus cc:Mail for Macintosh release 3
single user, $95; 10-user workgroup license, $495
Lotus Development Corp.
Cambridge, MA
(800) 343-5414
(617) 577-8500
http://www.lotus.com
Circle 991 on Inquiry Card.

Other handy features include droplets, which let you place mailing lists on the desktop for easy access when you are sending a message, and 150 new file viewers, which let you read and print files created in other applications without launching the application.

Lotus cc:Mail for Macintosh release 3 is available for PowerPC- and 680x0-based Macs. Mac users of cc:Mail need no longer look with envy at the rules technology of their Windows cousins; in fact, the shoe is now on the other foot.

—Dave Andrews

WINDOWS 95 DESKTOP-ENHANCEMENT UTILITY

PowerDesk for Windows 95 ($49.95) combines a customizable toolbar (including eight tools) with ExplorerPlus, which is an enhanced and expanded version of the Windows 95 Explorer. The program provides a drivebar giving one-click access to any drive; format, copy, and move commands; built-in PKZip-compatible file compression; quick entry of DOS commands without opening a DOS window; enhanced file viewing; and multiple windows, auto-tiled or cascaded, for drag-and-drop file management.

Contact: MicroHelp, Inc., Marietta, GA, (800) 777-3322 or (770) 516-0899; http://www.microhelp.com.

Circle 994 on Inquiry Card.

PC MESSAGES TO PAGERS

PC Beep (about $39.95) sends text messages from your PC to alphanumeric pagers. The Windows package, which works with most pagers and pager services, sends up to 4500 characters at a time, performs group paging, and keeps a log of your messages. You can send data from other programs to the pager. Pro Beep (about $59.95) adds the ability to send simultaneous messages to numeric and alphanumeric pagers and delayed-broadcast capabilities. It can also convert a PC fax image into text and forward that to your pager. Pro Beep can also look for messages with certain text, or from E-mail addresses that you specify, and forward those messages to your pager.

Contact: Integra Software, Inc., Greenville, SC, (864) 627-5000; http://www.integra @wwa.com.

Circle 1008 on Inquiry Card.

INTERACTIVE MESSAGING FOR WEB SITES

Now you can add off-the-shelf interactive messaging to World Wide Web sites. Web Crossing 1.0 (Mac and Windows NT, $395; Unix, $695) installs on the same machine as the Web-site server and works with the Web-server software.

The program allows you to post and review messages in a structured forum that threads topics and subtopics into conversations, access these dialogues, browse the most recent messages or read the entire conversation, and create a new conversation in any topic.

Contact: Lundeen & Associates, Alameda, CA, (510) 521-5855; http://webx.lundeen.com.

Circle 996 on Inquiry Card.

ISDN VOICE MAIL AND CALL MANAGEMENT

Phoneware-ISDN ($199) offers voice-mail and call management capabilities to ISDN subscribers with Windows PCs. Inbound callers can access their own private mailboxes, leave messages in department mailboxes, or listen to prerecorded information. Phoneware-ISDN systems log the date, time, duration, and telephone number of incoming and outgoing calls. You can attach notes to individual call records, which automatically pop up when you receive calls.

Contact: Tedas, Inc., Cupertino, CA, (408) 973-7835; 73076,1177 @compuserve.com.

Circle 997 on Inquiry Card.

SURVEYS OVER THE INTERNET

With Decisive Survey ($495), you can develop custom surveys and send them to customers, employees, resellers, and suppliers over a network. The program runs over the Internet, a LAN-based E-mail system, a host-based system, or a commercial on-line service. After the recipients complete and return the questionnaire, Decisive Survey automatically tabulates and graphs the responses for easy presentation and analysis. The program works with the following: Microsoft Mail, Lotus cc:Mail, Lotus Notes, and Novell GroupWise on Windows 3.1 or 95.

Contact: Decisive Technology Corp., Palo Alto, CA, (800) 987-9995 or (415) 528-4300; http://www.decisive.com.

Circle 993 on Inquiry Card.

ENHANCE EXCEL DATA-FILTER CAPABILITIES

A fuzzy-logic-based information search tool for Excel 5.0, FlexFilter ($40) lets you search and organize data records by their degree of overall fit with search criteria. The program analyzes the data in multiple fields of each record and then orders all records by their degree of fit with the chosen criteria.

Contact: Omron Advanced Systems, Inc., Santa Clara, CA, (408) 727-6644; http://www.oas.omron.com.

Circle 1001 on Inquiry Card.

VISUAL BASIC TOOLKITS

You can enhance the performance of your applications with the control-replacement functions and subroutines of Visual CodeBank 1.0 ($149). A code library manager, the program includes 200 royalty-free BASIC functions and subroutines to handle tasks such as database operations, graphics, multimedia, sorts, optimization, security, and text management and effects. You can add custom functions and subroutines to the central repository. Developers can create custom BAS modules with just a few mouse-clicks.

Source control software from ViewPoint Technologies, Visual SourceWorks 4.0 ($249) provides full support for Visual Basic 4.0, including new syntax and 16- and 32-bit versions. Available from Visual Components, version 4.0 provides an interface that emulates the Windows Explorer, support for private puts, expanded system administrator and user identity controls, new checks for existing projects, and easier tracking of projects with support for complex structures of folders and subfolders.

Contact: Visual Components, Inc., Lenexa, KS, (913) 599-6500; 72204,3521 @compuserve.com.

Circle 1004 on Inquiry Card.

INTERNET SERVER FOR WINDOWS NT

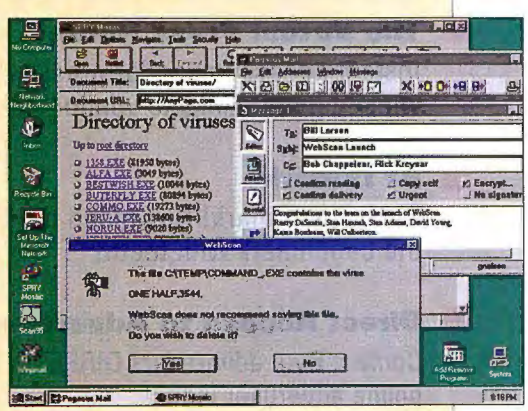
Integrating Web-server software with an applications-deployment architecture, Durand's MindWire NT ($1495) allows you to distribute client/server applications over the Internet. A 32-bit multithreaded Internet server for Windows NT Server, the program automatically updates and launches applications files each time a user connects to a MindWire server. MindWire NT includes built-in security and auditing; groupware communications, such as Internet E-mail, chat, and public message forums; a developers guide for Internet applications; and a drawing utility for creating multimedia Windows menus.

Contact: Durand Communications Network, Inc., Santa Barbara, CA, (805) 961-8700; http://www.durand.com.

Circle 1003 on Inquiry Card.

INTERNET VIRUS PROTECTION FOR WINDOWS

Integrating a browser and E-mail capabilities, WebScan prevents you from downloading virus-infected files and E-mail from the Internet. In addition to detecting known, unknown, boot, file, multipartite, stealth, encrypted, and polymorphic viruses, WebScan ($65) can also scan Microsoft Word DOC files and compressed file formats.



Contact: McAfee, Santa Clara, CA, (408) 988-3832; http://www.mcafee.com.

Circle 992 on Inquiry Card.

UPS MANAGEMENT

Liebert offers two power-monitoring packages for UPSes. SiteNet 2 ($69 to $199) adds support for Unix and Windows platforms, while SiteNet SNMP Manager ($499) adds support for IBM NetView on AIX and Hewlett-Packard OpenView on HP-UX platforms.

SiteNet 2 offers power surveillance and shutdown features, graphical displays of current power flow for utility and battery, remote functionality, flexible settings for alarm-notification parameters, event logging and management, and pinpoint accuracy of the units on a network. SiteNet SNMP Manager provides a GUI, automatic alarm notification, remote on/off capabilities, and multiple options, including test and diagnostic routines and battery and I/O power information.

Contact: Liebert Corp., Columbus, OH, (800) 877-9222 or (614) 888-0246; http://www.liebert.com.

Circle 999 on Inquiry Card.

PC TO ALPHANUMERIC PAGING DISPATCHER

To turn your PC into an alphanumeric paging dispatch station, you simply select the pager owner's name or names from a list, type the message, click to send, and Pronto ($49.95) does the rest. Pronto keeps a log of messages, with an icon that lets you see at a glance whether or not each paging attempt was successful. You can delete and resend messages from the log. In addition to alphanumeric pagers, Pronto works with digital and tone pagers.

Contact: Amtelco, McFarland, WI, (800) 242-1100 or (608) 838-4194; http://www.amtelcom.com/pronto/.

Circle 1006 on Inquiry Card.

Software Update

With the **AuditTrack 2.5** network-auditing software package, you can save report definitions, schedule report production, and combine multiple audit sets for consolidated reports and exported files. Version 2.5 includes capabilities for network administrators to run it on NetWare SFT III servers, to easily distinguish user security information, and to leverage Novell's new additive purchasing program for NetWare licenses. A 25-user server, $595.

Contact: On Technology Corp., Cambridge, MA, (800) 767-6683 or (617) 374-1400; http://www.on.com.

Circle 1016 on Inquiry Card.

A videoconference scheduling and control tool, **VC Wizard 4.1** lets you view or print the schedule of rooms, people, equipment, or ports in an hourly, daily, weekly, or customized format; manage and display the status of all conferences; filter the conferences you wish to display by conference name, status, company, or other options; and control conferences in progress. Stand-alone version, $9500; client/server version, from $13,000.

Contact: AC&E, Ltd., Chantilly, VA, (800) 733-2238 or (703) 968-5700; http://www.aceltd.com.

Circle 1011 on Inquiry Card.

Running on Windows PCs and Unix workstations, **LookIn+ 2.0** works over LANs and WANs, including the Internet, to support visual communication between participants in a CAD conference. Version 2.0 provides geometry measurement tools, store-and-forward features, cut-plane tools, and a direct interface to PDGS systems. Client version, $695; server version, $2995.

Contact: C-Tad Systems, Inc., Ann Arbor, MI, (313) 665-3287; john@ctad.com.

Circle 1012 on Inquiry Card.

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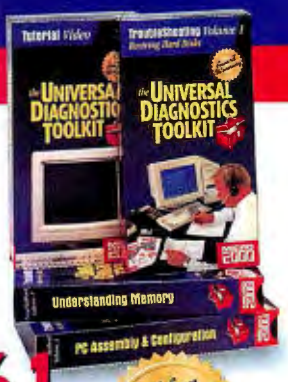

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"This is the only card that will function in every system on the market. The documentation is extensive, and not only covers the expected POST Codes for different BIOS versions, but also includes a detailed reference to the bus signals monitored by the card." **—Scott Mueller** from his globally recognized book, ***'Upgrading & Repairing PCs, Second Edition'***

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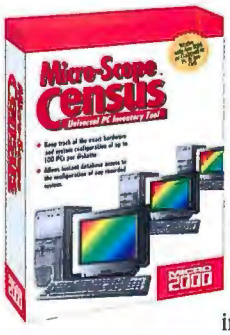
Micro-Scope CENSUS™

LETS YOU KEEP TRACK OF HUNDREDS or even thousands of computers and know each one's exact hardware and system configuration at a glance. Many technicians and MIS Directors use this software tool to save hours of downtime in companies with multiple computers.



Simply load the supplied disk into each computer on site (up to 100 PCs recordable on each disk). **CENSUS** automatically records complete system information and assigns each PC a unique ID number. The data can now be downloaded from the disk into any database program so it's ready to retrieve at a moments notice. For even greater productivity and speed, use CENSUS in combination with MICRO-SCOPE CLIENT to remotely diagnose each PC and arrive with the exact parts required, fully compatible. You'll be in and out in a flash with a greater profit margin. Call us for information on increasing productivity.

Micro-Scope BURN-IN™

A PROVEN WAY TO INCREASE QUALITY CONTROL. Completely accurate and thorough diagnostic routines repeatedly test the system's resources to the fullest extent to find any hidden bugs or problems. Essential for OEMs and Repair Facilities—reduces the number of returned PCs dramatically! Runs with or without a monitor or keyboard. User definable run time. Detailed system log written to disk after testing.

All products are Windows 95 Compatible

Windows 95 COMPATIBLE

MICRO 2000

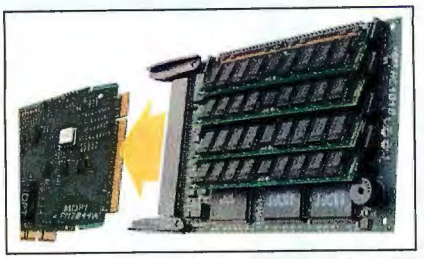
Circle 144 on Inquiry Card.

Lost data.
And a whole lot of questions!

Now there's a smart, low-cost answer from DPT, the leader in high-performance SCSI RAID technology. Introducing **SmartCache IV**, the ideal *hardware* RAID solution for your entry- to mid-range server needs. And the great news is that it's priced at $550* (estimated street price).

Hardware vs. Software RAID

SmartCache IV's hardware RAID eliminates problems like Operating System dependence, lack of a "Hot-Swap" capability, and slow performance that are normally associated with software RAID.



SmartCache IV with RC4040 RAID/Caching Module

The DPT **SmartCache IV** RAID Kit comes with support for RAID 0, 1 and 5 and room for up to 64MB of cache memory for improved I/O performance. And you also get Storage Manager, DPT's award-winning software utility that makes RAID setup and maintenance as easy as "point-and-click."

