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APRIL 1996

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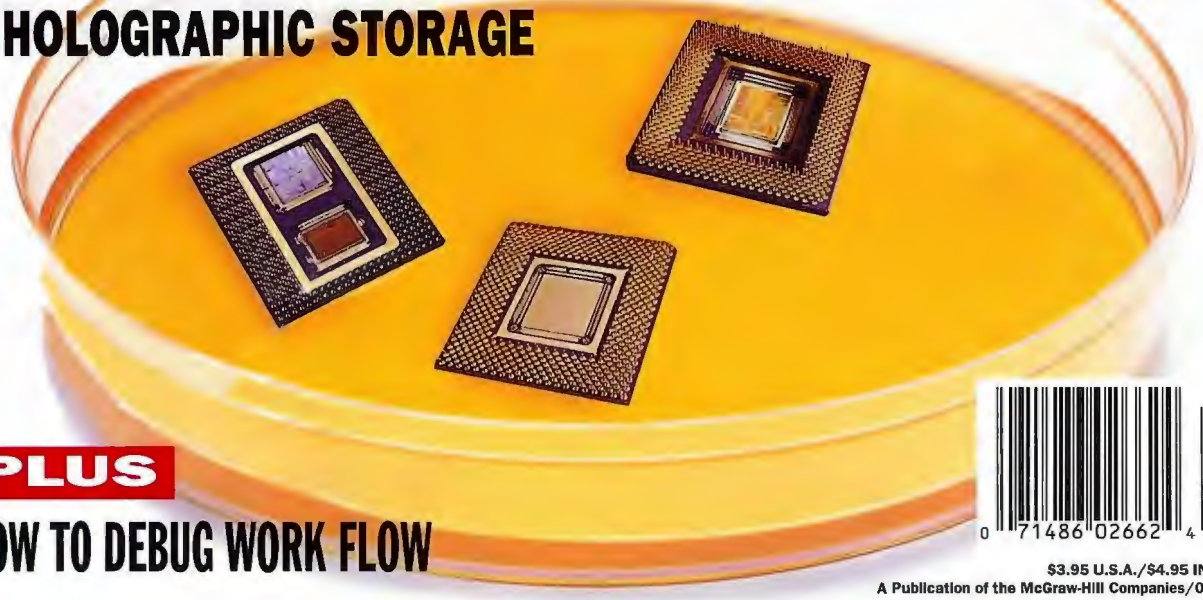

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Volume 21, Number 4

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December 1995
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- Microsoft Windows 95 CD
- Microsoft Office Pro 95 & Bookshelf 95 CDs
- Microsoft Home Pak includes: Works 4.0 for Windows 95; Publisher Deluxe for Windows 95; Encarta® 96; Encarta 96 World Atlas; Music Central™ 96; Wine Guide; Arcade 1.0; Scenes–Sports Extremes Collection; Cinemania® 96; Julia Child Home Cooking; Best of Windows Entertainment Pack; Money 4.0 for Windows 95; Holiday CD Sampler.
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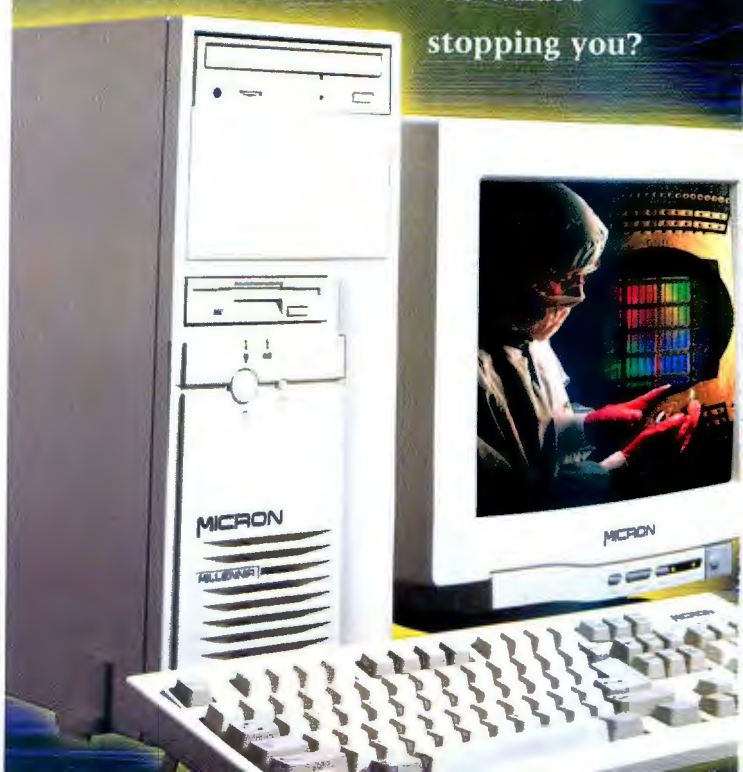
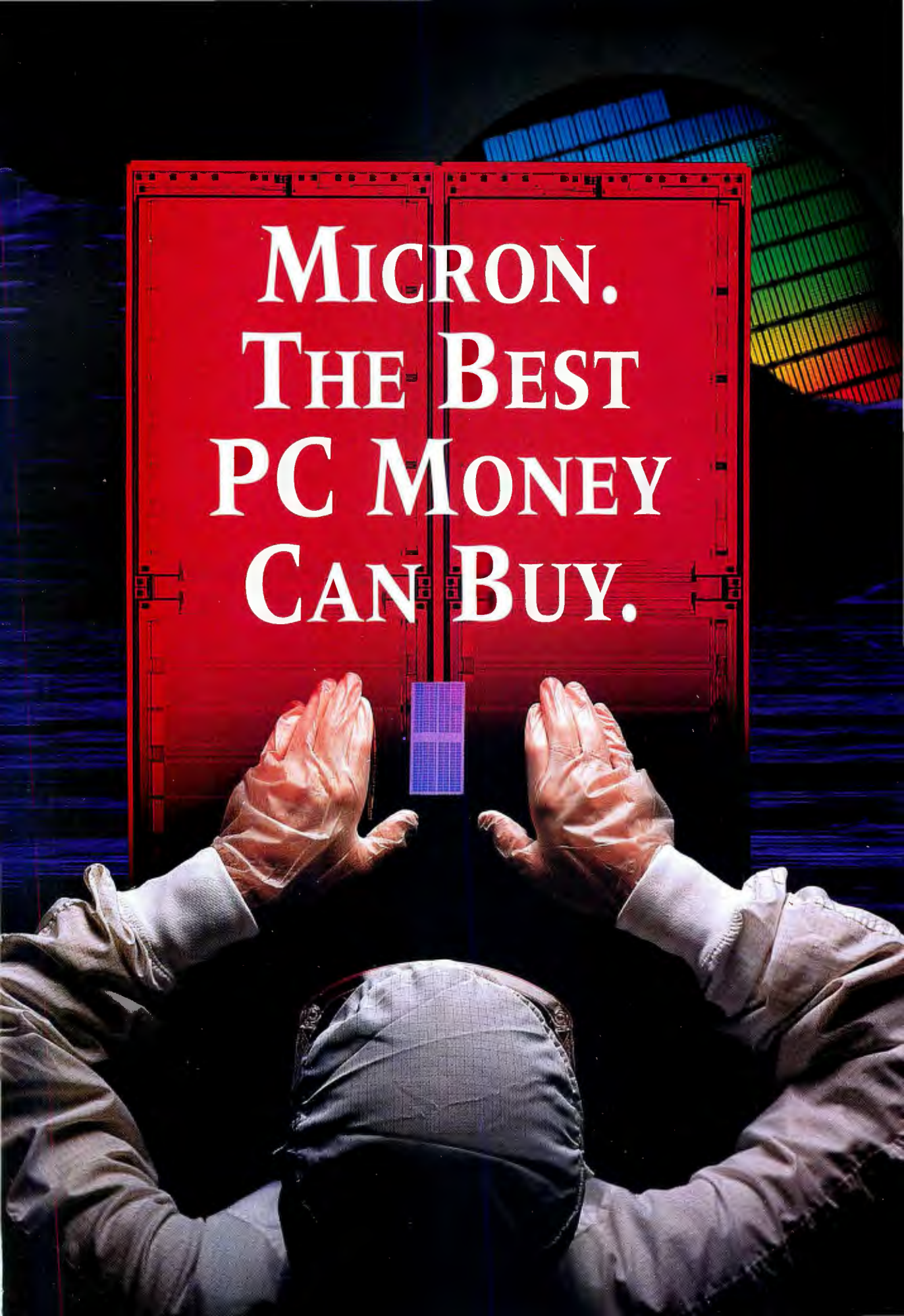
PC MAGAZINE BEST OF 1995 — January 9, 1996 MILLENNIA

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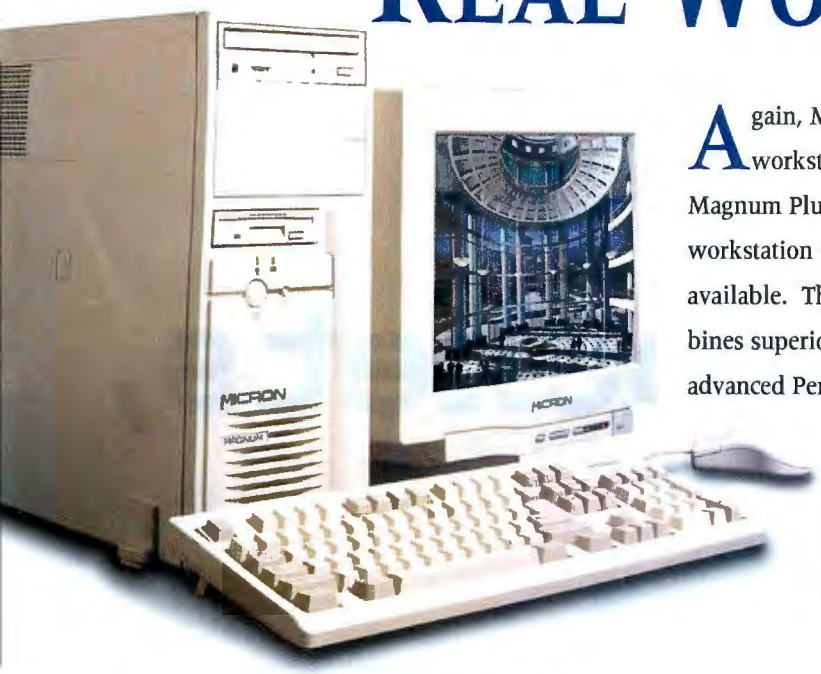

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intel inside PENTIUM PRO PROCESSOR

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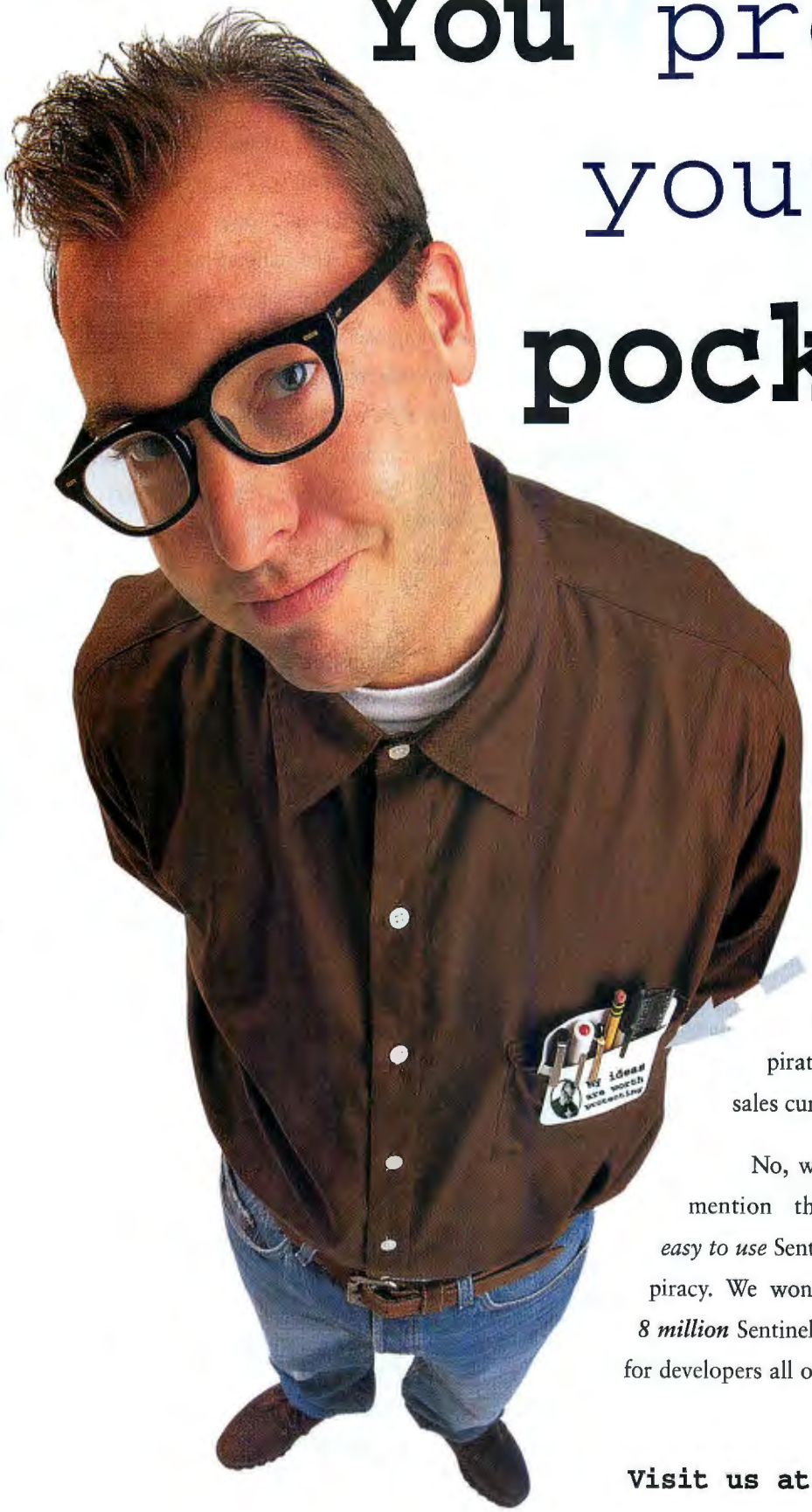

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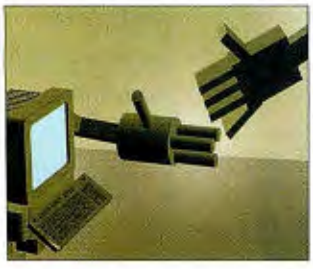

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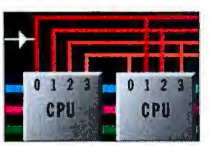

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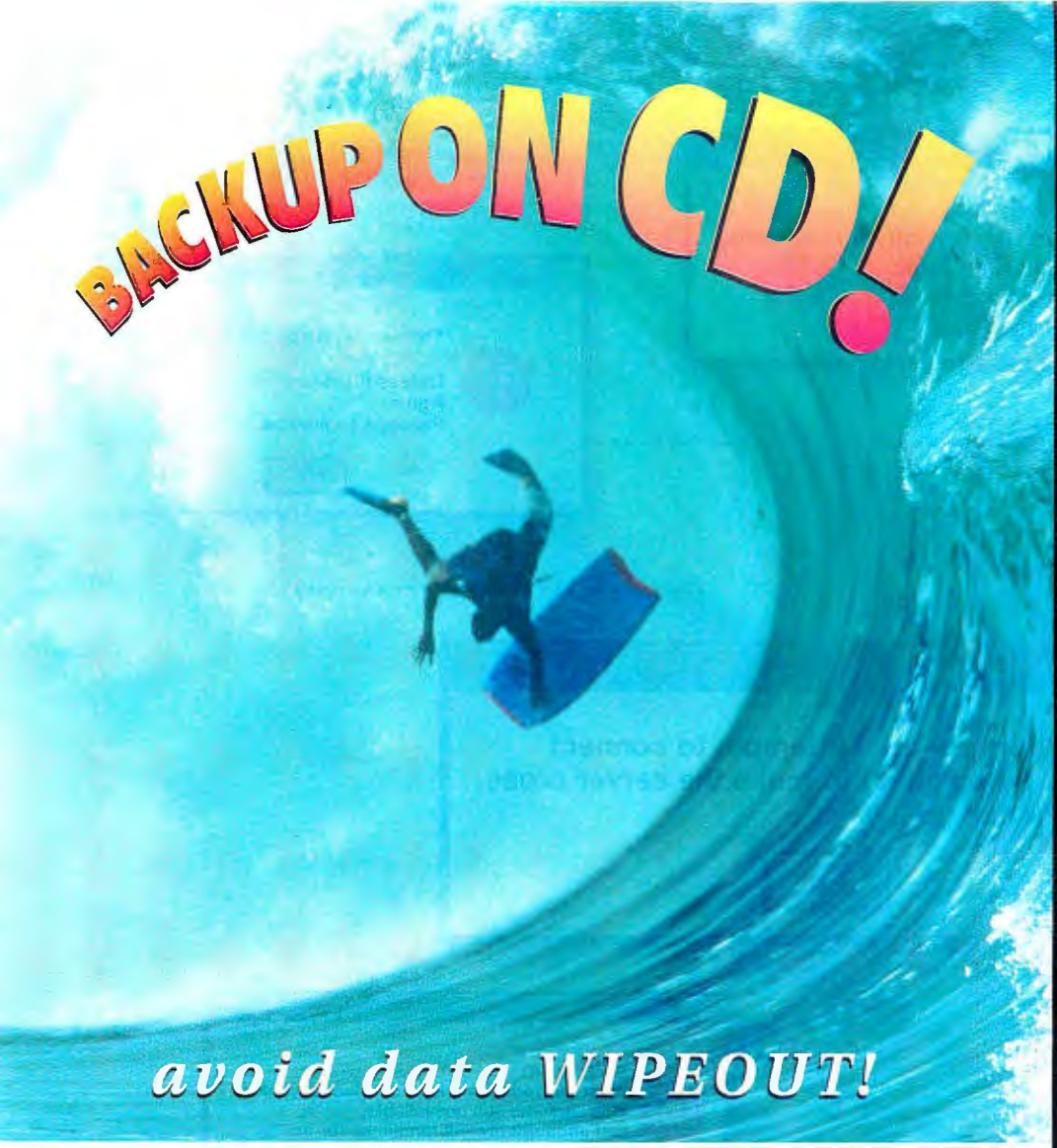

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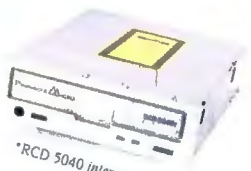
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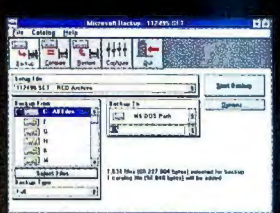

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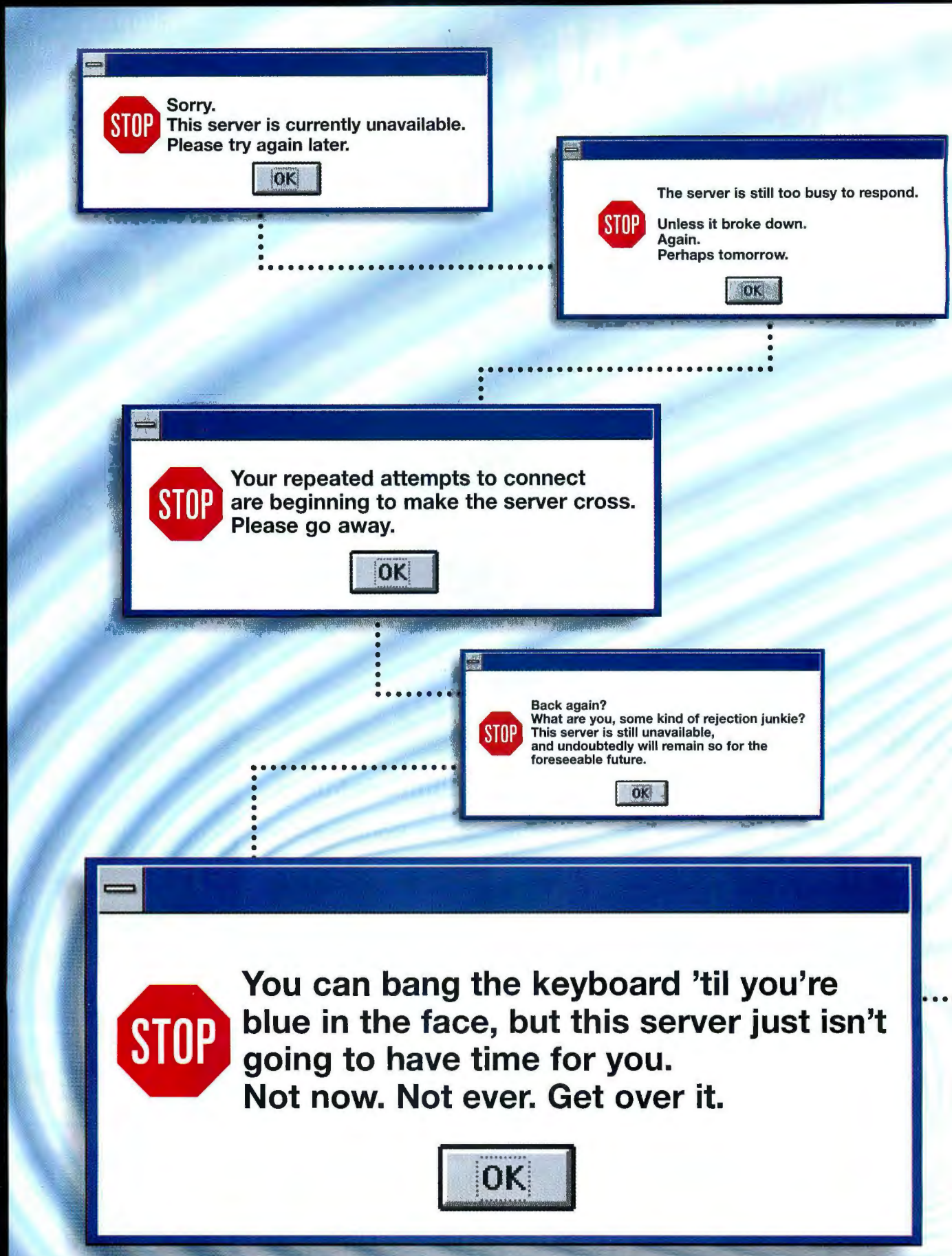
STOP
Sorry.
This server is currently unavailable.
Please try again later.
OK
The server is still too busy to respond.
STOP
Unless it broke down.
Again.
Perhaps tomorrow.
OK
STOP
Your repeated attempts to connect
are beginning to make the server cross.
Please go away.
OK
Back again?
What are you, some kind of rejection junkie?
STOP
This server is still unavailable,
and undoubtedly will remain so for the
foreseeable future.
OK
STOP
You can bang the keyboard 'til you're
blue in the face, but this server just isn't
going to have time for you.
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ABR

But Sir, I Have No Pornograph!

There's more to protecting free expression on the Internet than striking one bad law

Groucho Marx's play on *phonograph* reminds us that technology and censorship have had a running and tiresome battle for decades. To paraphrase W. C. Fields, another cinematic wag who sometimes offended the guardians of decency, all things considered, I'd rather be in Philadelphia than writing this editorial.

Actually, I'd rather be writing my editorial on Sun's cool new Java chips. But unfortunately, on February 8, President Clinton signed the Telecommunications Act into law, and with it, the Communications Decency Act. The CDA is not a good law. It is vague and restrictive in a multitude of ways. After Clinton signed it, numerous civil rights groups laid siege to the law. And fortunately, there are reports that Clinton's administration will not vigorously oppose efforts to challenge the CDA in court.

So with any luck, the anti-CDA portion of this column will be obsolete by the time you read it. But even if the law is judged unconstitutional, we all have to be aware that February 8, 1996, marks the beginning—not the end—of what must become a crusade for free speech and privacy in telecommunications. When it comes to privacy and free expression, the marvelous tools that we cover in BYTE, are, in fact, as dangerous as the CDA. And I'm afraid my first choice for a topic this month (the Java chip) is part of the problem.

Put three of the key tenets of the Telecommunications Act into a blender along with the technologies of the Java chip and the new cable modems, and what you've got is a cocktail almost guaranteed to knock free expression right off its feet. It all comes together in what will likely be the platform of choice for browsing the Internet in the latter part of this decade: The TV set.

First of all, the Telecommunications Act dramatically eases restrictions on the types of services that telecommunications companies can offer. Your cable company will be able to sell you phone service. The telcos might offer video over their wires. And everybody, of course, will be selling Internet access. A huge number of people will get this access on their TV through cable modems, a technology now under test in several markets.

Next, the CDA requires that "obscene" content be made inaccessible to minors through technological protective measures. On Internet sites with CDA-questionable content, this will mean registration records. On TVs, it means the "V-chip," a technology that parents can employ to block out programming they do not wish their children to see.

The Java chip is the final piece of the puzzle (see "Java Chips Boost Applet Speed" on page 25). These Internet CPUs will be finding their way into consumer products of all sorts—some predict they will appear in cellular phones. I predict they'll appear in TV sets.

Put it all together: We've built a super-TV set, one that receives broadcast, cable, and Internet transmissions. It knows what you watch. It can tell what programs you block—and which ones you don't. And it can report back to the Net. With a Java processor running in your TV all the time, and with a cable modem in constant contact with the Internet, you have no assurances of anonymity when browsing either the cable network or the Internet.

And make no mistake: Anonymity is not a convenience; it is not a refuge simply for terrorists and pedophiles. It is, as the U.S. Supreme Court has stated, "... a shield from the tyranny of the majority. It thus exemplifies the purpose behind the Bill of Rights and of the First Amendment in particular: to protect unpopular individuals from retaliation—and their ideas from suppression—at the hands of an intolerant society."

But there is hope. It appears that these early attempts to censor the Net are purely reactionary—no more than a technological Band-Aid slapped on a gaping wound that technology created in the first place.

What about the future? At an MIT seminar I went to a few months ago, I asked several computer-science students—the next generation of inventors—what they thought of all the technological wonders being discussed. One graduate student summed it up perfectly. He said, "It's all very cool, but I wonder what it really means."

I hope his question can reach beyond the MIT campus. The people who make our laws need to ask it, too. ■

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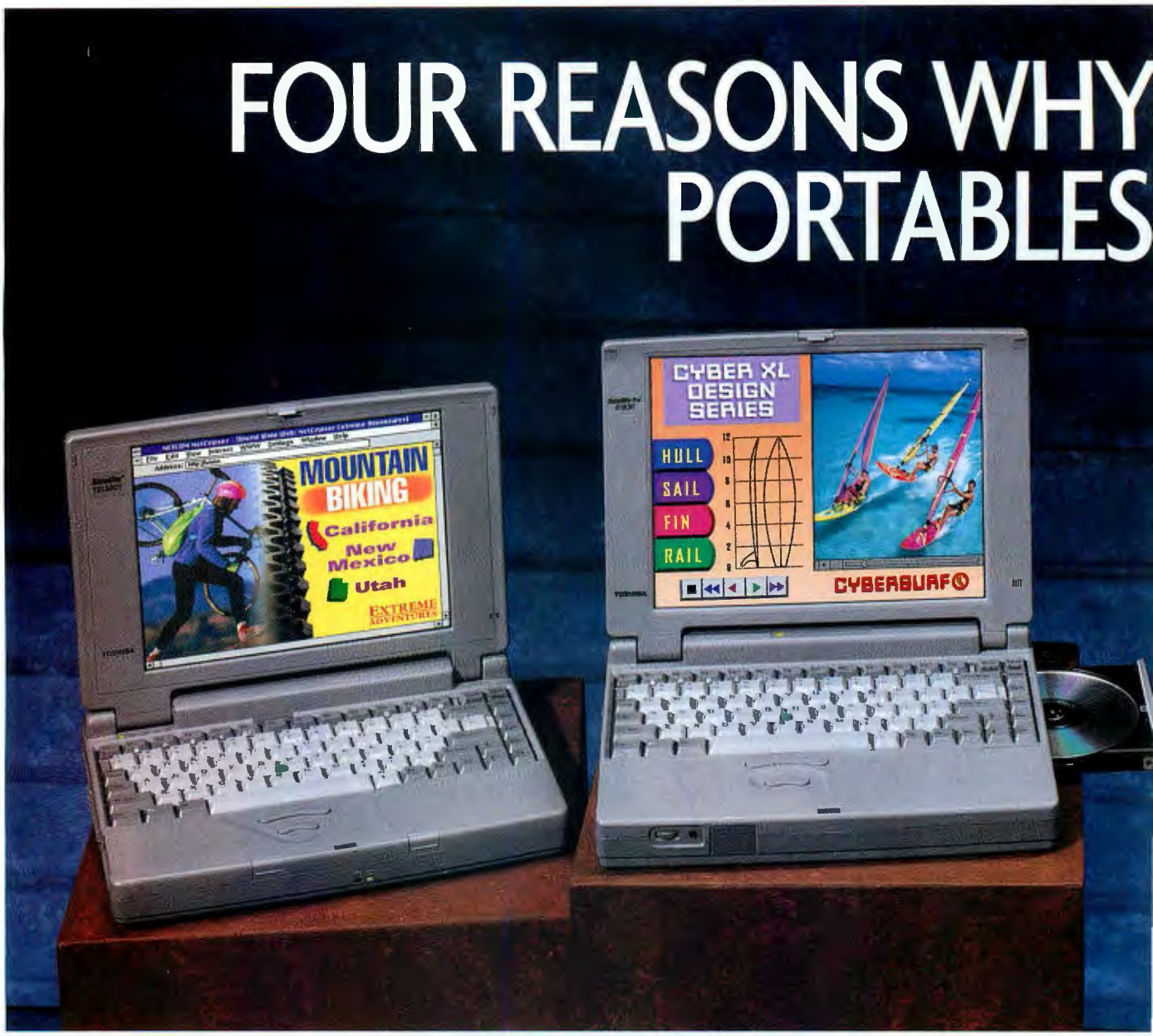

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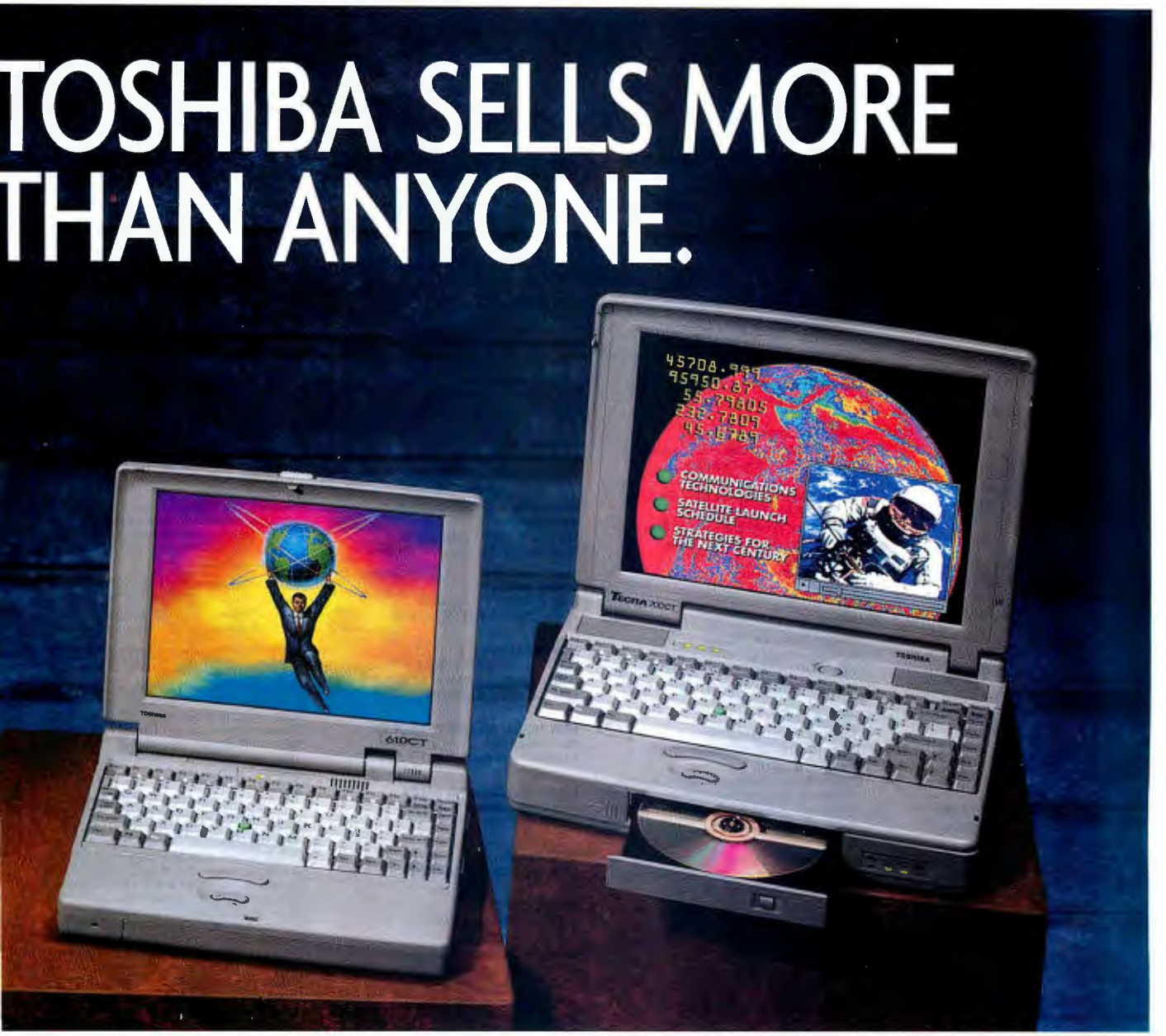

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Experts agree: Windows 95 and Windows NT Workstation demand APC protection

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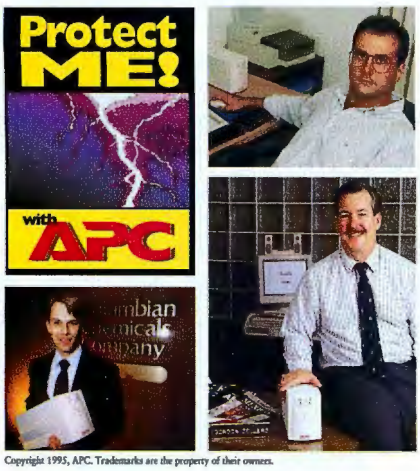

In short, if you still don't have proper protection (that $5 surge strip doesn't count) it's time to protect yourself before you kick yourself. Experts agree: If you choose not to decide on proper protection now, the next time you see this ad may be too late.

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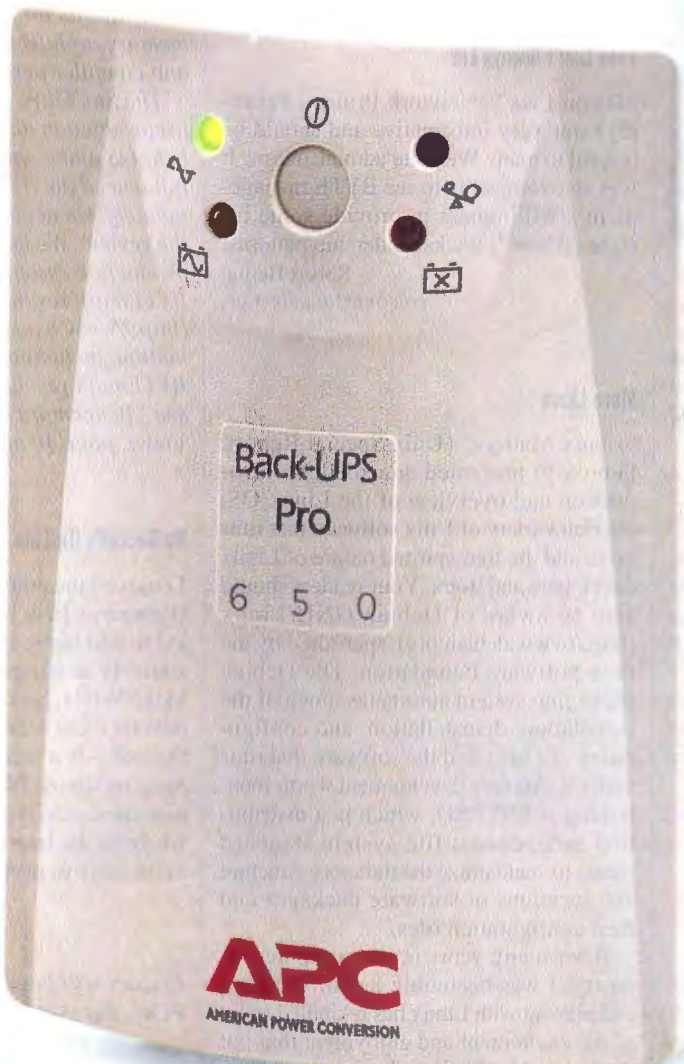

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600	(software not included)	$359	31 min
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*Runtime shown is for typical Pentium desktop system and may vary with your actual load. Note: Back-UPS 200 not recommended for Pentium systems

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LETTERS

No Sweat

Thank you for the great article "Integration, Not Perspiration" (State of the Art, January). We are in the middle of a shift toward decentralized operations and are thinking a great deal about the impact of rapid application development (RAD) and object-oriented approaches, as well as the OS/2–versus–Windows 95—or Windows NT—dilemma. Your article clarified a lot of the issues for us.

Bernard Veerman RI
IT Consultant, Schiphol Airport, The Netherlands
VEERMAN@schiphol.nl

Thanks!

Congratulations on one of the best-organized sets of pages on the World Wide Web. It's wonderful to see BYTE hit the Web in such style. Keep up the good work and the unbiased reporting of the facts.

James D. Carr
J.D.Carr@ed.ac.uk
http://www.ee.ed.ac.uk/~ee4jdc/

If you haven't visited the BYTE site, join us at http://www.byte.com.—Eds.

Pass the Results, Please

In "AMD K6 Takes On Intel P6" (January), I came upon the term *register-result bypassing* in a context unfamiliar to me. Usually, this term is used to describe the bypassing of the register file so that the results of instructions just executed are forwarded to the following instructions in parallel with the write-back stage. But what you describe happens "without accessing main memory." Do you refer to stores forwarding data to loads in the store buffer as "register-result bypassing," or is it some other feature?

Gad S. Sheaffer
IDC & PPD Architecture
gss@iil.intel.com

I meant to indicate that the K6 can bypass registers to provide results to subsequent instructions and that stores can forward data to loads. In other words, a load doesn't have to wait for a completed store instruction to put the result into memory; it can load the result directly from the store buffer.