Ultimate Solution, Ultimate Deal

Find out more about how DPT's **SmartCache IV** RAID can solve your important storage needs. For a limited time, call and request a copy of the DPT CD-ROM (while supply lasts). At the same time, ask if you qualify for our Ultimate Deal–great one-time pricing on **SmartCache IV**. **SmartCache IV**–it's the Smart Choice.

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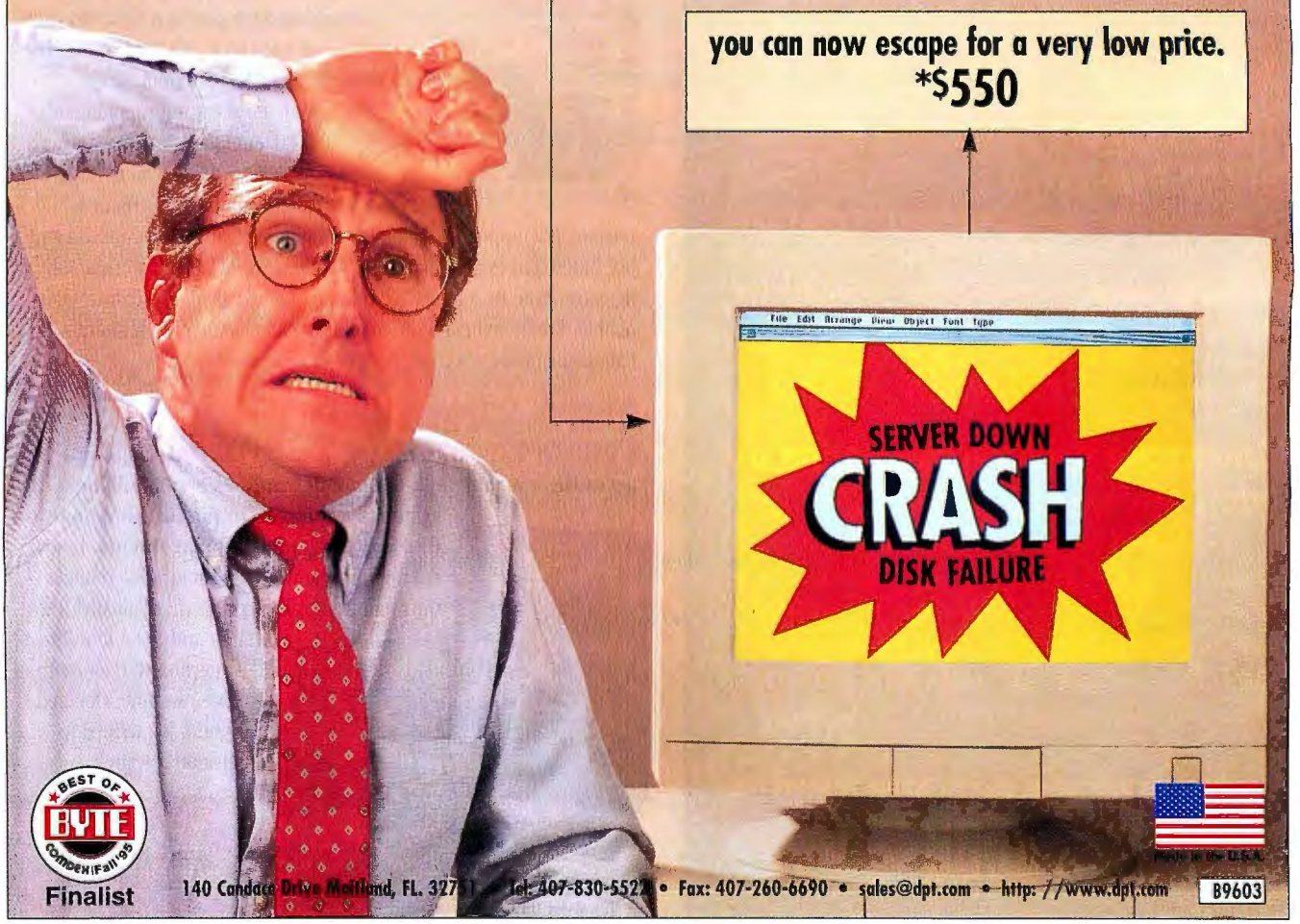
DPT
Distributed Processing Technology

What you'd pay to avoid at any cost



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B9603

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- **Supports any mixture of PC/Macintosh computers and Sun workstations - up to 4 in all**
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- **Full multimedia capabilities; keyboard, mouse, video, microphone, speakers, and serial port available**
- **Multiple users can access different computers simultaneously**
- **Convenient desktop size unit**

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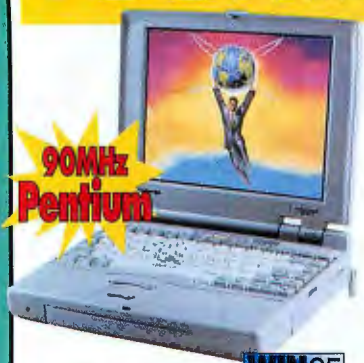


Portégé 610CT

Portégé 610CT

- Pentium 90MHz processor
- 9.5" True Color display for optimum color
- Built-in 16-bit sound (SoundBlaster Pro compatible), microphone & speaker
- Lithium Ion battery technology
- Accupoint stick for easy control

Processor	Screen	RAM/HD	Price
Pentium 90MHz	9.5" True Color	8/720MB	$3939

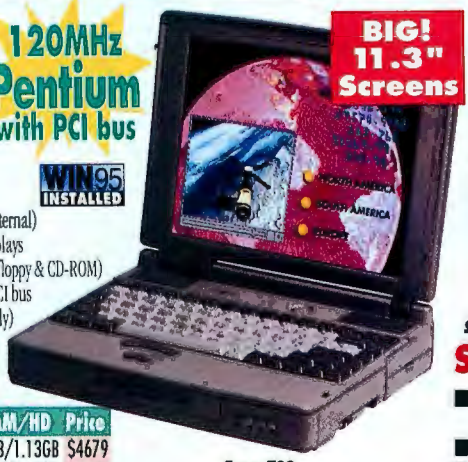
120MHz Pentium with PCI bus

WIN95 INSTALLED

Tecra 700

- Pentium 120MHz processor – fastest available on a notebook!
- PCI bus architecture (internal & external)
- 11.3", 800x600 high resolution displays
- Optional 4X CD-ROM Drive (swap floppy & CD-ROM)
- Multimedia docking station with PCI bus (optional accessory, priced separately)
- Built-in 16-bit sound, microphone, **2 speakers** & MIDI
- **HUGE**, 1.13GB hard drives

Processor	Screen	RAM/HD	Price
Pentium 120	11.3" Dual Scan	8MB/1.13GB	$4679
Pentium 120	11.3" Active	16MB/1.13GB	5949



Tecra 700

Satellite Pro 410

Satellite Pro 410

- Built-in 4X CD-ROM Drive (Swap floppy & CD-ROM) (Active model only - optional on Dual Scan)
- Built-in 16-bit sound, microphone, speaker & MIDI
- EDO RAM memory, exp. to 40MB
- Built-in AC adapter - small, sleek design & reduced weight
- Integrated Accupoint - small, accurate & easy to use
- Lithium Ion battery technology
- Built-in infrared for wireless communications

Processor	Screen	RAM/HD	Price
Pentium 90	11.3" Dual Scan	8/772MB	$3499
Pentium 90	11.3" Active	8/772MB	4679

Satellite 2130CS/100CS

Satellite 2130CS/100CS

Processor	Screen	RAM/HD	Price
486DX4/75	10.4" Dual Scan	8/500MB	$1969
Pentium 75	10.4" Dual Scan	8/500MB	CALL*

*EDO RAM

IBM®

ThinkPad® 365CD

ThinkPad® 365

- 10.4" Active & 10.4" Dual Scan
- Built-in infrared for no-hassle printer connections
- Multimedia models include built-in 2X CD-ROM, SoundBlaster compatible audio, speaker, microphone & MIDI/joystick port
- MS Windows 95 or Selecta System models available

Processor	Screen	RAM/HD	Price
486DX4/75	10.4" Dual Scan	8/540MB	$1999
486DX4/75	10.4" Active	8/540MB	2599
486DX4/75	10.4" Dual Scan	8/540MB	2499*
486DX4/75	10.4" Active	8/540MB	3099*

*Multimedia Models

ThinkPad® 760

- Up to 120Mhz Pentium with 32-bit local bus
- 12.1" Active displays with 800x600 resolution (selected models)
- 4X CD-ROM Drive, MPEG-2 support, & full motion video (ThinkPad760CD only *)
- Built-in 28.8 fax/modem
- SoundBlaster-compatible audio & telephony
- Lithium Ion battery technology

Processor	Screen	RAM/HD	Price
Pentium 90	10.4" Active	8/720MB	$5349
Pentium 90	12.1" Active	8/720MB	6049
Pentium 120	12.1" Active	8/720MB	6599
Pentium 90	12.1" Active	8MB/1.2GB	7449*

*Features built-in CD-ROM drive

WIN 95 models available. Call for details.

ThinkPad® 760CD

Call about NEW ThinkPad® 760 Models!

NEC

Versa 2000

Processor	Screen	RAM/HD	Price
486DX4/75	9.5" Active	4/350MB	$2099*
486DX4/75	9.5" Active	8/350MB	2399
486DX4/75	9.5" Active	8/540MB	2599

*14.4 fax/modem not built-in

NEC Versa 4000

NEC Versa 4000

- Built-in CD-ROM Drive! (Standard on some models, optional on others)
- Up to 120MHz Pentium processors
- 256KB Level 2 Cache to optimize performance
- Unbelievable displays – 65K color Dual Scan, 16.8 million color Active (High resolution Active Matrix displays available – 800x600 res.)
- Built-in 16-bit sound, microphone, MIDI and **2 built-in speakers**
- Multimedia docking station with outstanding Altec Lansing 4 speaker array (optional accessory, priced separately)

NEW 120MHz Pentium Model!

Processor	Screen	RAM/HD	Price
Pentium 75	10.4" Dual Scan	8/540MB	$3499
Pentium 75	10.4" Dual Scan	8/540MB	3799*
Pentium 75	10.1" Active	8/540MB	3999
Pentium 90	10.1" Active	8/810MB	4649*
Pentium 90	10.4" High Res.	8/810MB	4799
Pentium 120	10.4" High Res.	8MB/1GB	5499

*Features built-in CD-ROM drive

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COMPAQ

Contura 430

Processor	Screen	RAM/HD	Price
486DX4/100	10.4" Dual Scan	8/720MB	$2369
486DX4/100	10.4" Active	8/720MB	2939

LTE 5000 Series

- Up to 120MHz Pentium power w/PCI bus & 256KB cache
- 32-bit PCI Local bus graphics
- 8MB RAM exp. to 72MB
- Built-in 16-bit sound, microphone & **2 speakers**
- MultiBay – holds CD-ROM, 2nd HDD, Floppy, or 2nd battery
- Up to 1.35GB hard drives (2.7GB max. capacity)
- Built-in infrared for wireless communications
- Optional MPEG and TV video adapter

WIN95 INSTALLED

UP TO 120MHz PENTIUM with PCI BUS

Processor	Screen	RAM/HD	Price
Pentium 75	10.4" Dual Scan	8/510MB	$3799
Pentium 75	11.3" Dual Scan	8/810MB	4439
Pentium 75	10.4" Active	8/810MB	4729
Pentium 90	10.4" Active	8/810MB	5339
Pentium 90	10.4" Active	8/810MB	5599*
Pentium 120	10.4" Active	8MB/1.35GB	6149

*Features Built-In CD-ROM drive

LTE 5000

HEWLETT® PACKARD

HP OmniBook 600 NoteBook PC

HP OmniBook 600

- Weighs **ONLY 3.8 pounds!**
- Built-in 16-bit sound, microphone & speaker (active model only)
- Built-in infrared for no-hassle printer connections
- Lithium Ion battery technology
- Instant "ON" ready-to-work state – lasts for months on a charge

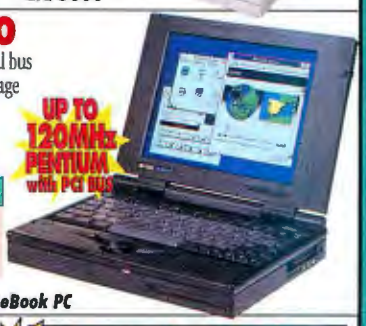
Processor	Screen	RAM/HD	Price
486DX4/75	8.5" Dual Scan	8/340MB	$2539
486DX4/75	9.5" Active	8/340MB	2999

HP OmniBook 5000

- Up to 120MHz Pentium with 32-bit PCI Local bus
- 1.2GB drives available for high capacity storage
- High resolution – 800x600 resolution on notebook display
- Built-in 16-bit sound, microphone & speaker

UP TO 120MHz PENTIUM with PCI BUS

Processor	Screen	RAM/HD	Price
Pentium 90	10.4" Active	8MB/1.2GB	$5329
Pentium 90	10.4" Active	16MB/1.2GB	5889
Pentium 120	10.4" Active	16MB/1.2GB	6539



HP OmniBook 5000 NoteBook PC

AST

Authorized Reseller

Ascentia 950N

- Up to 120MHz Pentium - for blazing performance
- High Res. SVGA displays - 800x600 res. on notebook (selected models)
- Built-in 16-bit sound, microphone & speaker
- Lithium Ion battery technology
- Built-in infrared for no-hassle printer connections

Processor	Screen	RAM/HD	Price
Pentium 75	10.4" Active	8/800MB	$2849
Pentium 75	10.4" Active	8MB/1.2GB	3229
Pentium 90	10.4" Active (SVGA)	8/800MB	3899
Pentium 90	10.4" Active (SVGA)	8MB/1.2GB	4279
Pentium 120	11.8" Active (SVGA)	8/800MB	4469
Pentium 120	11.8" Active (SVGA)	8MB/1.2GB	4849

Additional models available. Call for details.