—Tom R. Halfhill, senior editor

They Don't Always Lie

"Damn Lies" (Network Project, February) was very informative and should be helpful to many Web-site administrators. It was also refreshing to see BYTE management's willingness to provide some insight on how it tracks readership patterns.

Robert Hering
crhering@acy.digex.net

More Linux

"Linux Matters" (Unix Special Report, February) presented an excellent introduction and overview of the Linux OS, the rich variety of Unix software that runs on it, and the free-spirited nature of Linux developers and users. Your readers should also be aware of Debian GNU/Linux (http://www.debian.org), sponsored by the Free Software Foundation. The Debian packaging system automates much of the installation, deinstallation, and configuration of Linux and the software that runs under it. Another development worth mentioning is FSSTND, which is a distribution-independent file-system standard meant to standardize the directory structure and locations of software packages and their configuration files.

After many years in the computer industry, I was becoming jaded. Working and playing with Linux has rekindled some of the excitement and enjoyment that got me hooked in the first place.

Nick Busigin
nick@xwing.org

Benchmark Confusion

In "Intel Beats the Clock... Again" (News & Views, January), the SPECint benchmarks reveal that the 150-MHz PowerPC 604 processor is slower than the 167-MHz UltraSparc. However, in the review "UltraFast UltraSparcs" in the same issue, the BYTEmark test reveals the contrary: A slower, 133-MHz PowerPC 604 beats the 167-MHz UltraSparc. How come?

Hendrik Verroken
hob@eunet.be

The SPECint benchmarks that we published in the News & Views section, including those from Sun and IBM Microelectronics, were estimates provided by the companies. Like BYTEmark results, SPECint results depend not only on hardware factors, such as caching and memory architecture, but also on the OS and compiler performance.

The Sun Ultra I that we reviewed, a preproduction unit, was tested with a beta OS and compiler, which certainly influenced the BYTEmark scores. Unfortunately, we neglected to point this out in the review. We have arranged to retest a production system and will post updated BYTEmark results on the BYTE Web Site (http://www.byte.com). For more information, including Sun's latest BYTEmark results for the UltraSparc, see "Benchmark Update" in News & Views, page 40 of this issue.—Eds.

No Security On-Line

I enjoyed the editorial "Not Till It Flies!" (February). In it, you mention that the Web PC would likely store its data on-line, presumably at a user's Internet service provider. While this would certainly make the data far more accessible, security—or lack thereof—is a serious drawback. I cannot imagine storing files that are personal (and, in some cases, highly confidential) somewhere on the Internet, where they would be vulnerable to prying eyes.

Todd Dworshak
todd_dworshak@msn.com

Privacy will be a huge issue with Web PCs—but then, it's a huge issue already.

—Raphael Needleman, editor in chief

Cleaning Up the Garbage

In "Clean Up: C++ Garbage Collection" (January), you fail to mention that your garbage-collection scheme, RGC, increases the size of each object using it. You also overlook the fact that the use of the reference-counted classes is far from foolproof. Compilers implement virtual inheritance

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Fully scalable client/server architecture	✔	✔	—
Fast learning curve for increased productivity	✔	—	✔
More than 100 reusable components	✔	—	—
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Circle 67 on Inquiry Card.

by embedding hidden pointers—in addition to a class's virtual pointer (vptr)—inside objects inheriting from virtual base classes. There is one such hidden pointer per path to `TRGCObj`; given a simple class with no base classes and no virtual functions, adding virtual inheritance from `TRGCObj` adds two hidden pointers to the class. Complex classes might indirectly inherit from `TRGCObj` through more than one base class, and each path will contribute another hidden pointer. Your code also depends on the fact that reference-counted objects are always allocated on the heap, but this requirement is neither enforced by your classes nor documented in the article. For example,

```
#include "rgc.h"
class myclass:
   public virtual TRGCObj {};
typedef TRGCRef<myclass> Pmyclass;
void main()
   {   myclass m;
       Pmyclass A = &m;
   }
// m will be deleted here, but
// m is not on the heap!
```

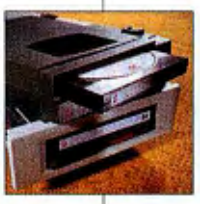
yields undefined (and typically disastrous) behavior. This doesn't mean that reference counting is a bad technique or that your approach isn't useful. But programmers need to understand the drawbacks before adopting the technique.

Scott Meyers
Author, More Effective C++
(Addison-Wesley, 1996)
smeyers@netcom.com

The RGC garbage-collection scheme does increase the size of each object. This is unavoidable with reference counting, as you must have an extra integer to store the count. Virtual inheritance worsens the problem. You can eliminate virtual inheritance if your class tree is structured such that each class inherits from `TRGCObj` *only once, and thereby save some memory. Regardless, if your program uses a great many objects, it's important to consider that each object is at least one word larger when using any reference-counting garbage collector. As you also point out, RGC does require that objects be allocated from the heap; that is, with new, and not-as-local, variables. Thanks for mentioning these two important points.*
—Justin Miller
jcmiller@MIT.EDU

DNA by the Numbers... to the Letter

In the text box "DNA by the Numbers" (December 1995, page 110) you mention "four common genes (D2SS44, D157, D1580 and D17S79...)." These are not genes, but DNA segments—the difference being that these are known markers with unknown function, as opposed to genes, which have known functions. Furthermore, the DNA segments that are listed (except for D17S79) do not exist. I believe the list should be D2S44, D1S7, and D1S80. D17S79 agrees with the picture in the text box. You can investigate this at the Genome database (http://gdbwww.gdb.org).



David Kitaguchi
GDB User Support
davidk@gdb.org

Thanks for pointing that out. Apparently we transcribed S *as* 5 *in those segment identifiers. We regret the errors.—Eds.*

FIXES

In "Best of Comdex Finalists" (January, page 40), we incorrectly described Distributed Processing Technology's SmartCache IV as a RAID controller. It's a half-size SCSI host adapter that can be upgraded to a RAID controller with an optional RC4040 RAID & Caching Module.

In "1995 Editors' Choice Awards" (February), the photo on page 44 with the entry about Iomega's Zip and Jaz drives was not properly cropped; as a result, it showed a Syquest drive in addition to the Zip drive.

In "Coming: A Better Multimedia Platform" (October 1995), we reported that OpenGL for Windows 95 would not be available until 1996. The product was released in the October 1995 Microsoft Developers Network Level-2 CD.

The chart "Relentless Pentium Improvement" (February, page 26) contains two bars labeled "NSTL Win95 Word 7." The lower bar should have been labeled "NSTL Win95 Excel."

In "An Alpha in PC Clothing" (February), we indicated that Digital's FX!32 translation and emulation technology was available now. FX!32 is currently being tested and is due to be released in mid-1996. ■

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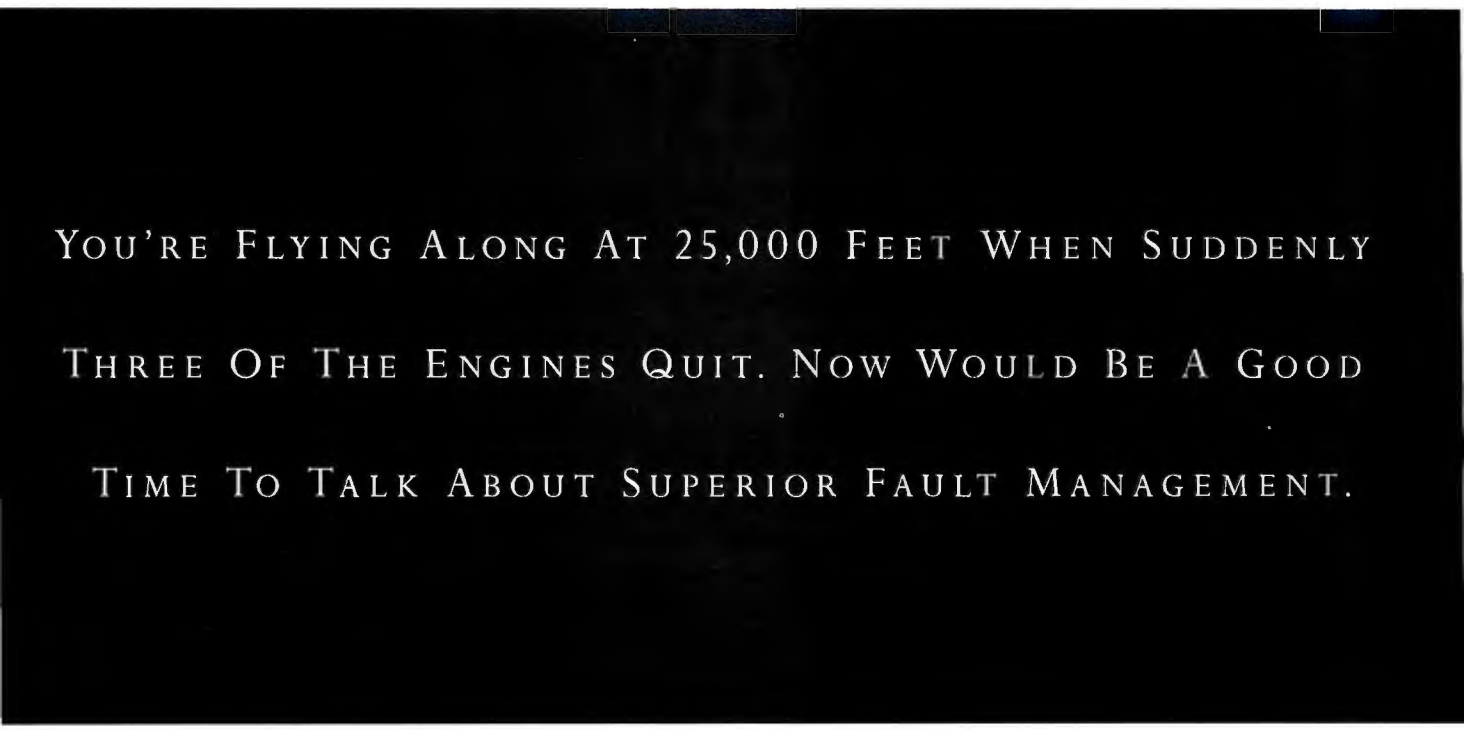

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LOW-COST NETWORK PCs

First Web PCs Arrive

Vendors of inexpensive network PCs have shown proof-of-concept systems, and in some cases have begun limited field trials. Here's a look at the first $500 network PCs.

DAVE ANDREWS

The first prototypes of $500-and-under Internet appliances portend a new type of computer that might appear in places that don't have a standard PC or Mac today. Unlike today's more expensive x86- and PowerPC-based computers, these new network PCs eschew hard-drive storage and are based on low-cost ($35 or less) processors. Thanks to their low cost, network PCs may appear in places as public as a shopping mall information center and as private as a family's living room or bedroom.

Many computer companies still speak of Web PCs in the future tense; Oracle, for example, says the first Web PCs based on its reference design probably won't ship until September. But at least one company has already begun limited field trials of the type of Internet device that may soon appear in a living room near you. ViewCall America (Atlanta, GA), a developer of interactive home-shopping services for cable TV, is currently field-testing about 1000 network devices that include a custom Web browser with TV-style remote controls. ViewCall's Web PC, called Webster, is based on Advanced RISC Machine's ARM7500 processor running at 33 MHz. Webster includes 4 MB of RAM, 2 MB of ROM, a built-in 28.8-Kbps modem, ARM's RISC OS, and a printer port. An infrared keyboard is optional since the browser supports an on-screen keyboard that you can drive with the remote control.

Colored icons on the remote-control keypad that correspond to buttons on the bottom of the screen let the user more easily perform actions—page up, page down, back, and forward—that one typically performs when navigating the Web. Internet content developers can take advantage of dynamic "soft buttons" in Webster's browser interface to present actions (e.g., buy a product) for the end user. Because the browser resides in EEPROM, it is upgradable.

Thanks to its compact system software, Webster doesn't need a hard drive—the ARM RISC OS resides in ROM. Webster connects to your television, so you don't need a monitor. ViewCall expects to have commercial versions of the Webster ready in June. The asking price: about $300.

The Webster lacks a number of PC features, not the least

Naysayers criticize Web PCs for their inability to run today's PC and Mac applications, but proponents counter that these new devices are designed for a different killer app: the Web itself.

Teknema's Easy Rider Web PC, which includes a 28.8-Kbps modem, VGA monitor, ARM7500 processor, system software, and Web browser, will sell for about $500.

of which is support for Mac and PC applications. But many new users who don't currently have a PC may be satisfied with just E-mail and the Web. "Our goal is to take the best of the Web and leverage it to the mass market rather than to just the PC literate," says Alan McKeon, president of ViewCall's parent company, Colorocs Information Technologies. "If the consumer wants applications like word processing, we'll put them in there. Our goal is continuous improvement rather than trying to hit the home run straight out of the shoot."

Teknema (Menlo Park, CA), a developer of networking products that include the TIBER multilingual Web browser, has also unveiled a prototype Internet device based on the ARM7500. The company is seeking to produce the machine in volume with manufacturing partners. Dubbed Easy Rider, the device will sell for about $500. It includes a VGA monitor, a mouse, a keyboard, and even an ISA slot that could accept a network interface card. The system software, windowing system, network protocols, and browser consume less than 500 KB, says Marco Graziano, president and CEO of Teknema. Graziano says the Easy Rider could have a variety of uses as an information kiosk, low-cost HTML client, or platform for vertical applications in an intranet. The system doesn't yet support Java applets, but Graziano says he is confident that ARM or some other company will develop Java virtual-machine software for the ARM7500 and StrongARM processors. Noel Hurley, ARM's Consumer and Multimedia Market Segment manager, confirms that a port of Java that will run across all ARM variants is underway.

Other companies will likely announce Web PCs as well. Oracle CEO Larry Ellison has been pitching his company's network computer reference design (see "Inside the Web PC," March BYTE) to manufacturers in the U.S. and overseas. Sun Microsystems has also demonstrated a prototype Web computer: It used a Sparc processor, had 8 MB of RAM, no hard drive, and can connect to a TV. But at press time, Sun officials weren't saying much about the system.

ViewCall's Web access device includes a TV-style remote control. Now families can argue about who gets to change the URL.

A division of Sun recently announced three chips dedicated to running Java applets natively (see related story on this page). Sun might use Sparc processors in addition to these future Java chips. "Sun is evaluating all different kinds of opportunities for its Internet devices," says spokesman George Paolini. "We'll focus on businesses first and consumers second because businesses have the bandwidth right now that you don't find in most homes." But Paolini stressed that although most of the focus on Java is centered on computers and the Web, Java chips may also appear in personal digital assistants, cellular phones, and other devices.

WEB PCS

Java Chips Boost Applet Speed

Three new microprocessors from Sun Microelectronics (formerly Sparc Technology Business; Mountain View, CA) are the first CPUs dedicated to running Java software. They're designed to run Java programs much faster than a software-based Java engine on a general-purpose microprocessor, such as an x86, PowerPC, or Sparc. Sun's objectives are to boost the performance of Java and to make it easier for vendors to build inexpensive Java devices, including Web PCs and embedded products like cellular phones and personal digital assistants (PDAs).

Developers write applets in the Java programming language, which closely resembles C++. A Java compiler translates that source code into a condensed format known as *bytecode*. The bytecode is more compact, more secure, and executes more efficiently than raw source code. It runs on a software layer called the Java virtual engine, which contains a run-time interpreter that translates the bytecode into the native code of the underlying microprocessor. Java bytecode is analogous to an executable binary, except it isn't specific to a microprocessor architecture, which is why Java applets can run on any computer that has a Java virtual engine.

Unlike compiled binaries, Java applets aren't translated into native machine code until the moment of execution. The technical drawback to this approach, of course, is that on-the-fly interpreting takes time and hurts performance. Sun's Java chips eliminate the need for run-time interpreting because they execute the bytecode directly. In effect, Java bytecode is the native instruction set of the Java microprocessors.

One of the three products that Sun recently announced is actually a CPU core that Sun will license to other chip makers and vendors. Known as the picoJava, this is an extremely small core (it's only about 25 square millimeters) that licensees can customize. Sun says that low-end Java chips based on the picoJava could cost less than $25.

The microJava is a Sun microcontroller based on the picoJava. It's about 50sq mm and is designed for telecommunications equipment and other embedded applications. Sun hopes to sample this chip in early 1997 and eventually sell it for $25 to $50.

At the high end is the ultraJava, a processor that's three to five times faster than the microJava. It has multimedia extensions similar to those built into Sun's UltraSparc processors for workstations. Among other things, these extensions allow fast 3-D graphics. The ultraJava is intended for Web PCs and similar multimedia devices. Sun hopes to sample this chip in late 1997 and sell it for about $100.

The biggest disadvantage of Java processors is that they can't run anything but Java software. However, in addition to enabling dedicated Java devices, they could also serve as high-speed Java coprocessors in general-purpose PCs. **—Tom R. Halfhill**

MIPS R5000 PROCESSOR

R5000 Cuts 3-D Cost

Programmers usually write their software to the metal, but now chip engineers are bending the metal to fit the software. The new R5000 microprocessor from Mips Technologies (Mountain View, CA) is specially optimized for the single-precision floating-point operations that characterize today's 2-D and 3-D graphics. The result is a powerful, affordable CPU that executes 400 million floating-point operations per second (MFLOPS) and is driving down the cost of high-end graphics performance.

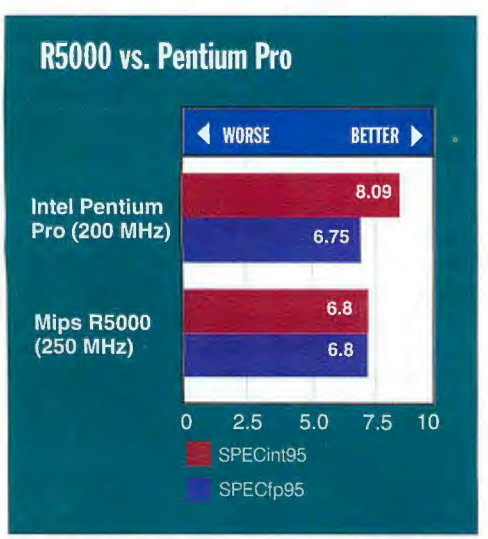
MIPS R5000: WHAT'S NEW

- **64-bit Rx000-compatible CPU**
- **Two-way superscalar FPU**
- **Target clock speed: 250 MHz (later in 1996)**
- **Performance: 6.8 SPECint95, 6.8 SPECfp95 at 250 MHz**
- **480 MFLOPS for single-precision geometry calculations**
- **On-board caches: 32 KB instruction, 32 KB data**
- **3.7 million transistors**
- **Die size: 84 sq mm at 0.32 microns**
- **Volume production: March 1996 (at 180-200 MHz)**

Silicon Graphics (Mountain View, CA), Mips' parent company, just announced three new models of its Indy desktop workstation based on early versions of the R5000. Prices range from $8495 to $13,995. SGI says the new systems handle 3-D graphics up to almost 100 percent faster than R4x00-based Indy workstations at the same price.

The R5000 inherits several architectural innovations from Mips' top-of-the-line R8000 and R10000 processors. For example, the R5000 is a 64-bit CPU that supports the latest Mips IV instruction set, and its FPU has two-way superscalar pipelines. The R5000 has separate primary caches for instructions and data, and each cache is 32 KB in size, as well as two-way set-associative, just like the R10000.

To cut corners, the R5000 doesn't have superscalar integer pipelines and can't execute instructions out of order. This greatly reduces the chip's complexity because it doesn't have to bother with scoreboarding and other tricky techniques to put instructions back in order again. In another cost-cutting measure, Mips eliminated the 128-bit secondary-cache bus found on the R4000 and R10000. Instead, the R5000 accesses its secondary cache over the general I/O bus, which is 64 bits wide.



Intel's fastest Pentium Pro outruns the Mips R5000 chip, but the R5000 isn't far behind, and it costs only about one-sixth as much as the Pentium Pro.

The payoff for the R5000's reduced complexity is a die that's exceptionally small (84 square millimeters on a .32-micron process) for a CPU of this capability. And a small die means less power consumption, lower manufacturing costs, and higher clock speeds.

In March, Mips licensees NEC Electronics (Mountain View, CA) and Integrated Device Technology (Santa Clara, CA) were expected to begin shipping early versions of the R5000 clocked at 180 and 200 MHz. Prices range from $225 to $285, and the estimated performance at 200 MHz is a well-balanced 5.5 SPECint95 and 5.5 SPECfp95. Later this year, both vendors plan to ship 250-MHz versions that will deliver SPECmarks of about 6.8 (for both integer and floating-point performance) and still cost less than $300.

Floating-point performance is the R5000's greatest strength. Mips says the R5000 can process more than 1.1 million 3-D graphics primitives per second, compared to about 670,000 graphics primitives for a 133-MHz PowerPC 604 and about 170,000 for a 133-MHz Pentium. Yet its overall performance is so well balanced that NEC and IDT expect to sell the R5000 to customers who will build the chip into a wide range of devices, including network routers, bridges, X Window terminals, laser printers, copiers, videogame machines, high-end PCs, and entry-level servers.

— Tom R. Halfhill

INTERNET

Web Crawlers to Index Java

A testimony to the expected popularity of Java on the Internet comes from developers of Internet search engines who are investigating ways to index Java applets. Once engines like Digital's Alta Vista, Lycos, and others make these new searchable indexes available, users may be able to search for and find specific Java applets.

A Hypertext Markup Language (HTML) tag called Applet has two fields (the name of the applet and its URL) that should help search engines find and locate Java applets, says Louis Monier, lead researcher on the Alta Vista Web search engine project at Digital Equipment Corp. Monier, who notes that Alta Vista has already indexed about 22 million pages on the Web, says the search tool now indexes Java applets by their names.

However, indexing Java applets is tricky, says John Leavitt, director of product development at Lycos, which is also investigating how to index other types of content (such as sound and video) on the Web. "We can't look at compiled Java code and say, 'Aha, this is code for a Java spreadsheet applet.'" But indexing will at least narrow the field.

Search engines will benefit from developers that assign intuitive names to their applets, Monier says. "If someone makes an applet and gives it a name that's totally obscure, the indexer will have difficulty making sense of it."

—Dave Andrews

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"(Watcom C/C++ 10.0) delivered the fastest executables we saw in this roundup." PC Magazine, April 11, 1995.

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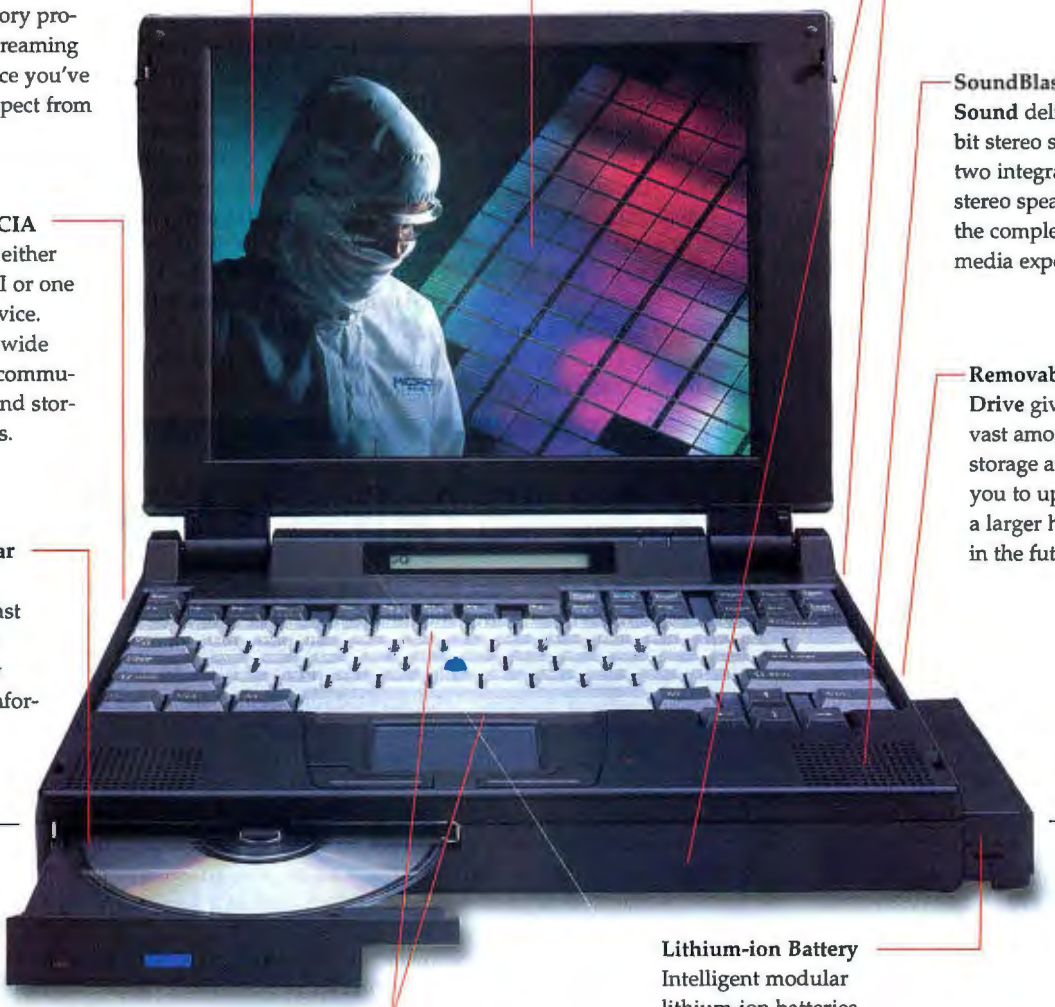

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X86 PROCESSORS

New CPUs Signal Better Multimedia PCs

Talk about strange bedfellows. Former blood enemies Intel (Santa Clara, CA) and Advanced Micro Devices (Sunnyvale, CA) have signed a landmark cross-licensing agreement that will allow them to introduce CPUs with new multimedia x86 instructions by the end of this year. Frozen out, however, is Cyrix (Richardson, TX) and its manufacturing partner, IBM Microelectronics (Fishkill, NY).

The surprising detente between the two leading x86 vendors could be the most significant step in the evolution of the x86 since Intel introduced the 32-bit 386 in 1985. Intel and AMD plan to make new x86 chips that recognize the same set of extended instructions for multimedia tasks. This technology, known as MMx, is supposed to dramatically improve the ability of x86 chips to process audio, video, and other multimedia data types.

The cross-licensing agreement ensures that Intel's and AMD's multimedia processors will be fully compatible with each other. Without the deal, each company might have introduced its own proprietary extensions. That would have forced software developers to support only one company's new instructions (most likely Intel's) or everybody's new instructions—a wasteful and potentially chaotic situation for both developers and users.

Two things are surprising about this agreement. First, it comes only months after Intel and AMD concluded a bitter five-year legal battle over microcode copyrights. All those differences are now settled. Second, the agreement leaves Cyrix out on a limb. Cyrix has been working on its own multimedia extensions, but they won't be compatible with Intel's and AMD's unless Cyrix either licenses or reverse-engineers the same technology.

At this writing, there is no indication from either Intel or Cyrix that a licensing deal is pending. If Cyrix must resort to reverse engineering, the extra effort could seriously delay Cyrix's multimedia CPUs. IBM suffers, too, because IBM licenses its latest x86 designs from Cyrix. But according to Steve Tobak, vice president of corporate marketing for Cyrix, reverse engineering may not be necessary.

"There are talks with Intel," Tobak says. "I can't say anything more about it, except that we have always been capable of producing processors that are x86 software-compatible, and we don't expect that to change."

NexGen (Milpitas, CA), a much smaller x86 vendor, was acquired by AMD last year and is covered by AMD's contract with Intel. NexGen's latest CPU, originally known as the Nx686 but now called the AMD K6, already incorporates a special multimedia unit for extended instructions. NexGen engineers are modifying the design to make it compatible with the MMx specifications. (See "AMD K6 Takes On Intel P6," January BYTE.)

Intel predicts the MMx-enabled Pentium (code-named P55C) will ship in large volumes in the fourth quarter. MMx versions of the Pentium Pro will probably follow in 1997. Intel will manufacture motherboards, primarily for the home market, that include special support for MMx processors, the company says. PCs based on those motherboards will be able to capture and compress video in real time and will have video outputs for TVs and VCRs. They'll also have universal serial bus (USB) ports, a new I/O standard backed by Intel and Microsoft.

— Tom R. Halfhill

Intel: 200-MHz Pentiums to Arrive This Year

By the end of the year, the fastest Pentium will run at a blazing 200 MHz and CPU prices will drop so fast that businesses will regard PCs with 120- and 133-MHz Pentiums as entry-level boxes. While low-end systems will range in price from $1200 to $1500, mid-range PCs costing $1500 to $2000 will have 150- and 166-MHz Pentiums.

It's not magic; it's science. Intel says the transition to its next-generation process technology is several months ahead of schedule. By the fourth quarter, Intel's foundries expect to manufacture 90 percent of their microprocessors on the denser 0.35-micron process.

That means higher clock speeds, higher yields, and lower prices. It also spells trouble for Intel's competitors. AMD, still struggling to get its next-generation x86 designs out the door, says the SSA-5 version of its K5 processor was expected to ship in March. But it runs at only 75 MHz and delivers about the same performance as a 75-MHz Pentium. AMD says an improved K5 that matches the performance of a 133- or 150-MHz Pentium won't ship until the fourth quarter.

AMD's K6, designed by NexGen, also is scheduled to ship in the fourth quarter. At 180 MHz, it's supposed to beat the performance of a similarly clocked Pentium Pro.

Cyrix is fighting hard to keep up, too. Its new 6x86 is now in production at 100, 110, 120, and 133 MHz. The 133-MHz 6x86 exceeds the performance of a 166-MHz Pentium, according to the new P-rating system adopted by AMD, Cyrix, and IBM. P-ratings measure application performance relative to a Pentium. For example, Cyrix says the 6x86-P166 is at least as fast as a 166-MHz Pentium, even though the 6x86-P166 actually runs at 133 MHz. To determine the P-ratings, AMD, Cyrix, and IBM submit their CPUs to MDR Labs, an independent testing facility operated by MicroDesign Resources, publisher of the *Microprocessor Report*. MDR Labs doesn't assign the P-ratings but provides raw data that's interpreted by the vendors.

— T.R.H.

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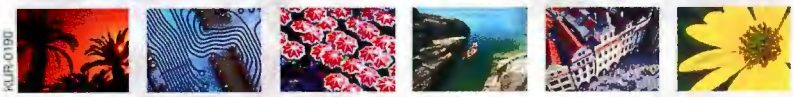

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WINDOWS NT

New NT to Offer Win 95 Look, Internet Links

Microsoft was expected to release by March a beta version of Windows NT that incorporates the Windows 95 interface, Network OLE, and links to the Internet. The server version of NT 4.0 will also include Microsoft's Internet Information Server (Web server software).

IS managers who've hedged on upgrading from Windows 3.1 to Win 95 say that if NT 4.0 is as stable as the current NT 3.51, they will probably bypass Win 95 and go directly to NT. "Most of the features we added to [NT] 4.0 are there to provide compatibility across Windows 95 and Windows NT systems," says Megan Bliss, NT group product manager at Microsoft. Microsoft moved certain GDI (Graphical Device Interface) and User functions into the NT kernel in part to reduce the working set size and compensate for the larger Win 95 shell and other technologies. However, NT 4.0 won't have support for Plug and Play and power management, so Win 95 will likely win preference for notebooks over NT. The table at right shows the road map and a list of new NT features.

WINDOWS NT 4.0 HIGHLIGHTS

FEATURE	COMMENT
FIRST BETA (RELEASED IN FEBRUARY)	
Win 95 interface	Common interface reduces retraining among mixed Win 95 and NT shops.
TAPI, Unimodem support	Provides two APIs that communications applications, such as Exchange, require.
NetWare 4.1 NDS client	Access LAN resources easier, run NetWare log-in scripts, access NetWare 4.1 servers natively.
WINS/DNS integration	Protocol gateway software interprets disparities between Windows Internet Name Service and Domain Name Service to allow NT to share files across the Internet and communicate with Unix.
Encryption APIs (Crypto API)	Provides support for developing encrypted data-exchange solutions over the Internet.
Insignia 486 emulator	Allows RISC versions of NT to run 386 enhanced-mode applications.
SECOND BETA (SLATED FOR MARCH TIME FRAME)	
DirectDraw, DirectSound	Better support for developing, playing games.
Win 95-compatible system policies	Easier desktop configuration and management.
Network OLE	Adds third tier to client/server network, allows encapsulation of business logic into components.
COMING SHORTLY AFTER NT 4.0 RELEASE (SLATED FOR MID-1996)	
Fax client/MSN support	Better support for communications.
NOT PLANNED FOR NT 4.0	
Plug and Play, power management	Wait until 1997 for Cairo.

PC UPGRADES

120-MHz Pentium Power for Under $400

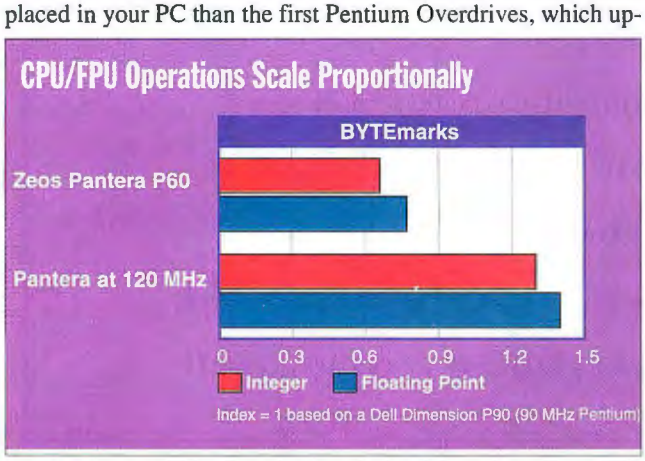
Tests of a preliminary version of Intel's Pentium Overdrive processor for upgradable Pentium PCs indicate that with a $399 upgrade, your applications can run more than 50 percent faster. The latest Pentium Overdrive turns 60- or 66-MHz Pentium systems into 120- or 133-MHz machines.

Intel also expected to release in March a 125-MHz Overdrive for 75-MHz Pentium PCs ($399). And 150- and 166-MHz Overdrives ($499 and $679) that upgrade 90- and 100-MHz PCs are slated for May arrival.

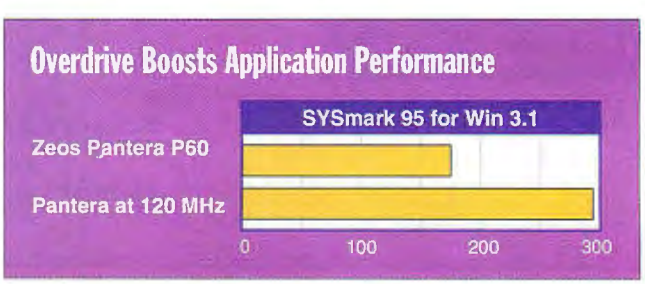
The newest Overdrive CPUs should feel more at home when placed in your PC than the first Pentium Overdrives, which upgraded 486 systems. Unlike the older Overdrives, the newer upgrade chips don't have to make special compensation for the 486's 32-bit I/O bus.

You can also improve your system's performance by adding memory. Tests performed by Intel indicate that if your PC runs business applications (e.g., spreadsheets or databases), upgrading your processor as well as RAM yields the best performance improvement. However, adding memory beyond 16 MB of RAM provides a minimal (about 1 percent) improvement, the tests show.

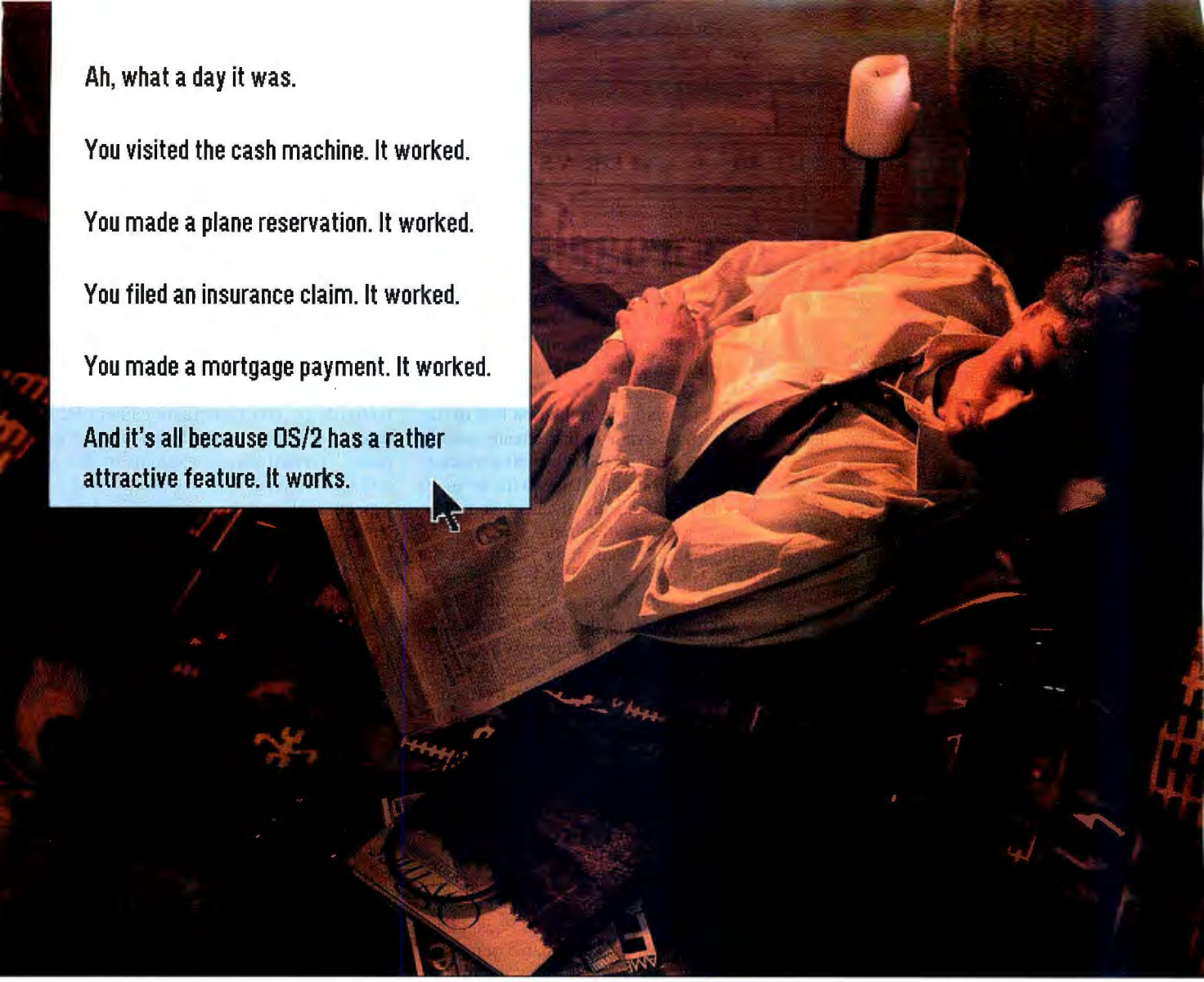
For consumer applications such as 3D Home Architect and Quicken, Intel says simply increasing system RAM from 8 to 16 MB results in a 7 percent improvement at most, while upgrading the CPU from 60 to 120 MHz and adding 8 MB of RAM results in increases ranging from 72 percent to 99 percent. Upgrading the Pentium alone results in performance boosts of 52 percent to 79 percent, according to Intel.



A Zeos Pantera with 16 MB of 70-ns RAM, 256 KB of asynchronous SRAM cache, 384 KB of shadow RAM enabled, and a Diamond ViperPCI graphics accelerator card with 2 MB of VRAM and a Weitek Power 9000 chip scales nicely on CPU/FPU tests.



Although the processor is running at 120 MHz, the same Zeos Pantera doesn't see performance improvements quite as high when running 16-bit Windows applications. Still, performance gain of about 68 percent is quite good.



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AFFORDABLE DIGITAL CAMERAS

Still Cameras Approach Picture Perfect

Sony's new digital camera, expected to sell for less than $2000 this summer, has a 12x zoom lens, removable PC Card, and color viewfinder.

Thanks to falling prices and improved performance, digital cameras could soon become popular peripherals for PC and Mac users. Affordable still-image digital cameras that cost $2000 or less can't yet take high-resolution photos (e.g., 1524 by 1012 pixels). But a new round of digital cameras offers improved resolution and even the ability to capture brief video clips with sound, for about $2000 or less.

In 1995, several companies, including Apple, Kodak, and Logitech, released digital cameras for under $1000 that could capture images at resolutions of up to 640 by 480 or 768 by 512 pixels. And Casio's QV-10, although capable of a maximum of just 480 by 240 resolution, added several features, including a tiny 1.8-inch LCD viewfinder for previewing and reviewing pictures and NTSC compatibility that lets you play a series of images on your TV (see "Digital Cameras for Real Work," October 1995 BYTE). New cameras expected to ship this year will be even better.

Although still a little pricey (about $1800), Ricoh's new RDC-1 camera, which should be available in the first half of this year, offers several improvements in addition to its maximum 768 by 480 resolution. It can capture still images with up to 10 seconds of sound, and it can even capture motion scenes with sound.

If you don't need all the features of the RDC-1, you can also buy less expensive units that still offer a good feature set. A good example is the Epson PhotoPC, which is expected to sell for less than $500. The PhotoPC takes images at up to 640 by 480 resolution, can store up to 16 color images in high-resolution mode, and includes EasyPhoto image-editing software.

Kodak's successor to its DC40 camera, the DC50 (about $979), has a motor-driven zoom lens that can focus on objects from 19 inches to infinity. It can also take wide-angle photos. The system has 1 MB of permanent memory and can take industry standard PC Cards for additional storage. Chinon's new $499 ES-1000 Pocket Digital Camera weighs less than 5 ounces.

"There's no question that eventually everyone will use digital cameras," says Alexis Gerard, editor of *The Future Image Report* (agfuture@aol.com or 800-749-3572). "The image quality will catch up to film quite rapidly and, with digital technology, you can create camera features that make people better photographers." Gerard says an example of this is an LCD screen that allows you to preview aspects such as exposure and adjust your camera accordingly. "When manufacturing volumes rise, digital cameras will be cheaper than analog cameras because they are solid state," Gerard says. During this year and next we will see "rapid growth in the market and continued price/performance improvements."

Kodak's DC50 camera takes 756- by 504-pixel images and weighs 22 ounces, including its four AA batteries.

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GOOD

- Fast input of images into Macs and PCs
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- Better pictures with real-image viewfinders
- Previews let you instantly discard bad photos

NEEDS IMPROVEMENT

- Digital cameras still expensive to buy
- Low resolution limits use

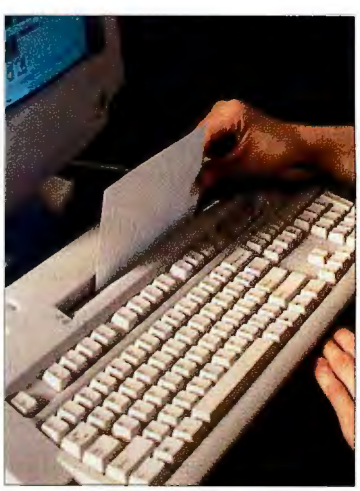
INPUT DEVICES

Keyboard Scanner Cuts Clutter

Compaq Computer (Houston, TX) and Visioneer (Palo Alto, CA), developer of the PaperPort input system, have combined their talents and their products. The result is the pictured Compaq Scanner Keyboard that integrates an optical scanner with a keyboard and plugs into your PC's serial port. You can use the keyboard and software to scan documents and images directly into more than 50 applications via PaperPort software.

The scanner supports optical resolution of 200 dots per inch horizontally and 400 dpi (interpolated) vertically. You can scan in photos at up to 8-bit gray-scale depth using the keyboard, but if you want color, you'll have to buy a digital camera or a color scanner: The scanner keyboard doesn't support color.

Compaq will include the scanner keyboard with its new Presario 7232 PC and will sell it separately for about $350.



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ON-LINE SERVICES

Proprietary Services Move to the Web

Being on-line used to mean being on a proprietary service, like CompuServe or Prodigy. Not anymore. In the past few months, AT&T Interchange, Delphi, eWorld, and The Microsoft Network have all either abandoned their proprietary platforms or at least expanded their presence on the Internet's World Wide Web.

AT&T New Media Services (Cambridge, MA), developer and content provider for AT&T Interchange Online Network, recently announced that by the middle of this year, the AT&T Business Network, which provides business-focused content for Interchange customers, will exist primarily on the Web. Eventually, the proprietary Interchange service will be eliminated.

Several other on-line services are spinning into the Web. Last year, Rupert Murdoch's News Corp. and MCI Communications (Washington, D.C.) formed a joint Internet ventures company that will develop content for the Web in cooperation with News Corp. media companies such as *TV Guide* and Fox Broadcasting. Nancy Morrisroe, a spokeswoman for the joint venture, said the new venture will eventually replace both Delphi and BIX.

Confusing the MCI-News Corp. project is MCI's new partnership with Microsoft. Microsoft, which says it has no immediate plans to close its proprietary on-line service, The Microsoft Network (MSN), is joining with MCI to form "MSN from MCI," which will be launched around the middle of the year. Microsoft officials admit that the Web may eventually replace the current MSN back engine. However, that doesn't mean that certain services, such as content resulting from the Microsoft/NBC partnership, will be available for free.

By mid-'96, Apple's eWorld will be completely Web-based. And GEnie is moving to the Web this year under different management. General Electric is selling GEnie to New York-based Yovelle Renaissance Corp., a subsidiary of International Discount Telecommunications (IDT).

Three other major on-line service providers, America Online, Prodigy, and CompuServe Information Service, continue to view the Web as a complement, not a replacement. Even with Internet access, "80 percent of our customers' time is spent on CIS," notes William Giles, corporate spokesperson for CompuServe.

But the trend is clear: Except for those services that have millions of loyal users, content providers are dashing to the Web. How these Web-based services will make money is still unclear. According to Internet analyst J.D. Falk, a few businesses currently profit from advertising and value-added services. One possible path to Web-based prosperity is that of Time-Warner's PathFinder, which provides free access now but will charge fees in the future. The strategy is that by the time it starts charging its customers, the site will have a reliable user community.

— Steven J. Vaughan-Nichols and Rachel Schmutter

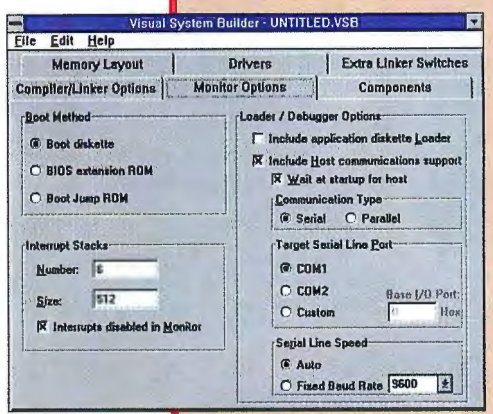
CODE TALK

RICK GREHAN

Phar Lap's Embeddable Kernel Leverages Win32 API

In my first Code Talk column, I wrote about Phar Lap's TNT DOS Extender. Now the company has released the TNT Embedded ToolSuite (ETS), which lets you build embedded applications in C or C++ atop a 32-bit protected-mode operating system running on PC/AT hardware—hardware that most of us have already figured out.

The TNT Embedded ToolSuite's main message is leverage. With it, you don't have to learn a boatload of new API calls. ETS uses a subset of the Win32 API that includes interfaces associated with threads and thread management. Nor with ETS do you have to buy expensive or esoteric hardware to start developing your embedded application; a modest 386-class machine works fine as a prototyping target (you can customize as you progress). You can use 32-bit C/C++ compilers and tools with which you may already be familiar, such as Microsoft Visual C++ 2.0 or better (32-bit version), Borland C++ 4.0 or better, and Watcom C/C++ 10.0 or better.



Phar Lap's ETS includes the Visual System Builder, which lets you quickly configure your embedded kernel.

ETS lets you begin working, literally, right out of the box. The system comes with a LapLink cable and a monitor boot disk. Compile and link your application on the host; hook the LapLink cable between host and target; boot the target from the monitor disk; and run the program launcher on the host. The launcher "talks" to the monitor on the target through the LapLink cable, downloads the kernel and your program, and you're rolling. Phar Lap even provides drivers for CodeView and Turbo Debugger; you can use either from the host station to work the kinks out of your "remote" embedded application.

In addition to the standard 386 PC/AT, ETS supports embedded development boards from Intel, Ampro, Real Time Devices, and Forth-Systeme. The documentation also describes how to tailor the kernel to whatever target fits your requirements.

The real-time edition of ETS adds even more features: threads, a "deterministic" scheduler (you can "know" when a thread of particular priority will run—exceedingly important in a real-time app), an MS-DOS-compatible file system, a floating-point emulator, and even an embedded DLL loader.

This last feature lets you "bind" 32-bit DLLs in with your embedded executable. Phar Lap says this will provide a smooth mechanism for extending the ETS kernel in the future.

The Embedded ToolSuite (Phar Lap, Cambridge, MA, 617-661-1510; fax, 617-876-2972; E-mail, info@pharlap.com) on its own is $2995; the real-time edition is $4995. This may seem steep, but once you figure in all the compilers, debuggers, and test-station hardware you won't have to buy, plus the shallow learning curve, it starts looking quite attractive.

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BENCHMARKS

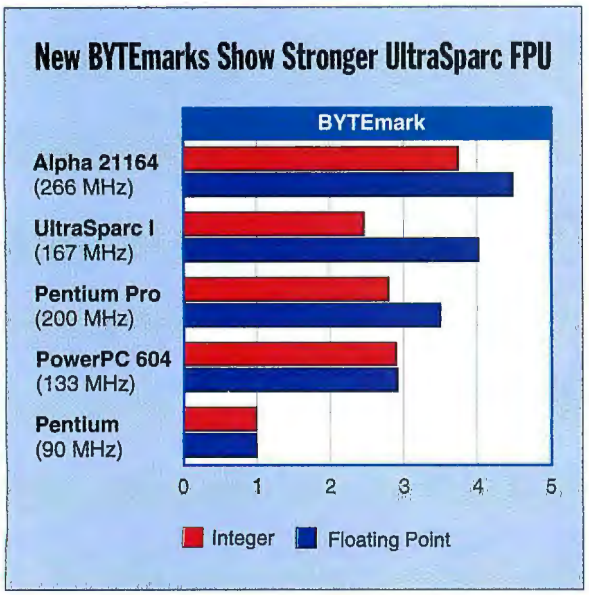
Benchmark Update

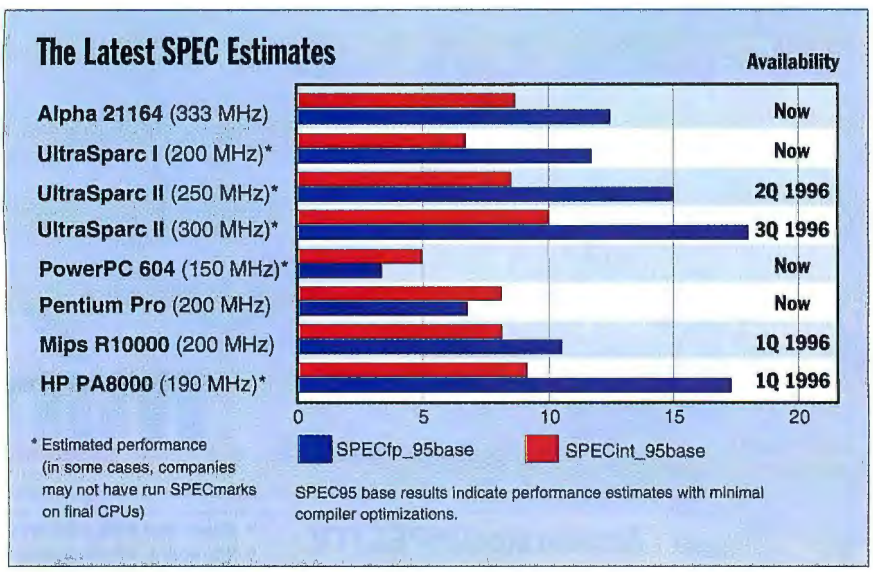
The new SPEC95 benchmark suites have replaced the old standby SPECint92 and SPECfp92 benchmarks, but not without a minor parting controversy. Critics contend that the SPECmark 92 suite had become obsolete and was too easily influenced by heavily optimized compilers (see "Bringing Benchmarks Up to SPEC," March BYTE).

In January, Intel said a bug in its compiler used to generate SPEC benchmark results led to an overstatement—15 to 18 percent—of SPECint92 results for Pentium processors running at 100 MHz or faster. The error did not affect performance results for SPECfp92 or SPEC95 results, the company says.

At about the same time that Intel clarified its Pentium Pro performance, BYTE learned it understated the performance of Sun's UltraSparc I. We erred in a January review of Sun's 167-MHz UltraSparc-based Ultra I workstation. Due to the use of a beta compiler in generating the BYTEmark tests, performance in the Integer and especially the FPU test suite was understated.

Keeping in mind that benchmark results provide only ballpark estimates of actual performance when running applications, here are the latest SPEC95 benchmark numbers of coming high-end processors, plus the restated UltraSparc BYTEmark numbers from Sun. BYTE will retest the UltraSparc system and post updated numbers on the BYTE Web site (http://www.byte.com).





Blasts from the Past

5 Years Ago in BYTE

Microsoft denied reports in the *Wall Street Journal* that it was "dropping OS/2" to focus on 32-bit Windows. The company said a new version of OS/2, called OS/2 3.0 (or OS/2 NT, for "new technology"), would incorporate a Win32 API for running 32-bit applications and would run on several processors. That operating system eventually became Windows NT. In the same issue, Dell advertised a 25-MHz 386 PC with 1 MB of RAM selling for $2899. In another story, Intel engineers predicted that by the year 2000, the company's leading microprocessor would operate at 250 MHz. Today, Intel already sells 200-MHz Pentium Pro processors.

10 Years Ago in BYTE

BYTE described how you can build a 16-node supercomputer machine for under $150,000 by lashing together standard 80286 processors. However, that system wasn't quite up to par with a Cray XMP-4, which the authors admitted outperformed the PC supercomputer by a factor of 4. Jerry Pournelle said the business software of 1985 had to be Microsoft Excel, which was originally released for the Mac.

15 Years Ago in BYTE

New peripherals that "transformed your S-100 computer from a slow, floppy-bound machine" into a high-performance machine delivered 31 MB of formatted capacity. Vista's 8-inch floppy disk drive system sold for around $1595. We also wrote about the new portable Osborne 1, which cost $1795 and fit under an airplane seat. It weighed just 24 pounds! Today, researchers at MIT envision PCs that are small enough to fit in your shoe.

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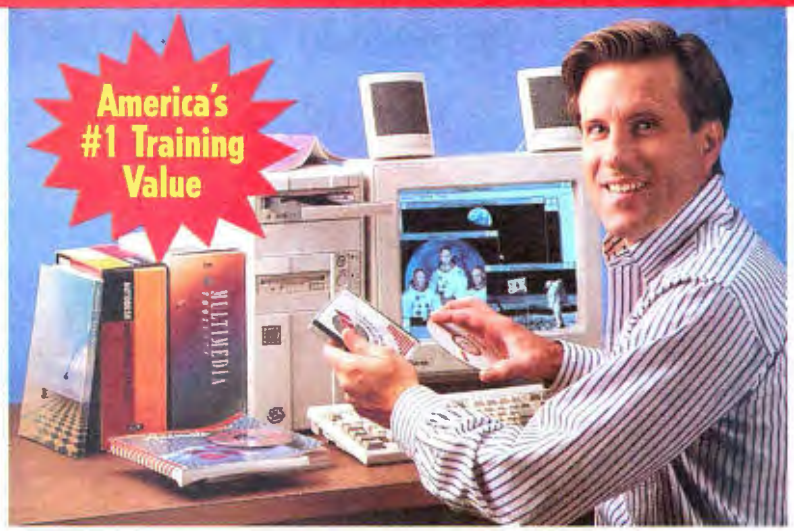

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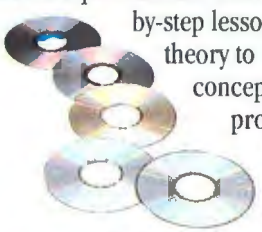

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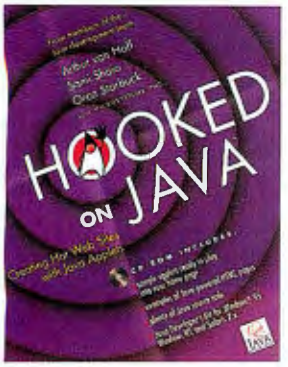


Baby's First Java Book

REX BALDAZO

Java, the cross-platform programming language from Sun Microsystems for building Internet applications, has been blessed by all the major Internet players, including Netscape and Microsoft. And while *Hooked on Java* is a bit too lightweight to be the definitive reference, if you want an overview and some sample code, this book is the place to start.

The authors are members of the Java development team at Sun, so they can perhaps be forgiven for spending the first part of the book detailing the Zen of Java and hyping its security and portability features. But it is disappointing that they don't even mention the update to Java expected from Sun later this year and don't discuss Netscape's Internet language called JavaScript.

They go into detailed discussion of the sample Java applets included on a bound-in CD-ROM. And the book contains URLs that link to other applets and to sites that contain up-to-date information on Java. Unfortunately, though the CD-ROM has the Java Development Kit (JDK) for Windows 95 and NT and Solaris 2.x, the book does not go into great depth about using the JDK or the javac compiler. But the discussion of Java syntax and the basic Java classes is a good introduction to the environment.

Only Netscape Navigator 2.0 and Sun's own HotJava browsers support Java as of this writing, but more are on the way, including ones for America Online and Microsoft Internet Explorer. But before Java can truly gain hold on the Web, more developers and users must become familiar with its capabilities and limitations. *Hooked on Java* is certainly not the last word, but it's a good introduction to a promising new technology.

HOOKED ON JAVA

Arthur van Hoff, Sami Shaio, and Orca Starbuck
Addison-Wesley, 181 pages
ISBN 0-201-48837-X

$29.95

Rex Baldazo (rbaldazo@bix.com) works in BYTE's New Media department.

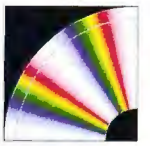
GOOD OLD DAYS

PC ROAD KILL by Michael Hyman, IDG Books Worldwide, 466 pages, ISBN 1-56884-348-8, $19.95

It's part of BYTE's storied folklore: Philippe Kahn, unable to finance his fledgling software company, hoodwinks a BYTE advertising representative into giving him ad space on credit he didn't have. Kahn ends up booking an ad for an innocuous product called Turbo Pascal, the orders pour in, and Borland is catapulted into software's top tier.

So go the anecdotes of an infant industry finding its legs, chronicled in Michael Hyman's *PC Road Kill*. Hyman tells history through a series of tales, figures, lists, quotes, and original memos. Whether all the stories are strictly true is sort of beside the point. These are the fables you will tell your children when they ask about the early days of the computer revolution.

The book includes lists you've probably seen posted on the Net or tacked up near the office coffee pot: Intel's Top Ten post-bug Pentium slogans (#7.9999414610: Nearly 300 Correct Opcodes!); the greatest all-time vapor software (headed by dBase for Windows, 40 months from announcement to shipment; in comparison, Windows 95 was whipped out in a mere 21 months); light-bulb jokes (Q: How many OS/2 programmers does it take to change a light bulb? A: I think that's a device-driver problem.). Appropriately dubbed "Nerd Humor," they are in fact snippets that could make only a nerd LOL. **— Stanford Diehl**



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If you're shopping for a car, buy this CD-ROM first. It's simply the best car-buying guide around. For twenty bucks, it could save you thousands of dollars on the initial purchase price of your automobile. This disc can also warn you away from some models that, according to *Consumer Reports*, are less reliable and have higher-than-average repair costs down the road.

The CD-ROM is well organized, easy to use, and, most important, is packed with tons of useful information that will help you become a wiser consumer. All the helpful magazine information is on the CD, including ratings and recommendations on more than 7300 makes, models, body styles, and trim lines from 1987 through the '96 model year.

There are a lot of other goodies on this CD-ROM as well, such as a financial calculator that lets you instantly compare lease versus purchase prices; a record-keeper template that lets you record maintenance information about your car; and an eye-opening role-playing game where you try to buy a car from a not-so-above-board salesperson. "Do I have a deal for you . . . but let me check with my manager first."

There are recommendations of which options you should buy and which you should avoid. A dealer's wholesale price list for the different car models puts you in a better bargaining position.

The CD-ROM, like *Consumer Reports*, contains lively writing that pulls few punches: "We like the Toyota Land Cruiser . . . however, at $40,000 it's more of a lifestyle statement than a viable substitute for a family car." Even if you're not in the market for a car, you'll definitely have more fun window shopping with this CD-ROM than going to the actual dealer showroom.

— Rich Friedman

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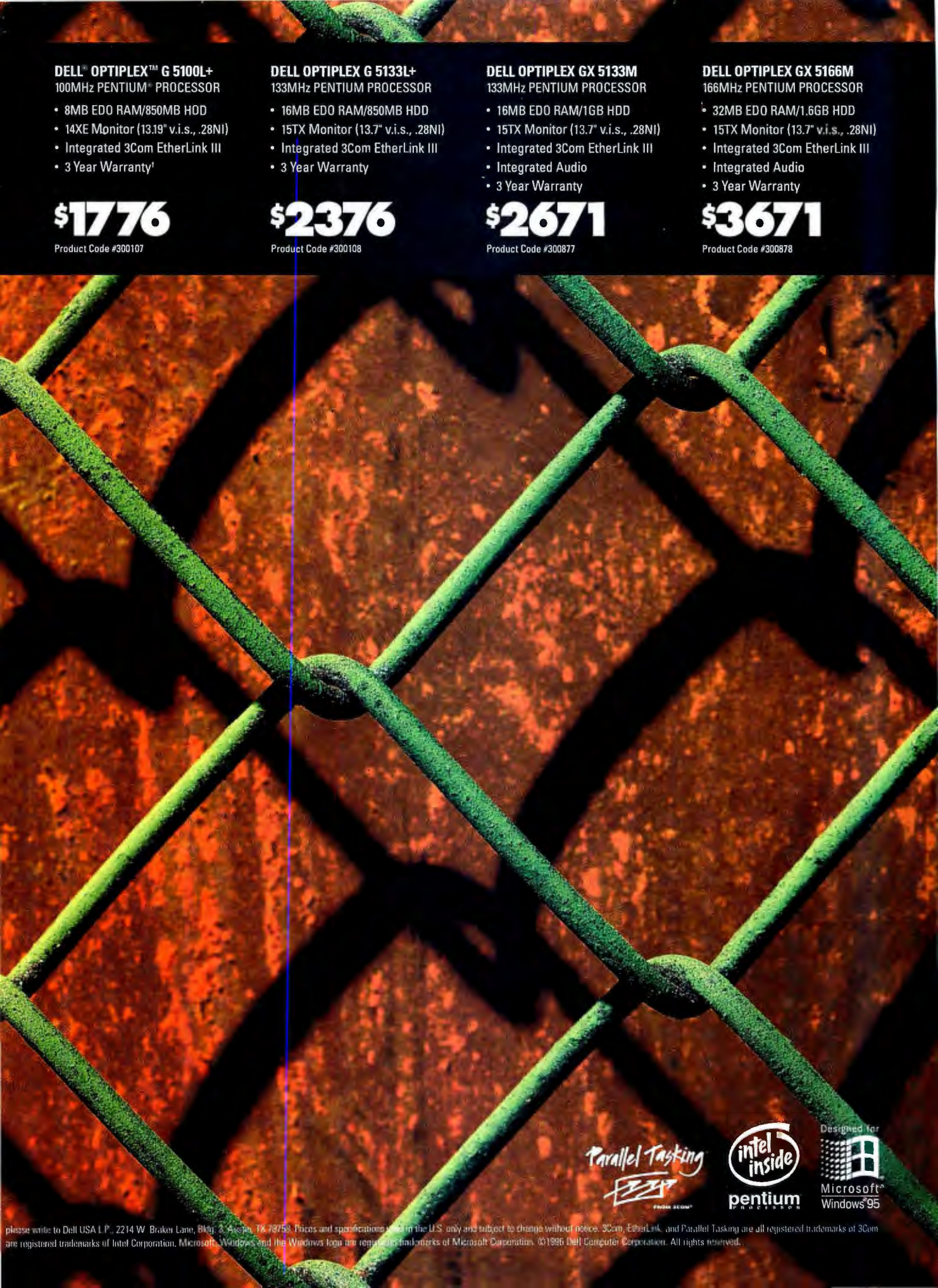

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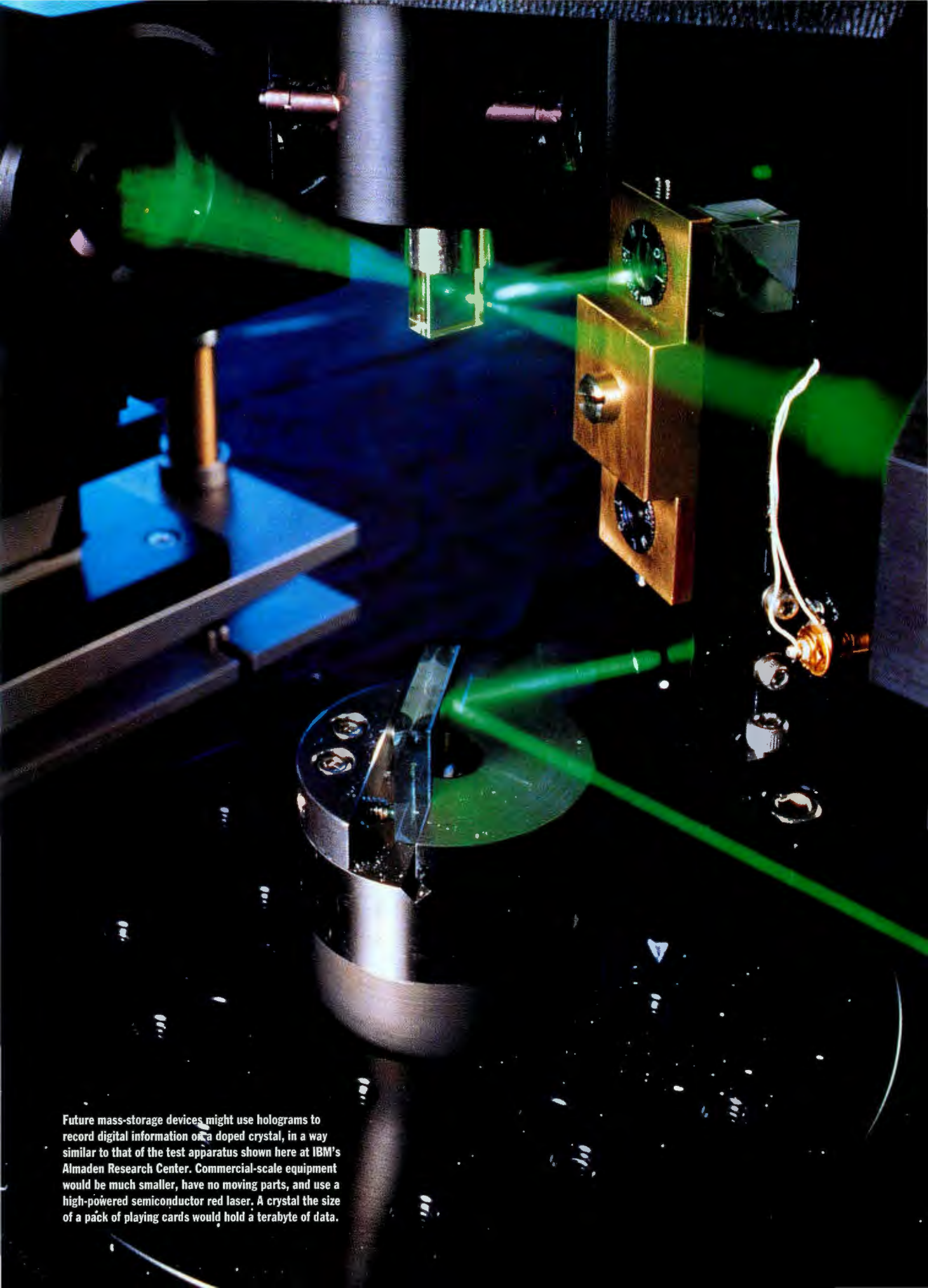


Future mass-storage devices might use holograms to record digital information on a doped crystal, in a way similar to that of the test apparatus shown here at IBM's Almaden Research Center. Commercial-scale equipment would be much smaller, have no moving parts, and use a high-powered semiconductor red laser. A crystal the size of a pack of playing cards would hold a terabyte of data.

WHEN SILICON HITS ITS LIMITS, WHAT'S NEXT?

A GLIMPSE AT THREE TECHNOLOGIES THAT COULD BE THE SUBSYSTEMS OF TOMORROW'S DESKTOP COMPUTERS

TOM THOMPSON

In 1987, BYTE reported that the International Electronic Devices Meeting in Los Angeles had decreed that VLSI technology was on the verge of obsolescence. Only a year later, no less a personage than Jack St. Clair Kilby, inventor of the IC in 1958, philosophically told BYTE: "Nothing goes on forever. There may not be another five orders of magnitude of improvements to be made."

Today, Kilby's creation is 38 years old, and there are no signs that its influence will wane in the near future. Incredibly resourceful engineers have managed to push the bounds of fabrication techniques so that chips with submicron features are a common staple in today's desktop computers. For example, the 200-MHz Pentium Pro and PowerPC 604e have circuit features measuring only 0.35 micron across. The delivery of devices composed of 0.25- and 0.18-micron features is virtually assured; such chips are in the development phase and will ship in the next several years.

But there are signs that this technology is reaching its limits. While the features on the chip die have shrunk, the cost of the equipment necessary to fabricate these devices has ballooned. Intel alone has spent over a billion dollars apiece for the construction of several new "fabs" (the manufacturing plants that fabricate the chips) located in Oregon, New Mexico, and Arizona. Both IBM and Motorola have also broken ground on new high-price fabs.

The soaring costs of these facilities may eventually slow or halt the development of chips sporting ever-smaller features before the technological limits do. Once that happens, what does the microcomputer industry do next?

As small as these chip features are, they are still made up of huge aggregates of atoms. New computing technologies might operate on smaller scales, possibly at the molecular or even the atomic level. Or fundamentally new ways to handle information might be the answer, such as storing binary data as a holographic pattern whose data can be written or read in parallel.

This month, let's look to the future—specifically at two new storage media and one new CPU technology that may one day supplant silicon. But to do that, we must first examine the technology already in place.

It's Not Just a Good Idea, It's Moore's Law

Since the IC was developed, the number of transistors that designers can pack on a chip has increased at a phenomenal rate. This rate, where the transistor count doubles approximately every 18 months, has become an axiom known as Moore's law. It's named after Gordon Moore, who first noticed this trend in the early 1960s. Within the span of 10 years, for example, the logic density in the x86 processor has increased 20 times, as shown in the figure "x86 Transistor Counts" on page 46.

The basis of these ever-higher logic densities is *photolithography*—the same technology that etches the plates that print this magazine, only more complex. Here's how it works: Companies make ICs by layering patterns of metal or chemically treated (i.e., doped) silicon, one atop another, onto a die of silicon. The layout of these patterns, composed of either conductive or insulating material, builds the transistors that make up the IC's logic gates.

Adding a new layer first involves covering the die with a photosensitive coating. A mask in the shape of the desired pattern blocks light from reaching the coating, as shown in the figure "The Limits of Silicon Fabrication" on page 46. Chemical processing etches off those sections of the coating that are exposed to the light. Logic gates thus get built, step by step, in a cycle where another doped layer gets applied, followed by another coating, another mask exposure, and more etching.

To accurately reproduce features onto the die, the wavelength of the light must be at least as small as the features themselves. Current lithographic processes employ a mercury light source whose 0.365-micron wavelength creates the 0.35-micron features. Successfully achieving the smaller 0.25-micron feature size requires the utilization of a krypton-fluoride ultraviolet

laser that has a 0.248-micron wavelength.

Still-smaller features will be handled in the future by the use of argon-fluoride lasers with a 0.193-micron wavelength. But achieving 0.1-micron feature size requires optical trickery involving masks that phase-shift the light to improve the resolution. Building even-smaller chip features requires using light sources with even shorter wavelengths. In doing so, chip designers have traversed the electromagnetic spectrum from visible light, to ultraviolet light, and finally into X-ray territory.

But using X rays for the photolithographic process introduces a whole new set of production problems. With visible and ultraviolet light, masks are typically four to five times larger than the feature size. When the fab machinery projects the masks onto the die, lenses perform a reduction operation. With X rays, the masks must be the size of the features themselves, since X rays can't be focused with optical lenses. In short, making defect-free masks is as difficult as making the chip itself. Also, materials that are opaque to light aren't necessarily opaque to X rays.

Finally, there's the issue of having a reliable X-ray source. Mark Bohr, an Intel Fellow, hints at the scope of that problem by joking, "Part of the price tag of a future fab, if X-ray lithography is used, might very well be for the construction and operation of an on-site synchrotron."

John E. Kelly III, vice president of systems, technology, and science at the T. J. Watson Research Center, says that his group has fabricated logic gates as small as 0.07 micron using X-ray lithography. "They work—they switch—but there are still manufacturing challenges to be addressed," he admits.

Despite these hurdles, Intel and IBM say that current CMOS technology still has a lot of life in it. Says Bohr: "There's no sign of the technology slowing down. If we're going to run into a wall, it's more than 10 years out." Kelly agrees. "With CMOS technology and a lot of hard work, in a decade we'll use X-ray lithography and other techniques to deliver a processor that has 50 million to 100 million transistors and operates at 1 GHz," he predicts.

Light Storage

Future compute-intensive jobs will present technical challenges in other areas besides the development of new processors. Whether they're made of CMOS or a fundamentally new technology, the quantity of data that these processors demand will tax the capabilities of other subsystems in a computer.

The capacities of today's mass-storage devices are indicative of this trend. Today, CD-ROMs are a common staple for distributing software, multimedia, and games. That's because they store up to 650 MB of error-corrected data on a single side of a platter. Magnetic-storage techniques are advancing rapidly as well. Within the last year or so, the typical storage capacity of the hard drive in a desktop computer jumped to more than a gigabyte.

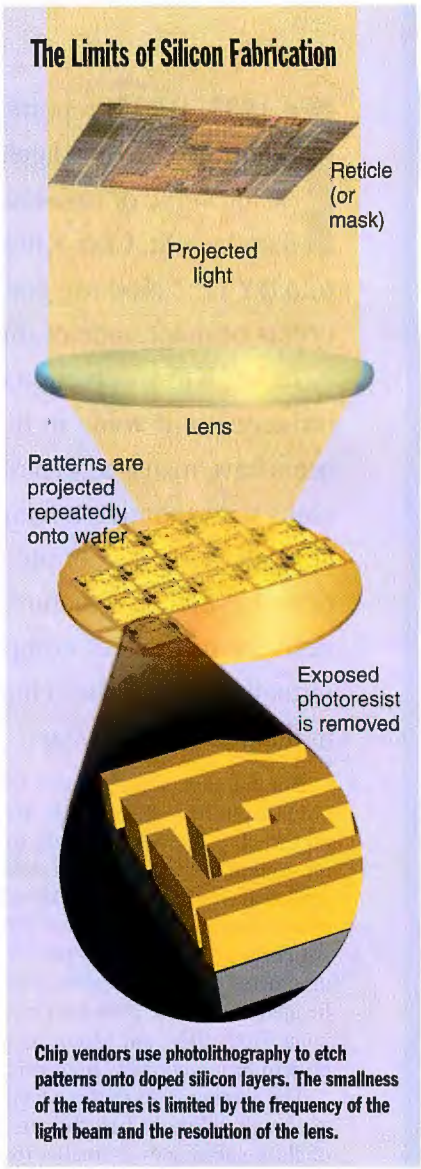
Still, future computers will routinely handle hundreds of gigabytes or terabytes of information—orders of magnitude larger than the capacity of any existing CD-ROM or disk drive. Managing such vast quantities of data and delivering it in a torrent to an ultrahigh-speed processor requires a radically different type of storage system.

An optical recording technology known as *holography* shows great promise because it achieves the necessary high storage densities as well as fast access times. This capability occurs because a holographic image, or hologram, encodes a large block of data as a single entity in a single write operation. Conversely, the process of reading a hologram retrieves the entire data block simultaneously. (For more on the fundamentals behind holographic recording, see the text box "Creating Holographic Storage" on page 48.)

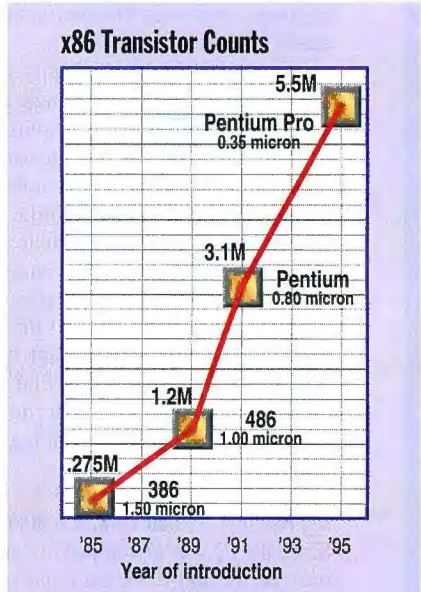
Holographic data storage uses lasers for both reading and writing blocks of data, or "pages," into the photosensitive material. Theoretically, thousands of such digital pages, each containing a million bits, can be stored within the volume of a sugar cube. This is a storage density of 1 TB per cm^3. Practically, researchers expect to achieve storage densities of 10 GB per cm^3—still impressive compared to today's magnetic-storage densities, which are around 100 Kb per cm^2 (not including the drive mechanism).