Ascentia 950N

NEW!

UP TO 120MHz PENTIUM

Ascentia J Series

- 10.4", SVGA (800x600 res.) on notebook display
- Up to 100MHz Pentium w/PCI bus and 256KB cache
- Long-lasting Lithium Ion battery technology

Call for Details!

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TEXAS INSTRUMENTS

TravelMate 5100/5200

Processor	Screen	RAM/HD	Price
Pentium 90	10.4" Active	8MB/1.2GB	$3699
Pentium 120	10.4" Active	8MB/1.2GB	5099

Extensa 560CD/ 560CDT

- 75MHz Pentium w/PCI bus & 256KB cache
- Built-in 4X CD-ROM drive
- Built-in 16-bit sound, microphone & speaker
- Integrated touchpad pointer
- 10.4" Active Matrix & 10.4" Dual Scan
- Built-in infrared for wireless communications

75MHz Pentium with PCI BUS

Built-In CD-ROM

Processor	Screen	RAM/HD	Price
Pentium 75	10.4" Dual Scan	8/810MB	$3199
Pentium 75	10.4" Active	8MB/1.2GB	3879

WIN95 INSTALLED

Extensa 560 Product differs slightly from photo

HEWLETT® PACKARD

HP DeskJet 340 $289.99

C2655A

HP LaserJet Printers

HP LaserJet 5P printer (18M, 6ppm, 600dpi) C3150A	$879.99
HP LaserJet 5L printer (1BM, 4ppm, 600dpi) C3941A	479.00

HP InkJet Printers

HP DeskJet 340 printer (portable) C2655A	$289.99
HP DeskJet 600 printer C2184A	289.99
HP DeskJet 600C printer C4547A	299.00
HP DeskJet 660C printer C2164A	389.99
HP DeskJet 660Cse printer C4548A	399.00*
HP DeskJet 855C printer C4551A	499.00
HP DeskJet 1600C printer C3540A	1349.99

Home Office Products

HP OfficeJet C2890A	$599.99
HP OfficeJet LX C2891A	689.99
HP FAX-700 C3530A	509.99

*Includes Family Font Package

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C3941A

BYTE 3/96

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BEN120	BOCALANcard Combo (16-bit) RJ45 & BNC	$70
BEN110	BOCALANcard TP (16-bit) RJ45 Only	64
BEN1P1	BOCALANcard PCI (64-bit) RJ45 & BNC	83

16-Port 10BASET Concentrator

- Reliable
- Compact
- Cost-effective!

Offers Sixteen 10BaseT ports with RJ45 connectors, One BNC and One AUI port for cascading hubs or connection to existing backbone, has 21 LED indicators for confirming status and operations. IEEE802.3 compliant.

BEN220	BOCAHUB-16 PLUS 10Base-T Concentrator	$264
BEN210	BOCAHUB-8 (Eight Port) 10Base-T Concentrator	135

NITC 10BASE-T/BNC Adapter Card

Features software selectable I/O, interrupt & PROM address (Jumperless). NE2000/IEEE 802.3 compliant with LED indicators for activity & link detection. Supports NOVELL, Microsoft and SCO UNIX. Compatible with all Bus systems, 10Mbps transfer & is FCC certified.

300-017-01	10BaseT/BNC Adapter (8/16bit)	$39
300-023-01	PCI 10 BaseT/2 Card	69

INTERFACE CONNECTION CORPORATION

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NITC 16-PORT HUB (10BaseT) CONCENTRATOR

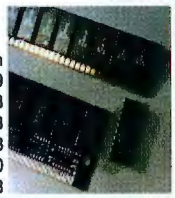
Offers IEEE802.3 Compliance, BNC and AUI ports are active for simultaneous connection, LEDs for port connection, link status, activity and collisions. Features auto polarity detection and connection on TP ports, Wall Mountable, Rugged Case and Auto partitioning disable/reconnect. UL/CSA/FCC certified. Limitations: UTP (100meters/24AWG), BNC (185m/RG58AU).

400-006-01	16- Port 10BaseT Hub	$264
400-004-01	8 Port 10BaseT Hub	$135

VISA MasterCard DISCOVER

SIMM MEMORY MODULES

72 Pin



Part#	Description	Each
1MEGPS2-70	256 x 36 Single, 70NS	$59
4MEGPS2-70	1x 36 Single, 70NS	148
4MEGPS2-60	1 x 36, Single, 60NS	153
8MEGPS2-60	2 x 36, Double, 60NS	278
1MEGX-70A	30-Pin, 1 Mb x 9, 70NS	40
4MEGX9-60	30-Pin, 4 Mb x 9, 60NS	153

CREATIVE LABS "4X BlasterValue" Edition Kit

Featuring CD-ROM Drive and 16-bit Sound Card with Software. Provides the power for todays newest, most dynamic applications and games like AirCombat, Ultima VII Black Gate, Seven Cities of Gold, WingCommander, Grollers Award Winning Encyclopedia and Ultima UnderWorld.

CREATIVE LABS, INC.

- *Quad Speed CD-ROM Drive with IDE Interface*
- *600Kbps data transfer with 250ms access*
- *Multisession/XA compatible*
- *Stereo Recording & Playback, 20 Voice FM Synthesis*
- *Stereo Line/CD Audio Interface*
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$289 STEREO-CDV

DATA/COMMUNICATION Line Surge Protectors

Protect your crucial network equipment from lightning, ground surge, faulty wiring - reducing glitches, lockups & damage.

TRIPP LITE THE POWER PEOPLE

DataShield

D10BT	RJ45	$24
DTEL2	RJ11 Two Line	23
DB25	Serial RS232 (Pin 1-8, 20)	23
DB9	Serial RS232 (Pin 1-9)	21

CATEGORY 5

		1-99'	100-999'	1000'
(UTP) Unshielded Twisted Pair				
VDC5-4	Level 5, 4 Pair, Unshielded CL-2 PVC	$0.16	$0.11	$90
VDC5-4P	Level 5, 4 Pair, Plenum	0.50	0.42	330

CATEGORY 5 (100Mbps Standards)

Colored Cable ONLY (No Boot)

* Simply fill in ____ with one of following cable colors desired:

70 (Gray) 73 (Green) 71 (Black)
74 (Red) 72 (Blue) 75 (Yellow)

Altex No.	Length	1-9	10-49
73-66___-3	3 ft	$4.00	$3.56
73-66___-7	7 ft	5.25	4.67
73-66___-15	15 ft	7.80	6.93
73-66___-25	25 ft	11.03	9.80
73-66___-50	50 ft	18.25	16.22

CAT 5 Surface Mount Jacks (8P8C)

		Each	25
SM8-2-5	Dual	$5.99	$4.99
SM8-5	Single	4.50	3.90

19"Patch Panels With 110 Punch Down Blocks

Part #	Desc.	1-4	5-9
PP824-5	8 Wire, 24 Port	$99	$96
PP848-5	8 Wire, 48 Port	199	194

Wall Plates for Inserts I=Ivory W=White

Part #	Description	1-9	10-24	25-99
KWP-1	1 Port	$1.49	$1.34	$1.22
KWP-2	2 Port	1.49	1.34	1.22
KWP-3	3 Port	1.49	1.34	1.22
KWP-4	4 Port	1.49	1.34	1.22
KWP-6	6 Port	1.49	1.34	1.22

110 Type RJ45 Jack INSERTS

Available Colors:White, Ivory, Black, Red, Green, Yellow, Orange & Blue

KJ-110WH	(White)	$5.50	$5.00	$4.58

Other Type Inserts

KP-IN	Blank Ivory	$0.30	$0.25	$0.20
KP-INW	Blank White	0.30	0.25	0.20
KP-BNC	BNC Feed through Ivory	3.00	2.73	2.50
KP-BNCW	BNC Feed Thru White	3.00	2.73	2.50
KP-ST	ST Insert	6.50	5.91	5.42

Wall PlateMounting Boxes

MB-IV	Ivory	$2.50	$2.27	$2.08
MB-WH	White	2.50	2.27	2.08

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Provides power protection (UPS, Surge) for PC stations, File Servers, Multi-User to Mini Computer Systems.

PCM-35	350VA, 10 min. Full Load Backup, 14lbs	$99
PCM-55	550VA, 15 min. Full Load Backup, 32lbs	$149

*** 1996 Electronic Parts or 1996 Computer CatalogAvailable Call 800-531-5369 ***

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BCPERS280	280VA/175W Personal UPS (2 Outlets)	$104	BCPERS500	500VA/350W Personal UPS (4 Outlets)	181
BCPRO675	675VA/425W LAN UPS (4 Outlets)	231	BCPRO850	850VA/570W LAN UPS (4 Outlets)	305
BCPRO1400	1400VA/990W LAN UPS (6 Outlets)	434			

OMNIPRO LINE INTERACTIVE UPS feature Pulse Width Modulated Output & Ultimate Life Insurance. DB9 LAN Port.

Part#	Output (Volts/Watts)	NEMA5-15R Outlets	DB9 LAN Port	Backup Time (Half Load)	Each
OMNIPRO280	280/175	4	No	17	$149
OMNIPRO450	450/280	4	Yes	17	207
OMNIPRO675	675/425	4	Yes	17	254
OMNIPRO850	850/570	4	Yes	21	355
OMNIPRO1050	1050/705	6	Yes	23	385
OMNIPRO1400	1400/940	6	Yes	24	459

ULTIMATE LIFETIME INSURANCE

"Tripp Lite will repair or replace this product and any equipment damaged by surges, including direct lightning strikes, while protected by this product...for life!"

BC Internet 450 UPS System

All the features of the BC Personal UPS system with built-in InterNet protection. RJ11 jacks provide superior surge, spike, EMI/RFI protection for your internet connection while reliable BC UPS protection keeps your PC running. $25,000 Ultimate Lifetime Warranty on connected equipment; 2-year Mfg ProductWarranty.

BCINT450 450VA, 2 Outlets **$159**

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SUPER7	7 Outlet, 18,000 amp spike, LEDs, 7' cord	$18
IB6	ISOBAR, 6 Outlet, 6'cord, 3 Filter Banks	51
IB6ULTRA	ISOBAR 6 Outlet, 3 Filter Banks	56
IB8ULTRA	ISOBAR 8 Outlet, 4 Filter Banks	61
ISOTELULT6	Modem/Fax, 6 Outlet,3 Filter Banks	61
ISOTELULT8	Modem/Fax, 8 Outlet, 4 Filter Banks	69
SK6-6	Spike Block, 6 Outlet, 6' Cord	$28
TERM-6	Super Surge Alert 6 Outlet, 36,000A	$32
TERM-6FM	6 Outlet, Fax/Modem	38

Line Conditioners/Stabilizers

LC-1800	1800W, 4 Outlet Conditioner	$188
LC-2400	2400W, 6 Outlet, 110V Conditioner	243
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Circle 126 on Inquiry Card.

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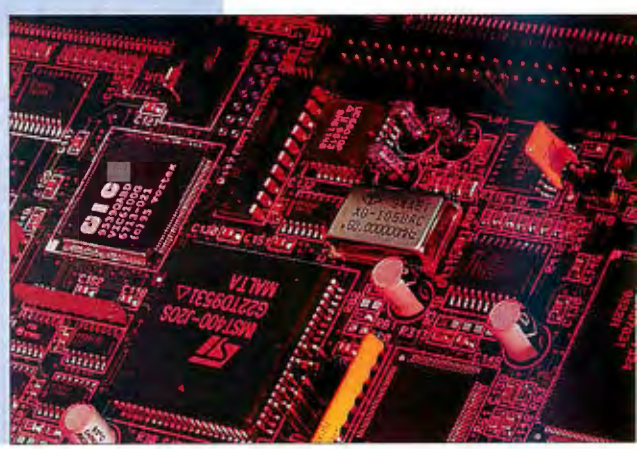

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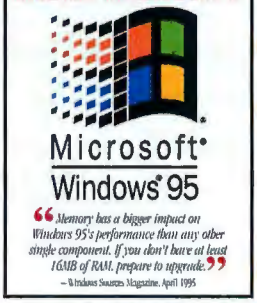

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– Windows Sources Magazine, April 1995

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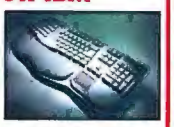

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Powerlook pcpro2 flbd 1200dpi SCSI w/sw	$2,769

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ST3660A	545MB	14MS	IDE	175-325
ST5850A	850MB	11MS	IDE	195-345
ST51080A	1.05GB	10 5MS	IDE	225-375
ST31214N	2.1GB	10MS	IDE	469-609
ST31231N	1.00GB	10MS	SCSI-2	349-499
ST12400N	2.1GB	9MS	SCSI-2	650-775
ST32430N	2.1GB	10MS	SCSI-2	675-800
ST43400N	3.5GB	11MS	SCSI-2	650-775
ST15230N	4.2GB	9MS	SCSI-2	935-1060
ST41600N	9.0GB	11MS	SCSI-2	2069-2269

SCSI-BARRACUDA • 7200 RPM				INT-EXT
ST32550N	2.1GB	8MS	SCSI-2	799-924
ST11510N	4.2GB	8MS	SCSI-2	1185-1335

NEC

FACTORY NEW-3 YEAR WARRANTY				INT-EXT
D3725	530MB	11MS	IDE	$168-319
D3727	1 1GB	11MS	IDE	245-395
D3747	1 6GB	11MS	IDE	309-459
D3827	1 1GB	11MS	SCSI	225-350
D3847	1 6GB	11MS	SCSI	350-475