At this density, a block of optical media roughly the size of a deck of playing cards would house a terabyte of data. Because such a system can have no moving parts and its data pages are accessed in parallel, it's estimated that data throughput on such a storage device can hit 1 Gbps or higher.

The extraordinary capabilities of holographic storage have attracted the attention of universities, industry research labs, and the government. This interest has sparked two research projects. One is the Photorefractive Information Storage Materials (PRISM) program, a 2½-year project jointly funded by the U.S. Department of Defense's Advanced Research Projects



Chip vendors use photolithography to etch patterns onto doped silicon layers. The smallness of the features is limited by the frequency of the light beam and the resolution of the lens.



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Agency (ARPA) and other project members, such as IBM's Alamaden Research Center (the principal investigator), GTE, and Rockwell International. The purpose of PRISM is to research optimal photosensitive materials for storing holograms and to understand their potential for storage.

The second research project is called the Holographic Data Storage System (HDSS). It has the same principal investigators as the PRISM project and includes such participants as IBM's Watson Research Center, Rockwell International, and GTE.

While PRISM investigates media, HDSS is developing the hardware technologies necessary to implement a practical holographic data-storage system. HDSS concentrates on building several

CREATING HOLOGRAPHIC STORAGE

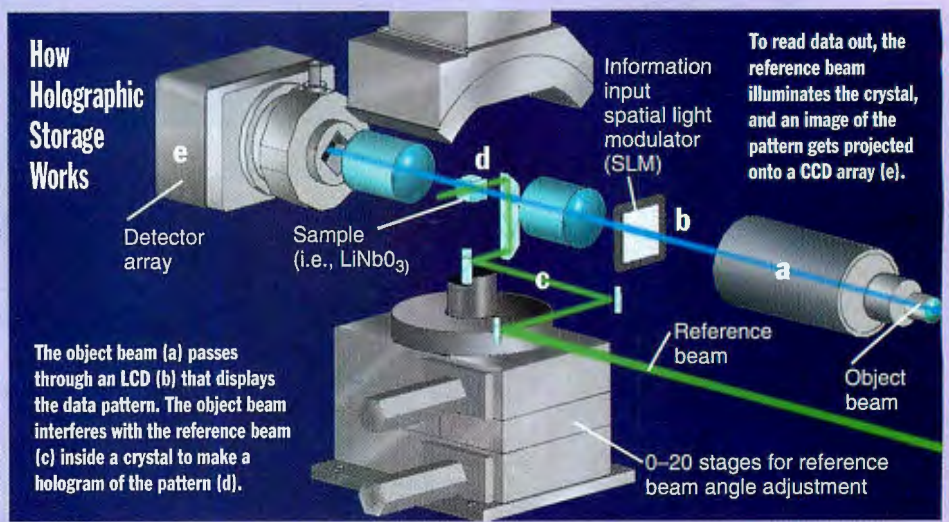
A research team at IBM's Almaden Research Center has built a precision Photorefractive Information Storage Materials (PRISM) test stand for evaluating photosensitive samples. It also illustrates the fundamental components of a holographic storage system, as shown in the figure at right.

The device first splits a blue-green argon laser beam into separate reference and object beams. The object beam, which carries the data, gets expanded so that it fully illuminates a spatial light modulator (SLM). An SLM is simply an LCD panel that displays a page of raw binary data as an array of clear or dark pixels.

The object beam finally interacts with the reference beam inside a photosensitive crystal. The ensuing interference pattern—the substance of the hologram—gets stored as a web of varying optical characteristics inside this crystal. To read out the data, the reference beam again illuminates the crystal. The stored interference pattern diffracts the reference beam's light so that it reconstructs the checkerboard image of the light or dark pixels. The image is directed upon a charge-coupled device (CCD) sensor array, and it instantly captures the entire digital page.

When reading out the data, the reference beam has to hit the crystal at the same angle that's used in recording the page. The beam's angle is crucial, and it can't vary by more than a fraction of a degree.

This apparent flaw in the recording process is actually an asset. It's how holographic storage achieves its high data densities. By changing either the angle of the reference beam or its frequency, you can write additional data pages into the same volume of crystal.



However, all the holograms appear dimmer because their patterns must share the material's finite dynamic range. In other words, the additional holograms alter a material that can support only a fixed amount of change. Ultimately, the images become so dim that noise creeps into the read-out operation, thus limiting the material's storage capacity.

The dynamic range of the medium determines how many pages it can hold reliably; therefore, the PRISM project examines the limitations in a variety of photosensitive materials. Current work uses iron-doped lithium niobate, strontium barium niobate, or barium titanate crystals. "We're also looking into polymers and other organic materials," says Glenn T. Sincerbox, the principal investigator from IBM.

Because the interference patterns are spread uniformly throughout the material, it endows holographic storage with another useful capability: high reliability. "While a defect in the medium for disk or tape storage might garble critical data, a defect in a holographic medium doesn't wipe out information. Instead, it only makes the hologram dimmer," he says.

The PRISM consortium has stored up to 200 holograms composed of 37.5-KB data pages (640 by 480 bits) into a crystal with less than 1 centimeter on a side, achieving a storage density of 48 MB per cubic cm. This is far short of the goal of a practical storage density of 10 GB per cubic cm, but it's sufficient to pursue the development of Holographic Data Storage System (HDSS) hardware.

Sincerbox believes that it will take several more years to refine the technology enough to build small desktop HDSS units. Such devices might be ready by about the year 2003.

Because HDSS hardware uses an acoustoptical light deflector (i.e., a crystal whose refractive properties change according to sound waves traveling through it) to modify the beam angle, Sincerbox estimates that an HDSS system can retrieve adjacent data pages in under 100 microseconds. "Any conventional optical or magnetic storage unit will require some sort of mechanical means to access different data tracks, which takes on the order of milliseconds to accomplish," he explains. "A gigabit-per-second data rate appears reasonable for holographic storage, and this should make it a cost-competitive leader with whatever exists."

While holographic storage appears to be a radically new technology, actually it's not. The basic concepts were worked out almost 30 years ago. What's changed, according to Sincerbox, is the availability of key low-cost components. "Consumer electronics has played a large part in making holographic storage feasible today," he says. "Thirty years ago, lasers were made of glass tubes that were 6 feet long and had unreliable output. Now they consist of small, reliable, semiconductor junctions, similar to those mass-produced for CD players. The SLM is the result of fabrication techniques that make LCD screens for laptop computers and calculators. The CCD sensor array comes straight from a digital video camera. Neither of these were available 30 years ago—perhaps not even 10 years ago."

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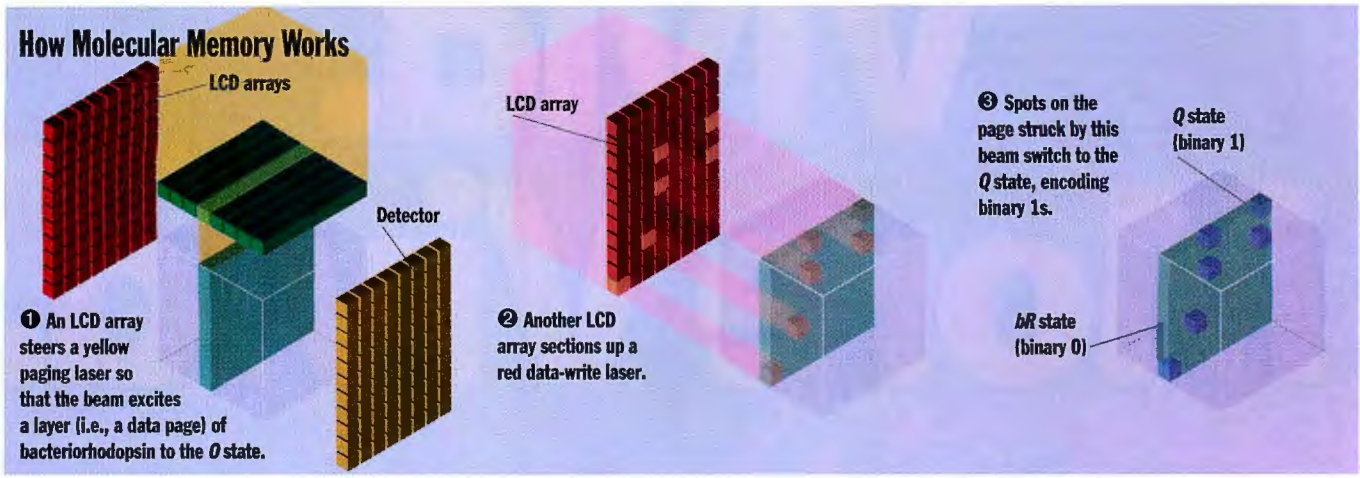


key system components: a high-speed data-input mechanism, a sensor array to recover the data, and a high-powered red-light semiconductor laser (required for holographic I/O). These components will be integrated with the PRISM medium into prototype storage platforms to demonstrate the potential of this technology.

Molecules as Bits

Even smaller objects might serve as storage devices or replace conventional semiconductor memory. Professor Robert R. Birge, director of the W. M. Keck Center for Molecular Electronics, has implemented a prototype memory subsystem that uses molecules to store digital bits.

The molecule in question is a protein called *bacteriorhodopsin*. This purple, light-harvesting protein is present in the membrane of a microorganism called halobacterium halobium, which thrives in salt marshes, where temperatures can hit 150°. It uses the protein for photosynthesis when the oxygen levels in the environment are too low for using respiration to obtain energy.

Birge selected bacteriorhodopsin because its *photocycle*, a sequence of structural changes that the molecule undergoes in reaction to light, makes it an ideal AND data-storage gate, or flip-flop (see the figure "Storing Bits in a Molecule"on page 51). According to Birge, the *bR* (where the state is 0) and the *Q* (where the state is 1) intermediates are both stable for many years. This situation is due, in part, to the remarkable stability of the protein, which appears to have evolved to survive the harsh conditions of a salt marsh.

He estimates that data recorded on a bacteriorhodopsin storage device would be stable for approximately five years. "We have lab samples that have held information reliably for two years," he says. Another important feature of bacteriorhodopsin is that these two states have widely different absorption spectra. This makes it easy to determine a molecule's current state using a laser tuned to the proper frequency.

Birge has built a prototype memory system where bacteriorhodopsin stores data in a 3-D matrix. He builds this matrix by placing the protein into a cuvette (a transparent vessel) filled with a polyacrylamide gel. The cuvette is oblong and 1 by 1 by 2 inches in size. The protein, which is in the *bR* state, gets fixed in place by the polymerization of the gel. A battery of kypton lasers and a charge-injection device (CID) array surround the cuvette and are used to write and read data.

To write data, first a yellow "paging" laser fires to pump up the molecules to the *O* state. A spatial light modulator (SLM), which is an LCD array, slices this beam so that it excites a 2-D plane of material inside the cuvette. This energized plane of material is a data page that has the ability to hold an array of 4096 by 4096 bits. (See the figure "How Molecular Memory Works" above.)

Before the protein can return to its resting state, a red data-write laser, located at right angles to the paging laser, fires. Another SLM displays the binary data, and it sections up this beam so that certain spots on the page are irradiated. Molecules at these locations convert to the *Q* state and represent binary 1s on the page. The remainder of the page returns to the rest state and represents binary 0s.

To read data, the paging laser fires again, which excites the targeted page into the *O* state. This is done to further widen the absorption spectra differences between the digital 0s and 1s (the *Q* state). Two milliseconds later, a low-intensity red laser bathes the page. The low intensity is required to prevent the molecules from flipping into a *Q* state. Molecules representing 0s absorb the red light, while those in the binary 1 state let the beam pass through. This creates a checkerboard pattern of light and dark spots on the CID array, which captures the image as a page of digital information.

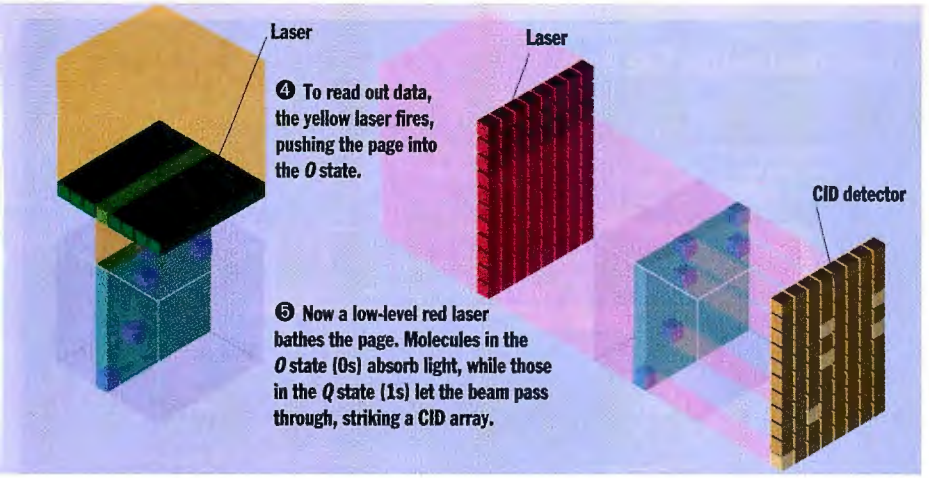
To erase data, a brief pulse from a blue laser returns molecules in the *Q* state back to the rest state. The blue light doesn't necessarily have to be a laser; you can bulk-erase the cuvette by exposing it to an incandescent light with ultraviolet output.

To ensure data integrity during selective page-erase operations, Birge caches several adjacent data pages. The read/write operations also use 2 additional parity bits to guard against errors. A page of data can be read nondestructively about 5000 times. Each page is monitored by a counter, and after 1024 reads, the page is refreshed via a new write operation.

How fast can data be accessed with this design? While a molecule changes states within microseconds, the combined steps to perform a read or write operation take about 10 milliseconds. However, like the holographic storage system, this device obtains data pages in parallel, so a 10-MBps rate is possible. This speed is similar to that of slow semiconductor memory.

By ganging up eight storage cells so that entire bytes can be accessed in parallel, Birge believes an 80-MBps data rate is possible. Maintaining this throughput depends on how you implement the memory subsystem. In some versions, the SLM does page addressing. Less-expensive designs use galvanometric mirrors that slew the beam to the correct page. While the SLM offers a millisecond response time, it also costs four times as much.

Says Birge: "Such a system would operate nearly as fast as semiconductor RAM



until a page fault occurs. Then we have to reposition the laser beam to access pages on the other side of the container. Depending on the design, we can keep the page-fault access time in the milliseconds so that the memory system behaves like a hard drive during paging. Page caching appears to solve the access-time problem, but it's expensive because of the large page size [about 1.7 MB per page]. If you're willing to spend the money to cache about 10 pages, then you can eliminate the paging effects."

Theoretically, the cuvette described could hold 1 TB. Practically, Birge has stored about 800 MB on the cuvette, and he hopes to achieve a storage capacity of approximately 1.3 GB. Problems with the lens system and protein quality limit the system to this amount for now.

However, the merits of molecular storage have garnered sufficient interest that three of NASA's Space Shuttle missions explored methods to improve the manufacture of the data cubes by using microgravity. The resulting material was more homogeneous and provided an enhanced storage density. It remains to be seen, however, whether microgravity manufacturing will be sufficiently cost-effective to justify the observed factor-of-four improvement.

Birge's system, which he categorizes as a level-I prototype (i.e., a proof of concept), sits on a lab bench. He has received additional funding from the U.S. Air Force, Syracuse University (Syracuse, NY), and the W. M. Keck Foundation to develop a level-II prototype. Such a prototype would fit and operate within a desktop personal computer. "We're a year or two away from doing internal testing on a level-II prototype," says Birge. "Within three to five years, we could have a level-III beta-test prototype ready, which would be a commercial product."

Can molecular storage compete with traditional semiconductor memory? The design certainly has its merits. First, it's based on a protein that's inexpensive to produce in quantity. In fact, genetic engineering is being used to boost the output of the protein by the bacterium. Second, the system has the ability to operate over a wider range of temperatures than semiconductor memory.

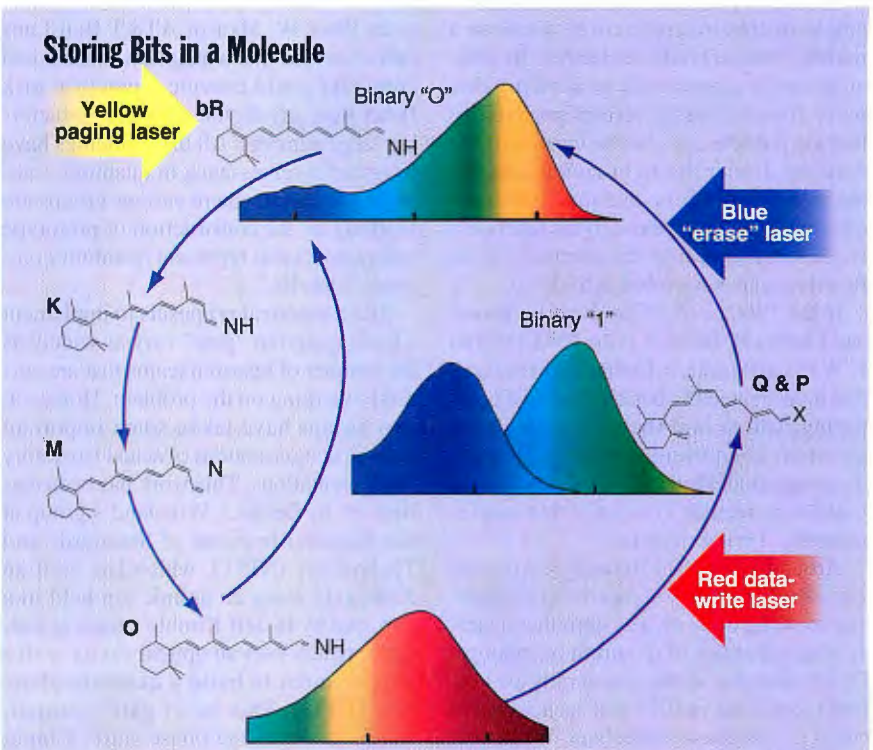
Third, the data is stable. If you turn off the memory system's power, the bateriorhodopsin molecules retain their information. This makes for an energy-efficient computer that can be powered down yet still be ready to work with immediately because the contents of its memory are preserved.

Finally, you can remove the small data cubes and ship gigabytes of data around for storage or backups. Because the cubes contain no moving parts, it's safer than using a small hard drive or cartridge for this task.

Quantum Computing

The scale of the function of new mass-storage and memory subsystems has grown progressively smaller. Holographic storage imprints data on crystalline lattices, and the rhodopsin memory system operates on batches of molecules.

But what about the processor itself? Is there a way to replace its machinery? Perhaps with something even smaller: individual atoms. For years, physicists have manipulated individual atoms in the lab. Now they're trying to coax computations out of them. But this work is like nothing you can imagine. At this scale, you get a whole new set of rules: The normal phys-



A photocycle is the sequence of structural changes that a molecule undergoes in reaction to light. The molecule remains at a resting state, known as *bR*. Yellow light starts the photocycle, where the molecule goes through several intermediate states, known as *K*, *M*, and *O*. If left alone, the molecule returns to the *bR* state. If the molecule is illuminated with red light during the *O* state, the photocycle detours into a *P* state, and then *Q*. The molecule remains at the *Q* state until irradiated by blue light, at which point it returns to the *bR* state. Both *bR* and *Q* are stable configurations and represent a binary 0 or 1, respectively.

ical behavior that you expect even for minuscule CMOS logic gates no longer applies. Instead, quantum mechanics dictates the manner in which subatomic particles behave.

Quantum mechanics has every atom act as either a particle or a wave (the so-called wave-particle duality). This means that when subatomic particles behave as particles, they occupy only discrete energy states, called *quanta*.

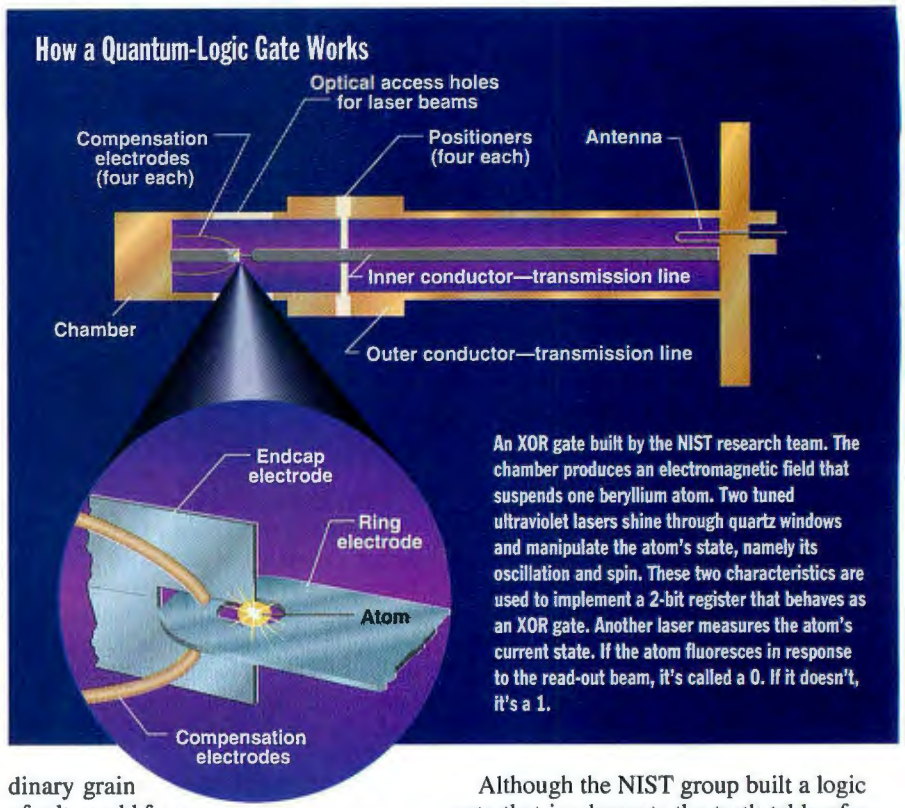
When particles behave as waves, they exhibit strange counterintuitive behaviors. As the quantum wave that represents, say, an electron spreads out over time, its location becomes vague, and the laws of probability reign supreme. (The situation is analogous to throwing a rock into a pond: The wave centers around the point of impact the moment the rock hits the water. Over time, the wave spreads out over the surface of the pond and is everywhere.) The electron, in a sense, can be everywhere at once.

This fuzzy state of affairs continues until the electron interacts with another particle or photon that reveals its position, at which point the spread-out wave "collapses" into several localized waves (the electron and the other particle). As an example of this bizarre action, suppose a minute junction holds an electron. Its presence can be represented as a wave. This wave function has a certain probability that the particle can also be *outside* of the junction. Under the right conditions, the electron escapes from one junction to another by "tunneling" through the junction's walls, simply because the electron's wave function makes it probable to do so.

In the 1960s and 1970s, Rolf Landauer and Charles H. Bennett at the IBM Thomas J. Watson Research Center did research that investigated the basic physics of computing, which laid the groundwork for quantum computing. Notably, Bennett demonstrated abstractly that you could build a molecular computer that implemented a Turing machine.

Around 1980, Paul Benioff of Argonne National Laboratory showed that computing could be done on a system that exactly obeys the laws of quantum mechanics. David Deutsch at the University of Oxford pointed out in 1985 that such a system could do quantum parallelism. While this research was still in the abstract stage, it indicated that a quantum computer could have greater capabilities than a classic digital computer.

In 1993, Seth Lloyd, who was then at Los Alamos National Lab, showed that many quantum systems, including an ordinary grain of salt, could function as quantum computers. That same year, Peter W. Shor of AT&T Bell Labs demonstrated that a quantum-mechanical computer could execute a practical task faster than any digital computer—factoring large numbers. All these findings have triggered a renaissance in quantum-computing research, where various groups are working on the construction of prototype components that represent quantum-computer "circuits."



An XOR gate built by the NIST research team. The chamber produces an electromagnetic field that suspends one beryllium atom. Two tuned ultraviolet lasers shine through quartz windows and manipulate the atom's state, namely its oscillation and spin. These two characteristics are used to implement a 2-bit register that behaves as an XOR gate. Another laser measures the atom's current state. If the atom fluoresces in response to the read-out beam, it's called a 0. If it doesn't, it's a 1.

The theoretical proposals to implement a basic quantum "gate" vary as widely as the number of research teams that are currently working on the problem. However, two groups have taken some important steps in demonstrations of actual laboratory implementations. This work has been carried out by David J. Wineland's group at the National Institute of Standards and Technology (NIST), which has built an XOR gate using an atomic ion held in a trap, and by H. Jeff Kimble's team at CalTech, which uses an optical cavity with a trapped atom to build a quantum phase gate (QPG). This latter gate's output, which modifies the phase shift of input laser beams, might be used to implement a variety of functions.

Constructing these building blocks isn't easy. NIST's logic gate involves a vacuum chamber with four electrodes, as shown in the figure "How a Quantum-Logic Gate Works" above.

Although the NIST group built a logic gate that implements the truth table of a classic electronic gate, it's important to note that quantum logic doesn't have to function that way. As mentioned earlier, quantum computing can exploit a kind of parallel processing because of that fuzzy-wave behavior of particles, and even the NIST gate exhibits this feature. "The state space of a quantum-computing system is far larger than the state space of a classic computer system, because the quantum system can exist in exponentially many states all at once," says Kimble.

Because of this, quantum bits are termed *qubits* to distinguish them from conventional bits. "A 3-bit register holds only one number, but a 3-qubit register can hold all eight possible numbers until you read it out," according to Chris Monroe, a member of the NIST team.

In theory, this quantum parallelism allows you to perform complex tasks quickly. For example, factoring a large number normally requires a computer to perform numerous divide operations, which can quickly reach an exponential amount of computations for large numbers. "A quantum computer would attack the problem by raising a smaller number to all different powers at once," explains Bennett. "A repeat period for a particular power function tells you how to factor the original number."

Furthermore, a quantum computer does not have to perform digital computations.

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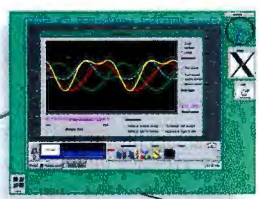

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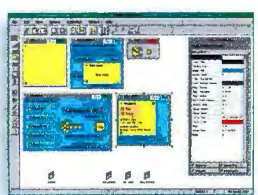

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The late Richard Feynman proposed that quantum computers could simulate other quantum-mechanical systems—in other words, operate as analog computers.

This idea is championed by Seth Lloyd, who's now with the department of mechanical engineering at MIT. As an example, Lloyd wants to simulate the time evolution of 40 particles that make up the matter at the core of an exploding star. Performing these calculations digitally would require setting up and working on 2^{40} by 2^{40} matrices that would accurately describe all the quantum characteristics of these particles, such as their spin.

"It would take 10^{24} digital operations to compute the result," says Lloyd. "A TFLOPS system would require a trillion seconds—31,709 years—to compute the outcome. However, by using lasers to program the behavior of 40 ions in an ion trap, a quantum computer would have to operate for only a hundred quantum interactions." Such a quantum analog computer would use the very quantum properties of these particles, such as the spin, to compute the quantum effects of the simulation. Most of the purposes of quantum analog computing are similarly specialized.

Although quantum computing has lots of potential, there are still many problems yet to be solved. According to Landauer, there's the formidable issue of maintaining a coherent quantum system. "A quantum computer has to operate under two conditions that are hard to reconcile," he explains. "The qubits must interact strongly with one another to perform the computations. Yet they must do so without interacting with the environment itself. That's very difficult to do, especially if you're trying to perform computations over any length of time. For example, the thermal vibrations of the frame that holds the bits in their proper positions will cause the quantum logic to lose its coherence. Another problem is that flaws in the equipment cause errors to build up—unlike with digital computation, where at every stage the system is pushed back to a level of 0 or 1."

Monroe admits that "nobody's really studied these issues. Even the XOR gate loses coherence after 10 or 20 operations, perhaps due to minute instabilities in the laser." Bennett and others have investigated the use of error-correcting quantum codes to tackle the problem. According to Bennett: "Peter Shor discovered promising leads in quantum data storage for correcting errors. He proved that we could use 9 qubits to maintain an error-correcting code. It's not efficient, but it works. However, these codes require reliable quantum processing to function. Unfortunately, it looks like we're going to need a breakthrough just to achieve reliable quantum processing."

Although the picture appears bleak, remember that quantum computing as a technology is still in its infancy. The situation is similar to when Bell Labs built the first transistor in 1947. Researchers are just starting to cast some of quantum computing's decades-old theories into real-world components that can do something. Says Kimble of the situation: "Implementing the quantum analog of classical circuits probably isn't the optimum strategy. Quantum physics is a rich and unexplored land where we're still discovering how to do things."

Even if quantum computing's problems are intractable, future processors will be built—somehow. "Between the limits of conventional lithography and moving atoms around, there's a lot of space to build logic gates," says Kelly.

History is littered with technologies that showed great promise but failed to live up to expectations or usability. (See the text box "Whatever Happened to Josephson Junctions?" above as a case in point.) This applies to all the technologies described here, not just quantum computing. Any one of them might founder due to unforeseen technical problems or because of cost issues. However, it's equally possible that offshoots from other disciplines might usher in a breakthrough, just as an eighteenth-century technology—photolithography—did for digital electronics. ■

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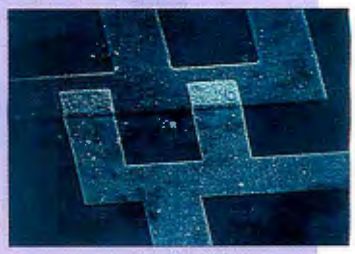
WHATEVER HAPPENED TO JOSEPHSON JUNCTIONS?

Sometimes a new technology shows great promise, but it founders when practical issues surface. So it is with Josephson junctions.

In 1962, Brian D. Josephson described a phenomenon peculiar to quantum mechanics. Suppose two superconductors are separated by a thin film of insulating material. These superconductors are part of a circuit, and since the insulating film breaks the connection, no current flows.



However, if the film is thin enough, the quantum-wave functions of electron pairs (so-called Cooper pairs, which are a product of supercooling and are responsible for superconductivity) on either side of the film overlap. If the overlap is large enough (i.e., the film is thin enough), the Cooper pairs tunnel through the insulator, creating a current flow. This phenomenon is known as the Josephson effect.

Experiments showed that the current flow is extremely sensitive to magnetic or electric fields because they interfered with the tunneling effect. This interference turns the superconducting circuit on or off within a few picoseconds, making such a junction a very fast switch. Thus, Josephson junctions held out the promise of making ultrafast logic gates.

But making practical versions of these junctions turned out to be tough. There were huge fabrication problems: Circuit traces simply tore apart as the logic gates contracted when cooled in a bath of liquid helium. The junction's switching speed also failed to live up to expectations. Combined with the huge operating expense of chilling them to a few degrees above absolute zero (–273°C), this made producing processors out of these gates unfeasible.

Scientists performed further research when new high-temperature superconductors (these materials became superconducting when cooled to only –196°C, the temperature of liquid nitrogen) came to light in the late 1980s. However, at these higher temperatures, thermal noise degraded the sensitivity of the device.

While Josephson junctions didn't realize their potential as computer logic gates, their sensitivity to electromagnetic fields makes them an ideal sensor. In the medical field, for example, Josephson junctions perform real-time measurements of brain activity and monitor the currents that control a heart's muscle activity. These noninvasive measurements of organs allow doctors to isolate brain tumors or recognize cardiac problems without resorting to dangerous and expensive surgery.

Work Flow Without Fear

KELLY TRAMMELL

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Six reasons why work flow fails, and what you can do about it

Work-flow systems can be a lot like the federal government: slow to change, plagued by immaturity, and prone to regular shutdowns. The good news is that you can actually fix a problematic work-flow system.

One of the keys to successful work-flow programming comes before you write your first line of code. You must first understand which processes are good candidates for automation and which ones can be handled only with human intervention. Once you begin programming your system, you should pay particular attention to how you incorporate your company's business rules into the process design.

Finally, you must plan for success in the long run: How you maintain your work-flow system will determine whether the fast performance it shows in the beginning degrades over time.

Here are six fundamental reasons why work-flow systems fail. Steer clear of these pitfalls, and you'll increase your chances of making work flow work for you.

REASON #1:

Not All Processes Can Be Automated

Scenario: You need to automate your company's production line. However, because your product catalog is so varied, one process input (e.g., order entry) might have thousands of possible outcomes determined by the combination of dozens of variables, depending on your customers' needs.

Analysis: Processes like this aren't good candidates for work-flow automation. Work-flow engines require well-defined rules and conditions, and this means you must program all possible roles, actions, and exceptions that could occur within a work-flow process. This extremely complex task requires you to work through all the possible outcomes in advance and program each permutation into the engine. Even if you could program and debug a work-flow system for all of a company's actions, maintaining the program would be difficult and costly.

Solution: The quick answer is to avoid automating processes that rely on randomness and variability. But this advice is analogous to saying you should buy a car that can only make left turns. It works, but it's worthless.

A more practical solution is to keep humans responsible for the major decision points in the process—where highly variable and complex issues are most likely to occur—and use the work-flow system to move data from one decision point to the next. This approach capitalizes on two of the primary strengths of work-flow technology: communications speed and automated record keeping.

An automated work-flow system can offer a variety of communications options, including E-mail, fax, pagers, and Electronic Data Interchange (EDI). Most engines support such industry standards as MAPI, SMTP/MIME, and OLE. These tools enable you to increase the speed and number of participants in the work-flow process.

In an automated work-flow system, you can compress the cycle time tremendously when you use electronic communications to move data among work-flow elements. By contrast, moving

data from person to person and from task to task takes up the majority of the cycle time in a manual system.

REASON #2:

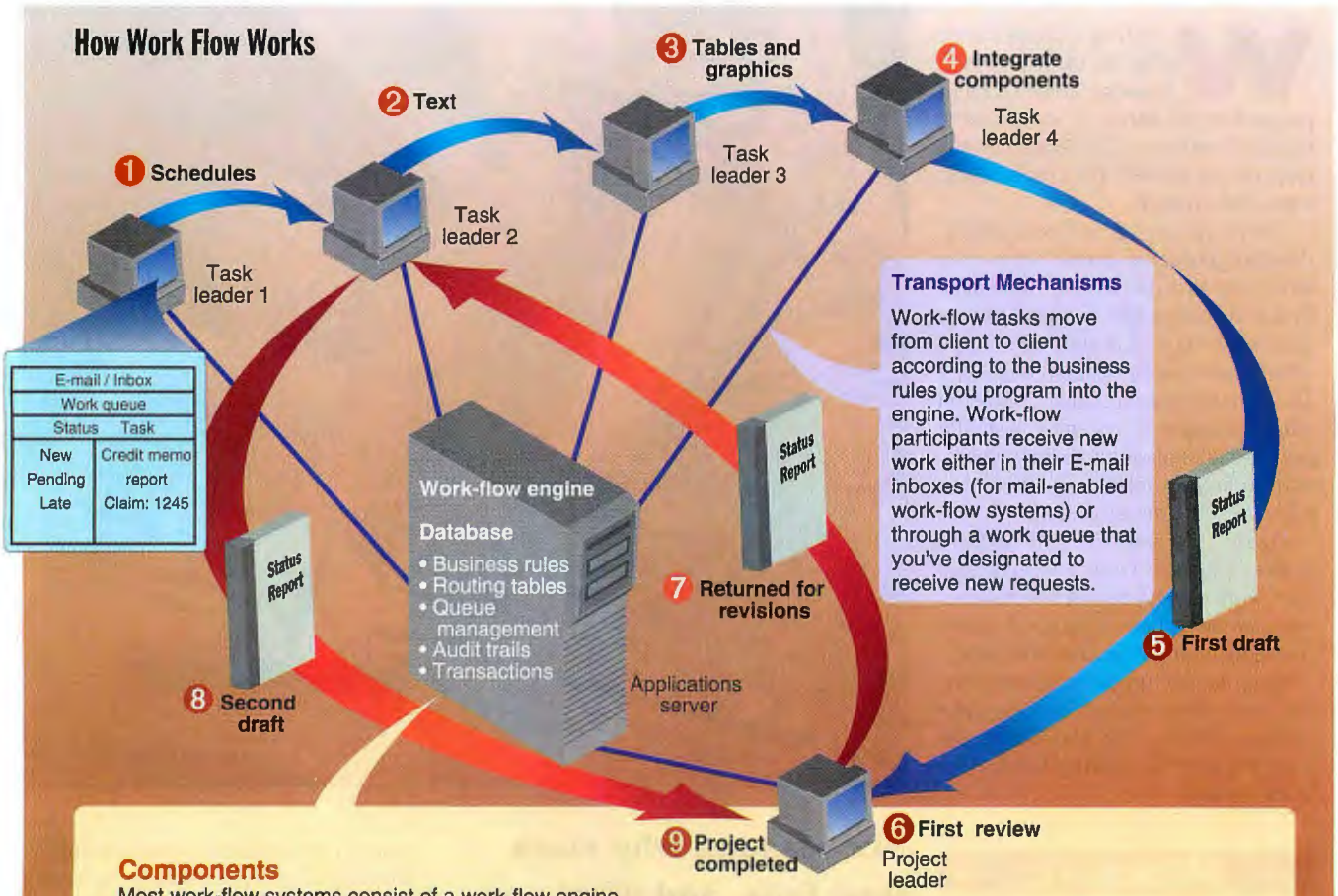
Subjective Events Define Your Work Flow

Scenario: A project manager at your company needs regular status reports from task leaders to make sure they're meeting internal schedules and to provide updates to a customer. In the current manual system, the project manager checks each report for clarity, consistency with the other reports, and proper formatting. If the project manager likes a report, it goes to the client. If not, the report travels back to the author for revision.

Analysis: Programming this process is a challenge, because the report review relies on a subjective evaluation and human intervention (e.g., what the project manager likes or doesn't like). The simple rule is, if you can't quantify it, you probably can't program it. Today's work-flow engines cannot handle ad hoc decisions or those that require the use of fuzzy logic.

The best that a work-flow system can do in this example is to receive the draft status reports in an inbound work queue, organize them for processing by their due date, run the document through a grammar/spelling checker, and pass the results to another process, where someone could quantify and score the results. Based on the scores, the system would either forward the documents to the client or send them back to the author with comments.

Here the work-flow engine adds little



Components

Most work-flow systems consist of a work-flow engine that sits on top of an applications server and interacts with work-flow clients over a LAN. The work-flow engine centrally controls and monitors each work-flow task from instantiation through completion. A company's business rules, which reside on either a proprietary or an industry-standard database, direct the work-flow engine. The business rules represent the program code and tell the engine what tasks need to be performed, who the players are, and the timing and sequence of each task. The work-flow database or repository also stores the information about each current work-flow instantiation, as well as a detailed transaction history for process monitoring and reporting.

Work-Flow Engines

Active work-flow engines monitor the state of the work-flow system and determine what tasks need to come next. When a work-flow client completes an action, it sends this information back to the work-flow engine.

Passive work-flow engines don't actively manage the work flow as it's performed. These systems rely on each client to process its particular piece of the work-flow process and send on the data or results to the next participant in the chain.

Pros and Cons

Active engines can start and stop work-flow tasks at any time. Active work-flow engines can also route work in different ways (serial, parallel, and conditional). This flexibility lets the work-flow engine take action if something doesn't go according to plan. However, if the work-flow engine or applications server goes down, the entire work-flow system crashes with it.

Passive systems aren't as flexible as active work-flow processes. However, the system still works, even if the work-flow engine happens to crash.

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value to the process, because the system can evaluate only quantitative—not qualitative—characteristics of the reports. No magic APIs or AI agents exist to help the work-flow engine subjectively evaluate work-flow events.

Solution: Quantify and convert the business rules into the format your work-flow engine expects. You should document business rules using the syntax and format that the engine requires as part of your design effort. Then evaluate the process elements from the perspective of what your engine can do.

Reduce the process map or flowchart to quantifiable business rules during the design or prototyping activities. Otherwise, you'll spend a lot of time programming functions and features outside of the engine—or, worse, you'll find out late in the development or pilot stage that the work flow just can't be automated.

REASON #3:

System Performance Degrades over Time

Scenario: Your claims-processing department uses document imaging to receive claim forms in the mail and scan the data into a work-flow system for routing and processing. But someone must manually index the documents with codes for document types, dates received, and claim numbers. The system can generate some of these indexes for date received (system date) or document ID. But for the other indexes, an operator must review each document to determine what type of document it is and how it should be processed.

Analysis: Even if the system processes the same type of document 20,000 times in a row, it cannot learn how to automatically index these documents. Indeed, instead of getting smarter about a process, work-flow systems often get dumber.

What generally happens is that a work-flow system works fine for the first few weeks. But then, as the process ages and matures over time, slight variations creep in, so there are more and more process exceptions and a greater need for exception-handling procedures (most often outside the system). Exception handling can typically require two to three times the normal cycle time, so as more exceptions creep in, system performance degrades and overall cycle times increase.

Solution: The best way to control a downward spiral in performance is to continuously monitor the work-flow process and change the program as the process changes. System performance and effectiveness correlate directly with the frequency and quality of the program maintenance you do. Look for engines that provide detailed audit trails, event logs, transaction monitors, and capacity alerts. These results can ease your maintenance burden and alert administrators in advance to processes that are going out of control.

Workgroup Snapshot

Work-flow systems are supposed to be the processing glue that cuts across the boundaries of multiple computing platforms, applications, departments, and locations. These systems would essentially run the business process, and in so doing eliminate such corporate fixtures as interoffice mail, paper, and clerical tasks.

The benefit would be efficiency through automation, which would shrink process-cycle times from weeks to days. When computers run the show, human interaction will no longer be the bottleneck to getting work done: All those pesky human-resource problems become a thing of the past.

Here's a news flash: We haven't realized that dream. Work-flow product vendors who clumsily jumped on the bandwagon are partly to blame. Some E-mail, forms, BBS, imaging, fax, and browser vendors claim that their products are, do, or know work flow. Labeling most of these products as work-flow systems is analogous to calling Visual Basic a database management system. Such mislabeling confuses buyers and makes selecting work-flow engines difficult, because there are so many players with different technical characteristics and capabilities on the market.

Today's better work-flow systems approach the market from one of two perspectives. At the high end are document-imaging product vendors; pushing up into the work-flow realm are developers of E-mail, groupware, and electronic-forms products. The current crop of work-flow engines is a combination of front-end development environments tied to common back ends, riding over de facto standard E-mail transports and connected to proprietary, simple logic-processing engines.

REASON #4:

New Tasks Corrupt Existing Designs

Scenario: You want the claims-processing system that you designed in the previous example to implement a temporary claims-handling process for a particular client that will be in effect for the next 10,000 documents.

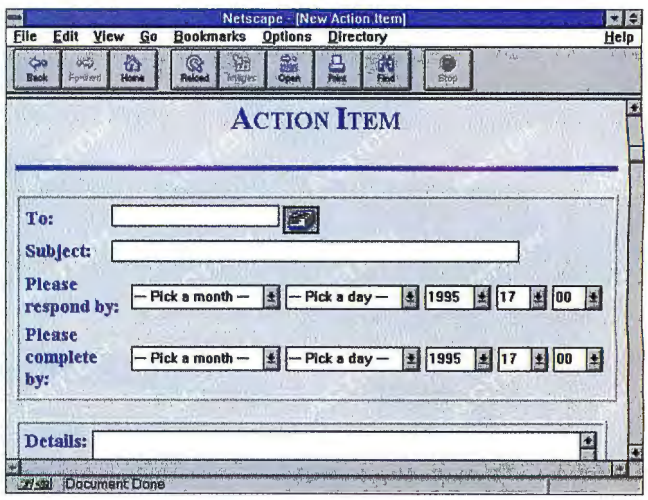
Analysis: The engine cannot respond to this situation unless you program it, and before that happens you must complete all work in progress and clear all work queues before the changes can take effect.

Solution: Select one of the new object-oriented work-flow tools on the market, such as FileNet's Visual Workflo or IBM's FlowMark. Like object-oriented programming (OOP) development tools, object-oriented work flow (OOW) makes it easier for you to build complex work flows and maintain work-flow object libraries that can streamline development. It lets you develop object libraries around common work-flow-process elements, such as approvals, routings, data validation, and security. With work-flow objects, you embed the task or work-flow data within the process rules.

OOW offers several distinct advantages over the more traditional work-flow tools. OOW tools give you fundamental OOP features, such as inheritance, encapsulation, and reusability, which help you create objects that are flexible and easy to maintain. Any changes you make to your business rules are immediately reflected in the work-flow process.

Since the data travels with the code, each work-flow instantiation is independent of the others. You can make changes to the work-flow objects without affecting work in progress. The work-flow engine can immediately recognize changes in the process when you change the object attributes. The ability to maintain class libraries reduces the work-flow development and maintenance burden.

What's the downside of OOW? The development environments are complex, and



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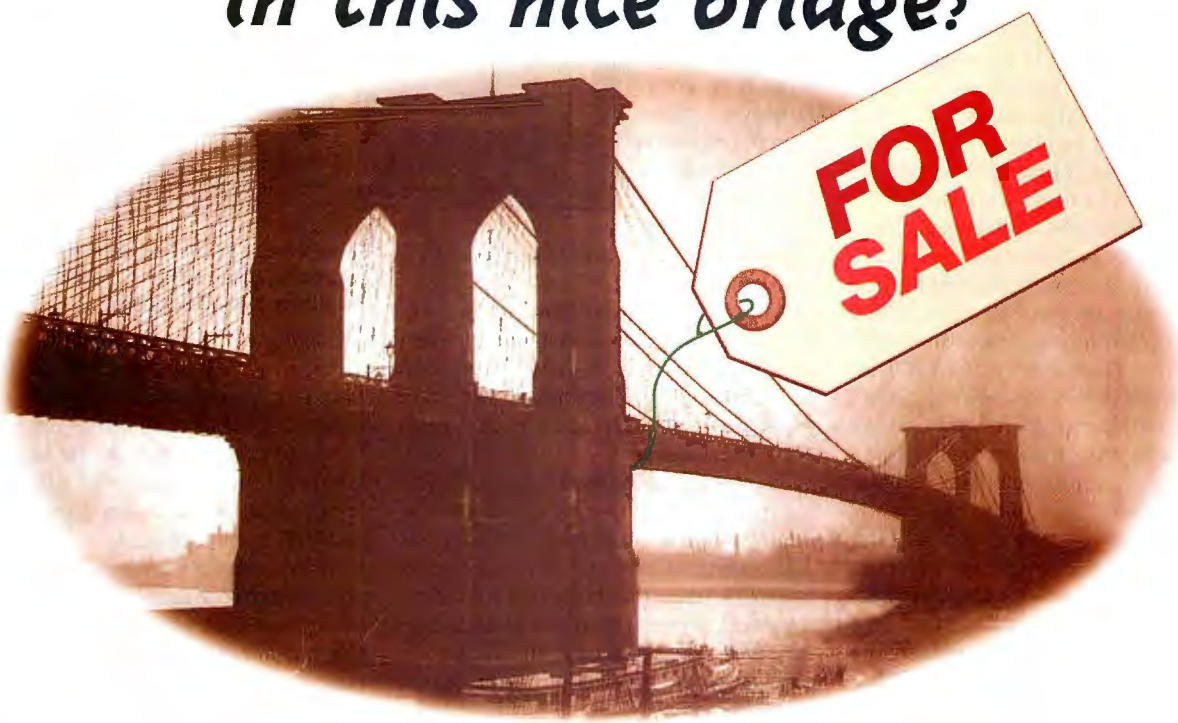

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there are few OOW standards. Each vendor takes a different approach to adding OOP functionality to its tool set, which lengthens the learning curve for developers and limits any interoperability among tool sets.

REASON #5:

Work-Flow Systems Aren't Heterogeneous

Scenario: You need to design a work-flow process that spans three departments, in different cities, with users running a mixture of DOS, Windows, and Mac systems over an IPX/SPX network. The clients connect to a combination of servers running Windows NT for applications and NetWare for file and print services.

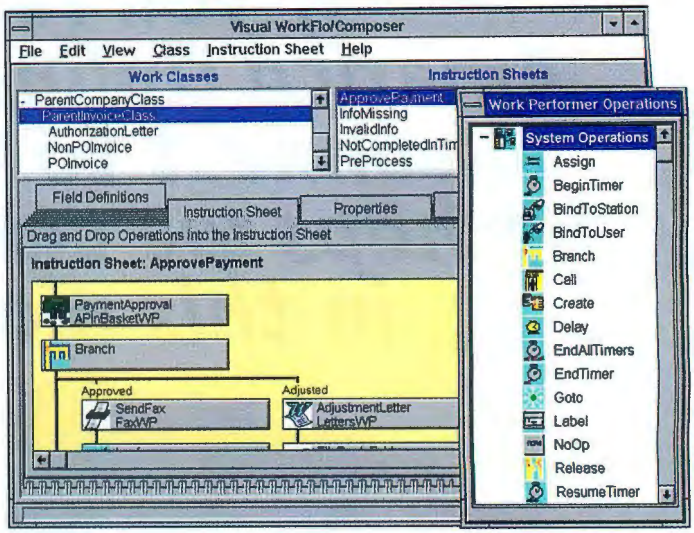
Analysis: You have a fundamental problem: Work-flow systems falter when running in heterogeneous environments. Few work-flow engines can operate on multiple-server platforms or support multiple-client OSes. The majority of work-flow vendors support Windows-based clients; however, multiple-platform and OS support might be way down on the list of priorities as vendors struggle to establish their core feature sets.

Solution: Select a work-flow tool that can operate within a variable environment. Some products, such as Computron's Work Flow and Odesta's LiveLink, support almost every client environment, including Windows, NT, OS/2, the Mac, and Unix. But make sure you understand any limitations that might come up. If you're relying on a particular work-flow feature, such as cc:Mail integration, make sure that feature is available on *every* client you might use. For example, some features that work on a Windows client cannot work on a Mac client (e.g., OLE 2.0 Controls) and vice versa.

REASON #6:

Work-Flow Systems Aren't Scalable

Scenario: You need a work-flow process that supports 1000 concurrent users for an accounts-payable system. You have a work-flow engine residing on a server in Chicago. Users in Dallas, San Francisco, and New York cannot participate in the work flow unless they are connected to the Chicago work-flow server. However, unlike E-mail or groupware products that employ server-to-server communication, work flow requires centralized processing.



FileNet's Visual Workflo is an object-oriented program that combines modules for building applications and managing work-flow systems.

Analysis: Most work-flow product vendors design engines to maintain constant control over each work-flow instantiation in progress. These engines do not share work flows or exchange business rules with other engines.

In most cases, you must store work-flow business rules on one server so that the engine can track and monitor all events and conditions centrally. This kind of architecture limits the ability of a work-flow system to support enterprise-wide and inter-enterprise processes, and it also restricts work flow to workgroup or departmental processes.

Solution: Scalability and enterprise applicability are the next logical steps for work flow. If you need this capability now or want to position your work-flow applications for the future, choose a work-flow system that's moving toward distributed work-flow engines and work-flow engines that can link to internal and external networks, such as the Internet.

Action Technologies' Action Workflow Metro connects work-flow clients to work-flow engines sitting on top of World Wide Web servers. Other vendors, such as Netscape and Microsoft, are currently building work-flow capabilities into their Internet browsers.

In addition, it's possible that in the future you might be able to use Sun's Java and IBM's VisualAge to transform browsers into full-featured work-flow and transaction-processing clients that support connections to multiple work-flow servers. Users would download applications from a Web server into a Java interpreter residing on the client. One of Java's promised benefits is that work-flow applications can be platform-independent, because the Java client interpreter has the ability to translate the application into code that the client OS and GUI can understand.

Web work-flow engines might also be able to interact with each other to exchange business rules, works in progress, and information about work-flow resources. Functions such as transaction security, data validation, and event logging will also become part of the engine's responsibility. Order-processing, customer-service, and technical-support work-flow systems might one day all become commonplace over the Internet.

Growth Experience

Work-flow products are currently still immature, but they are not alone in failing to solve some of computing's grand challenges. After all, few technologies support multiple platforms, locations, and applications while also eliminating human interaction.

The effectiveness of work-flow systems should improve when subsequent generations of products appear. In the meantime, there's simply no substitute for good programming fundamentals and a deep knowledge of your company's business processes. ■

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The Word on VLIW

DICK POUNTAIN

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Intel and HP hope to speed CPUs with VLIW technology that's riskier than RISC

The dust has barely settled in the CISC vs. RISC battle (late score: CISC won by stealing RISC's clothes). The next big one is between very long instruction words (VLIWs) and RISC. While VLIW ideas have been around since the dawn of computing—Turing designed a VLIW computer in 1946—none has been commercially successful. Yet now an Intel/Hewlett-Packard partnership intends to exploit VLIW ideas in next-generation processors.

Can even these industry giants make the concept viable? Maybe not, because VLIW, though promising massive speed gains, involves moving intelligence out of hardware and into the compiler. Success becomes a software problem—and that's a problem.

VLIW: Hardware plus Software

VLIW represents the ultimate of internal parallelism in microprocessor designs. You can do two things to make a microprocessor run faster: Speed up its clock or make it perform more operations during each clock cycle. Speeding up the clock requires inventing ever-faster (read: smaller) fabrication processes and adopting architectural features such as deep pipelines to keep the silicon busy. Performing more operations per cycle means both building multiple function units on the same chip as well as executing enough instructions concurrently—and safely—to keep those units busy.

Safely in this context means producing the correct result. For example, consider two expressions that have a data dependency, such as A:= B + C and B:= D + E. The value of variable A differs depending on which executes first—and only one of these is what the programmer intended. If you execute these expressions in parallel, how do you guarantee the right result?

This scheduling problem is the crux of modern processor design. Superscalar processors such as Intel's Pentium and Pentium Pro (P6) or HP's PA8000 employ special hardware (and lots of it) to uncover instruction dependencies. The Pentium Pro's reorder buffer is one example. However, this approach goes only so far, since the scheduling hardware increases geometrically with the number of function units and eats more chip real estate. Superscalar design already bogs down at around five or six instructions dispatched per cycle.

The alternative is to let software do all the scheduling, and that's precisely what a VLIW design does. A smart compiler can examine a program, find all instructions with no dependencies, string them together in very long batches, and execute them concurrently on an equally big array of function units. Very long instructions are typically between 256 and 1024 bits wide. Such meta-instructions contain many smaller fields, each of which directly encodes an operation for a particular function unit (see the figure "Inside a VLIW Processor" on page 62).

In hardware terms a VLIW processor is very simple, consisting of little more than a collection of function units (adders, multipliers, branch units, etc.) connected by a bus, plus some registers and caches. This is good news for semiconductor manufacturers for two reasons. First, more silicon goes to the actual processing (rather than being spent on branch prediction,

for example), so you get more bang for the buck. Second, a VLIW processor should run fast, as the only limit is the latency of the function units themselves.

Another attraction to firms like Intel: VLIW may implement old CISC instruction sets more effectively than RISC can. Why? Because programming a VLIW chip is very much like writing microcode. Back when memory was expensive, you could conserve program size by using complex instructions, like the 8086's STOS and LODS (indirect store and load). CISC implements such instructions as microprograms in a microcode ROM on the chip. Microcode is the ultimate low-level language: synchronizing gates and buses and passing data between function units.

RISC eliminated microcode in favor of hard-wired instructions. VLIW, on the other hand, is like taking that microcode off the chip and putting it into the compiler. As a result, emulating 80x86 instructions like STOS very efficiently as a set of macros should therefore be possible.

The trouble is that writing microcode is unbelievably hard. VLIW becomes viable only if a smart compiler can write it for you. This difficulty has thus far confined VLIW machines to niches such as scientific array processing and signal processing (see "Short History of Long Instructions" on page 64).

VLIW Compiler Techniques

Behind the renewed interest in VLIW architectures for general-purpose computing lie significant advances in compiler design over the last decade. A VLIW compiler packs groups of independent operations into very long instruction words in a way that uses all the function units efficiently during each cycle. The compiler discovers all the data dependencies, then determines how to resolve these dependencies—probably reordering the whole program by moving blocks of code around.

This process differs from a superscalar CPU, which uses special hardware to determine dependencies dynamically at run time. (Optimizing compilers can certainly improve the performance of a superscalar CPU, but the CPU does not depend upon them.) Most superscalar processors will detect dependencies, and schedule parallel execution, only within basic blocks (a group of consecutive statements with no halting or branching except at the end). Some reordering systems, such as those in the Pentium Pro and PA8000, are beginning to reach further afield.

To find more parallelism, a VLIW machine must look for operations from *different* basic blocks to pack into the same instruction. Trace scheduling is a common technique to do this.

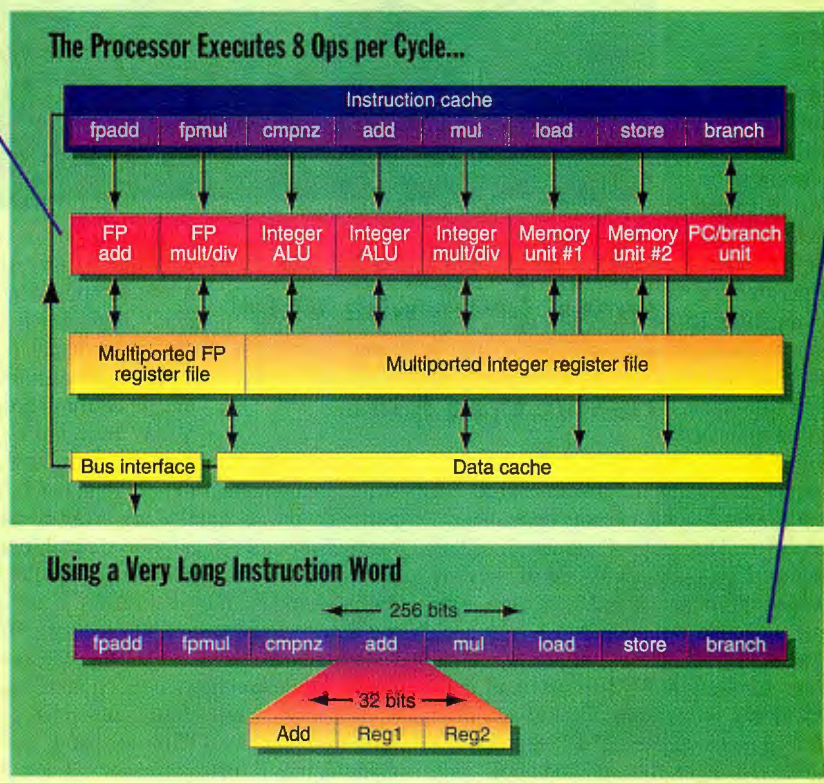
A trace is a possible path through a program—the way execution may go for some set of input data. A trace scheduling compiler optimizes at the level of whole traces rather than basic blocks. For VLIW, as for RISC, branching is the enemy of efficient execution: Typical nonscientific code contains a branch about every six instructions.

While RISC predicts branches with hardware, VLIW leaves it up to the compiler. The compiler, in turn, uses information gathered by profiling the program

INSIDE A VLIW PROCESSOR

A VLIW processor like the generic one illustrated below should execute eight operations per cycle on most cycles—with a 200-MHz clock it would be 50 to 100 percent faster than current superscalar chips. Unfortunately, such performance requires the compiler to know intimate hardware details, like the latency of each function unit.

Adding extra function units can increase performance (by reducing resource conflicts), with little effect on overall complexity. However, physical limits restrict such expansion: limited read and write ports onto the register file (which requires simultaneous access from all function units), and interconnections that rise geometrically with the number of function units. Also, the compiler must find enough parallelism in the program to warrant any extra units.



This hypothetical 256-bit-wide instruction word has eight operation fields, each one a traditional three-operand RISC-like instruction: <op> <source register> <destination register>. In practice, extra bits may hold immediate values. Each operation field can directly drive a specific function unit with minimal decoding.

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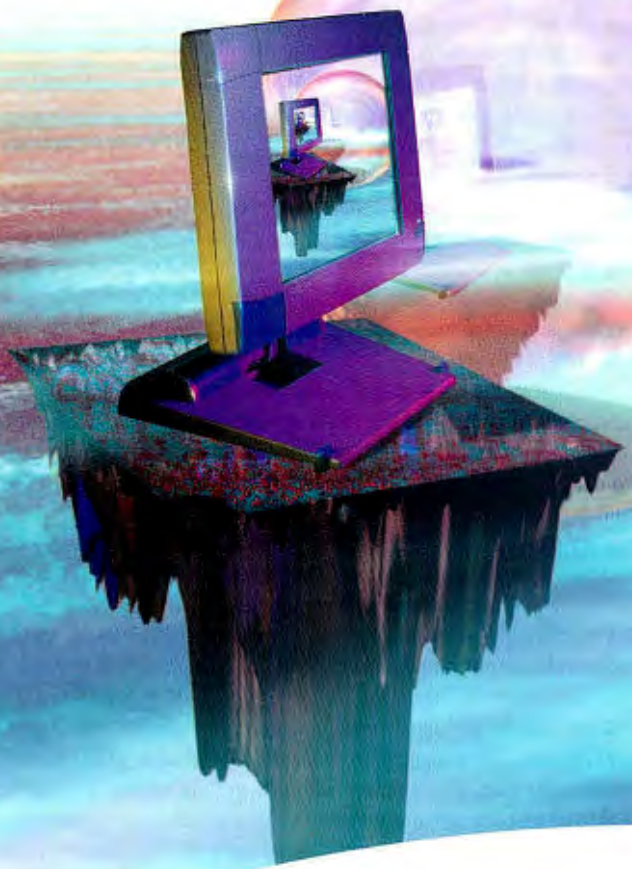

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(though future VLIW processors might add a little hardware to collect run-time branch statistics for the compiler). The compiler predicts the most likely trace and schedules it like a big basic block, then repeats this process for all other possible branch outcomes. The compiler may also perform other sophisticated code analyses and tricks, such as loop unrolling and IF-conversion (which temporarily removes all branches from the section being scheduled). Where a RISC might speculatively execute code, a VLIW compiler actually moves that code up before the predicted branch, while preserving enough program state to undo the moved code if necessary.

Proper VLIW hardware design can offer some support to the compiler. For example, a multiway branch operation allows several branches to go into a single wide instruction and perform during the same cycle. Also, conditionally executed operations, whose execution depends on the results of a previous operation, can replace many explicit software branches altogether.

The price to pay for VLIW's increased execution speed is much slower compilation and more expensive compilers. One of the few currently available, Archelon's Rocket C for Sun, costs $10,000.

The Downside of VLIW

VLIW faces other big obstacles. A VLIW compiler must have an intimate knowledge of the hardware details of its processor, down to the number of function units and even their individual latencies. So launching your next-generation CPU with more (or even just faster) units will probably break all the old software, which will require recompiling everything. Had the 486 forced everyone to throw out their 386 software, Intel's balance sheet would undoubtedly have reflected the change.

VLIW advocates suggest a two-stage compilation process. All software would come in a hardware-independent intermediate code that translates into native code only after installation on the user's machine. The OSF's Architecture-Neutral Distribution Format (ANDF) shows that such a system can work. However, while cross-platform software is a desirable goal, PC software developers are often slow to adopt radically new technologies.

Another issue arises over the static nature of VLIW compiler optimizations. How well will such programs perform when faced with dynamic run-time events (such as waiting for I/O) unforeseen at compile time? VLIW arose to meet the needs of scientific number crunching, but it might prove less capable on the sorts of object-oriented and event-driven programs that are more common in the PC community. Not only that: How can you verify that a compiler performing such extensive transformations will preserve the correctness of your programs? The truth is, nobody knows. VLIW compilers are still primarily an *objet de recherche.*

So will the Intel/HP VLIW gamble pay off? They've already started to hedge their bets about moving to a purely VLIW architecture. Intel now intends to produce a version of the P7 that's a straight successor to the Pentium Pro, directly executing x86 instructions. HP will work on a VLIW version of P7 that emulates both x86 and PA-RISC instructions. Target speed: 1 billion instructions per second.

Should Intel/HP's VLIW adventure not pan out, it certainly won't be the first time—nor will it be the last. The intricacies of coordinating VLIW hardware and software offer challenges that have eluded researchers before. It should come as no surprise that the lure of ever-greater speed may sometimes lead down blind alleys. ■

Dick Pountain is a BYTE contributing editor based in London. You can reach him at dickp@bix.com.

Short History of Long Instructions

Very long instruction word (VLIW) ideas came from the horizontal (i.e., parallel) microcode way back in computing's earliest days and from the first supercomputers such as the Control Data CDC6600 and IBM 360/91. In the 1970s, many attached array processors and dedicated signal processors used VLIW-like wide instructions in ROM to compute fast Fourier transforms and other algorithms.

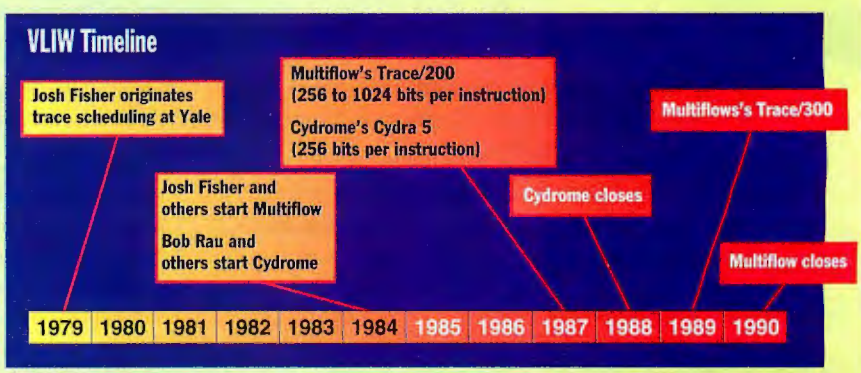
The first true VLIW machines were minisupercomputers in the early 1980s from three companies: Multiflow, Culler, and Cydrome. They were not a commercial success. Still, the compiler-writing experience from these endeavors didn't go to waste: Hewlett-Packard bought Multiflow, and now Josh Fisher (ex-Multiflow) and Bob Rau (ex-Cydrome) lead HP's VLIW compiler effort. Trace scheduling and software pipelining, pioneered by Fisher and Rau, respectively, are now central pillars of VLIW compiler technology.

The trailblazing Multiflow 7/300 used two integer ALUs, two floating-point ALUs, and a branch unit (all built from multiple chips). Its 256-bit instruction word contained seven 32-bit operation codes. The integer units could each perform two operations per 130-ns cycle (i.e., four in all) for a performance of about 30 integer MIPS. You could also combine 7/300s to build 512- and 1024-bit-wide machines.

Cydrome's pioneering Cydra 5 also used a 256-bit instruction word, with a special mode that executed each instruction as a sequence of six 40-bit operations. Its compilers could therefore generate a mix of parallel and conventional sequential code.

While both those VLIW machines used multiple chips, some regard Intel's i860 as the first single-chip VLIW. It depends on the compiler rather than on the hardware to sequence operations correctly.

VLIW isn't solely for CPUs. Holland's Philips Semiconductors, another VLIW innovator, recently launched its VLIW TriMedia digital signal processor chip. TriMedia aims at high-end applications such as multimedia PCs, videoconferencing, TV set-top boxes, and digital video cameras. The goal is to be fast enough to eliminate the need for a host CPU and cheap enough at $50 to keep total system cost down. Such dedicated niche applications may keep VLIW on the charts.



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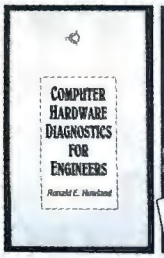

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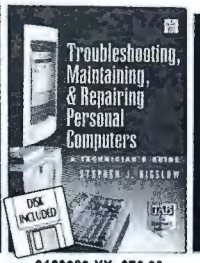

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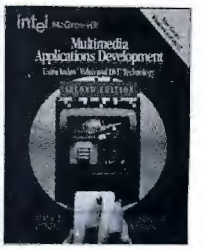

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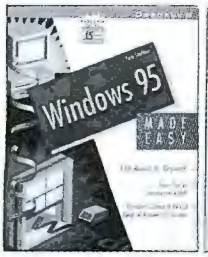

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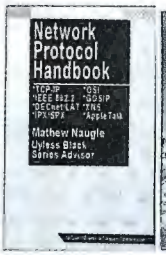

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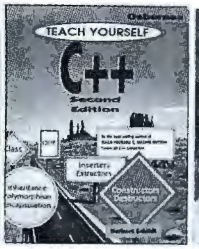

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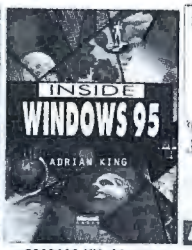

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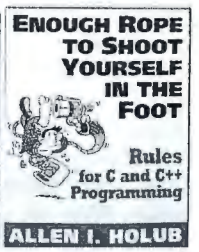

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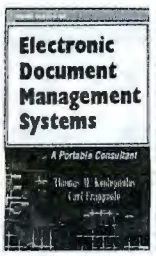

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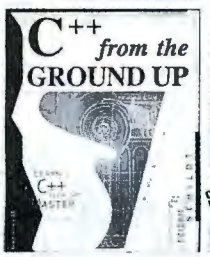

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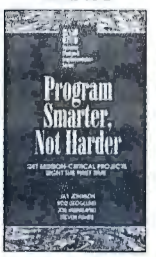

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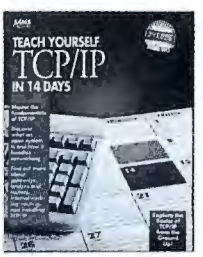

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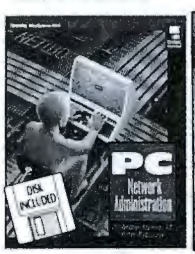

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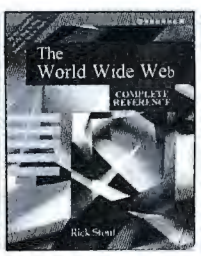

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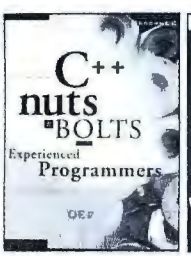

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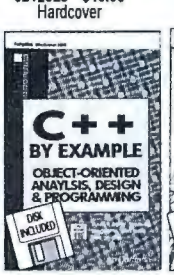

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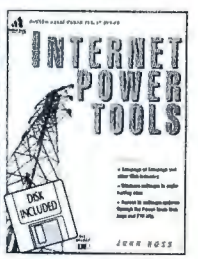

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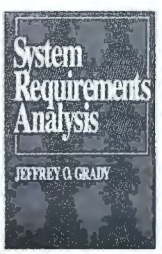

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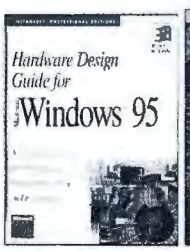

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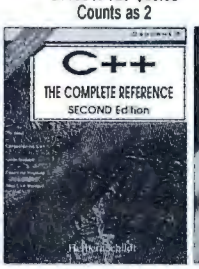

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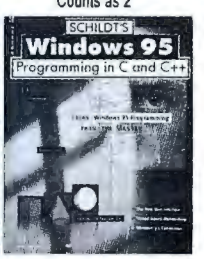

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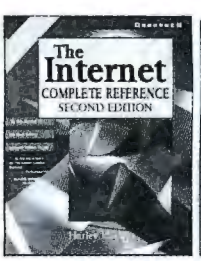

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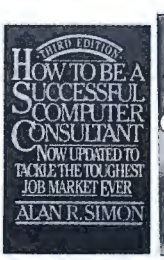

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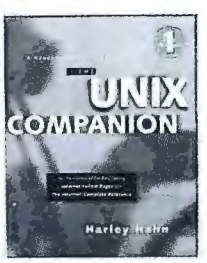

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When COBOL Is Cool

DAVID W. BAUM

First Image was addicted to COBOL. Fast growth and acquisitions brought a dozen mainframes and minicomputers into the fold of this electronic document and image management company. What did these large computer systems all have in common, besides their spiraling maintenance costs? COBOL programs—7000 of them, to be exact.

So, when First Image decided that it could no longer afford its mainframes, weaning itself from a COBOL dependency seemed about as pleasant as checking into the Betty Ford Center. "We didn't want to step onto a new platform and have to spend five years rewriting all our applications," says Brian Altman, vice president of technical development, who often talks about First Image as if it were an aircraft and his development staff the ground crew. "Rather than trying to build an entirely new airplane, we simply converted some of its key parts," he adds. That meant that First Image would stick with COBOL.

The approach paid off. At the start of the transition, First Image learned that its existing programs could run fine on Unix workstations and servers as long as programmers addressed some key technical issues. Then its latest acquisition—a division of NCR—imposed a breakneck deadline on the development staff to integrate NCR's additional 8000 mainframe programs into First Image's production system.

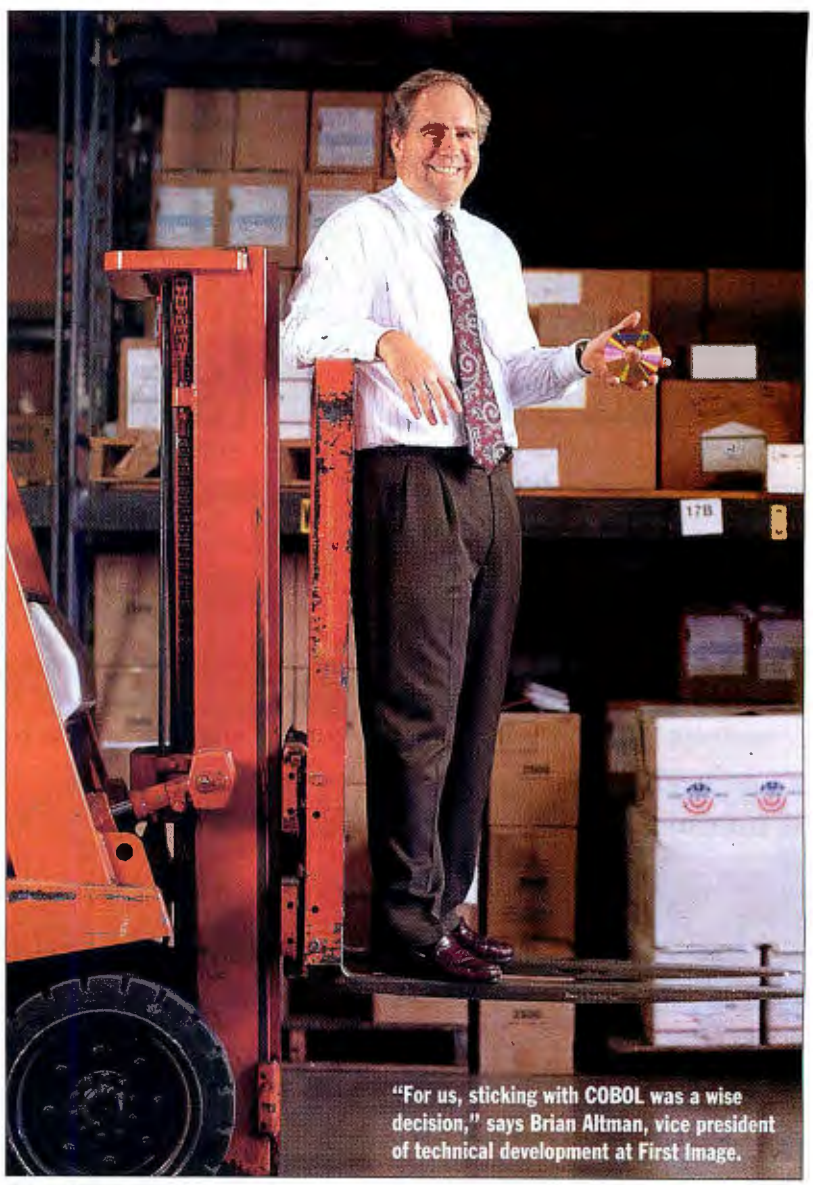
Every day that First Image would have spent rewriting those COBOL programs was a day the company wouldn't be recouping its acquisition costs. By staying with COBOL and rewriting only a fraction of the code, First Image installed its workstation network and kept the business running efficiently enough to serve its existing customers and even take on some new business.

"A lot of people told us we should rewrite all our COBOL code in C," Altman recalls. "Two years ago, I might have agreed. Today, I realize that COBOL is a dynamic language in its own right with an enormous user base and a future. It's very open and transferable as an application language."

Staying Current

Although the NCR acquisition catapulted First Image's downsizing efforts, the company had already begun to shut down its mainframes. Altman wanted to pave the way for emerging technologies, such as imaging, document processing, database retrieval, and archiving, all of which were strongest on Unix and client/server platforms and stagnant on mainframe platforms.

These new technologies play directly into First Image's core business. Headquartered in Atlanta, Georgia, First Image helps other large corporations manage, organize, and distribute their information more efficiently. "Most companies create more information than they can deal with effectively, making seemingly simple tasks, such as formatting and printing monthly account statements, an immense chore," Altman says. "Our specialty is or-



"For us, sticking with COBOL was a wise decision," says Brian Altman, vice president of technical development at First Image.