CONNER

FACTORY NEW-1 YEAR WARRANTY				INT-EXT
CFS850A	850MB	10MS	IDE	161-290
CFS1275A	1.3GB	10MS	IDE	249-299
CFP1080S	1.06GB	9MS	SCSI-2	255-380
CFP2105S	2.1GB	9MS	SCSI-2	649-790
CFP2107S	2 1GB	9MS	SCSI-2	699-824
CFP4207S	4 2GB	9MS	SCSI-2	1039-1164

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IBM

IBMHDN520	520MB	IDE	$399

Seagate

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8205	2.5GB TAPE INT/EXT	1325-1549
8505	5GB TAPE INT/EXT	2025-2399
850SXL	14GB TAPE INT/EXT	2200-2498

MICROPOLIS

FACTORY NEW-5 YEAR WARRANTY				INT-EXT
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MC4110	1.05GB	9MS	SCSI-2	650-775
MC2217	1.75GB	10MS	SCSI-2	875-1823
MC4221	2.05GB	8 5MS	SCSI-2	859-784
MC4321	2 1GB	9MS	SCSI-2	900-999
MC3243	4 3GB	8MS	SCSI-2	969-1094
MC1991	9 0GB	11MS	SCSI-2	1989-2244
MC4221AV	2.05GB	8 5MS	SCSI-AV	1199-1349
MC3243AV	4 3GB	8.5MS	SCSI-AV	1059-1200
MC1991AV	9 1GB	11MS	SCSI-AV	2119-2269

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FACTORY NEW-3 YEAR WARRANTY				INT-EXT
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WDAC2850	850MB	10MS	IDE	190-340
WDAC31000	1GB	10MS	IDE	229-379
WDAC31200	1 2GB	10MS	IDE	265-415
WDAC31600A	1 6GB	9MS	IDE	335-485

digital

FACTORY NEW-2 YEAR WARRANTY				INT-EXT
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FUJITSU

FACTORY NEW-5 YEAR WARRANTY				INT-EXT
M1606T	1 1GB	9 5MS	IDE	235-385
M1606S	1 1GB	13MS	SCSI	235-360
M2915S	2.1GB	9.5MS	SCSI	542-767
M2043S	4 3GB	8.5MS	SCSI	899-1024

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3120FBS	1 2GB	12MS	FSCSI-2	299-424

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CONNER

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21075W	2 1GB	8 5MS	7200RPM	1198
4207W	4 2GB	9MS	7200RPM	1189

Seagate

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ST32430W	2 1GB	9MS	3 5X1"	799
ST32550W	2 1GB	8MS	3 5X1"	899
ST15230W	4 3GB	9MS	3.5X1"	1042
ST15150W	4 3GB	8MS	3 5"	1349
ST41080W	9.0GB	11MS	5.25"	2279

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XP34300W	4 2GB	8MS	3 5"	1299

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MC1991W	9 1GB	10MS	FH	2339

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TEAC

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2X36-8MB-70NS/60NS MAJOR	260/265
4X36-16MB-70NS/60NS LOGIC	440/450
4X36-16MB-70NS/60NS MAJOR	500/510
8X36-32MB-70NS LOGIC	950
8X36-32MB-60NS LOGIC	975
4X36-32MB-70NS MAJOR	1050
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4-IDE4 + 2HD/2FD	59

DATA TECHNOLOGY

2278D+	VESA 4 IDE/EIDE Device, FDD 16550 UART SERIAL, Parallel & Game Ports $30
2278E	Same as 2278D + W/ECP EPP Port 35
813PCD	PCI SPEEDIDE (4 Devices) 30
2278VL	32 Bit VLB IDE w/highspeed I/O 35
3270	PCI SCSI 128
3270VL	VLB SCSI 128

TEKRAM

KT445C	32-Bit VLB Fast SCSI-2 Kit $199
KT545C	16-Bit ISA BusMaster Fast SCSI-2 Kit 209
KT742A	32-Bit EISA SCSI-2 Kit 289
KT747C	32-Bit EISA Fast SCSI-2 Kit 299
BT757S	32-Bit EISA Fast Wide SCS Card 349
KT936C	32-Bit PCI Fast SCSI-2 Kit 290
KT956C	32-Bit PCI Fast Wide SCSI-2 Kit 329

IDE CACHE CONTROLLERS

KT510A	ISA/IDE Cache Controller 95
KT410A	VESA/IDE Cache Controller 125
KT910A	PCI/IDE Cache Controller 168

PROMISE TECHNOLOGY, INC.

IDE A SCSI CACHE CONTROLLERS	
DC200	2HD/4HD ISA (exp to 16MB) $99
DC2300+	Enhanced IDE VLB w/16550 Vo 69
5030	32-Bit PCI BusMaster IDE Caching 159
DC440	BusMaster SCSI/IDE VLB w/10 179
DC540	BusMaster PCI SCSI WIDE (no cable) 199

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HI PERFORMANCE IDE CONTROLLERS	
11	8-Bit 4FD & 250MB Tape Accel Card $59
18	Co-Exist, High Perf IDE Card 55
31	2HD, 4HD (up to 8MB) 69
32	8Multi-port IDE, Flop, Tape, & I/O Accel 129

SUPER CONTROLLERS

IDE CONTROLLERS	
200	2HD/2FD Controller Cables $22
241	2HD/2FD VLB Smart\ Par\ Game 29
243	2HD/2FD VLB EIDE w/ig 2s/1p/1g 49
400	16550 2HD/2FD 2-16550 2s/1p ISA 95
500	16550 2HD/2FD 2-16550 2s/1p/1g VLB 99

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QL-ISACO	16-Bit ISA for CD ROMs	$49
QL-ISA-FL	16-Bit ISA	139
QL-VLB-FL	32-Bit VLB	205
QL-BAFL	32-Bit EISA	229
QL-PCMCIA	PCMCIA	189
QL-VLC-10	32-Bit PCI Basic Entry Level	179
QL-PCI-10	32-Bit IO-PCI Wide SCSI-2	299

BUSLOGIC

KT445C	32-Bit VLB Fast SCSI-2 Kit $199
KT545C	16-Bit ISA BusMaster Fast SCSI-2 Kit 209
KT742A	32-Bit EISA SCSI-II Kit 289
KT747C	32-Bit EISA Fast SCSI-2 Kit 299
BT757S	32-Bit EISA Fast Wide SCS Card 349
KT936C	32-Bit PCI Fast SCSI-2 Kit 290
KT956C	32-Bit PCI Fast Wide SCSI-2 Kit 329

IDE CACHE CONTROLLERS

KT510A	ISA/IDE Cache Controller 95
KT410A	VESA/IDE Cache Controller 125
KT910A	PCI/IDE Cache Controller 168

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1X8-100-70-60	1X2,4X36-70-60	1X2,4X32-70-60
4X1-80-70-60	2,4,8,16X36-80-70-60	2,4,8,16X32-70-60
4X4-80-70-60		

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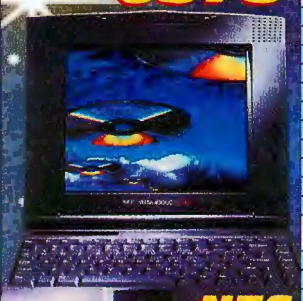

NEC
Versa 4000
PENTIUM 75
10.4" Color Dual Scan
540MB 8/40RAM
$3799

TOSHIBA
SATELITE PRO410 CDT
PENTIUM 90
10.4" Color Active
772MB 8/40EDO RAM
$4679

NOTEBOOK MODEL	PROCESSOR Type/Speed	SCREEN SIZE	RAM Std/Max	HARD DRIVE	PC CARD Qty/Type	POINTING DEVICE	VIDEO RAM	SIZE WxDxH	WEIGHT LBS.	PRICE
COMPAQ										
Contura 420C	486DX4/75	10.4" Color Dual Scan	8/32	420MB	2/II or 1/III	Bit-in TrackBall	1MB	11.9x9x2.2	6.25	$2089
Contura 430CX	486DX4/75	10.4" Color Active	8/32	420MB	2/II or 1/III	Bit-in TrackBall	1MB	11.9x9x2.2	6.25	2559
Contura 420C	486DX4/100	10.4" Color Dual Scan	8/32	720MB	2/II or 1/III	Bit-in TrackBall	1MB	11.9x9x2.2	6.25	2369
Contura 430CX	486DX4/100	10.4" Color Active	8/32	720MB	2/II or 1/III	Bit-in TrackBall	1MB	11.9x9x2.2	6.25	2939
LTE Elite 4/75C	486DX4/75	9.5" Color Dual Scan	8/32	510MB	2/II or 1/III	Bit-in TrackBall	1MB	11.8x8.9x2	6.9	2999
LTE Elite 4/75CXL	486DX4/75	10.4" Color Active	8/32	810MB	2/II or 1/III	Bit-in TrackBall	1MB	11.8x8.9x2	6.9	4427
LTE5000	Pentium75	10.4" Color Dual Scan	8/72	510MB	2/II or 1/III	EasyPoint II	1MB	12.2x9x2	6.25	3799
LTE5000	Pentium75	11.3" Color Dual Scan	8/72	810MB	2/II or 1/III	EasyPoint II	1MB	12.2x9x2	6.25	4439
LTE5000	Pentium75	10.4" Color Active	8/72	810MB	2/II or 1/III	EasyPoint II	1MB	12.2x9x2	6.25	4729
LTE5100	Pentium90	10.4" Color Active	8/72	810MB	2/II or 1/III	EasyPoint II	1MB	12.2x9x2	6.25	5339
LTE5100CD	Pentium90	10.4" Color Active	8/72	810MB	2/II or 1/III	EasyPoint II	1MB	12.2x9x2	6.25	5599
LTE5200	Pentium120	10.4" Color Active	8/72	1.35GB	2/II or 1/III	EasyPoint II	1MB	12.2x9x2	6.25	6379
NEC										
Versa 2000	486DX4/75	9.5" Color Active	4/32	350MB	2/II or 1/III	Glide Touch Pad	1MB	11.8x9.4x2.1	6.4	$1899
Versa 2000	486DX4/75	9.5" Color Active	8/40	350MB	2/II or 1/III	Glide Touch Pad	1MB	11.8x9.4x2.1	6.4	2399
Versa 2000	486DX4/75	9.5" Color Active	8/40	540MB	2/II or 1/III	Glide Touch Pad	1MB	11.8x9.4x2.1	6.4	2599
Versa 2000 (Modem)	486DX4/75	9.5" Color Active	8/40	350MB	2/II or 1/III	Glide Touch Pad	1MB	11.8x9.4x2.1	6.4	2599
Versa 2000 (Modem)	486DX4/75	9.5" Color Active	8/40	540MB	2/II or 1/III	Glide Touch Pad	1MB	11.8x9.4x2.1	6.4	2799
Versa 4000	Pentium 75	10.4" Color Daul Scan	8/40	540MB	1/III or 2/II	Glide Touch Pad	1MB	9.5x11.7x2.1	6.3	3499
Versa 4000CD	Pentium 75	10.4" Color Daul Scan	8/40	540MB	1/III or 2/II	Glide Touch Pad	1MB	9.5x11.7x2.1	6.3	3799
Versa 4000	Pentium 75	10.1" Color Active	8/40	810MB	1/III or 2/II	Glide Touch Pad	1MB	9.5x11.7x2.1	6.3	3999
Versa 4050CD	Pentium 90	10.1" Color Active	8/40	810MB	1/III or 2/II	Glide Touch Pad	1MB	9.5x11.7x2.1	6.3	4649
Versa 4050 High Res.	Pentium 90	10.4" High Res.	8/40	810MB	1/III or 2/II	Glide Touch Pad	1MB	9.5x11.7x2.1	6.6	4799
Versa 4080 High Res.	Pentium 120	10.4" High Res.	8/40	1GB	1/III or 2/II	Glide Touch Pad	1MB	9.5x11.7x2.1	6.6	5499
AST										
Ascentia 950N	Pentium 75	10.4" Color Dual Scan	8/40	500MB	2/II or 1/III	TrackPoint Stick	1MB	11.5x8.5x1.8	6.4	$2639
Ascentia 950N	Pentium 75	10.4" Color Dual Scan	8/40	800MB	2/II or 1/III	TrackPoint Stick	1MB	11.5x8.5x1.8	6.4	2879
Ascentia 950N	Pentium 75	10.4" Color Dual Scan	8/40	1.2GB	2/II or 1/III	TrackPoint Stick	1MB	11.5x8.5x1.8	6.4	3249
Ascentia 950N	Pentium 75	10.4" Color Active	8/40	800MB	2/II or 1/III	TrackPoint Stick	1MB	11.5x8.5x1.8	6.4	3799
Ascentia 950N	Pentium 75	10.4" Color Active	8/40	1.2GB	2/II or 1/III	TrackPoint Stick	1MB	11.5x8.5x1.8	6.4	4199
Ascentia 950N	Pentium 90	10.4" Color Dual Scan	8/40	800MB	2/II or 1/III	TrackPoint Stick	1MB	11.5x8.5x1.8	6.4	3259
Ascentia 950N	Pentium 90	10.4" Color Dual Scan	8/40	1.2GB	2/II or 1/III	TrackPoint Stick	1MB	11.5x8.5x1.8	6.4	3639
Ascentia 950N	Pentium 90	10.4" Color Active	8/40	800MB	2/II or 1/III	TrackPoint Stick	1MB	11.5x8.5x1.8	6.4	4199
Ascentia 950N	Pentium 90	10.4" Color Active	8/40	1.2GB	2/II or 1/III	TrackPoint Stick	1MB	11.5x8.5x1.8	6.4	4579
Ascentia 950N	Pentium 120	11.8" Color Active	8/40	800MB	2/II or 1/III	TrackPoint Stick	1MB	11.5x8.5x1.8	6.4	4919
Ascentia 950N	Pentium 120	11.8" Color Active	8/40	1.2GB	2/II or 1/III	TrackPoint Stick	1MB	11.5x8.5x1.8	6.4	5199
TOSHIBA										
Satelite T2110CS	486DX4/75	10.4" Color Dual Scan	4/28	320MB	2/II or 1/III	AccuPoint Stick	1MB	11.8x7.9x2.1	6.8	$1679
Satelite T2130CS	486DX4/75	10.4" Color Dual Scan	8/32	500MB	2/II or 1/III	AccuPoint Stick	1MB	11.8x7.9x2.1	6.8	1969
Satelite T2130CT	486DX4/75	10.4" Color Active	8/32	500MB	2/II or 1/III	AccuPoint Stick	1MB	11.8x7.9x2.1	6.8	2414
Satelite Pro 400CS	Pentium 75	10.4" Color Dual Scan	8/40	772MB	2/II or 1/III	AccuPoint Stick	1MB	11.7x8.8x2.2	6.8	2899
Satelite Pro 400CDT	Pentium 75	10.4" Color Active	8/40	772MB	2/II or 1/III	AccuPoint Stick	1MB	11.7x8.8x2.2	7.3	3999
Satelite Pro 410CS	Pentium 90	11.3" Color Dual Scan	8/40EDO	772MB	2/II or 1/III	AccuPoint Stick	1MB	11.7x8.8x2.2	6.8	3379
Satelite Pro 410CDT	Pentium 90	11.3" Color Active	8/40EDO	772MB	2/II or 1/III	AccuPoint Stick	1MB	11.7x8.8x2.2	7.3	4539
Portege 610CT	Pentium 90	9.5" True Color	8/32	720MB	1/III or 2/II	AccuPoint Stick	1MB	9.9X7.9X2.0	4.8	3939
TECRA 700CS	Pentium 120	11.3" Color Dual Scan	8/40	1.13GB	1/III or 2/II	AccuPoint Stick	1MB	11.8x9.1X2.3	7.3	4539
TECRA 700CT	Pentium 120	11.3" Color Active	16/48	1.13GB	1/III or 2/II	AccuPoint Stick	1MB	11.8x9.1X2.3	7.3	5799
DIGITAL										
HiNote	486DX2/50	9.5" Color Active	4/20	240MB	2/II or 1/III	Bit-in TrackBall	1MB	8.5x11x1.6	5.5	$2239
HiNote	486DX4/75	9.5" Color Dual Scan	4/20	510MB	2/II or 1/III	Bit-in TrackBall	1MB	8.5x11x1.6	5.5	2239
HiNote	486DX4/75	9.5" Color Active	4/20	340MB	2/II or 1/III	Bit-in TrackBall	1MB	8.5x11x1.6	5.5	2239
HiNote	486DX4/75	9.5" Color Active	4/20	510MB	2/II or 1/III	Bit-in TrackBall	1MB	8.5x11x1.6	5.5	2239
HiNote Ultra	486DX2/50	9.5" Color Dual Scan	4/20	340MB	2/II or 1/III	Bit-in TrackBall	1MB	8.5x11x1.2	4	2549
HiNote Ultra	486DX2/50	9.5" Color Active	8/24	340MB	2/II or 1/III	Bit-in TrackBall	1MB	8.5x11x1.2	4	3079
HiNote Ultra	486DX4/75	9.5" Color Dual Scan	8/24	528MB	2/II or 1/III	Bit-in TrackBall	1MB	8.5x11x1.2	4	3079
HiNote Ultra	486DX4/75	9.5" Color Active	8/24	340MB	2/II or 1/III	Bit-in TrackBall	1MB	8.5x11x1.2	4	3319
HiNote Ultra	486DX4/75	9.5" Color Active	8/24	528MB	2/II or 1/III	Bit-in TrackBall	1MB	8.5x11x1.2	4	3639

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10Base-T XJ10BT $129
Combo 10Base-T & Base-2 XJ10BC $155

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IBM

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NOTEBOOK MODEL	PROCESSOR Type/Speed	SCREEN SIZE	RAM Std/Max	HARD DRIVE	PC CARD Qty/Type	POINTING DEVICE	VIDEO RAM	SIZE WxDxH	WEIGHT LBS.	PRICE
IBM										
ThinkPad 365CS	486DX4/75	10.4" Color Dual Scan	8/24	540MB	1/III or 2/II	TrackPoint III	1MB	4.7x8.3x2.0	5.8	$1999
ThinkPad 365C	486DX4/75	10.4" Color Active	8/24	540MB	1/III or 2/II	TrackPoint III	1MB	4.7x8.3x2.0	5.8	2599
ThinkPad 365CSD	486DX4/75	10.4" Color Dual Scan	8/24	540MB	1/III or 2/II	TrackPoint III	1MB	4.7x8.3x2.0	6.3	2499
ThinkPad 365CD	486DX4/75	10.4" Color Active	8/24	540MB	1/III or 2/II	TrackPoint III	1MB	4.7x8.3x2.0	6.3	3099
ThinkPad 701C	486DX4/75	10.4" Color Dual Scan	8/24	360MB	1/III or 2/II	TrackPoint III	1MB	9.6x7.8x1.6	4.5	2469
ThinkPad 701C	486DX4/75	10.4" Color Dual Scan	8/24	540MB	1/III or 2/II	TrackPoint III	1MB	9.6x7.8x1.6	4.5	2849
ThinkPad 701C	486DX4/75	10.4" Color Active	8/24	360MB	1/III or 2/II	TrackPoint III	1MB	9.6x7.8x1.6	4.5	2924
ThinkPad 701C	486DX4/75	10.4" Color Active	8/24	540MB	1/III or 2/II	TrackPoint III	1MB	9.6x7.8x1.6	4.5	3199
ThinkPad 701C	486DX4/75	10.4" Color Dual Scan	8/24	720MB	1/III or 2/II	TrackPoint III	1MB	9.6x7.8x1.6	4.5	2847
ThinkPad 701C	486DX4/75	10.4" Color Active	8/24	720MB	1/III or 2/II	TrackPoint III	1MB	9.6x7.8x1.6	4.5	3399
ThinkPad 755CD	Pentium 75	10.4" Color Active	8/40	810MB	1/III or 2/II	TrackPoint III	1MB	11.7x8.3x2.2	7.3	4949
ThinkPad 755CD	Pentium 75	10.4" Color Active	8/40	1.2GB	1/III or 2/II	TrackPoint III	1MB	11.7x8.3x2.2	7.3	5399
ThinkPad 755CX(Value)	Pentium 75	10.4" CA(no audio-modem-phone)	8/40	540MB	1/III or 2/II	TrackPoint III	1MB	11.7x8.3x2.2	6.1	3749
ThinkPad 755CX(Value)	Pentium 75	10.4" CA(no audio-modem-phone)	8/40	810MB	1/III or 2/II	TrackPoint III	1MB	11.7x8.3x2.2	6.1	4149
ThinkPad 755CX	Pentium 75	10.4" Color Active	8/40	540MB	1/III or 2/II	TrackPoint III	1MB	11.7x8.3x2.2	6.1	3799
ThinkPad 755CX	Pentium 75	10.4" Color Active	8/40	810MB	1/III or 2/II	TrackPoint III	1MB	11.7x8.3x2.2	6.1	4149
ThinkPad 755CX	Pentium 75	10.4" Color Active	8/40	1.2GB	1/III or 2/II	TrackPoint III	1MB	11.7x8.3x2.2	6.1	5699
ThinkPad 755CV	Pentium 75	10.4" Color Active	8/40	810MB	1/III or 2/II	TrackPoint III	1MB	11.7x8.3x2.0	6.5	5949
ThinkPad 755CV	Pentium 75	10.4" Color Active	8/40	1.2GB	1/III or 2/II	TrackPoint III	1MB	11.7x8.3x2.0	6.5	5899
ThinkPad 755CDV	Pentium 75	10.4" Color Active	8/40	810MB	1/III or 2/II	TrackPoint III	1MB	11.7x8.3x2.0	6.5	5999
ThinkPad 755CDV	Pentium 75	10.4" Color Active	8/40	1.2GB	1/III or 2/II	TrackPoint III	1MB	11.7x8.3x2.0	6.5	6449
ThinkPad 760C	Pentium 90	10.4" Color Active	8/40	720MB	1/III or 2/II	TrackPoint III	1MB	11.7x8.3x2.0	6.1	5349
ThinkPad 760C	Pentium 90	12.1" Color Active	8/40	720MB	1/III or 2/II	TrackPoint III	1MB	11.7x8.3x2.0	7.3	6049
ThinkPad 760C	Pentium 120	12.1" Color Active	8/40	720MB	1/III or 2/II	TrackPoint III	1MB	11.7x8.3x2.0	7.3	6599
ThinkPad 760CD(4X)	Pentium 90	12.1" Color Active	8/40	1.2GB	1/III or 2/II	TrackPoint III	1MB	11.7x8.3x2.0	7.3	7449
HEWLETT PACKARD										
Omnibook 600C	486DX4/75	8.5" Color Dual Scan	8/16	340MB	2/II or 1/III	Pop-Up Mouse	1MB	11.1x7.3x1.6	3.8	2539
OmniBook 600CT	486DX4/75	9.5" Color Active	8/32	340MB	2/II or 1/III	Pop-Up Mouse	1MB	11.1x7.3x1.6	4.6	2999
OmniBook 5000C VL75	Pentium 75	10.4" Color Dual Scan	8/64	540MB	2/II or 1/III	Bit-in TrackBall	1MB	11.6x8.9x1.9	6.8	3279
OmniBook 5000CT VL75	Pentium 75	10.4" Color Active	8/64	1.2GB	2/II or 1/III	Bit-in TrackBall	1MB	11.6x8.9x1.9	6.8	3589
OmniBook 5000C VL90	Pentium 90	10.4" Color Dual Scan	8/64	810MB	2/II or 1/III	Bit-in TrackBall	1MB	11.6x8.9x1.9	6.8	3859
OmniBook 5000CT VL90	Pentium 90	10.4" Color Active	8/64	1.2GB	2/II or 1/III	Bit-in TrackBall	1MB	11.6x8.9x1.9	6.8	4889
OmniBook 5000CT	Pentium 90	10.4" Color Active	8/64	1.2GB	2/II or 1/III	Bit-in TrackBall	1MB	11.6x8.9x1.9	6.8	5234
OmniBook 5000CTS	Pentium 90	10.4" Color Active (800X600)	16/64	1.2GB	2/II or 1/III	Bit-in TrackBall	1MB	11.6x8.9x1.9	6.8	5797
OmniBook 5000CTS	Pentium 120	10.4" Color Active (800X600)	16/64	1.2GB	2/II or 1/III	Bit-in TrackBall	1MB	11.6x8.9x1.9	6.8	6539
TEXAS INSTRUMENTS										
EXTENSA 450	486DX4/75	10.4" Color Dual Scan	4/32	340MB	1/II	Touch Pad	1MB	11.7x8.2x1.7	5.0	$1627
EXTENSA 450T	486DX4/75	9.5" Color Active	4/32	340MB	1/II	Touch Pad	1MB	11.7x8.2x1.7	5.0	2014
EXTENSA 550	Pentium 75	10.4" Color Dual Scan	8/40	524MB	2/II or 1/III	Touch Pad	1MB	11x6X9x2.2	6.2	2394
EXTENSA 550CD	Pentium 75	10.4" Color Dual Scan	8/40	524MB	2/II or 1/III	Touch Pad	1MB	11x6X9x2.2	6.2	2867
EXTENSA 550CDT	Pentium 75	10.4" Color Active	8/40	524MB	2/II or 1/III	Touch Pad	1MB	11x6X9x2.2	6.4	3444
TM5000	Pentium 75	10.5" Color Dual Scan	8/32	524MB	2/II or 1/III	Point Stick	2MB	11x8.7x2.2	6.7	2769
TM5000	Pentium 75	10.4" Color Active	8/32	772MB	2/II or 1/III	Point Stick	2MB	11x8.7x2.2	6.7	3469
TM5100	Pentium 90	10.4" Color Active	8/32	1.2GB	2/II or 1/III	Point Stick	2MB	11x8.7x2.2	6.7	4199
TM5200	Pentium 120	10.4" Color Active	8/32	1.2GB	2/II or 1/III	Point Stick	2MB	11x8.7x2.2	6.7	4979
ZENITH										
Z-Star	486DX4/100	10.4" Color Dual Scan	4/20	420MB	2/II or 1/III	Bit-in TrackBall	1MB	11x8.7x1.8	5.2	2329
Z-Note MX	486DX4/100	9.5" Color Dual Scan	8/32	420MB	2/II or 1/III	Pressure Pad	1MB	11.1x8.7x1.9	5.9	2499
Z-Note MX	486DX4/100	9.5" Color Dual Scan	8/32	540MB	2/II or 1/III	Pressure Pad	1MB	11.1x8.7x1.9	5.9	2599
Z-Note MX	486DX4/100	9.5" Color Dual Scan	8/32	810MB	2/II or 1/III	Pressure Pad	1MB	11.1x8.7x1.9	5.9	2799
Z-Note MX	486DX4/100	10.4" Active Color	8/32	810MB	2/II or 1/III	Pressure Pad	1MB	11.1x8.7x1.9	6.1	3499
SAMSUNG										
SENS 700	486DX4/75	10.4" Color Dual Scan	8/32	520MB	2/II or 1/III	Bit-in TrackBall	1MB	11.3x8.9x2.2	6.2	$1999
SENS 700	486DX4/100	10.4" Active Color	8/32	810MB	2/II or 1/III	Bit-in TrackBall	1MB	11.3x8.9x2.2	6.5	2499
SENS 800	Pentium 75	10.4" Color Dual Scan	8/32	520MB	2/II or 1/III	Bit-in TrackBall	1MB	11.3x8x2.1	6.2	2399
SENS 800	Pentium 75	10.4" Active Color	8/32	810MB	2/II or 1/III	Bit-in TrackBall	1MB	11.3x8x2.1	6.5	2999
SENS 800	Pentium 90	10.4" Active Color	8/32	1.3GB	2/II or 1/III	Bit-in TrackBall	1MB	11.3x8x2.1	6.5	3499