PHOTO: PETER FOX © 1996

Replacing your mainframes with workstations is easy; the pain comes when you have to convert thousands of mainframe programs without missing a day's work

ganizing, manufacturing, and distributing information in the right format, where it is needed and when it is needed."

First Image's services include data acquisition and conversion, imaging, document processing, database retrieval, archiving, and distribution. For example, the company creates and distributes monthly account statements to a multinational customer base for one large mutual-fund group. And for the Ellis Island immigration authorities in New York, First Image regularly organizes immense databases of information onto easy-to-read CD-ROMs.

"We are a clearinghouse for people who want to transform electronic documents into any human-readable form or transform human-readable documents into any electronic form," Altman explains. In four years, First Image's annual revenues grew from $80 million to $250 million. Today the firm operates 90 sites in the U.S. and claims annual sales of approximately $275 million.

As the company expanded, it acquired several other companies, each with unique information systems. When First Image's managers decided to downsize, they knew the changeover wasn't going to be easy, but the motivation was clear. "To continue to grow, we had to establish a common [hardware and software] topology," Altman says. "We wanted a common, low-cost hardware platform to take advantage of the downward spiral in the cost of CPU power and peripherals. There was just this small matter of 15,000 old COBOL programs," he adds.

Glass-House Menagerie

First, the technical staff at First Image had to determine the best microprocessor-based platforms for COBOL. Many programmers consider COBOL a mainframe language, but First Image discovered that there are COBOL compilers on just about every type of computer, including Unix workstations and PCs. "What runs on an IBM 370 or 390 platform will, for the most part, run on a smaller platform," Altman notes. "The compilers are mature, with well-established standards."

Sun Microsystems' implementation of COBOL on its SparcStation platform and Sun's Solaris OS particularly impressed Altman. Some of First Image's largest customers also rely on this Sun gear, which simplified compatibility issues. These factors convinced First Image to purchase 15 Sun SparcStation 20 and SparcStation 1000 workstations running Solaris 2.3, which now are connected to a TCP/IP WAN.

First Image then evaluated several COBOL development and run-time environments for the Solaris platform. The company especially needed an environment that included strong code-conversion tools, since this would determine the success or failure of a mainframe-to-Unix porting effort. Altman and his team established several criteria for the COBOL environment, including the following:

- The ability to move programs without modification.
- Overall system performance on the workstations that was equal to or better than the existing mainframe performance.
- A COBOL compiler for Solaris that could accommodate new development and ongoing changes to the code.

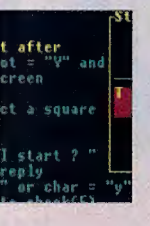
Selecting the Tools

After evaluating several Unix-based COBOL development environments against these criteria, Altman and his team chose Micro Focus and its family of products: Micro Focus COBOL for Unix, Micro Focus Toolbox for the Sun platform, and Micro Focus COBOL Workbench for DOS and Windows. Altman says he perceives Micro Focus as a market leader, and Sun recommended the products as well. He also considered AcuCobol and a competing product from Computer Associates—CA-Realia—

LOSING MAINFRAMES

The Challenge

Convert 15,000 COBOL programs designed for a variety of mainframe computers to run under a Unix-based client/server system.



The Problem

A corporate acquisition creates an immediate need to port production programs to the new platform. Development staff is inexperienced with Unix and the porting tools.

The Solution

Keep existing COBOL programs intact by rewriting a minimum of code.

The Benefits

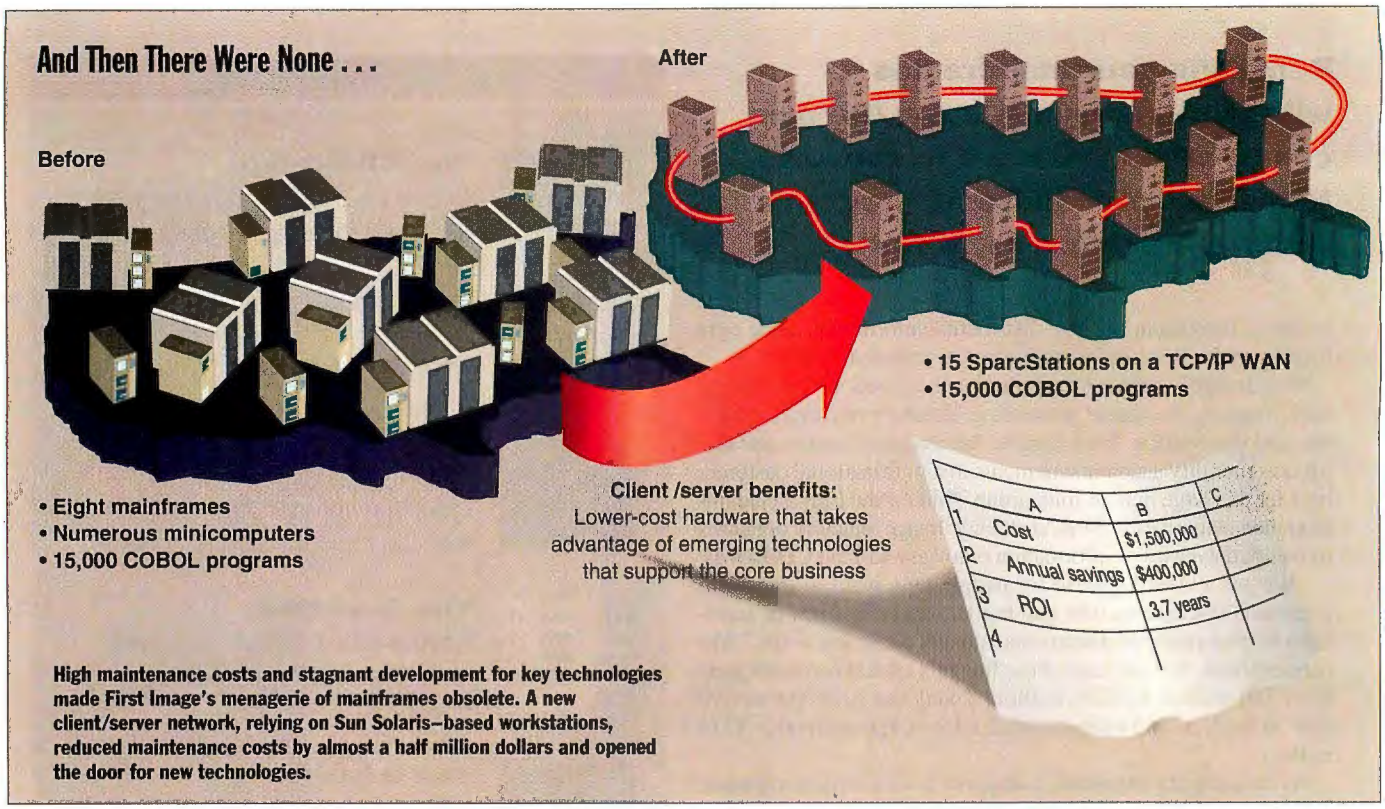
A better position to adopt new technologies; annual savings of $400,000 per year.

Lessons Learned

Don't rewrite everything in C. COBOL can be a dynamic language for business applications, regardless of the platform that's used.

Words of Wisdom

Make sure technical managers understand business goals; elicit strong support from upper management. Otherwise, business issues that can stall or stop the project will creep in.



High maintenance costs and stagnant development for key technologies made First Image's menagerie of mainframes obsolete. A new client/server network, relying on Sun Solaris–based workstations, reduced maintenance costs by almost a half million dollars and opened the door for new technologies.

but did not formally evaluate either one.

First Image uses Micro Focus COBOL for Unix as the main development environment. Together with the Toolbox, it integrates a COBOL compiler with workstation-based development and testing tools. The Workbench includes a graphical development environment, GUI data management tools, and extensive COBOL syntax and behavior support. Programmers can use the software to develop applications that run on mainframes, workstations, minicomputers, and PCs.

Altman says the visual nature of these tools aids productivity because developers can have several active windows open simultaneously. This means developers can test in one window, edit in another, compile in a third, and move from one to the next by pointing and clicking.

First Image's developers particularly like Micro Focus's Animator component, which lets them visually monitor the execution of a COBOL program for testing and troubleshooting. They can watch programs run and see potential problems without impacting other applications and processes on the production platform.

Before committing to Micro Focus, First Image tested it on some small COBOL applications. "Not only did the code convert from platform to platform very easily, but we found the processor speed to be equal to or better than that of a large IBM mainframe running the same program," Altman says.

The real challenges and learning curve came as mainframe programmers strove to become proficient with Unix and its different editors, OS functions, ways of addressing system memory, and so forth. For a couple of weeks, First Image conducted formal training sessions in conjunction with Micro Focus; then it set up a core competency group to answer questions for the rest of the staff. "For the most part, we dove in and learned as we went along," Altman explains.

When developers were performing a few final tests with the new tools, an unforeseen event spurred them to action: the acquisition of the Data Copy Division of NCR. First Image had the option to either purchase the NCR division, along with its mainframe computers, or leave the mainframes out of the deal and simply purchase the mainframe code. It chose the code.

"We went from zero to 900 miles per hour in two days," Altman notes. "Suddenly, we had both the funding and the motivation to begin a large-scale mainframe-to-Unix port. We had to complete the code-conversion project before we could reap any real business benefit from the NCR deal. So we had to move fast."

And move fast they did, converting 8000 COBOL mainframe programs to the Solaris platform in just four months. "It was like walking through a dark room with foreign furniture," Altman recalls. "We knew nothing about the [former NCR] programs, we had no experience with the new computer gear, and we were using a COBOL compiler that we had little practical experience with."

How did the company make the daunting transition happen? Terry Wade, chief financial officer at First Image, says the philosophy that kept the company from getting into trouble as it carried out the downsizing project was a simple one: Do not try to change everything at once.

"Your costs can spiral out of control in a downsizing effort if you try to change too much too fast or expect all your mainframe programmers to suddenly become proficient with the C language and personal computers," Wade says. "In the early days of data processing, the computer was the most expensive resource. Now the people are the most expensive resource, especially the teams of programmers needed to write and rewrite software applications."

The project had its share of glitches. The first was a management misstep: Top-level managers lost sight of the project's focus, and the development staff had to remind them that the COBOL-conversion effort was just as important as any new development activities, because the former NCR programs were revenue-generating systems. "In [management's] view,

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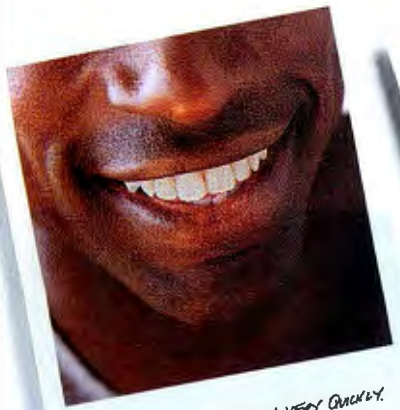

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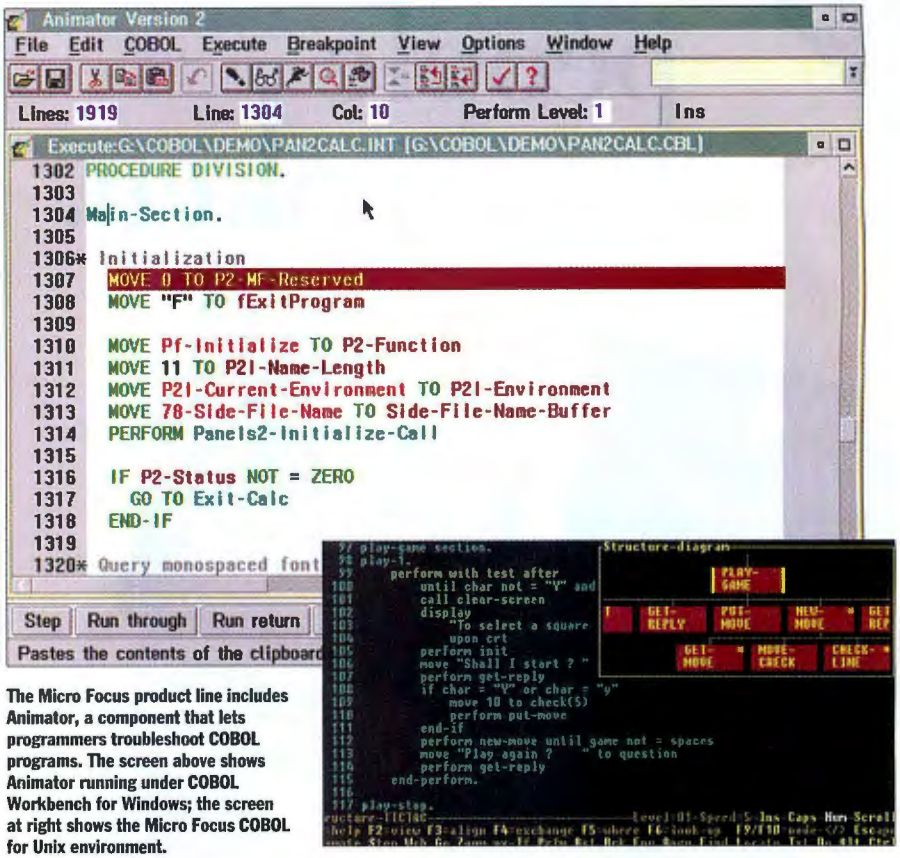
the people devoted to swapping out the engine on the plane could have been devoted to building a new plane," Altman explains.

Technical problems centered around getting information off tapes and putting in place a consistent way to convert EBCDIC code to ASCII code. The I/O capabilities of the Micro Focus products weren't designed for the variety of tape formats that First Image encountered. Altman's team had to do some programming to get the I/O routines off the tapes.

In hindsight, the technical staff's bold maneuver was equivalent to changing the engine on an airplane that's in flight, says Wade. "Since this code was the key ingredient to our revenue base, we couldn't afford to lose a single customer during the conversion," he notes. But the risk paid off. "With the mainframes out of the picture, we estimate an annual savings in computer operations and maintenance of $400,000," he adds. "That translates into an ROI of a little more than three years."

First Image kept costs down for the $1.5 million downsizing project in part because it didn't have to add additional staff. Also, the 10 Micro Focus COBOL Workbench licenses, at $3000 each, represented only about 2 percent of the total project cost.

To obtain a foothold on the new platform, First Image migrated large portions of the code base intact. The company rewrote only what had to be rewritten for performance or reusability reasons. Altman estimates that this amounted to only about 5 percent to 10 percent of the code. The small rewriting demand was one reason why the company didn't lose any existing business during the NCR conversion—and evn added some new business.



The Micro Focus product line includes Animator, a component that lets programmers troubleshoot COBOL programs. The screen above shows Animator running under COBOL Workbench for Windows; the screen at right shows the Micro Focus COBOL for Unix environment.

Smooth Landing

As the dust started to settle following the first wave of the program-conversion process, Altman and his colleagues devised a careful migration strategy to ensure a smooth landing. For example, all procedural code and applications programs remain written in COBOL "because of our investment and skill base," he explains. "Programmers come and go, but COBOL is verbose—almost self-documenting—making it easier for one developer to take up where another developer leaves off."

Perhaps more important, there's a huge reservoir of people who know COBOL, and these developers are often accustomed to production requirements. "COBOL developers know how to write programs that work every single time," Altman says. "Our C programmers have written some very sophisticated applications, but not one of them has written a system to deliver payroll, or a general ledger, or a core-business process."

Once it converted the NCR programs, First Image turned to its own mainframe programs at five different sites. In less than a year, the staff ported all the 15,000 programs from eight mainframe computers.

Staying Power

COBOL may be First Image's strategic choice for legacy applications, but when it comes to new development, the company's use of COBOL is strictly tactical. The company carries out new development with a combination of tools on PC and Unix platforms. For example, it used the Oracle 7 relational database and Sybase's PowerBuilder development tools to build a new order-entry system "simply because that made the best sense for this particular application," according to Altman.

While Oracle 7 can handle First Image's large production database requirements, the company chose PowerBuilder for its rapid application development (RAD) capabilities, such as live prototyping. "The trick is using the right tool for each project," Altman says. "When we need a batch process to convert images from machine-readable to human-readable form, we use Micro Focus COBOL. Our developers are striving to achieve a high degree of reusability so that we don't have to rewrite the code for each customer. We've begun to implement better inventory management and code management practices, and we are considering Object COBOL for upcoming tasks," he adds.

Some companies choose to take an all-or-nothing approach to downsizing and client/server challenges, Altman concludes. They want to adopt brand-new tools and simply throw away all the old ones. "But don't throw away your hammer just because you think you have a good screwdriver," he says. "For us, sticking with COBOL was a wise decision. It remains one of our core competencies." ■

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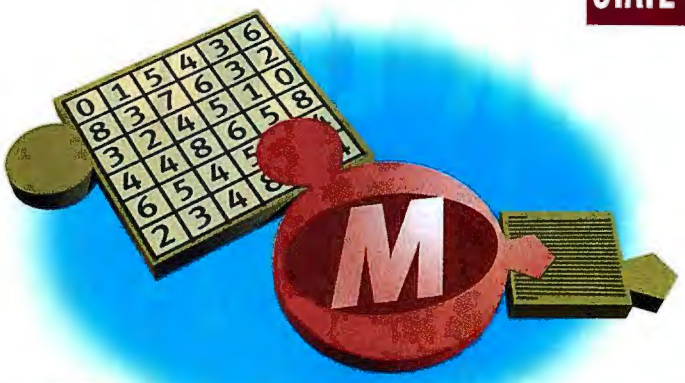
THE MIDDLEWARE RIDDLE



What is it? Why is it? And how can you leverage its power?

When you think of frightening places, your server closet probably isn't one. But fear has many forms. Is that the ghost of mainframe database past? Is that the multiheaded API monster? Are those the four protocols of the apocalypse?

Maybe that's a bit silly, but programmers today face impossible tasks: dealing with multiple APIs, making applications portable to any network, connecting to any database. All the "standards" that were supposed to make their lives easier didn't. Instead, they must know the specifics of each one to create their applications. Nobody has time for this mess. And that is what middleware is for: to make the muddle in the back room sufficiently abstract, which in turn enables real people to write applications for it.

Middleware succeeds in this task by providing five main services: hardware independence, interchangeability of key software components (e.g., DBMSes), network independence, operational savings (i.e., some middleware facilitates manual load balancing), and administrative savings (e.g., if you need to redeploy a server piece to a different box, you can simply change its location in the middleware component).

We zero in on cross-platform access to databases in this State of the Art. John R. Rymer tackles the task of defining middleware, and differentiating among products, in "The Muddle in the Middle." In "Middle(ware) Management," Salvatore Salamone offers tips for anyone buying or implementing middleware solutions. Finally, John Kador looks at where middleware may be heading in "The Ultimate Middleware." His ideas may surprise you.

Middleware Diversity

The term *middleware* might refer to anything from your cerebellum to the herds of wild electrons that are galloping along silicon mesas. To make it even more confusing—if that's indeed possible—different areas of computing use the same term differently. Here's a sampling of some other middleware technologies.

A cottage industry is growing up around mobile and remote-access methodologies. The goal is to ease the strains of remote connection. Another example: telephony middleware. Systems—typically APIs for connecting telephone and data networks, and videoconferencing—are coming to you from industry heavyweights and newcomers alike.

Document management has its middleware, too. These APIs receive documents from multiple sources, store them, and provide controlled access and editing services.

It seems any difficult task is a target for middleware, even creating graphics. Writing GUIs has never been easy—especially 3-D GUIs, for frivolous games to serious business applications.

No matter which part of the middleware world you're looking at, it is one segment of the software business that is growing explosively. It also makes life easier for developers of all kinds of applications. So what's not to like about middleware? Nothing—except that name. ■

—**Edmund X. DeJesus, Senior Editor**

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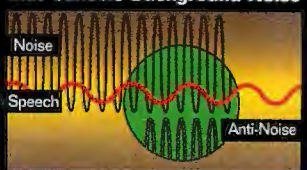

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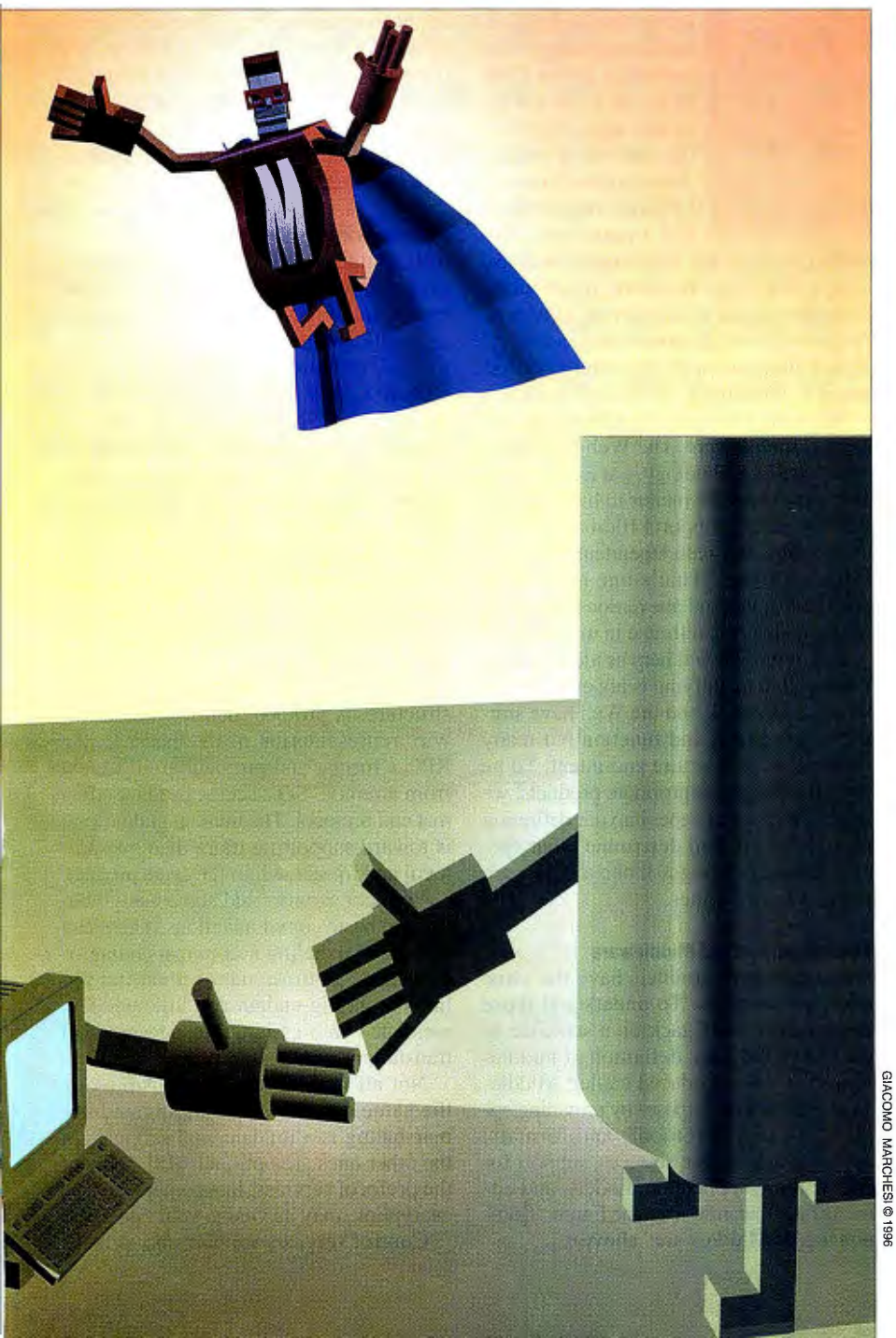
THE MUDDLE IN THE MIDDLE

Middleware's everywhere as developers look for ways to streamline client/server systems

JOHN R. RYMER



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Middleware *n* **1:** stuff that links clients and servers (helpful, but vague) **2:** the slash in client/server (not helpful, but clever) **3:** software to manage communications with databases (clearer, but do all client/server applications involve database transactions?).

Such vague definitions of middleware are becoming a problem. Not for you? Think again. Because distributed-computing architectures affect nearly all commercial applications, middleware has become the key technology to build or buy. Your choice of middleware may be more important than your choice of OSes. It makes sense: You want developers to do their thing independently of hardware, and you want to simplify operations with a central point of administration. Corporations should be striving to establish a strategic middleware platform to support their varied application needs now and through the millennium. Yet without a clear definition of terms, each new application project will result in the purchase of a new middleware platform. The consequence will be a variety of redundant, incomplete, and even contradictory products.

Most organizations already have a middleware muddle on their hands. Having purchased SQL middleware from database vendors in the early 1990s, many found disappointment in the limited scalability, performance, and range of functions these products offered. Organizations are repeating this scenario by using new development tools (e.g., Forté and Open Environment's Entera) without proper evaluation of the middleware those tools incorporate.

The changing nature of middleware compounds this confusion. Middleware products are evolving from specialized system-level facilities to broad-based environments supporting many types of applications. Those low-level interfaces and protocols that only rocket-scientist network programmers could master are now

Middleware was once communications software only. However, today's middleware includes development tools, an execution environment, and deployment facilities. Of these three components, the execution environment is typically the primary thrust of middleware. Deployment facilities and development tools are often either rudimentary or absent.

turning into application-level products that mere mortals can navigate successfully. Middleware has evolved from products such as IBM's APPC, an interface to the LU6.2 protocol, to today's application-level products. Now, middleware is evolving from products that perform only one function—such as remote SQL access—to those capable of many functions.

Defining Middleware

Can't define middleware, but you know it when you see it? Pop-quiz time. Is Information Builders' EDA/SQL middleware? OK, that one's easy. What about Novell NetWare? Hmm. How about the Internet's World Wide Web? Is that middleware? Well, maybe a definition wouldn't hurt.

Middleware is software that allows elements of applications to interoperate across network links, despite differences in underlying communications protocols, system architectures, OSes, databases, and other application services.

The key parts of this definition are "elements of applications," "interoperate," and "despite differences." First, middleware isn't meant specifically to link physical clients and servers (that's the job of connectivity protocols such as TCP/IP). Rather, middleware seeks to link the logical elements within applications. Second, the paramount goal of middleware is any-to-any interoperability. Application modules interoperate using a variety of methods, including file exchanges and sharing, shared databases, transactions, and remote procedure calls (RPCs). Third, middleware shields applications from diversity in the underlying environment. Middleware helps your applications operate happily in any environment.

We can recognize EDA/SQL in this definition. We also recognize messaging products such as IBM's MQSeries transactional middleware. However, using this definition, we can also answer the question about NetWare. It is, in a way, middleware. NetWare can link logical application elements. It does so by supporting network file operations. Novell's new Net2000 API initiative will also support database operations, transactions, and other modes of interaction. However, NetWare is still hardware-dependent, so it fails the test about overcoming differences in underlying system architectures.

We can, however, conclude that the Web is middleware. The Web isn't a private network technology—at least not yet. But it provides the means to link application elements, supports file-based interoperability, and is independent of underlying platforms. That's one of its most popular features and one reason some think of the Web as the ultimate in middleware.

Our definition will help us identify middleware, but identifying is not enough. After all, EDA/SQL and the Web have similarities in intent and function but many differences in structure and intent. To be able to select the appropriate products, we need to dive a bit deeper into our definition of middleware and determine what specific features distinguish one middleware product from another.

The Components of Middleware

All middleware products have the same basic components. To understand those components, we'll tack on a sentence to the end of the basic definition of middleware that was introduced earlier: Middleware achieves its purposes by providing application-level protocols and formats, access to application services, support for one or more application models, and administrative facilities (see the figure "Components of Middleware" above).

Middleware products address all three phases of applications development: development, execution, and deployment (including management). Of course, most of us are interested in the execution environment. Over the last several years, middleware has expanded in this area.

In the early days, middleware was almost totally communications software. For example, PeerLogic's Pipes platform, Intersolv's recently acquired SequeLink, and Software AG's Entire Broker are almost pure communications products. Now, however, the execution environment includes application services (e.g., transaction monitors, SQL optimization and routing, and database replication). The trend during the last year has been toward bundling: Vendors bundle communications and other products and integrate them with application services.

Communications Services

Still, middleware starts with communications services. The communications protocols and formats of middleware describe interactions among application components. By contrast, TCP/IP, Novell's IPX/SPX, and IBM's Systems Network Architecture (SNA) protocols are network transport protocols, not to be confused with middleware. Middleware communications services do use these and other networking protocols. Middleware provides three basic communications services: formats and protocols, protocol services, and control services.

A format describes the structure of a message that will travel across the wire, including the syntax required to create that structure. A protocol defines the on-the-wire representation of the message. An RPC's format and protocol are different from a remote SQL access product's format and protocol. The trend in middleware is toward supporting more than one protocol and format within the same product.

Protocol services add some useful features to basic communications. These can include marshaling and unmarshaling of messages, platform data-format translations (e.g., big-endian and little-endian), message compression, transport protocol translation, and message encryption.

Not all middleware products provide the same services. Marshaling and unmarshaling is a fundamental service, but the other ones are optional. Still, some of the protocol services, like compression or encryption, may be vital to your operation.

Control services support one or more

communications model or style of distributed processing. Each model differs in the way it structures communications among the elements of applications. Control services provide the signaling protocols, queues, message binding, and other services required to support each communications model.

The 10 Communications Models

There are 10 communications models that middleware control services support: datagram, one-shot, query, asymmetric, and symmetric models, each in network-dependent and network-independent flavors (see the table at the right). A key characteristic of each model is the need for an immediately available network link. Network-independent models have message-queuing facilities that effectively allow postponing the completion of an interaction if no link is available. Benefits can include sharing of network resources and deferral of communications until low-cost hours.

Each communications model specifies a style of interaction between two (or more) application elements. For example, the datagram is one-way: An application sends out a message without expecting any response. This model is useful for applications that monitor devices, systems, and other applications.

By contrast, in the one-shot model, an application issues a single request message and expects a single message back. For example, a formula and some values might go to a fast calculation server, and the result would return.

The query model is similar to the one-shot model, except that the sender expects more than one response. For example, a database query triggers a chain of messages bearing the results set.

The asymmetric and symmetric models can raise the throughput of messages by allowing applications to send and receive as swiftly as bandwidth availability permits. In asymmetric models, incoming and outgoing messages share a single communications channel, so the module can send or receive but not both at the same time. With symmetric models, incoming and outgoing messages have their own channels. Both models must track the context of a given interaction within a flurry of messages.

What about synchronous and asynchronous communications? You should forget about them. At one time, they represented a real distinction among middleware products. However, in recent years, vendors of so-called synchronous technologies have added asynchronous capabilities to their products. Also, vendors of asynchronous products have added support for synchronous modes of communication. Therefore, this distinction has for the most part disappeared.

Evaluating middleware using the 10 communications models listed here is more productive.

What's Your Name and Who Are You?

The execution environment of middleware also includes core services. These support the operation of middleware products in several ways.

The most important core services are logical name management and security. Name-management services, often called *directories,* map the logical names of application modules to their physical addresses in the environment. Security services control access to application modules. For example, the Open Software Foundation's (OSF) Distributed Computing Environment (DCE) contains naming and directory services and a security service.

Other core services include distributed memory management, gateways to external systems, and server-to-server communications services that can segment large environments into domains.

The trend is to let the user choose those core services needed rather than bundle them with a product. For example, Open Horizon's Connection lets the user choose from among several security and directory products. So does Entire Broker. Both products use available APIs to directory and security to give the user a choice.

Applications with Personality

The execution environment also includes application services that support the guts of application functions, such as SQL database access, transaction processing, E-mail distribution, work flow, and document management. Application services give middleware a personality stamp that users recognize (e.g., submitting a customer order or confirming inventory).

Middleware today offers 10 such personalities, which we call *application models* (see the table on page 70). The application models appear in order from the most concrete, at the top, to the most abstract, at the bottom.

Store-and-forward and publish-and-subscribe are models that users will probably recognize. Store-and-forward is the basis for E-mail. Publish-and-subscribe is an up-and-coming model used in systems integration. The two models are related. The difference: In the subscribe half of publish-and-subscribe, application modules "pull" data in from other modules. In store-and-forward (and the publish half of publish-and-subscribe), modules solely push data out to the environment.

Work flow is also a model that users readily recognize. Work flow employs conditions—and satisfaction of conditions—to route information and responsibility from one application to another.

Distributed transactions handle a database update using the customary two-phase commit protocol to complete the task.

Remote file access is a familiar task, something users do every day. The same is

MIDDLEWARE COMMUNICATIONS MODELS

Ten communications models that middleware supports, with sample applications for each.

COMMUNICATIONS MODELS		NETWORK-DEPENDENT EXAMPLES	NETWORK-INDEPENDENT EXAMPLES
Datagram			
	Single outbound message	Network device status notification	Paging system
One-shot			
	Single outbound message; single response	Network-based calculation server	File transfer
Query			
	Single outbound message; chained responses	LAN-based database query	Web search
Asymmetric			
	Multiple outbound messages and responses; single session	Customer-service call center	Web-based publishing application
Symmetric			
	Multiple outbound messages and responses; in two dedicated channels	High-throughput reservation system	High-throughput Web publishing application

The Muddle in the Middle

becoming true of remote database access, though many users have little experience with it. Data warehousing will introduce remote database access to many users.

The last five models are probably all mysterious to the average user but are familiar—and helpful—to applications developers. Distributed object interaction and access to remote functions are closely related. While the developer employs an object-oriented design with distributed objects, he or she uses good old subroutines with remote function access.

Distributed database management and database replication are both used for synchronizing distributed data. However, in distributed database management, the developer creates a single logical view of distributed databases. In database replication, the developer synchronizes multiple copies of one database.

In the distribution-of-display model, the developer employs a terminal data stream to create a remote representation of a host-based application's presentation functions. It's just like being there.

What? No messaging? Nope: We don't include it because this term (like synchronous and asynchronous) has become too vague to be useful in distinguishing middleware products.

In a "one from column A, one from column B" style, messaging products generally implement the store-and-forward application model using the one-shot/network-dependent communications model. By using the 10 application models and the 10 communications models in this way, you can reveal any middleware product's true nature.

Middleware support for applications development ranges from full-blown development environments to naked APIs. That support will determine how transparent distributed computing will be to applications developers. Usually, APIs will force developers to master message binding, memory management, and other mechanics of distributed processing. Interface definition languages (IDLs) hide some of these mechanics. Object request brokers (ORBs) such as IBM's SOMobjects, Sun's NEO, and Iona's Orbix automate message binding. IDLs conceal the underlying mechanics of distributed processing, not the fact that application components are on a network.

Multi in the Middle

Until recently, a middleware product would offer just one application model. DCE gave users the remote function access model, but not remote SQL access. Oracle's SQL*Net supported remote database access, but not database replication or distribution of display. With single-function middleware, each new application might need a new middleware product. The result: middleware hell for corporate technology planners. Multiple products mean high support costs and low leverage of technology investments.

This began to change about two years ago, with the introduction of multifunction middleware products. The first was the TransAccess product line from Netwise. Netwise was a leading RPC environment vendor and specialized in linking LANs and PCs to CICS and mainframe COBOL programs. In 1994, Netwise added a SQL-access product built on top of its RPC. The result: support for two of the 10 application models in the same middleware environment.

More recently, the EDA/SQL product line has added support for the OSF DCE RPC and API. Sybase is porting its OpenClient remote database access API to its new store-and-forward middleware environment (EMA).

The trend toward multifunction middleware will continue. Software vendors will start competing on combinations of functions. Multifunction middleware is good news for user organizations because it promotes leverage. Now, users can benefit from a single middleware environment that supports a variety of application models.

Don't Diddle with the Middle

Another factor that may be contributing to the confusion about middleware is the specialization inherent in the very structure of corporate IS organizations: Database administrators think about SQL. Developers concentrate on tools. Deployment specialists work with network and administration systems. Yet middleware cuts across all these specialties, demanding new coordination of specialists.

To foster this cooperation, IS organizations must find a common ground for their specialists on middleware. Agreeing on terminology is helpful. Examining the specific components of middleware ensures that consideration and comparison of new products will be rational and based on fact, not vagueness. ■

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10 APPLICATION MODELS OF MIDDLEWARE

The 10 application models of middleware, arranged from the most concrete (at the top) to the most abstract, from a user perspective.

1 Store-and-forward/publish-and-subscribe
Directs message to recipient either by pushing data out (store-and-forward and publish) or by pulling it in (subscribe).

2 Work flow
Directs message to recipients according to either conditions or policies.

3 Distributed transactions
Manages simultaneous updates to multiple databases under transaction control.

4 Remote file access
Redirects file requests across a network.

5 Remote database access
Transmits SQL requests across network to servers.

6 Distributed object interaction
Supports messaging between objects across a network.

7 Access to remote functions
Redirects program call to a function across a network.

8 Distributed database management
Maintains a single local database across multiple physical databases.

9 Database replication
Synchronizes copies of a single database.

10 Distribution of display
Makes presentation functions of an application available to a remote client.

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MIDDLE(WARE) MANAGEMENT

Don't panic! Middleware tips from the experienced can smooth over a project's bumps.

SALVATORE SALAMONE

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It's Monday morning. You arrive at the office, check your E-mail, and look over your to-do list for the week. There it is, staring you right in the face, the top item on your list: Implement middleware. Gulp.

If that's truly the top item on your list, you had better block out a substantial amount of time. While you're at it, block out a lot of time for your staff, too. Middleware projects are complex and labor-intensive, according to industry analysts and managers who have gone through middleware-implementation projects. Like any other application of technology to a problem, companies justify the expense of such a project claiming they will recoup their costs over time.

The key to a successful middleware implementation is keeping these costs down. How do you do that? That's the $64 million question these days. Because there are no shrink-wrapped middleware solutions and because middleware covers a broad range of technologies, there's no simple answer. However, following some general guidelines should help you complete a middleware project successfully.

Changing Times

Middleware should do several things. First, it provides a way to get data from one place (say, a mainframe-based database) to another (say, a PC-based office application). Second, it should mask the differences between OSes, platforms, and network protocols. Third, it should conceal the complexity of the network transport process from the applications developer.

That's the theory. However, when undertaking a middleware project, what companies face is a slew of acronyms in a rapidly changing market. Adding to the problem is a lack of standards. Perhaps even more troubling, you'll find very few skilled programmers with breadth and depth of knowledge about the variety of tools and technologies. *continued*

Large companies often employ dozens of applications, a handful of desktop platforms and OSes, and numerous database systems (many customer-written), running on a range of hosts. The idea that a simple piece of software can somehow tie all these disparate systems together (at the application layer, no less) is obviously absurd.

Middleware Goals

First, it's good to set some realistic goals before undertaking a middleware implementation. Understand at once: Middleware is an evolving technology.

We have moved beyond the original client/server notion of one client forever wedded to the same server. It used to be a one-to-one implementation—getting data from a DB2 database application running on an IBM mainframe into Excel spreadsheet cells on a user's Windows PC, for example. Today, as we move toward a more distributed computing environment, it's more likely that a client will need to connect to multiple servers and hosts.