IBM ThinkPad 760CDV/CD
PENTIUM 90
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1.2GB 8/40RAM
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HEWLETT PACKARD OmniBook 5000CTS
PENTIUM 90
10.4" Color Active
1.2GB 16/64RAM
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TEXAS INSTRUMENTS TravelMate 5200
PENTIUM 120
10.4" Color Active
1.2GB 8/32RAM
$4979

NOTEBOOK MEMORY

SIZE	PRICE
AST RESEARCH MEMORY	
Ascentia 900N 4/50, 4/75, 910N	4MB $189
Ascentia 900N 4/50, 4/75, 910N	8MB 389
Ascentia 900N 4/50, 4/75, 910N	16MB 649
COMPAQ MEMORY	
LTE Lite/20, Lite/25, Lite/25C, Lite/25E	4MB 189
LTE Lite/20, Lite/25, Lite/25C, Lite/25E	8MB 389
LTE Lite/20, Lite/25, Lite/25C, Lite/25E	16MB 689
LTE Lite 4/25C, /33C, /25E, /25SL Mono Notebk	4MB 189
LTE Lite 4/25C, /33C, /25E, /25SL Mono Notebk	8MB 389
LTE Lite 4/25C, /33C, /25E, /25SL Mono Notebk	16MB 649
LTE Lite 4/40C, /50E, /40CX, /50CX, /75CX	4MB 189
LTE Lite 4/40C, /50E, /40CX, /50CX, /75CX	8MB 389
LTE Lite 4/40C, /50E, /40CX, /50CX, /75CX	16MB 789
Contura 4/25, 4/25C, 4/25CX	4MB 189
Contura 4/25, 4/25C, 4/25CX	8MB 389
Contura 4/25, 4/25C, 4/25CX	16MB 649
Contura 3/20, 3/25, 3/25C	4MB 189
Contura 3/20, 3/25, 3/25C	8MB 349
Contura 400C, 400CX, 410, 410C, 410CX	4MB 189
Contura 420 DX4/75, 430 DX4/100	
Contura 400C, 400CX, 410, 410C, 410CX	8MB 349
Contura 420 DX4/75, 430 DX4/100	
Contura 400C, 400CX, 410, 410C, 410CX	16MB 649
Contura 420 DX4/75, 430 DX4/100	

HEWLETT-PACKARD MEMORY		
OmniBook 600C	4MB	$189
OmniBook 600C	8MB	389
OmniBook 4000	4MB	189
OmniBook 4000	8MB	349
OmniBook 4000	16MB	649
IBM MEMORY		
ThinkPad 701	4MB	$189
ThinkPad 701	8MB	349
ThinkPad 701	16MB	649
PS/2 CL57SX, ThinkPad 700, 700C, 720C; ThinkPad 750, 755, 355, 340 (All Models)	4MB	189
PS/2 CL57SX, ThinkPad 700, 700C, 720C; ThinkPad 750, 755, 355, 340 (All Models)	8MB	389
ThinkPad 750, 755, 355, (All Models)	16MB	699
ThinkPad 750, 750CS, 750C, 750P, 755	32MB	1449
ThinkPad 730T, 750, 755, 360, (All Models)	4MB	189
ThinkPad 355, 355CS, 355C		
ThinkPad 730T, 750, 755, 360, (All Models)	8MB	349
ThinkPad 355, 355CS, 355C		
ThinkPad 730T, 750, 755, 360, (All Models)	16MB	699
ThinkPad 355, 355CS, 355C		
ThinkPad 755 Series	8MB	449
NEC MEMORY		
UltraLite Versa, Versa E, M, P, V, 4000	4MB	$189
UltraLite Versa, Versa E, M, P, V, 4000	8MB	349
UltraLite Versa, Versa E, M, P, V, 4000	16MB	649
Versa E, M, P, V, 4000 P75	32MB	1509
Versa S, 2000	4MB	189
Versa S, 2000	8MB	349
Versa S, 2000	16MB	649

TEXAS INSTRUMENTS MEMORY		
TravelMate 4000, 4000E, 4000M	16MB	$849
TravelMate 5000	8MB	389
TravelMate 5060	16MB	749
Extensa 450, 450T, 455, 455T	4MB	189
Extensa 450, 450T, 455, 455T	8MB	349
Extensa 450, 450T, 455, 455T	16MB	649
TOSHIBA MEMORY		
Portege 610CT, Satellite Pro 400CS, 400CDT	8MB	$389
Portege 610CT, Satellite Pro 400CS, 400CDT	16MB	749
Portege 610CT, Satellite Pro 400CS, 400CDT	32MB	1499
T2100, /CS, /CT, T2105, /CS, /CT T2150CDT, T2150CDS, T2155CDT, T2155CDS	4MB	189
T2110, T2115, T2130, T2135		
T2100, /CS, /CT, T2105, /CS, /CT T2150CDT, T2150CDS, T2155CDT, T2155CDS	8MB	389
T2110, T2115, T2130, T2135		
T2100, /CS, /CT, T2105, /CS, /CT T2150CDT, T2150CDS, T2155CDT, T2155CDS	16MB	699
T2110, T2115, T2130, T2135		
T2100, /CS, /CT, T2105, /CS, /CT T2150CDT, T2150CDS, T2155CDT, T2155CDS	24MB	1279
T2110, T2115, T2130, T2135		
ZENITH DATA MEMORY		
Z-Star EX	4MB	$189
Z-Star EX	16MB	649
Z-NoteFlex	4MB	189
Z-NoteFlex	8MB	389
Z-NoteFlex	16MB	689

NOTEBOOK DRIVES

IBM
MODELS 755-355-360-750
524MB-$895 810MB-$1095
710MB-$995 1.2GB-$1695
MODELS 700-700C-780-720C
340MB-$995 720MB-$1495
524MB-$1295
MODELS 701C-701CS
540MB-$795 720MB-$895

NEC
VERSA E,M,V, P
340MB-$595 720MB-$1095
524MB-$895 1.2GB-$1695

TOSHIBA

MK2526FC	524MB	15MS	IDE	$399
MK2428FC	520MB	15MS	SCSI	449
MK2628FC	810MB	13MS	IDE	499
MK2720FC	1.3GB	13MS	IDE	575

SEAGATE

ST9150AG	131MB	16MS	$169
ST9000AG	210MB	16MS	199
ST9420AG	420MB	16MS	289
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ST9816AG	810MB	16MS	549

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8MEG–$439 16MEG–$879 32MEG–$1759

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64Kx1	–	11.00	9.00	8.00
64Kx4	–	11.00	9.00	8.00
64Kx8	–	15.00 (5V)	19.00 (3.3V)	–
16Kx4	–	8.00	7.00	6.00
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CACHE MODULES

256K (160 pin) Pipeline Burst Cache Module $79.00

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Individual D-RAM Chips

MEMORY FOR IBM & APPLE	50NS	60NS	70NS	80NS	100NS
1Megx1	–	6.85	6.45	5.95	4.95
1Megx4	–	49.00	39.00	38.00	–
1Megx4 (Zip Pk)	–	24.00	22.00	21.00	–
256x4(Page Dip)	–	7.25	6.75	6.50	5.95
256 4(Static Dip)	–	–	9.95	–	–
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64x1	–	–	2.50	–	2.00
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4Meg x 9	–	–	–	152.00	149.00	142.00	–
16Meg x 9 (9 chip)	–	–	–	497.00	497.00	–	–

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256 x 36 1 mg	–	54.00	49.00
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4 x 32 16 mg	499.00	489.00	489.00
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	8Meg	500987-003	259.00
	16Meg	500987-004	489.00
	32Meg	500987-005	978.00
Premmia LX P/60, MX4/66d, 4/100T, P/60	8 Meg	500987-003	320.00
	16 Meg	501340-002	549.00
	32 Meg	500987-005	958.00
	64 Meg	501569-001	Call
Premmia 4133, 4133S, 4/50d, 4/60d	8 Meg	501159-002	338.00
Premmia SE 4/33, 4/66d, P/60	16 Meg	501159-003	658.00
Premmia MTE 4/33, 4/66d, P/60	32 Meg	501159-004	1149.00
Manhattan G, V Series Server	64 Meg	501159-005	2298.00
Power Premium 3/33, 4/33, 4/33S, 4/50d, 4/66d	8Meg	500780-001	378.00
Premium 486/25, 486/25E, 486/33, 486/33E Premium 386/33TE, 486/25TE, 486/33TE			
Prem. II 386/25, 386/33, 486/33, 486 SX/20			
Bravo 486/25, 486/33	2 Meg Kit	500780-005	118.00
Advantage 486/25, 486/33, 486/33P, 486 SX/20			
Premium SE4/22	8Meg Kit	500780-001	338.00
Premium SE 4/50, d, 66d, P/60	1 Meg	500780-003	59.00
Prem. 386/33E, 386 SX16, Prem.II 386SX-20, 386/25	4Meg	500780-004	169.00
Premmia GX P/90, P/100	8Meg Kit/16MegKit	501565-001/501566-001	378/699
	32Meg Kit/64Meg Kit	501567-001/501568-001	1358/2699
AST Cupid Board	0-32 Meg	500818-001	159.00

AMBRA

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Ambra N Series	4/8/12/16 Meg	179/319/549/619
Ambra SN Series	4/16 Meg	179/539
Ambra Sparing SLC II	2/8 Meg	89/319
Ambra N-75, N-100	4/8/16	164/319/619

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MODEL	AMT. UPGRADED	MFG. PART #	PRICE
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30F5360 (2Meg)	30-286, 25-286, 50 MTHR BD.	104.00
6450375 (1Meg)	80-041	79.00
6450379 (2Meg)	80-111, 311-121, 321, 081, 161	84.00
6451090 (4Meg)	80-A21, A-81, B0-A31, B0-111, B0-311	189.00
6450604/92G7196 (2Meg)	70-061, E61, 121, 50Z, 555X, 655X, P-70, 55LS, 65LS, X-Station 120 & 130, 35SX, 35LS, 40SX	99.00
6450628 (2Meg)	70-A21, A-81, B-21, B-61, 35SX, 35LS, 40SX, Val Pt. 32ST	90.00
76H8935 (1MEG)	25	36.00
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87F9757/87F7799 (8Meg)	55SX, 55LS, 65SX, 40SX, 35SX, 35LS	154.00
11B1735 (512K)	P/S1-286	49.00
92F9935 (2Meg)	P/S1 & P/S1/386SX-2121	109.00
92F9944 (4Meg)	P/S1 & P/S1/386SX, Model-2121	189.00
92G7260 (4Meg)	PSI Expert, Consultant, Willow	154.00
90X7761, 76H8328 (8Meg)	Value Point Performance, PC Server 4/66	154.00
92F3759 (4Meg)	Aptiva 310, 330, 350, 510, 530, 710, 730	129.00
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92F3540 (16Meg)	Aptiva 310, 330, 350, 510, 530, 710, 730	489.00
92F3545 (32Meg)	Aptiva 310, 330, 350, 510, 530, 710, 730	972.00
79G3132/92G7293 (8Meg)	Value Point Performance, PC Server 4/66	299.00
90X6162/92G7294 (16Meg)	Value Point Performance, PC Server 4/66	559.00
92G7295 (32Meg)	Value Point Performance, PC Server 4/66	1239.00
6450692 (2Meg)	56, 57, 57SX,90, 95, P-75, 57SLC	90.00
6450128/92G7200 (4Meg)	Value Point 77 486DX2, 486SX, SVR 85	139.00
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6450129/92G7428 (8Meg)	Value Point 77 486DX2, 486SX, SVR 85	319.00
6450130/92G7202 (8Meg)	35SX, 40SX	319.00
	56, 57, 57SX, 90, 95, P-75, 57SLC	
6451158/92G7206 (4Meg ecc)	Value Point 77 486DX2, 486SX, SVR 85	199.00
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66G0094 (4Meg)	Thinkpad 755, 360, 355, 340, 450	164.00
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66G0094 (16Meg, 32Meg)	Thinkpad 755, 360, 355, 340, 450	609/1220
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8189099 (8Meg, 16Meg)	Thinkpad 500, 510CS (3.3 volt)	319/609
79F0999 (2Meg)	LX40, N33SX, PS Note	103.00
79F1000 (4Meg)	LX40, N33SX, PS Note, Tkpd 350, 350c. PS Note 425	164.00
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(4Meg/16Meg w/Adap	Thinkpad 755 Dimm Modules	169/519
60G0376 (8Meg)	Thinkpad 755	239/678
60G0378 (8Meg)	Thinkpad 350, 350c. PS Note 425	319.00
60G0379 (16Meg)	Thinkpad 350, 350c. PS Note 425	569.00
92F6804 (2Meg)	N45SL	109.00
92G7259 (4Meg)	Thinkpad 701C, CS, Butterfly	164.00
92G7261 (8Meg)	Thinkpad 701C, CS, Butterfly	319.00
92G7263 (16Meg)	Thinkpad 701C, CS, Butterfly	609.00
4Meg/8Meg/16Meg (730T only)	Thinkpad 340, 730T	199/319/629
(4Meg, 8Meg, 16Meg)	Thinkpad 760	179/339/639
8Meg/16Meg	Thinkpad 820	390/729
4Meg/8Meg/16Meg/32Meg	Thinkpad 850	193/399/719/1439
4Meg/8Meg/16Meg/32Meg	PC300 Pentium	179/339/629/1259