At the same time, there's a more mixed client environment. In the recent past, it was common for all nodes on a network to be identical (e.g., PCs all running DOS). Today, you are likely to find several platforms, including Macs, PowerPCs, PCs, and RISC-based workstations. Even if you have only a single hardware platform, you may be dealing with two or three OSes (e.g., DOS, Windows 3.x, and Windows 95 on PCs).

Multitier Middleware

Second, the business applications at the heart of a middleware project are becoming more complicated. In the past, companies might have been content with access to data—period. Today, access is a given, a starting point. Companies want decision-support systems and advanced data-mining capabilities that squeeze more useful information out of the mountains of data residing on their hosts and servers.

Because of these changes, there has been a major paradigm shift in the way we use middleware. In the single-client-to-single-server days, you might use remote procedure calls (RPCs) from the client to the server. That portion of the middleware responsible for handling the transaction would reside on the client and the server. Such a system is called a two-tier middleware implementation.

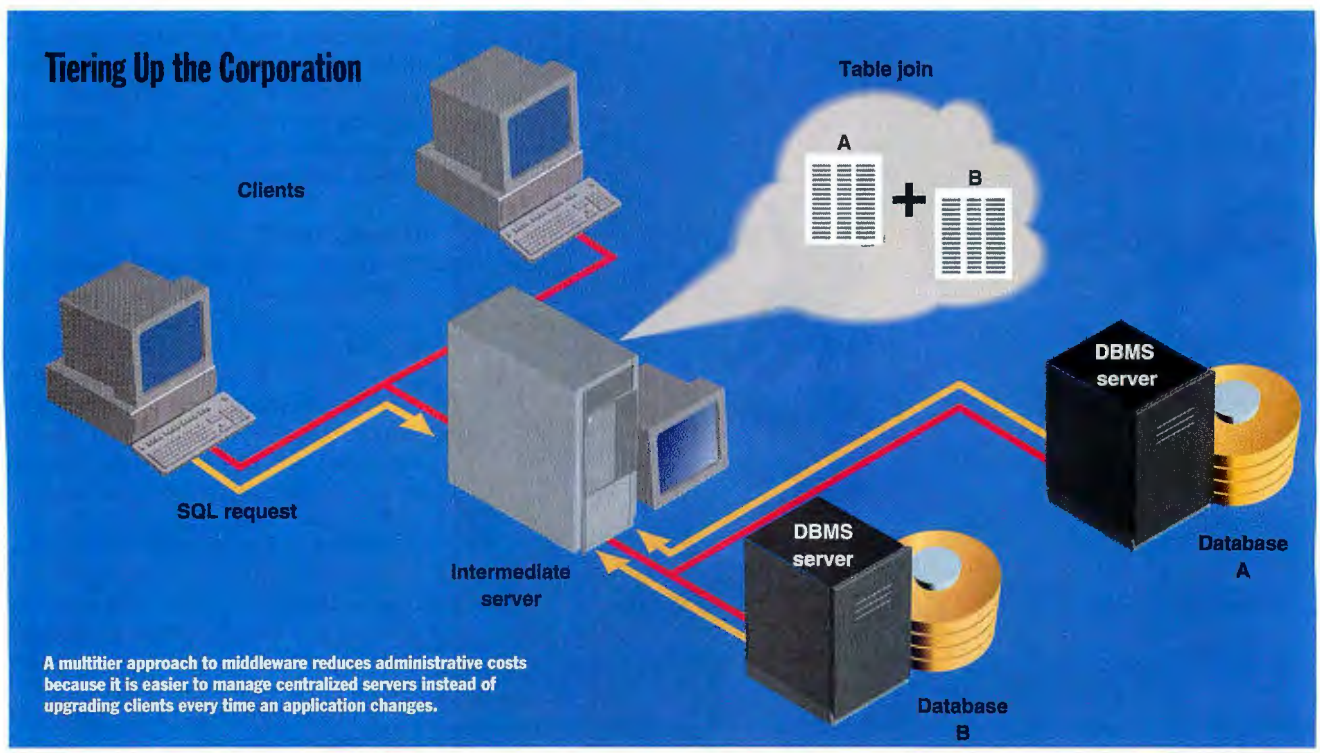
Today, however, it is more common to see three- or even four-tier middleware implementations where intermediate servers also run part of a middleware program's code (see the figure "Tiering Up the Corporation" below). The move to a multitier architecture addresses two important issues facing middleware implementers today: complexity and scalability.

In the past, you may have used a single middleware technology, RPCs, for example. Today, it is likely you will need multiple modes of operation within a single architecture. This adds complexity to the design of a middleware system.

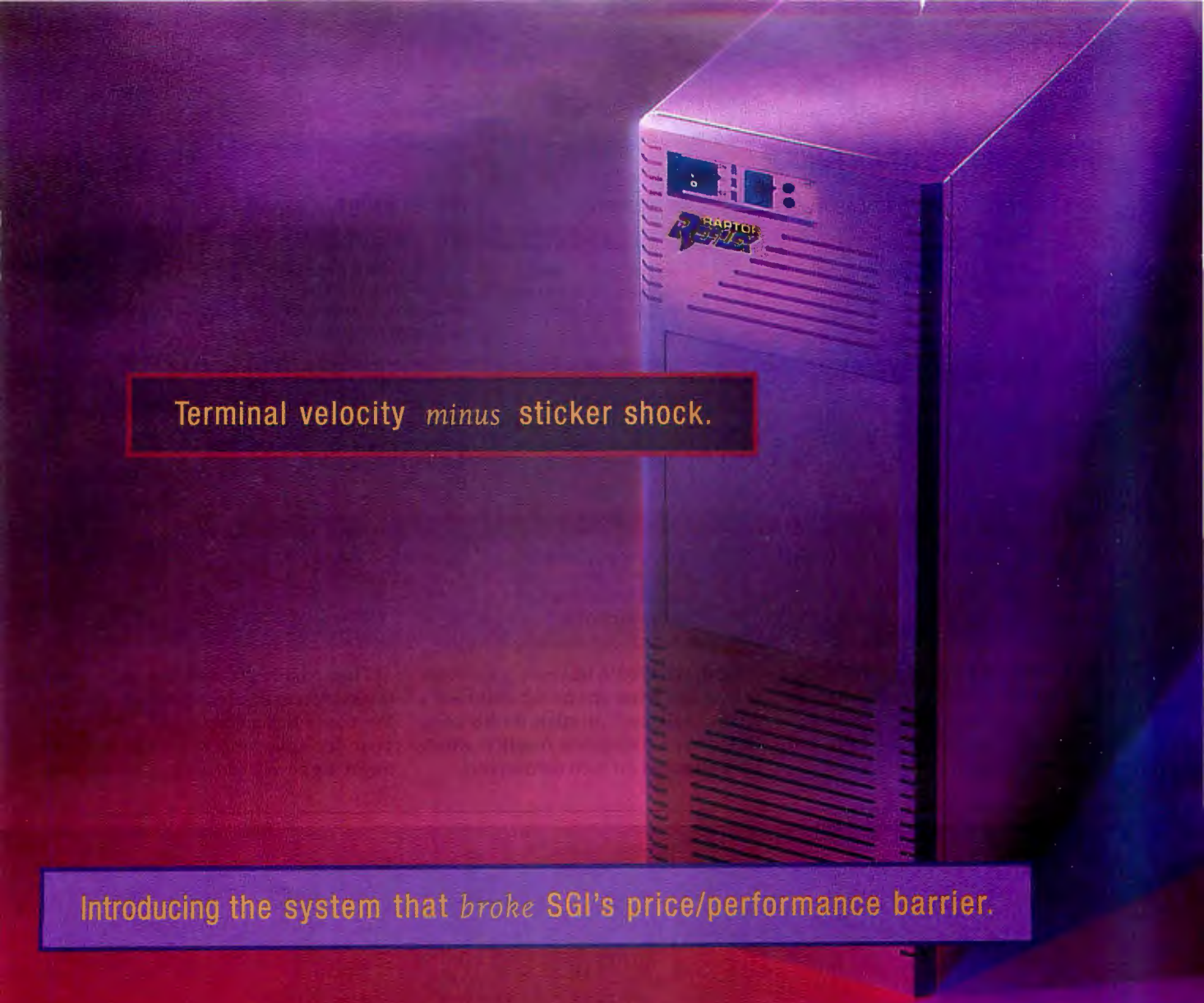
For example, consider a transaction where a customer makes a withdrawal at a bank's branch office. The withdrawal

SIX STEPS TO MIDDLEWARE SUCCESS

1. Set realistic goals.
2. Use a multitier architecture.
3. Use a thin client.
4. Centralize tasks on the server as much as possible.
5. Bring a wide circle of developers into the planning process.
6. Make a detailed cost analysis—the final total will be mostly labor costs.



A multitier approach to middleware reduces administrative costs because it is easier to manage centralized servers instead of upgrading clients every time an application changes.



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MIDDLEWARE SOLUTION FINDER

TASK TO COMPLETE	APPROPRIATE MIDDLEWARE SOLUTION	WHY THIS WORKS	THINGS TO CONSIDER	EXAMPLES OF PRODUCTS
Task 1				
Develop distributed client/server database application.	SQL/remote procedure calls (RPCs).	A common solution. Many products available. Good way to partition large C applications.	RPCs work best in simple setups but often lack the flexibility developers need for complex client/server environments.	EDA (Information Builders), DataDirect and SmartData (Intersolv)
Task 2				
Connect widely dispersed applications.	Message-oriented middleware (MOM).	The nature of MOM means applications that send messages are not blocked while waiting for a response.	Implementing a MOM-based solution requires that a developer have a higher level of sophistication compared to RPC solutions.	X*IPC (Momentum Software), Pipes (PeerLogic)
Task 3				
Develop on-line transaction processing (OLTP) application.	Transaction processing (TP) monitors.	TP monitors provide message-queuing transaction features, load balancing, and backup and recovery services.	Standards for distributed TP monitors are still evolving.	Tuxedo (Novell), CICS (IBM)

might involve a SQL query against a customer's balance. Middleware may have to interpret the syntactical differences between the SQL queries on the front-end and back-end systems.

Next, you need to make the actual withdrawal and must update the customer's account balance. You might do this using RPCs and a transaction monitor, which are well suited for such transactions.

Then, you might want to replicate the transaction to databases that are not on-line transaction processing (OLTP)—say, your decision-support system—which might not be available at the moment. To

make the guaranteed modification would require a method such as that afforded by message-oriented middleware (MOM).

Skinny Clients

A third consideration pertains to the client hardware. One philosophy on performing all these application functions is to load the client up with the various stub programs required. However, industry sentiment is inclining more toward a thin-client approach to middleware—the client has the minimum amount of code possible, and the intermediate servers handle many of the tasks.

The thin-client approach is gaining favor because it centralizes the complexity of a middleware application to a few servers that an IS staff can easily access. Additionally, the thin-client approach is better suited to large-scale deployment of middleware applications. Consider an application that changes frequently—an order-entry system for a company with seasonal merchandise or a tax-preparation system, for example.

With fat-client implementations, the client does most of the processing. Typically, a client will send a request for data using such common techniques as a SQL query or an Open Database Connectivity (ODBC) driver. The server returns the data requested, and the client does something clever with the data.

On the surface, this approach makes sense. Typically, you have clients with much processing power. Also, you have many users, perhaps hundreds of them, querying a single server. It makes sense not to burden the server with any additional tasks beyond data manipulation and processing SQL requests.

Still, there's a problem with such an approach to client applications design when the number of users grows. If you design most of the business logic into the front-end application that runs on the client, you will need to change the software on every client whenever there's a change in the business application (e.g., when the new season's products roll out or when they pass new tax laws). Software changes may even require souping up the client hardware with more memory or hard drive space. Updating every client is time-consuming, and the time required to perform this task grows as the number of clients grows—especially when you're dealing with geographically dispersed and mobile clients.

One way around this issue is to split the program logic between the client and an intermediate server (à la the three-tier architecture) so that the part of the application that changes resides on the server. In that way, changes are easier to manage.

Servers Beef Up

Our fourth point relates to the server side of the equation. A thin-client approach means the intermediate servers in a multitier middleware implementation must do more. Moving tasks to centralized servers has several advantages.

For one thing, you can give your users access to higher-powered functions than they would ever have using a two-tier system. For example, a sales manager might

need to find out who the top five buyers are for the last quarter. A common way to accomplish this task is to have the PC send a query to the customer database requesting a list of the buyers' names and the amount each one spent in each quarter. After receiving this information, the client must calculate the total sales for the year and sort the data to come up with the top five spenders.

However, if your end users are running older PCs, they may not have the processing power or memory to carry out such a task. This is a simple example, but many applications require more data manipulation than a desktop—any desktop—can handle. For instance, you might need to join two large tables from different databases—a Microsoft SQL Server table on Windows NT and an Oracle database table on a Unix server, for example—to get at the information needed for a decision.

With a three-tier approach, you could design the system so that an intermediate server handles much of the heavy lifting. Such an approach has some practical business implications. You can make changes to an application quickly because it resides on only a single server and not on every client in the organization. Furthermore, you do not have to make changes on the system running the database (i.e., you do not need to rewrite custom applications running on mainframes).

Off-loading tasks from clients can also improve system performance by lightening the load on the network. You can, for example, reduce the number of times that large database files must pass over the network for processing by a client. Instead, you can pass these files to an intermediate server that processes the data and passes only the results to a client. That lets you optimize a network's design so that large files pass only between servers and hosts. So, you can, for instance, design the network so the servers link over a high-speed backbone and clients remain on a lower-speed network, such as a 4-Mbps Token Ring or 10Base-T Ethernet LAN.

That said, you can probably still imagine a scenario where you would want a fat client—say, when you have hundreds of users hitting a single server with some

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compute-intensive decision-support query. Then you might want fat clients that logged in, cached data, and left the back end alone as much as possible for the rest of the day.

Mapping Success

The fifth point hinges on planning. With any middleware implementation, there are several logical steps to undertake (see "Six Steps to Middleware Success" on page 72), including such things as settling on a middleware technology and developing a pilot project.

Who should be in the planning process? Almost everybody. The approach that seems to work best when evaluating middleware is to form a team that includes the applications developers who will be using the middleware, the networking folks who must provide the infrastructure the applications will ride on, and, of course, the end users of the applications developed using middleware.

The final consideration? Cash, of course. Even with good planning, implementing middleware requires a substantial commitment of money. Because there are so many variations when it comes to implementing a middleware solution, getting firm cost numbers that would apply to every situation is difficult.

Ford, one of the major automobile makers, estimates that implementing a middleware project costs between $150,000 and $200,000 per application. Of that amount, only 20 percent is for the actual product. The other 80 percent is for the labor of the developers.

Adding to the cost of implementing middleware is the cost of training. You'll find few workers with breadth and depth of knowledge across all middleware technologies to carry out a middleware implementation on their own.

Once a project finishes, you'll have to budget money for staffers to administer the middleware. Administering a middleware application is not trivial, yet most companies have no idea how much to budget when they are developing their implementation plans.

"When most users look at middleware, they typically underestimate the wherewithal it takes to effectively manage a middleware application," says John G. Senor III, vice president of the EDA Division of Information Builders. "There's no free lunch. Middleware requires a degree of administration like any other system software." Senor says a good rule of thumb is that it takes the same number of people to administer middleware as it does to administer a database.

The best advice? Set realistic goals for a middleware project. Remember that middleware still doesn't handle everything. Even the most elegant solutions cannot deal with every client platform, OS, application, and flavor of back-end system and applications. At least now you have one less reason to cringe when you scan your to-do list. ■

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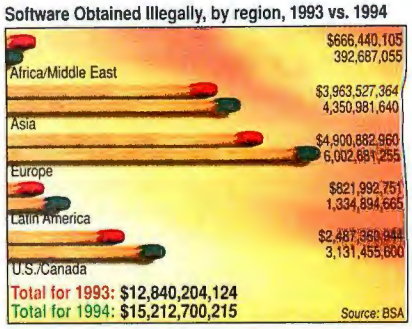

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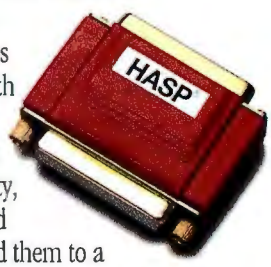

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NSTL TEST RESULTS, OCTOBER 1995†

Scoring Category	Aladdin HASP	Rainbow Sentinel	Glenco/FAST Hardlock	Software Security Activator/M
Security	9.3	6.3	6.9	6.2
Ease of Learning	9.1	7.1	8.8	7.7
Ease of Use	8.3	7.2	6.8	6.3
Versatility/Features	10	8.7	8.8	8.6
Compatibility/ Power Consumption	6.7	6.5	6.6	7.4
Speed of API Calls	0.9	1.2	10	4.1
Final Score	**8.5**	6.5	7.5	6.6

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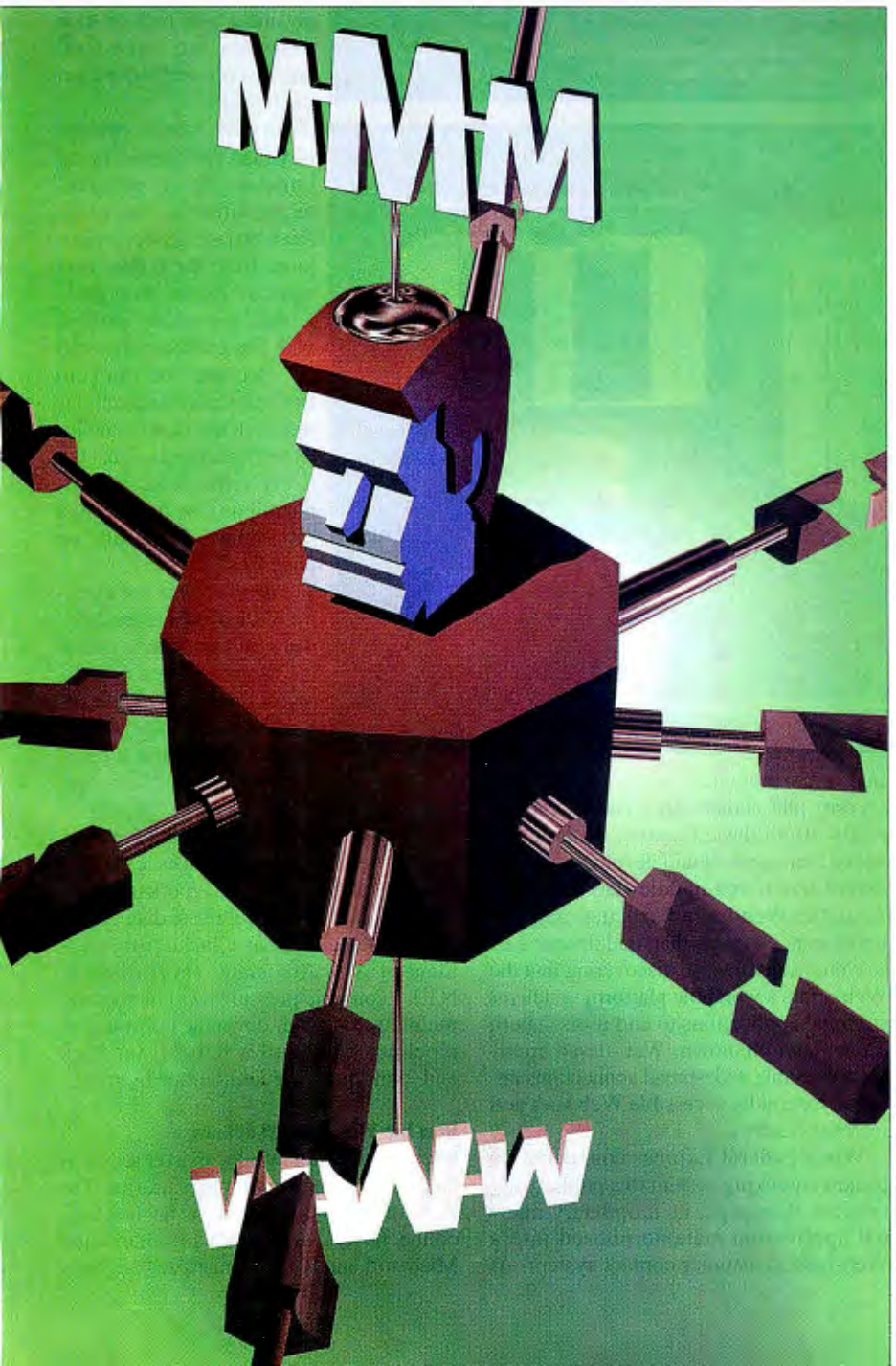
THE ULTIMATE MIDDLEWARE

The Internet and the World Wide Web may be all the middleware you need

JOHN KADOR



GIACOMO MARCHESI © 1996

What future is there to being in the middle, especially when all the action and all the perceived value sit on either end? Not much. Right now, middleware serves an indispensable—and growing—role in enabling distributed computing. It controls and manages the flow of information between clients and servers on different platforms.

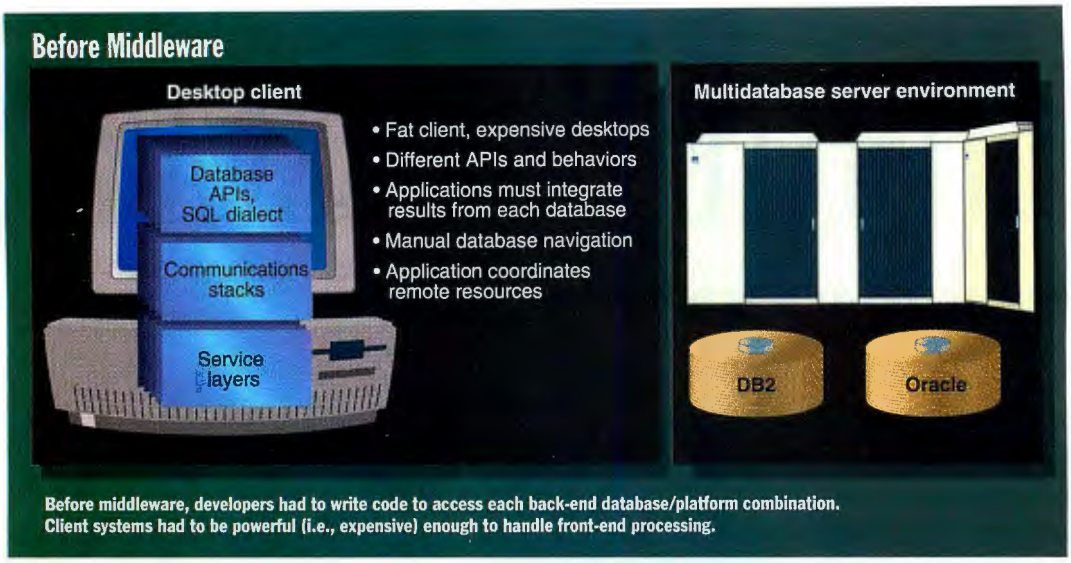
Within a few years, however, the Internet will squeeze this market segment. Middleware will fall victim to merciless demands that the boundaries between desktops and information vanish. When the Internet becomes the primary vehicle for enterprises to deliver traditional and new corporate applications to end users, adios to much of the middleware we depend on.

Steering the Middle Course

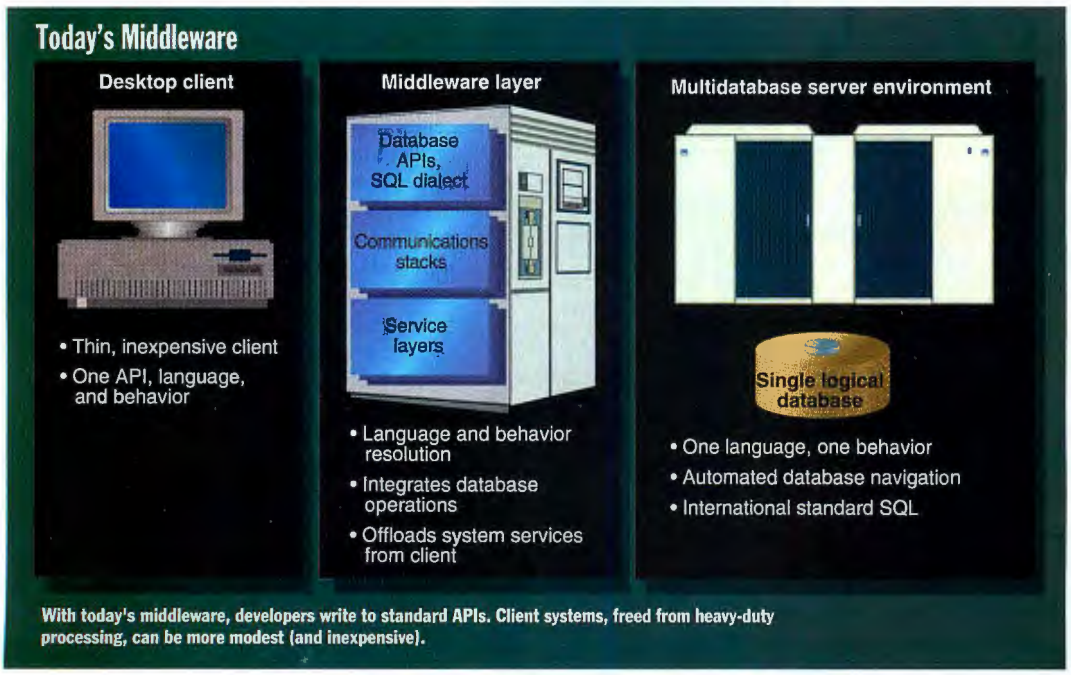
How ironic that the very indispensability of middleware guarantees its demise as a niche technology. That's the paradox of middleware: The better a middleware solution gets, the more invisible it becomes and the easier to swap for another variation. For middleware to succeed as a niche technology, it must call attention to itself. Yet calling attention to itself erodes its ultimate value. How inconvenient for middleware marketers, who, after all, must play a variation of the theme: "Buy us; you'll never know we exist."

Also, because middleware is constantly in a state of flux, it's hard to judge just where an application stops and the middleware begins. Thus, developers and users alike tend to project their frustrations and disappointments onto middleware.

"Some developers think of middleware as an ex post facto solution to design problems," says Peter Burris, director of Open Computing and Server Strategies at the Meta Group (Stamford, CT). "People actually believe they can relax systems or database design because middleware will clean up after the fact." Middleware won't



Before middleware, developers had to write code to access each back-end database/platform combination. Client systems had to be powerful (i.e., expensive) enough to handle front-end processing.



With today's middleware, developers write to standard APIs. Client systems, freed from heavy-duty processing, can be more modest (and inexpensive).

mask bad design. Substandard applications design will just become worse with a layer of middleware.

The temptation is to chuck middleware—but it makes everyone's life so much easier. If only there were some legitimate alternative.

The Web's Middle Ground

Many see the World Wide Web as that alternative. As the Internet becomes the platform of choice for day-to-day electronic business, it is likely that the Web will quietly assume most of the services now identified as middleware.

Think about it. Middleware aspires—with varying levels of success—to openness (interoperating across heterogeneous domains), scalability (without loss of function or performance), and integrity (data security plus auditability). The Internet already offers these features, without the added management and development burden of traditional middleware solutions. Also, the Web has a far better claim of transparency to users than middleware has.

Companies are also discovering that the Web offers a workable platform to deliver strategic applications to end users—both known and unknown. Web-based applications enable widespread connections between externally accessible Web sites and internal systems.

When Federal Express connected its package-tracking system to a publicly accessible Web page, its proprietary internal application metamorphosed into a Web-based customer contact system. At the front end, at least, middleware is nowhere to be found as companies begin using the Web to deliver increasingly robust and secure applications to users' off-the-shelf browsers.

Dozens of vendors, from Apple to Sun Microsystems, are embedding Internet access in their OSes. By doing so, they are creating an environment where individual users can have applications with parts on their desktops, on networks, and—soon—anywhere on the Internet.

An even larger opportunity than the Internet is the intranet—the use of the Internet within an enterprise. Such private networks, isolated from the public network, empower an organization's working groups with unprecedented flexibility. Because you can control and secure applications more readily than on the Internet, intranets are ideal delivery vehicles for new applications (see the text box "Rejecting Middleware" on page 81).

The Web will not eliminate all need for middleware. In fact, it may create the need for a new class of object-oriented middleware. But the technology will integrate tightly and hide itself from users increasingly hostile to proprietary limitations.

"Companies with multiple, disparate, and heterogeneous data sources resist proprietary solutions because proprietary middleware interfaces complicate data access and maintenance," says Shaku Atre, president of Atre Associates (Port Chester, NY). Economic pressures will likely push middleware further down the information-pipeline chain until it falls off the back end, unnoticed and unmourned by most.

How the Web Does Middleware

Users want middleware to deliver seamless data access across multiple platforms. The Web offers just this type of far-reaching connectivity. As the industry, including Microsoft and IBM, standardizes on Sun's

Java cross-platform programming language, users will begin to enjoy new Web applications without middleware anxiety. With these services, programmers can write an application to a common API without worrying about the platform, other tool sets, or back-end databases.

The glue that may bind this new class of Web applications is, ironically, a kind of middleware itself: the Object Management Group's (OMG) Common Object Request Broker Architecture (CORBA) 2.0. This technology offers developers their best hope to bridge multiple languages and OSes on the Web. Designing Web applications on CORBA's communications protocol makes dynamic applications possible. Contrast this with static Hypertext Markup Language (HTML) pages on the Web.

Robust object management is one key to success for these dynamic Web applications. Object request brokers (ORBs) are the messaging middleware by which objects in heterogeneous distributed environments make and receive requests and responses transparently. The OMG's Internet Interoperable ORB Protocol (IIOP) puts any required middleware where it belongs: out of sight and out of mind.

Another benefit of applets constructed under the IIOP paradigm is that applications would bypass the Common Gateway Interface (CGI) or HTTP used in most Web applications communications. This bypass is desirable because it would eliminate an entire software layer and its

Rejecting Middleware

Indiana University rejected a traditional middleware solution when it deployed a statewide client/server financial-information system to run the university's eight-campus system (see the figure below). It features an electronic-transaction system, with secure electronic routing and approval.

The university decided that the middleware problems found with traditional database front ends were just not worth the hassle. "Client/server computing is complicated enough as it is," says Barry Walsh, associate director of Financial Management Support. "We became disenchanted with the middleware issues. The middleware became a huge hurdle."

The university now has a World Wide Web–based data-access, retrieval, and analysis system using no proprietary middleware. Instead, a Netscape Navigator front end supports Microsoft's Word and Excel going directly against Sybase data. The access method is in SybPerl (Sybase's dialect of the Perl scripting language) and Common Gateway Interface (CGI).

This alternative has turned out to be a cleaner implementation than middleware threatened to be. First, according to Walsh, developing the application without resolving proprietary middleware issues is faster.

More important to the university than speed, however, are the significant training and logistical support benefits of any application using the Web. "The world is educating people in the use of Netscape, so I don't have to," Walsh adds.

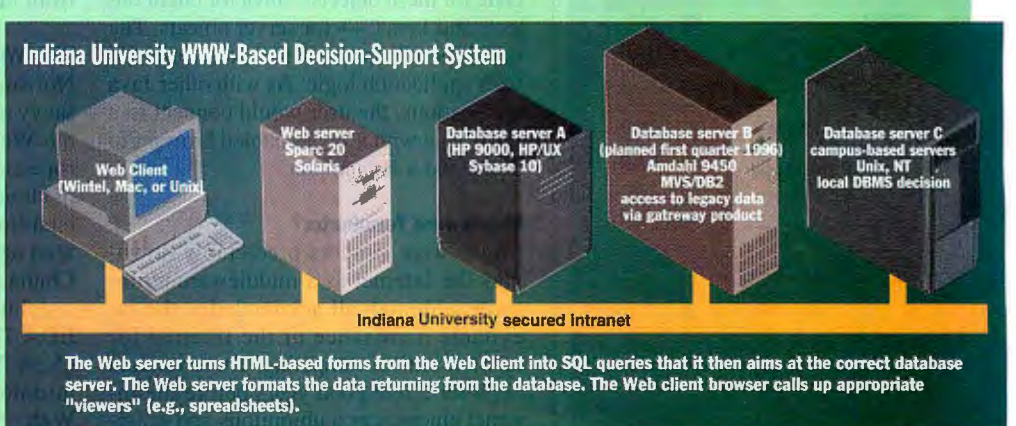
In addition, the Web solution is cheaper. Outfitting more than a thousand users with proprietary middleware would cost $75 to $150 a pop.

The university also avoids a major headache: software distribution. The services of the Web make it ideal to distribute new versions of the financial-information system.

Yet by far the biggest benefit is that the Web delivers information in a form that users can immediately use: rows and columns. More than 90 percent of what users request ends up in Excel spreadsheets. "That fact, more than anything else, pointed us toward the Web," Walsh recalls. "Our users didn't want table joining to yield all that denormalized data. All middleware implementations require extra steps to get data into spreadsheet form."

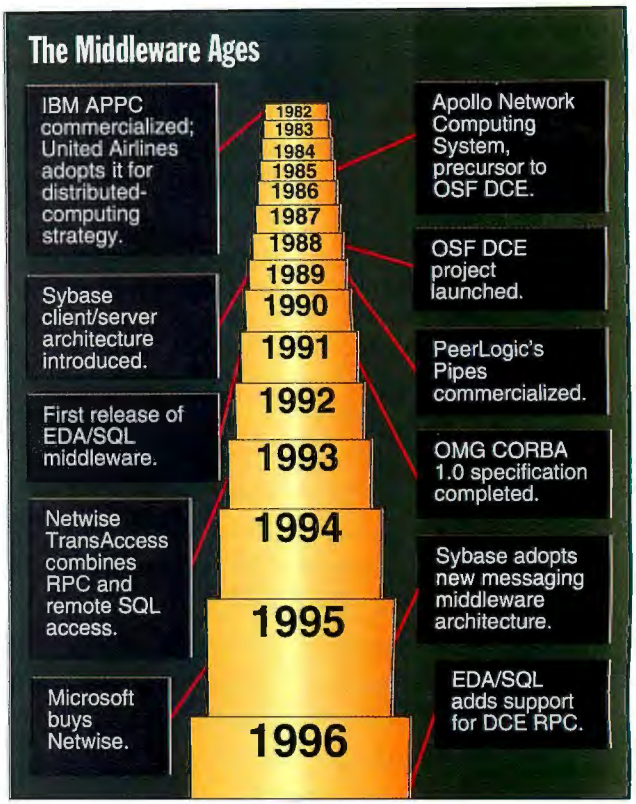
The Web-based decision-support system lets the university's financial analysts construct their queries by selecting fields and then clicking on the query icon. "The next thing they see is the result of their query populating the Excel spreadsheet, complete with column headings. They can start work right away analyzing the information. Users think it's fantastic," Walsh says.

What about the molasses performance of the Web? "Performance is a matter of perception and expectation," says Walsh. First, users expect the slow response typical of Web applications. Second, because the system removes layers of middleware, the actual performance is decent. "Combine the low expectation with the real performance, and you have a perceived performance that is pretty good," he says.



The Web server turns HTML-based forms from the Web Client into SQL queries that it then aims at the correct database server. The Web server formats the data returning from the database. The Web client browser calls up appropriate "viewers" (e.g., spreadsheets).

The Ultimate Middleware



resulting performance overhead.

Instead, the applet would talk with the server by way of IIOP, a protocol more capable than CGI in many ways. For example, under IIOP, a program session can stay open between calls. CGI must open and close a session with each call.

In addition, CGI limits the kinds of information that can pass on the network. For instance, CGI does not support direct transmission of floating-point data, according to Suresh Challa, vice president of business development at PostModern Computing Technologies. The CGI protocol requires converting floating-point numbers into strings before transmitting and converting back to floating-point numbers at the other end. IIOP eliminates this unnecessary conversion and gains a performance boost, too, he says.

Tools such as PostModern Computing's BlackWidow are integrating the domains of networked ORBs and Java-based Web applications. BlackWidow's development environment links Web applets made with Java and CORBA 2.0, joining two fast-growing technologies: objects and the Web.

Now, users can develop CORBA-compliant Web clients and servers simply by defining the functions each object will expose. BlackWidow then generates skeleton code for these objects—Java for client objects and Java C++ for server objects. The developer fleshes out the skeleton code with application logic. As with other Java applications, the user would connect to a Web page with a Java-enabled browser to download a Java applet.

Middleware Terminator?

Middleware vendors predictably downplay the Internet as a middleware terminator, although all acknowledge the inevitable dominance of the Internet for mission-critical computing. These vendors hope for a few good years before the Internet emerges as a ubiquitous and seamless information-delivery environment. Middleware—like platforms, data types, and OSes—will then become irrelevant to most participants.

"The Internet is certainly going to be a powerful influence over the coming years," says Dr. Bill Highleyman, chair of NetWeave (Wilmington, DE), "but its use will concentrate on individual users and electronic commerce, not much for the mission-critical systems that companies depend on. These critical applications must tie together disparate, incompatible legacy and open systems, and that is the true role of middleware. This need will not go away. Look for middleware providers to be providing access into the enterprise systems from the Internet via CGI."

Web-Wise Middleware

Not surprisingly, vendors with Internet-savvy middleware are more sanguine about the Web subsuming their services. "We foresee the Web becoming the platform of choice to conduct day-to-day business, enabling all the mission-critical distributed applications to be developed," says Challa.

John G. Senor III, vice president of the EDA Division of Information Builders (New York, NY), is also confident that middleware has a durable place on the Web. "I see the Internet as a new application-partitioning paradigm, not a replacement for middleware," he says. "We

will still need middleware to provide SQL translation services, SQL processing, RPC [remote procedure call] processing, and messaging." (EDA data-access software provides a uniform, relational view of data whatever its organization.)

Senor prefers a model like Unix's X Window System–terminal mode: Applications sit on a server and all that happens on the desktop is presentation management. The Internet, in this view, is a new presentation model. When the user clicks on a home page, an applet activates on the back end. That applet talks to the other layers necessary to resolve user actions into a SQL request or other processing.

In this type of scenario, EDA middleware is still critical for data access. At the back end of an extremely thin client, after the request crosses the Internet, middleware must still receive the request and process it against the appropriate database. "There's simply no way around middleware," Senor claims.

Middleware on Demand

As long as companies must reconcile the Web-based new world with old-world legacy systems, the need for middleware will never completely vanish—it will just appear so. Middleware will download on demand over the Internet, just as all the other just-in-time applications, systems software, and data that users may need. The middleware will perform as needed—to connect, say, to a legacy database—and then go away. In this scenario, the prospects for middleware persisting as an independent entity are not strong.