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Deskpro 386S	1Meg Module/4Meg Module	79/169
	1Meg Board/4Meg Board	149/249
Deskpro 386 25E/20E	1Meg Module/4Meg Module	79/169
	1Meg Board/ 4 Meg Board	149/249
Deskpro 386/25, 20	1Meg Module/4Meg Module	79/169
Deskpro System Pro 386/33, 486/25, 486/50L	2/8/32Meg	99/299/1399
Deskpro 4/66l, 4/33i, 4/25iS, 3733i, 3/25i	2/4/8Meg	89/154/319
Deskpro "M" Series	Expansion Board 0K	119
Deskpro 450, 466, 4100, 575, 590, 5120, 5133	4/8/16/32Meg	159, 319, 619, 1149
Deskpro XE 433S, 450, 466	2/4/6Meg	89/154/319
Deskpro XE 560	8/16/32/64/128Meg	356/616/1276/2476/Call
Deskpro XL450, 466, XL560, xl566, XL575, 5100 xl590	4/8/16/32/64Meg	176/336/639/1236/2378
Presario 433, CDS520, CDJV520, CDL524, CDS526, CDTV528 680, CDS660, CDS720, CDS724, CDS744, CDS860 CDS920, CDTV920, 924, CDS924, CDS954	2/4/8/16/32Meg	139/278/549/1049
Presario 400 Series, 600 Series, 800 Series	2/4/8/16/32Meg	89/154/319/619/1189
Presario CDS774, CDS972, CDS962, CDTV978, CDS974 (in pairs) CDS992, 7152, 7170, 7180, 9546, 9548, 9564	4/8/16/32Meg	139/279/549/1099
Prolinea 4/25S, 4/33, 4/33S, 4/50, 4/66, CDS	1/2/4/8Meg	59/89/154/319
Prolinea MT 4/33S, 4/50, 4/66, Enhanced 4/33S, 4/50S, 4/50, 4/66	2/4/8/16/32 Meg	89/154/319/549/1189
Prolinea 450, 466, 4100, 575, 590, 5120, 575, 590, 5120 575 mini, 5100 mini, 5133 mini	4/8/16/32Meg	154/319/619/1189
Proliant 1500 5/75, 5/100, 1500R 5/75, 5100	(install in pairs) 4/8/16/32Meg	154/319/619/1189
Prosignia 300, 575, 590, 500 5/90, 500 5/120	(install in pairs) 4/8/16/32Meg	154/319/619/1189
Proliant 1000 5/60, Prosignia 5/60	16/32/64/128/256	616/1276/2476/4756/Call
Proliant 2000 486/50, 5/66, 5/90, 2000R 5/66, 5/90 4000 486/50, 5/66, 5/90, 5/100. 4000R 5/66, 5/90, 5/100 4500 5/100, 4500R 5/100	16/32/64/128/256	616/1276/2476/4756/Call

COMPAQ LAPTOPS & NOTEBOOKS

Elite 5000	8Meg/16Meg/32Meg/64Meg		329/639/1249/2569
LTE/386S/20	4Meg Module	121125-002	209.00
LTE LITE/20, 25, 25C	4Meg Module	129788-002	209.00
LTE LITE/20, 25, 25C	8Meg Module	129789-002	439.00
LTE LITE/20, 25, 25C	16Meg Module	129769-004	669.00
LTE LITE 425C/33C/25E/25L	4Meg Module	142337-002	179.00
LTE LITE 425C/33C/25E/25L	8Meg Module	142337-003	319.00
LTE LITE 425C/33C/25E/25L	16Meg Module	142337-004	619.00
SLT/286	4Meg Module	110237-001	179.00
SLT/386	2Meg Module	118304-001	109.00
SLT/386	4Meg Module	118305-001	185.00
Concerto, LTE Elite	4Meg	144790-001	164.00
	8Meg	144790-002	319.00
	16Meg	144790-003	609.00
Contura 320, 325	2Meg	139497-001	99.00
	4Meg	139498-001	164.00
	8Meg	139499-001	319.00
Contura 400, 410	4Meg/8Meg/16Meg		169/319/609
Contura 420, 430	4Meg/8Meg/16Meg/20Meg		169/319/609/799
Contura 4/25, 4/25C, 4/25CX	4Meg	146520-001	164.00
	8Meg	146521-001	319.00
	16Meg	146531-001	619.00
Aero 4/25, 4/33	4Meg	196532-001	164.00
	8Meg	190597-001	319.00

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CONNER		MAXTOR		WESTERN DIGITAL	
850MB CFS 850A	$189	850MB 7850 AV	$199	850MB AC2850	$199
1.2 GIG CFS 1275A	259	1.2GIG 71260 AV	259	1.2 GIG AC31200	279
1.6 GIG ---	319	1.6 GIG ---	309	1.6 GIG AC31600	349

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MODEL	PRICE
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S-RAM Cards 2MEG	229
28.8/14.4 Data/Fax Modem	189
14.400/14.400 Data/Fax Modem	99
Readwriter Card (15A Slot)	149
Lan Ethernet (Coax), (10 Base T)	99
Portable CD ROM (4x)	Call

MODEL	PRICE
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Audio Card	169
Multimedia Combo, Sound/SCSI	299
Panasonic KXL-D720 port. CDRom player	339
Type III 170 Mg Hard Drive	429
Type III 260 Mg Hard Drive	529
Type III 340 Mg Hard Drive	629
Xircom Combo Ethernet + Modem II 28.8 Adapter	549

FLASH MEMORY 2 Meg–99.00 6 Meg–229.00 10Meg–349.00 16Meg–529.00

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TOSHIBA LAPTOP MEMORY

MODEL	AMT. UPGRADED	MANU. PART #	PRICE
T2000SX/T2000SX/T1800, 1850, C	2Meg/4Meg/8Meg	PC-PA2000U	69/159/319
T2100, 2105, 2150, 2155, 2110, 2115	4Meg/8Meg/16Meg/24 Meg		164/319/609/899
T4400SX, SXD T6400, T6600	4Meg	PC-PA2004U	189.00
T4400SX, SXD T6400, T6600	8Meg	PC-PA2005U	379.00
T4400SX, SXC T6400, T6600	16Meg	PC-PA2010U	689.00
T4500, C, T4600, T4700, T1900, G, T1910, T1950 (3.3 v)	4Meg	PC-PA2012U	189.00
T4500, C, T4600, T4700, T1900, C, T1910, T1950 (3.3 v)	8Meg	PC-PA2013U	319.00
T4500, C, T4600, T4700, T1900, C, T1910, T1950 (3.3 v)	16Meg	PC-PA2014U	609.00
T4700, 4800, 4850 (Hard Drive)	524Meg/710Meg/1.3 Gig		739/969/1119
T3400CT, T2400, T3600	4Meg/8Meg/16Meg	PC-PA2019U	179/349/619
T3400CT	32Meg		1549.00
T3100SX	2Meg	PC15-PA8308U	109.00
T3100SX	4Meg	PC15-PA8310U	189.00
T5200/T8500	2Meg	PC10-PA8304U	49.00
T5200/T8500	8Meg	PC10-PA8313U	369.00
T600, 610, CT	8Meg/16Meg/32Meg		439/879/1759
T700	8Meg/16Meg/32Meg		579/1159/2318
T400CS, 400CDT	8Meg/16Meg/32Meg		439/879/1759

NOTEBOOK, LAPTOP MEMORY

MODEL	AMT. UPGRADED	MANU. PART #	PRICE
AST Ascentia 700, 750, 760	4Meg/8Meg/16Meg/32Meg		
AST Ascentia 700, 750, 760, 794, 796, 797, 900, 910, 930, 940, 950	4Meg/8Meg/16Meg/32Meg		
ACER Notes Pro, ACER Note Lite	4Meg/8Meg/16Meg/32Meg		
ALR Venturis 4086	4Meg/8Meg/16Meg/32Meg	12407980	
ALR Venturis 4086SX, 386SX	4Meg/8Meg/16Meg/32Meg		
ALR Bravo & Legacy	4Meg/8Meg/16Meg/32Meg		
ALR Power Exec 4086SX/20/25/33/50SL	4Meg/8Meg/16Meg/32Meg	501255-001, -002	
ALR Power Exec 6200, 4250L, 4255L	4Meg/8Meg/16Meg/32Meg	500814-003	
ALR Power Exec 6200, 4250L, 4255L	4Meg/8Meg/16Meg/32Meg	501166-001, -003	
AT&T Globalyst 6000, 6200, 6300	4Meg/8Meg/16Meg/32Meg	501318-001,002	
AT&T Globalyst 6000, 6200, 6300 (Call for other Globalyst)	4Meg/8Meg/16Meg/32Meg		
Bondwell B-311, P/S	2Meg/4Meg/8Meg/16Meg		
Bondwell B-311, P/S	2Meg/4Meg/8Meg/16Meg	PEC 37651	
Bondwell B-311, P/S	2Meg/4Meg/8Meg/16Meg		
Bondwell B-311, P/S	2Meg/4Meg/8Meg/16Meg	23050-09100	
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Jameco 80486 Turbo Motherboard

- AMI BIOS
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- Supports 256K x 9, 1M x 9 and 4M x 9 flexible cache RAM 32KB/64KB/128KB/256KB (0KB installed)
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*Compatible w/ DX2-66/50 or DX33/40/50

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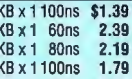

DIPs

Part No.	Product No.	Pins	Description	Price
41620	4164-100	16	64KB x 1 100ns	$1.39
41435	41256-60	16	256KB x 1 60ns	2.39
41443	41256-80	16	256KB x 1 80ns	2.19
41371	41256-100	16	256KB x 1 100ns	1.79
42243	511000P-70	18	1MB x 1 70ns	6.29
42251	511000P-80	18	1MB x 1 80ns	6.19

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53701	94000S-70	4MB x 9 70ns	$169.95
53719	94000S-80	4MB x 9 80ns	164.95
41486	41256A9B-10	256KB x 9 100ns	8.95
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- 8088/80286/80386 and compatible
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19465

19465	150 Watt (8088)	$59.95
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65728	300 Watt	109.95

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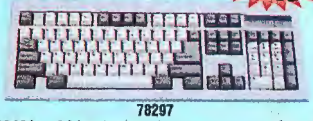

78297

20431	84-key keyboard	$19.95
114868	84-key keyboard, AT, use 114850	59.95
114850	18-key keypad for 114868 only	34.95
78297	101-key AT compatible keyboard	19.95
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119167	101-key foldable, PC/XT/AT; PS2	69.95
17128	101-key enhanced keyboard	69.95
119554	101-key w/ built-in phone headset	99.95
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119669	124-key programmable keyboard	69.95
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Our new Windows 95 keyboards include three additional keys for use in switching between active applications, accessing preloaded applications and files, and creating context-sensitive shortcuts. Utilizing these keys makes work within Windows 95 faster and easier.

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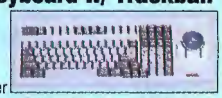
101-Key Keyboard w/ Trackball



- PC/AT and compatibles
- Tactile click sound and feel
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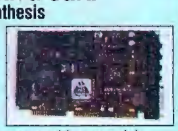
With Wavetable Synthesis



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- FREE MICROPHONE! • Complete manuals
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SPECIAL

This drive is ideal for all your multimedia needs! The enhanced IDE/ATAPI interface allows the CD-ROM drive to share the same data bus and interface card with a disk drive. The included sound card gives you real 16-bit stereo CD quality sound.

- AT/386/486/Pentium compatibles with DOS 5.0 or higher, Windows 3.1, Windows '95 or OS/2
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127677 5X CD-ROM drive w/ sound card $269.95

3.5" and 5.25" External IDE Cases

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- Uses parallel port to interface to IDE device (Bi-directional port recommended)
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128776

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- File formats supported: TIFF, PCX, BMP, TGA, GIF, JPEG
- Includes inferface card, 3.5" disks and manuals
- Weight: 2.1 lbs. • One-year warranty

128784	256 gray shades scanner	$69.95
128776	16.8M color scanner	139.95

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- Microsoft® Mouse compatible
- One-year warranty
- Weight: 1 lb.

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- PC/XT/AT and compatibles
- Support international CCITT and Bell standards
- 100% reliable data transfer with V.42 bis/MNP5 error detection
- Five test feature for fault locating
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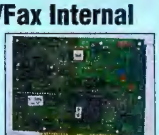
- CCITT V.32 bis, V.32 14.4 bps data
- Industry standard "AT" command set
- Delrina 4-in-1 software for Windows/DOS
- Hayes compatible • FCC compliance
- Weight: 1.5 lbs • One-year warranty

116599 Internal 14.4 fax/modem $69.95

28.8 bps Data/Fax Internal Modem



- Data throughput up to 115,200 bps (data compression)
- 28.800 bps (Data V.34)
- 14,400 bps group III fax
- V.42/MNP 2-4 error control
- 16,550A compatible UART interface
- Hayes compatible • FCC class B, part 68 certified
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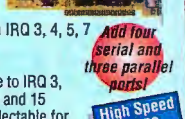
124476 Internal 28,800 fax/modem $169.95

Jameco Fast Input/Output Card



- UART chips emulate 16550 UARTs
- 16-bit card
- PC/XT/AT and compatibles
- Can be used in an 8-bit system with IRQ 3, 4, 5, 7
- Four serial ports
- Three parallel ports
- All ports configurable to IRQ 3, 4, 5, 7, 9, 10, 11, 12, and 15
- Parallel ports are selectable for normal or bi-directional modes
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Add four serial and three parallel ports!

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–Byte Magazine, 11/95.

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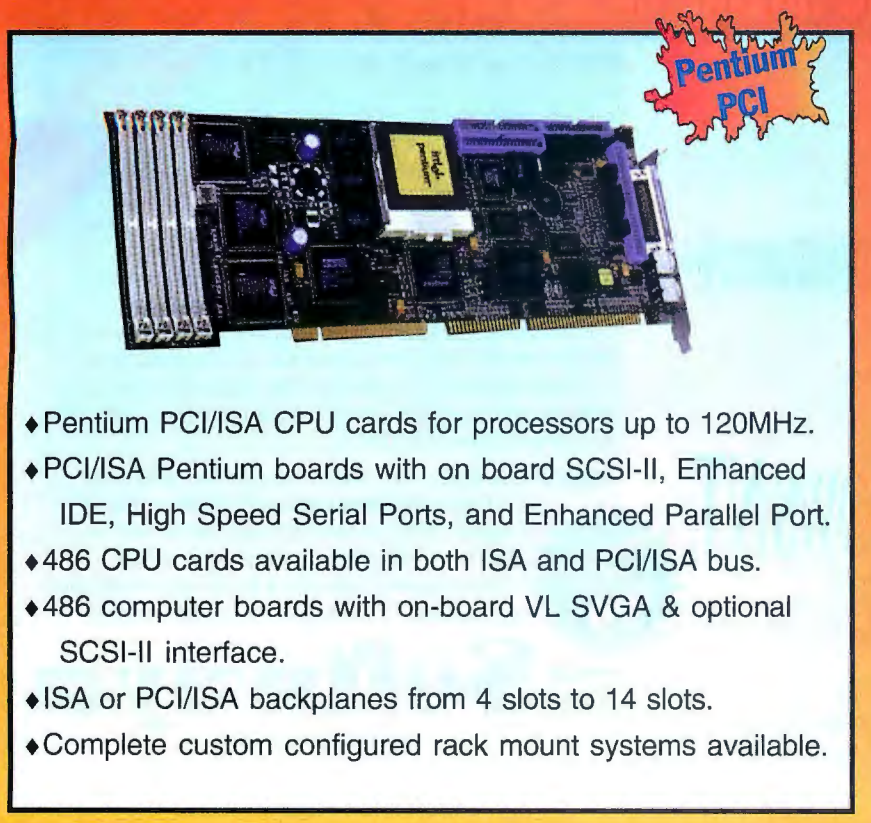

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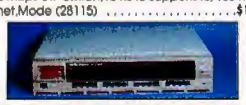

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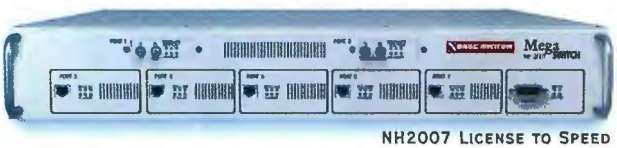

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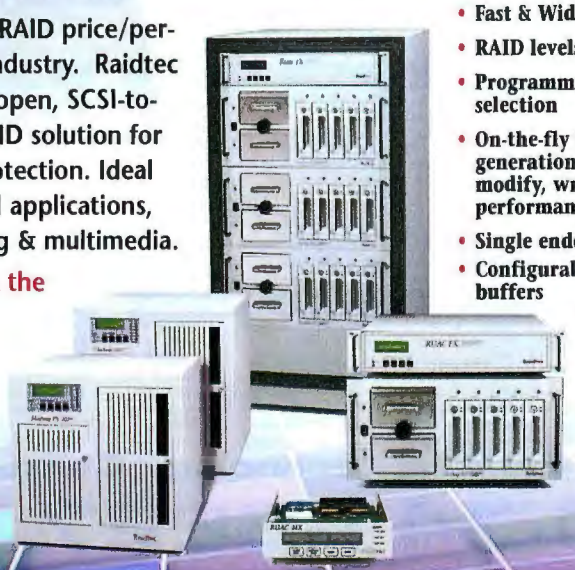

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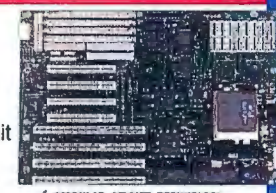

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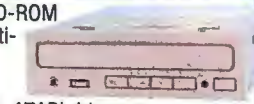

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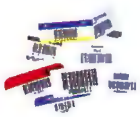

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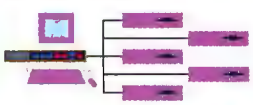

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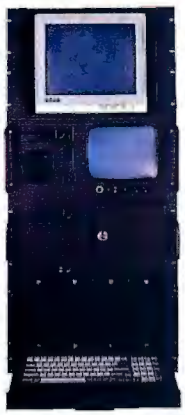

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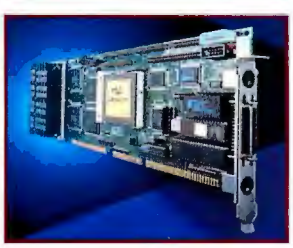

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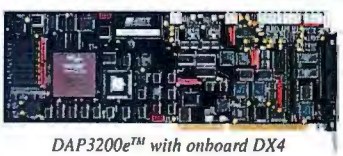

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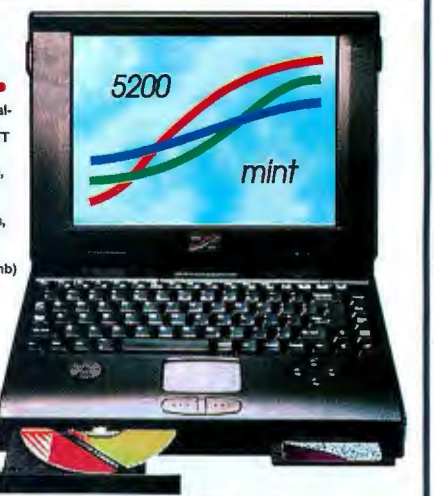

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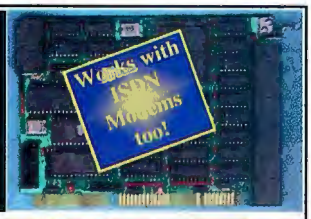

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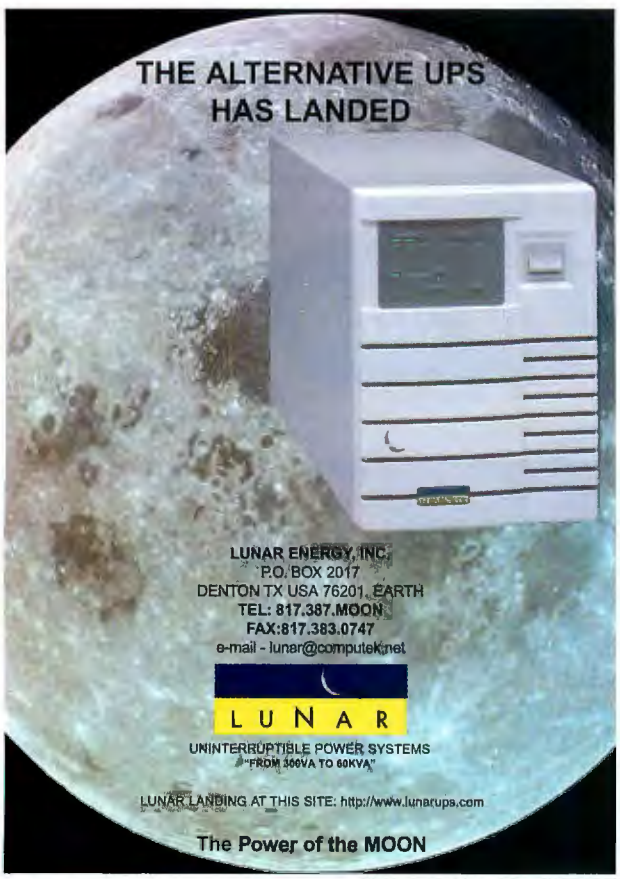

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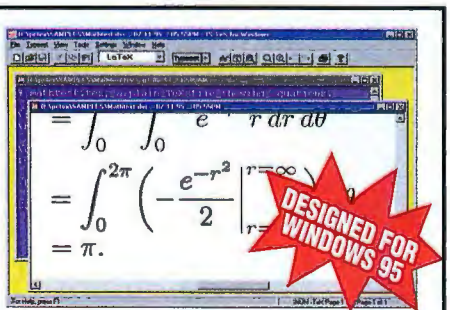

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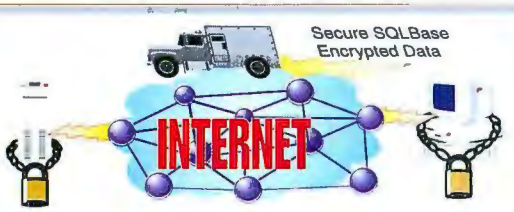

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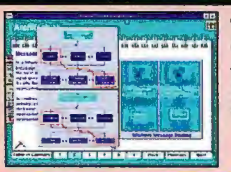

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3 ☐ Reseller/distributor/OEM/integrator/consultant
4 ☐ Other (please describe): _____

B. My job function is best described as: (check one)
5 ☐ Company Management
6 ☐ IS/MIS/IT Management
7 ☐ Systems Engineering/Integration
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9 ☐ Technical Services Support
10 ☐ Other (please describe): _____

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13 ☐ Mac/OS
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15 ☐ Windows
16 ☐ Windows/NT
17 ☐ NetWare
18 ☐ Other (please describe): _____

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19 ☐ Mobile Computing
20 ☐ Application development
21 ☐ Client/Server
22 ☐ Internet/on-line
23 ☐ Video Conferencing
24 ☐ Multimedia
25 ☐ PC Telephony

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29 ☐ LAN hardware or software
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Oh, Grow Up

It's time for technology and product developers to stop acting like adolescents

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Adolescence is hard. It always has been. That's why every society tries to channel the energy, creativity, and potential for utter chaos that comes with adolescence in such a way that adults don't go bonkers and adolescents make it to adulthood. Now well into its twenties, the PC industry is still behaving like an adolescent. It's high time for those of us who depend on technology to say it loud and clear to everyone involved in designing hardware and software: Grow up.

OK, you ask, what does adolescence have to do with the computer industry? Well, this industry is showing, and has been for a while, some classic symptoms of adolescence: a hypersensitivity to critical comments from others, an enormous amount of energy guided by an amazing lack of focus, an ego-driven world view that is almost entirely self-centered, and impressive intelligence bereft of all guidance from wisdom. Adolescence is a necessary stage of development, but the time has surely come to start acting a little more like a grown-up. Let's look at some of the immature behaviors we could live without.

"You're picking on me": Customers need information on the products they buy. Some companies are so troubled by the idea of customers getting information from someone not in their marketing department that they put up legal barriers to avoid product reviews.

Technology du jour: This industry is great at coming up with new technology but tends to lack something in focus and application. Need proof? Pen computing.

Product life cycles measured in weeks: Industry honchos point to collapsed life cycles with perverse pride, but when computer resellers complain that they can't learn a product's features before it goes out of production, things are definitely out of hand. So much for the symptoms.

What would maturity bring? What would we all get out of a more adult attitude? Here are some of the benefits.

A more mature relationship with the press: The computer press does a pretty good job of telling end users what new hardware and software does, but the fact is that writers want access to new products and technologies and will trade kid-gloves treatment to keep that access. Consumers, the press, and the manufacturers themselves would all benefit from insisting on more rigorous evaluations of technology and products.

Rational collaborations: Your reaction to a new industry consortium is probably a stifled yawn. Rampant egos, lingering paranoia about trade secrets, and disregard for what's best for the customer have made meaningful computer-industry consortia nearly impossible to create and sustain. Of course, differences drive improvements, but there are many areas—file formats, anyone?—where reasonable agreement would be a godsend for users.

A customer focus: The industry needs to show enough maturity to care about what customers need. Too often, change in this industry is driven by what engineers and programmers want to build rather than what users need to have. Mature industries tend to respect the marketing people who talk to customers. In the computer industry, the technical types disdain them.

Getting the products right: Mature industries can produce mature products. With all the technological flash and sizzle of the latest generation of hardware and software, none of it is truly easy to use or solidly reliable. Here's a tip to vendors: Enduring system crashes is not a touching bonding ritual; it's a painful damper on market growth. Taking the time to get it right rather than rushing to the next project would be a sign of industry maturity welcomed by customers (and potential customers).

Mature businesses fearlessly solicit feedback from customers. Some software companies claim their rigorous usability testing tells them what people like and don't like, and what they find easy or hard to use. But these usability tests are skewed. They're designed by insiders, by computer literates who have far more experience than most customers. Having product developers design and administer usability tests is like having Einstein put together a high-school physics exam.

The computer industry has convinced itself that its adolescent energy is a virtue. That was once true. But computers now do too many jobs for us. We can't have systems that crash without apparent reason, or software that talks back to us in that tone of voice so familiar to parents of adolescents. Product manufacturers and sellers need to care more about customer needs than developer whims. It's time to grow up—before you're grounded. ■

Curtis Franklin Jr. is director of labs at Client/Server Labs in Atlanta, Georgia. You can reach him on the Internet or BIX at cfranklin@cslinc.com.

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