Efforts to embed middleware services in the Web infrastructure are already under way. The explosive growth of the Internet makes it increasingly viable that every constituency—employee, partner, customer, supplier—is always a member of the network. The Internet is integrating frontware and backware so rapidly that there may be little opportunity or need for middleware of the type we know today. The result—for the user, the enterprise, and the developer—will be a simpler environment with goodies on both ends—but no middle at all. ■

Where to Find

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John Kador, a freelance writer in Geneva, Illinois, reports on the business value of information technology. You can reach him on-line at 71321.1645@compuserve.com.

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E-MAIL ADVENTURES

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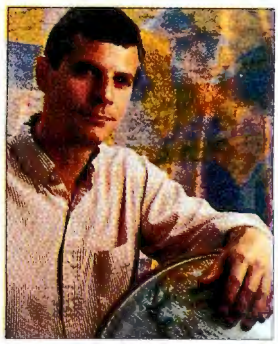


AL KARVEY ©1996

We add mail service to The BYTE Site and mine a rich vein of mail-enabled Web applications

Recently, BYTE's publisher, Dave Egan, asked BYTE's marketing manager, Rob Mitchell, to send a thank-you message to everyone who has contributed to the Virtual Press Room (vpr), our Web-based archive of press releases. Clearly, the message had to travel as E-mail—we could hardly fax it, because we designed vpr to be a superior alternative to fax. So I began rounding up and testing Internet mail servers. That project led to a flurry of new developments at The BYTE Site, including mail front ends to document databases, groupware applications, and an automatic failure notification system. Here's a progress report.

Building a Mailing List

To enable Rob to send Dave's message, I extracted a list of E-mail addresses from the Hypertext Markup Language (HTML) files in the vpr archive. The Perl script that did that (see http://www.byte.com/netcol/netproj.htm) used a regular expression to match Internet mail addresses in the <contact> field of each document. I have since replaced my own regular expression with the smarter one used in Earl Hood's MHonArc (see http://www.oac.uci.edu/indiv/ehood/).

How could I send a message to the resulting list of 300 addresses? That's too many to string out on the To: line of a message header. Instead, I created a list account, vprusers@byte.com, aliased to a file containing the 300 addresses. On our BSD/OS 2.0 server running sendmail, you do that by adding this line to /etc/aliases:

```
vprusers: :include: /usr/vpr/vprusers.list
```

On our Windows NT 3.51 server running post.office, you achieve the same result by pasting the list into a field on an HTML form. Either way, mail to vprusers from Rob should go to everyone on the list, and replies should come back to Rob. I tested the setup on a list of local BYTE addresses, swapped in the real list (plus my own address, for tracking), and told Rob to fire away.

The Sorcerer's Apprentice

Sendmail gurus who have bothered to read this far are probably chuckling to themselves. They won't be surprised by what happened next. Rob's message arrived promptly in my mailbox. However, smug satisfaction became horrified panic when, a few minutes later, another copy of the message showed up from Company X, one of the list members. I had created a mail loop. When Company X got Rob's message, it sent the message back to the list, one member of which was Company X, which then got another copy of the message, which it sent back to the list…each iteration fanning out to 300 recipients. Oops!

The arrival of a third message interrupted my contemplation of this hall of mirrors. I disabled the list account and went looking for the explanation. The long message header, which casual mail users may regard as a nuisance, immediately proved its worth. It's the audit trail that administrators use to debug and maintain the planetary communications system that is Internet mail. Within hours, I had found all the pieces of the puzzle (see "Anatomy of a Mail Loop" on page 86).

If you look closely at this picture, you'll see that things went wrong at step 3. Just like a real letter, an Internet message comes in an envelope. In our case, there were 300 envelopes addressed to 300 destinations, each containing the same header (From: Rob Mitchell, To: vprusers@byte.com) and the same body (Dave's thank-you note).

When the envelope addressed to Company X reached Company Y, Y's sendmail correctly performed the final step of mail routing—it discarded the envelope and delivered the header and message into X's mailbox. Pullmail incorrectly performed an extra step. Lacking the now-discarded envelope address, it routed to the address in the To: field of the header. Because that field contained vprusers@byte.com, a mail loop formed.

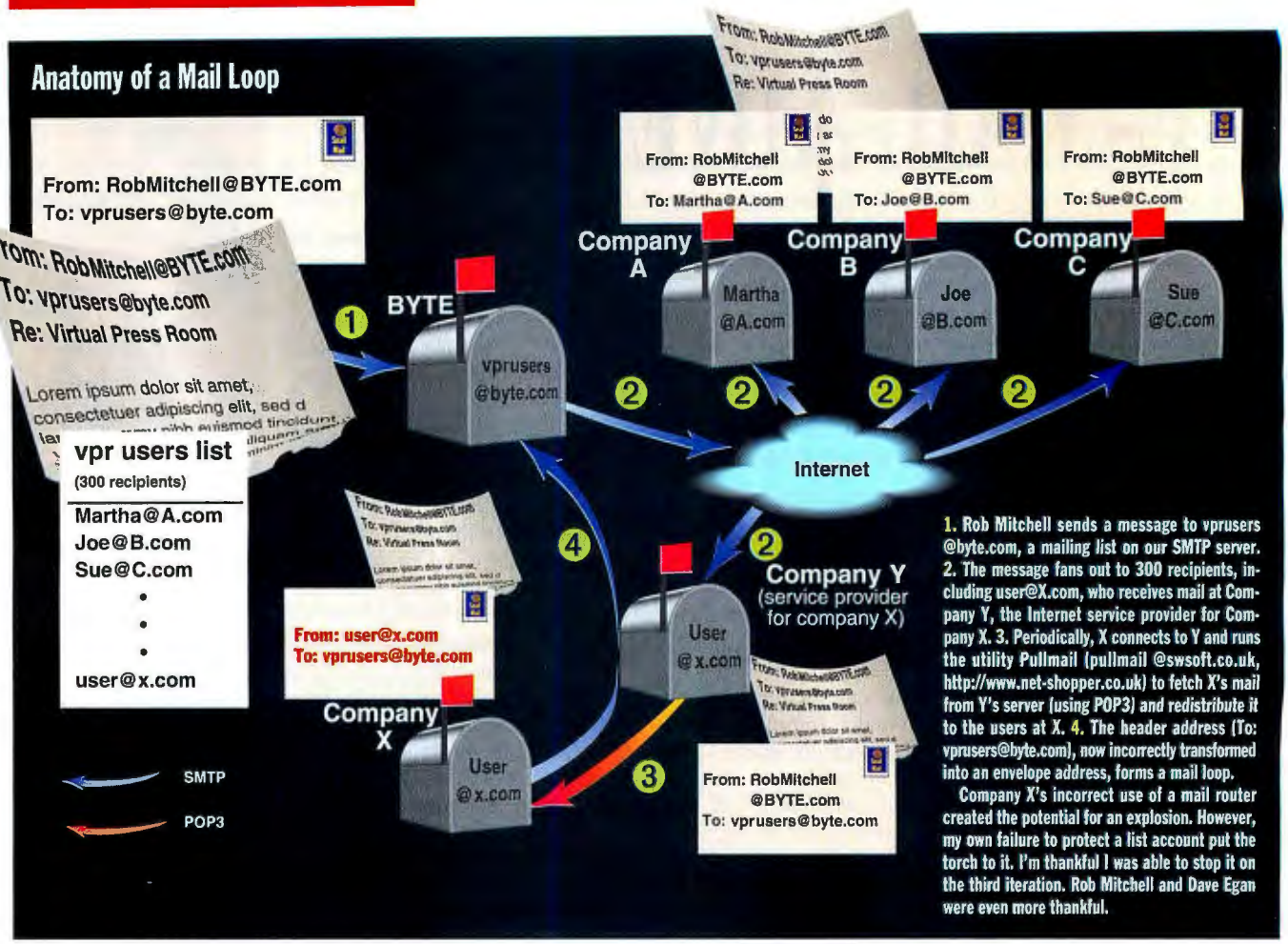
Postmortem

The author of Pullmail, Mark Woollard (mark@swsoft.co.uk), wrote it specifically for use

PAGING THE WEBMASTER

The BYTE Site has so far experienced remarkably little downtime, but there have been a few outages ranging from 4 to 12 hours. Now, our Unix development server pings the primary NT server every 10 minutes and, if there's no answer, sends an E-mail alert to my Notable Technologies' pager. Insane dedication on my part? Or maybe just a way to outgeek editor in chief Rafe Needleman, who also uses Notable's AirNote service? Joking aside, it's helpful to always know the status of the server. I won't drive to Peterborough at 4:00 a.m. to reboot a server. I will, however, investigate an out-of-band remote restarter for those few occasions that require a reboot.

The AirNote pager



with Frontier Internet Services' mail servers, which copy envelope addresses into the custom X-Frontier-To: field of message headers, thereby enabling correct routing. It wasn't meant for general-purpose mail routing, and that's what created the potential for an explosion—but I lit the match.

There are two compelling reasons not to use a list of forwarding addresses as I did. Along with the looping problem, there is the possibility of unauthorized use. Rob could send a message to vprusers@byte.com, but so could any of the tens of millions of Internet mail users from around the world. Hence the need for list managers such as majordomo, a set of Perl scripts that can, among other things, null the To: field of headers (to prevent looping) and reject messages from those who aren't list members (to prevent unauthorized use).

But what if you don't have a list manager? John MacFarlane, president of Software.com—whose Unix and NT mail server, post.office, which I am using, is also now available under the Netscape label—suggested the following defensive maneuver:

```
To: null@byte.com
From: rob_mitchell@byte.com
Bcc: vprusers@byte.com
```

This setup traps inappropriate use of the address in the To: field.

Mail and Web Synergy

I haven't installed a list manager because, until we need to do another broadcast mailing, I'm busily mining a rich vein of mail-enabled Web applications. When a Web server lacks a complementary mail server, it's at best just passively mail-enabled. It can channel user-initiated mail by means of mailto: uniform resource locators (URLs), but it cannot itself send or receive mail.

When I began mail service at our site, things began to get more interesting. For example, consider the BOMB, a feedback mechanism that solicits comments by means of a form that's linked to every page of the BYTE on-line archive (see "BOMB's Away," October 1995 BYTE, http://www.byte.com/netcol/netproj.htm).

The original version of the BOMB fed information into a database, but it didn't transmit that data to individuals responsible for particular articles. If you comment on a News & Views article, for example, Dave Andrews (who edits that section) ought to hear about it. Now he will.

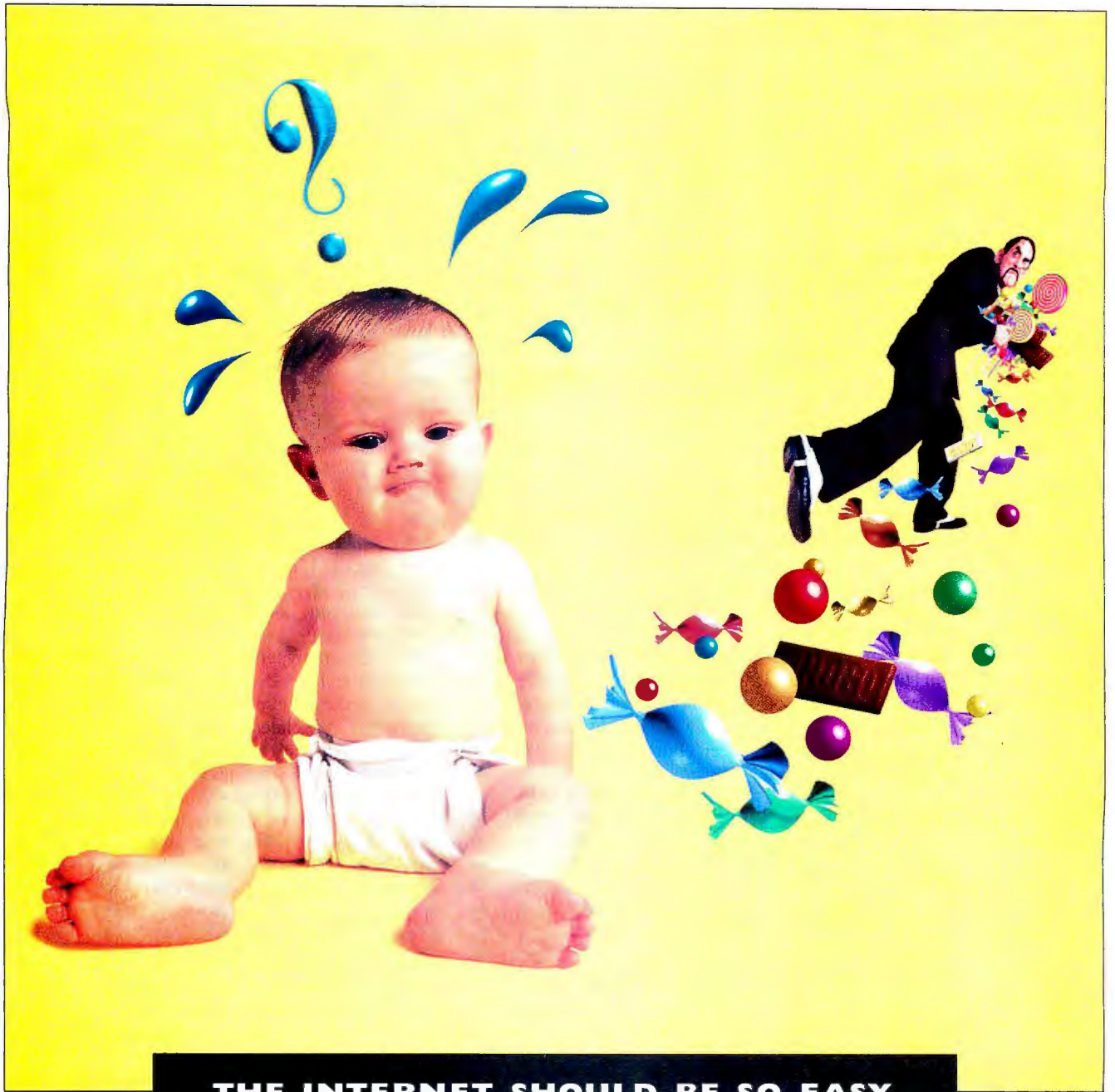
The revised comment-logging script maps a set of section names ("News & Views," "Features") to a corresponding set of role definitions. Here are some role definitions in Perl:

```
@news_ed = 'dave.news@bix.com';
@feature_ed =
'jmontgomery@bix.com,
thalfhill@bix.com,
tom_thompson@bix.com';
@managing_ed =
'rafe@bix.com,mschlack@bix.com';
```

Here is a Perl associative array that maps section names to roles:

```
%RoleMap = (
'News & Views', '@news_ed,
@managing_ed,bomb@bix.com',
'Features','@feature_ed,
@managing_ed,bomb@bix.com');
```

When you submit a comment, the script updates the database and also routes your



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comment to appropriate editors with a line such as:

```
`mail $RoleMap{$section_name} < $comment_file`;
```

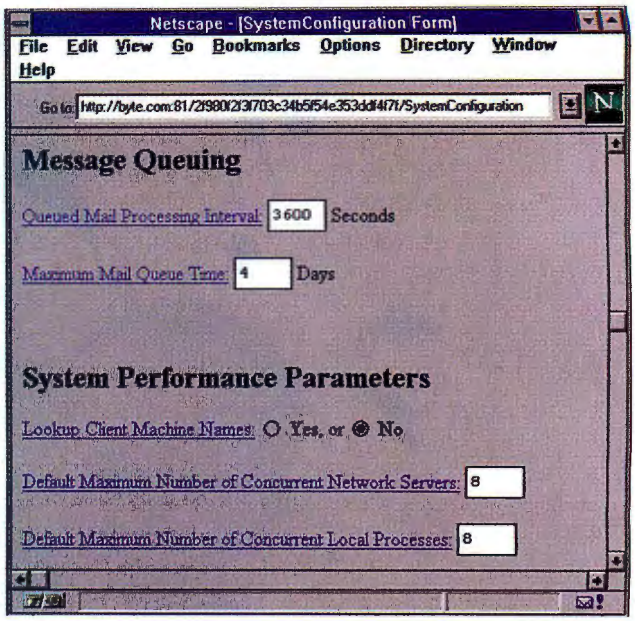
Mail-to-HTML Transducers

Why copy all comments to bomb@byte.com? I've been looking for a way to present the textual information the BOMB has been collecting. The original BOMB database was intended for SQL queries against numeric data. It lacked a way to view the anecdotal remarks entered into the BOMB's multiline text-input field. Once comments began funneling into the BOMB account, it became possible to review the text comments with a POP3 mail client such as Eudora or Netscape Navigator 2.0.

However, there's an even better way. Programs exist that can convert SMTP-style mailboxes into HTML archives. I mentioned two last month—Earl Hood's MHonArc and Kevin Hughes' hypermail (http://www.eit.software/hypermail). Both are excellent. They build views by subject, author, and date, and can also link replies to original messages to create threaded views.

I've used MHonArc, which is written in Perl, to convert 30 MB of mail downloaded from my BIX account over the last few years into a navigable archive. As a bonus, it decodes some kinds of Multipurpose Internet Mail Extensions (MIME) attachments. For the BOMB archive, I used hypermail, a C program that's faster and simpler to deploy than MHonArc.

Both tools produce neat piles of HTML documents—one per mail message. You can easily feed these to a Web indexer such as freeWAIS or SWISH (another of Kevin Hughes' contributions to the Internet) to make your Web-based mail archive searchable. An example of the application of these techniques is the archive of the www-talk discussion list at http://www.eit.com/www.lists/.



This forms-based management interface works identically for Unix and Windows NT versions of post.office. From any Web browser in the world, you can add or modify accounts and monitor mail queues (see http://www.software.com).

Mail-Enabled Data Entry

Because the BOMB is a Web application, its users construct database records in an HTML form and insert them by invoking a Common Gateway Interface (CGI) script. But what about users who are not running Web browsers? There should be an automatic way for them to enter their data.

Consider the `demos` application that converts staff reports on vendor demonstrations into a private Web archive (see "Global Groupware," November 1995 BYTE, http://www.byte.com/netcol/netproj.htm). BYTE staffers file these reports in our private conference on BIX. The first version of `demos` proved we could convert that conference into a more easily searchable and navigable Web archive.

However, the conversion wasn't automatic. I had to download the conference, massage it, and build the archive. And, of course, whatever isn't automatic tends to slip; the online `demos` archive soon went out of date. With the revised version of `demos`, users who post reports to the conference can at the same time mail them to a special account on our mail server. Arrival of a new report triggers hypermail, which updates the Web archive. Because I'm out of the loop now, the archive is current.

A related application is the E-mail interface to `vpr` that my associate Rex Baldazo is developing. `Vpr`'s Achilles' heel is that it presumes Web access. For some of the PR agents and marcom specialists who are the primary intended users of `vpr`, that can be a tall order. Far more of them can readily use Internet mail than can conveniently access the Web.

Thus, Rex's rite of passage into the Perl programming fraternity is to rig `vpr` to accept mail input. You'll send mail to vprinfo@byte.com to retrieve a copy of the form. Then you'll send the completed form to vprsubmit@byte.com. Just like the interactive Web-based version, mail-based `vpr` will either report errors in case of an incomplete or incorrect form or log the data and report success. However, these reports will, in this case, travel as E-mail.

There are still more mail-enabled developments in the pipeline. What about a system that enables BYTE's marketing staff to update Web pages for which they're responsible by mailing them to the server? Or that enables the sales staff to mail in their ad-insertion orders? The combination of Web and Internet mail technologies puts all this within easy reach. ■

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

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Even if you never use sendmail, but instead opt for a modern commercial reimplentation of Internet mail service such as post.office, you will benefit from this encyclopedic discussion of Internet mail technology

BYTE
SPECIAL REPORT

HOW TO MAKE WINDOWS 95 WORK FOR YOU

What's behind the promise of better integration and ease of use? We found answers in Win 95 products—and the technologies that drive them.

Dock and Play — Almost 91

Win 95's most impressive trick, Plug and Play (or is it Punt and Pray?) is even harder to do with notebook docking stations. We dared to try it at home.

OLE's Missing Links 99

OLE 2 is a standard for cross-application communication that makes compound documents possible. Too bad vendors can't agree on its implementation.

Underground Upgrades for Windows 95 105

Every version of Windows had holes that software vendors were eager to fill. This year's crop of low-cost utilities is plugging up Windows 95.

Better Connections in Windows 111

Who needs separate telecom, E-mail, and fax programs when Win 95 already has those tools? Maybe you do.

When Networking Is Not Working 117

No doubt about it: Windows 95 is more network-aware than its predecessor. Still, conflicts and setup problems are scaring off some LAN administrators.

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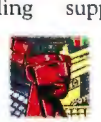

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DOCK AND PLAY—ALMOST

DAVE ROWELL

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Plug and Play is the crown jewel of Windows 95, and notebook docking is its ultimate test

Plug and Play (PnP), though quirky and erratic, is a big Windows 95 benefit. When it works, it's nearly magical (no snickering from the Mac crowd, please). When it doesn't, the results range from disconcerting to disastrous. Still, it's much better having it than not, and its usefulness grows as vendors introduce more PnP products and debug existing ones.

Notebook docking is one of the most impressive parts of the PnP specification, and perhaps its ultimate test. Not only must a notebook handle a variety of hardware components, it must configure them on the fly. Win 95 provides these capabilities, but PnP docking also depends on the system BIOS, device drivers that can load dynamically, and the devices themselves (see the figure "Docking Procedures" on page 94; also see "Transforming the PC: Plug and Play," September 1994 BYTE). How well they all work together, and how far a notebook vendor takes Microsoft's PnP recommendations, determine how convenient and reliable a docking system is.

As the demand for desktop replacements increases (see "New Docks Improve Commuter Computers," February BYTE), docking notebooks' PnP capabilities gain importance. We tested the PnP features of docking setups from Compaq, Dell, Hewlett-Packard, and IBM, and found that their abilities vary significantly.

Our typical test setup included an external mouse, a keyboard, a monitor, and a 10Base-T network connection. For those units with SCSI-2 ports, we attached an NEC MultiSpin 6Xe CD-ROM drive. We also plugged ISA, Peripheral Component Interconnect (PCI), and PC Card devices into expansion slots where appropriate.

Surprise or VCR

To Win 95, there are only two kinds of docking mechanism: surprise and VCR-style. A surprise mechanism lets you undock the notebook without warning. Win 95 doesn't get a chance to warn device drivers and PnP-aware applications of the event so they can prepare for it. Surprise is the least desirable design, but it's common. There's also no reasonable alternative for port replicators, which must be portable and inexpensive. With this type of system, you should initiate all docking releases through software by using the Eject PC choice in the Win 95 Start menu.

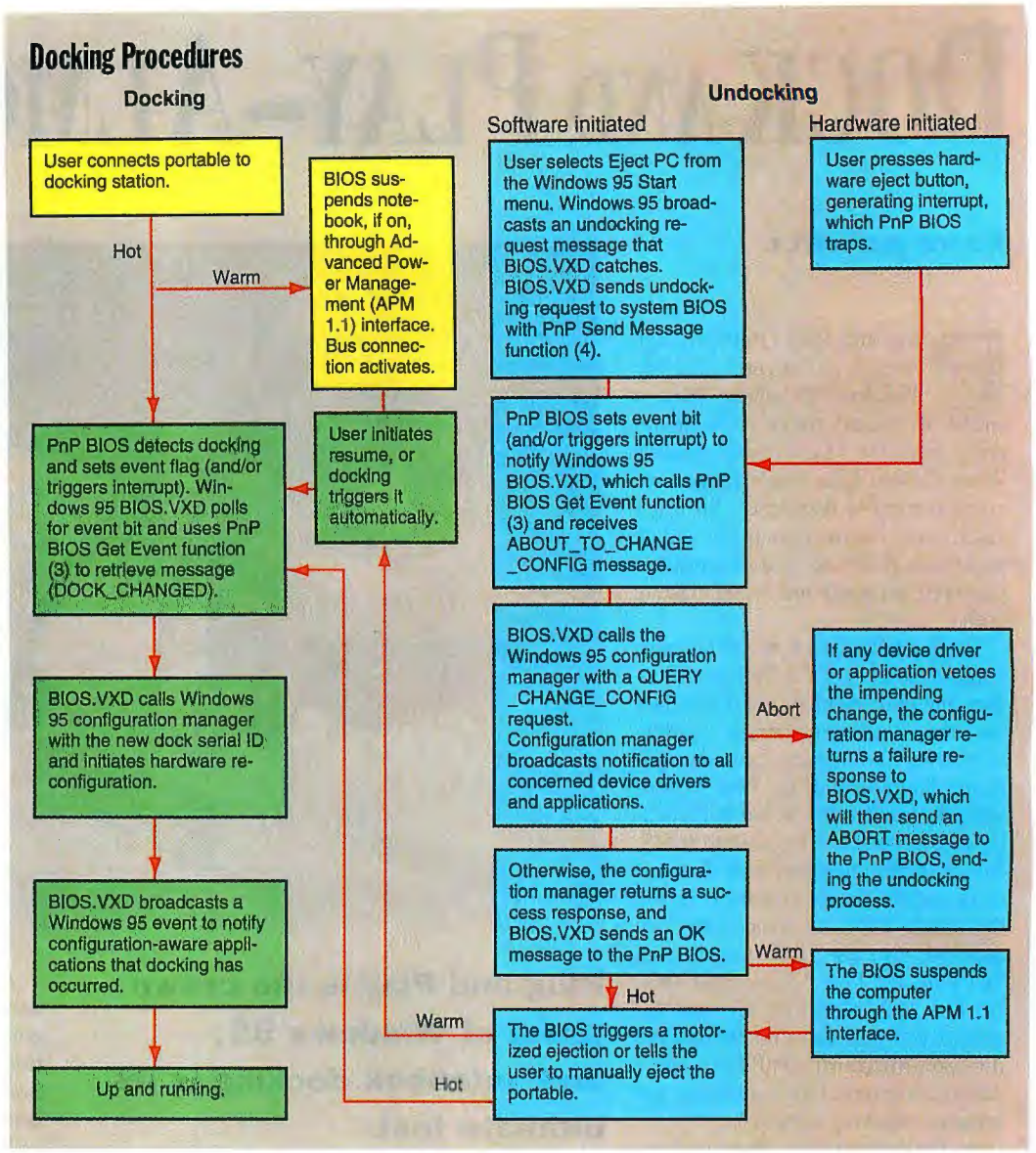
A motorized VCR-style mechanism provides an electrically consistent, secure bus connection and allows the docking station to physically lock the notebook in place. The locking ensures a planned decoupling process that lets device drivers and PnP-aware applications veto an inappropriate undocking, thus preventing data loss or a system hang-up. You unlock and eject either with a physical button on the dock or through software. Of the products we tested, only the HP Docking System provides a motorized mechanism. The IBM ThinkPad Dock II, though not motorized, does lock and prevent surprise ejections.

The ability to dock or undock a notebook while it is running (i.e., hot docking) or in suspend mode (i.e., warm docking) is a matter of convenience. Who likes to watch Win 95 reboot itself? When it works, the system takes docking hardware changes in stride, with minimal delay, using Win 95's ability to reconfigure and load device drivers dynamically.

Hot docking is technically more impressive and slightly more convenient. Hot and warm docking are not Win 95 hardware requirements, so cold docking is something you may run into. Also, systems claiming hot or warm docking may do so only under constrained conditions; this is true of the Compaq and IBM machines.

With any new hardware situation, such as a first dock, the Win 95 Hardware Detection window comes up while the configuration manager creates a new hardware profile. This takes

Plug and Play docking is a complex communications process involving a PnP BIOS, Windows 95, device drivers, and even applications.



about 3½ minutes on the 90-MHz notebooks we used in testing. When this process goes wrong—and it will if you make enough hardware changes—the best solution is to undock, delete all docked hardware profiles, and start over once you've determined what caused the problem.

Even when you have everything configured, your PnP problems may not be over. If you have SCSI hard drives hooked to the docking unit, for example, you may have to cold dock (with a reboot) or the drives won't show up in Win 95.

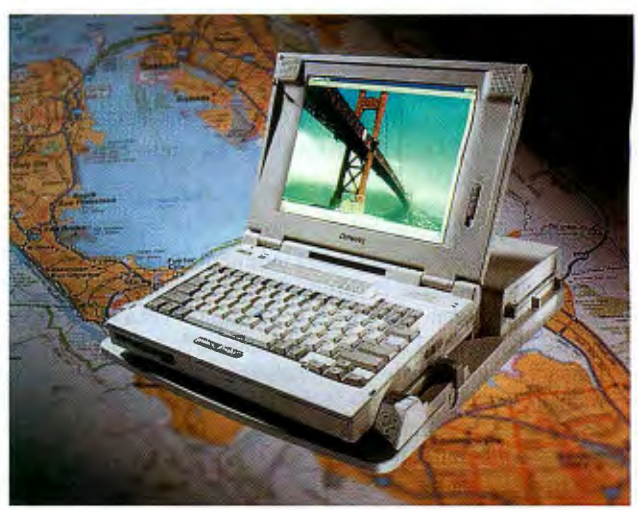
Compaq's Modular Bays

If you consider PC Card slots as expansion slots, Compaq's MultiBay Expansion Base for LTE 5000 series notebooks is a full docking station. It replicates I/O ports and provides Ethernet ports (both BNC and RJ-45), but it has no SCSI port or ISA expansion slots. However, the MultiBay Expansion Base has two Type III PC Card slots and spaces for two of Compaq's MultiBay drives (floppy, hard, or CD-ROM) or batteries.

Because the LTE 5100 also has two MultiBay slots, you can move drive and battery modules between the notebook and the dock, or you can have four batteries charging at once. The Compaq dock has a useful security option that lets you attach a single Kensington cable lock to the docking base and lock the notebook into the base at the same time (by preventing forward movement of the docking lever).

Compaq's docking mechanism isn't motorized or locking, so you can surprise it, though not accidentally. A lever system provides a mechanical advantage and guidance to both docking and undocking. Compaq's manual suggests that you can hot dock and undock, but if the docking station contains any MultiBay drives or is connected to a network, you must reboot to see these devices after docking. We found that hot docking hangs the system about half the time, but it allows access to docked drives and a network connection when it does work. Hot undocking always hung the system.

We determined that warm docking works consistently with docked drives (all of them based on enhanced IDE) and network connections. The system doesn't allow undocking warm, because there isn't any way to suspend it when docked. We noted some occasional quirks. Several times with a cold dock, for example, the notebook's trackstick device stayed active rather than the external PS/2 mouse connected to the



Compaq's MultiBay Expansion Base can exchange drive and battery modules with the Compaq LTE 5100 notebook. The monitor support cover is not shown.

PnP Docking with OS/2

BARRY KASINDORF

IBM provided the ThinkPad 750 series with plug-and-play (PnP) docking in the Dock II before the advent of Windows 95, so it's no surprise that you also get it with OS/2 Warp. It takes an OS/2 PnP driver, existing Advanced Power Management (APM) support, and device drivers that can handle the sudden appearance or absence of a device, but you gain some capabilities that Win 95 lacks.

OS/2 docking required a device driver to interface OS/2 to the PnP functions provided by the ThinkPad BIOS. There already was a driver (APM.SYS) to support APM BIOS functions (and thus wake up from warm docking). The PnP driver (DOCKPDD.SYS) is in IBM's Dock II support package. It allows both drivers, via the IDC system interface, and applications, via an IOCTL interface, to send and receive PnP messages and poll for PnP events.

OS/2 lacks a configuration manager, and it can't load and unload device drivers to accommodate the hardware changes involved in docking and undocking. OS/2's resource manager resolves resource conflicts only at boot-up time. To make devices absent at boot-up time able to start working after a warm dock, OS/2 emulates dock devices so that all necessary drivers load at boot-up time.

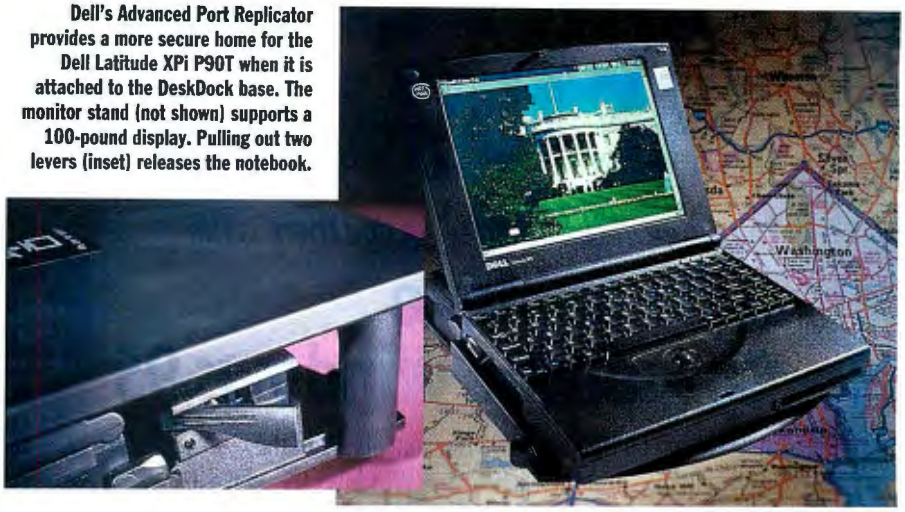
OS/2 also assigns resources such as drive letters to devices at boot-up time, whether they're attached or not—something Win 95 doesn't do well. If you boot undocked, a SCSI hard drive in the dock can't become active with docking, because it has no drive letter.

With Dock II under OS/2, if you boot while docked, the device driver for the SCSI controller in the dock checks for new devices and updates its configuration to emulate the presence of the device the next time you boot with the unit undocked. OS/2 assigns a drive letter for the device, which is not really there.

Activation of new hardware during docking relies on APM, the battery management specification from Intel and Microsoft. OS/2 hardware drivers already had APM capability to support laptops and machines where devices power down. The OS/2 docking support relies on APM to do the actual work of activating and deactivating device drivers.

An alert program (DOCKMGR.EXE) in the Dock II support package polls the PnP BIOS for event messages. When you press the undock button on the front of the Dock II, or insert a ThinkPad into the dock, this GUI program catches the ABOUT_TO_CHANGE_CONFIG PnP message and puts up a screen that gives you the choice to continue or abort the undocking. If you choose to continue, the GUI program acknowledges the PnP docking message, and the BIOS initiates an APM suspend. Resuming causes the OS/2 device drivers to reevaluate the hardware environment and either initialize the hardware in the dock or handle missing hardware for an undock.

Barry Kasindorf is chief scientist at Communica, Inc., a system software design company in Bourne, Massachusetts. You can reach him on the Internet or BIX at bkasindorf@bix.com.



Dell's Advanced Port Replicator provides a more secure home for the Dell Latitude XPi P90T when it is attached to the DeskDock base. The monitor stand (not shown) supports a 100-pound display. Pulling out two levers (inset) releases the notebook.

dock's mouse port. Also, we had to manually switch between LCD and CRT using the appropriate function key.

Dell's Advanced Replication

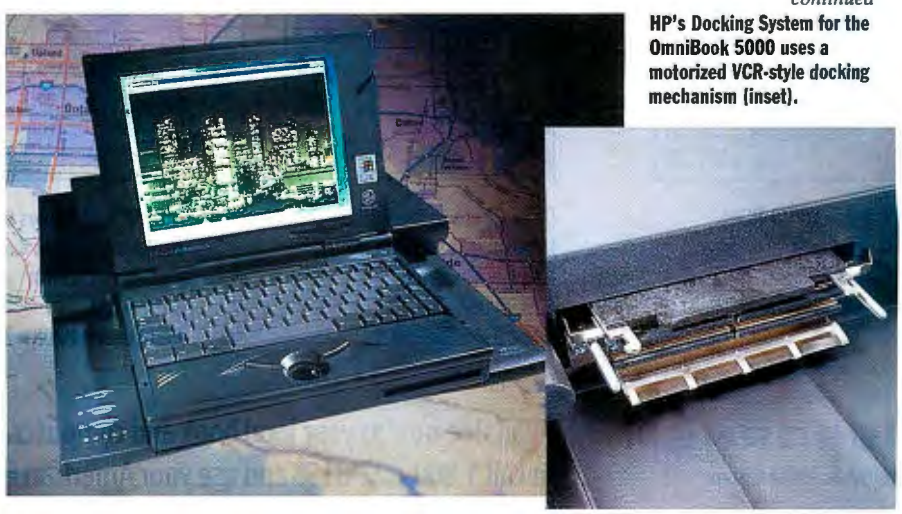
Dell's Advanced Port Replicator is more than just a port replicator for Latitude notebooks, because it provides a built-in 10Base-T Ethernet port. You can also make it into more of a docking station by connecting it (with one screw) to DeskDock, a plastic base that makes for a more stable docking area. With its sturdy monitor stand, it reduces the footprint of the docking setup. The combined setup costs $299.

As a modified port replicator, the resulting docking setup lacks mechanical assistance for making the docking connection, so you must pay more attention to ensure a clean, secure connection. (You hear two clicks if you do it right.) You must also remember to swing out the notebook's two rear feet before docking, or the connection won't work. Two levers, one on each side of the port replicator, release the connection. Also typical for a port replicator, the Dell unit uses a surprise release mechanism, so you must remember to use Eject PC on the Win 95 Start menu to initiate undocking.

The Dell unit is capable of warm docking and undocking. Both kinds worked, though not the same way every time. After a warm undock, the notebook sometimes resumed automatically. Other times, it needed help from the power button. In the latter case, it would occasionally reboot instead of resume.

We also noted a configuration problem if the network cable was connected to the port replicator's 10Base-T port the first time we docked. Win 95's hardware configuration created two hardware profiles (Dock1 and Dock2), one with a network card and one without. We could then set up a NetWare connection, but the spurious configuration created further problems. Win 95 remained confused. The solution was to undock, delete the new hardware profiles, redock with the network cable unconnected for configuration, and then reboot with the cable attached to bring up the network. It works thereafter.

continued



HP's Docking System for the OmniBook 5000 uses a motorized VCR-style docking mechanism (inset).

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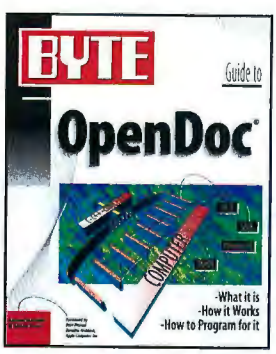

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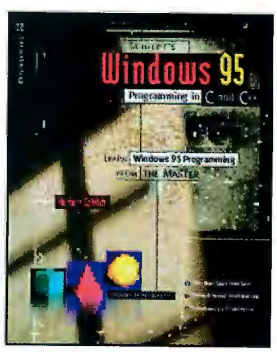

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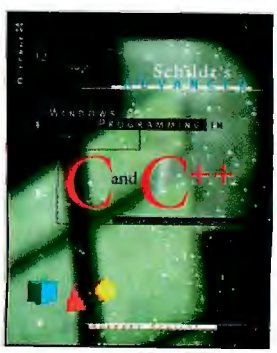

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PLUG AND PLAY DOCKING SYSTEMS

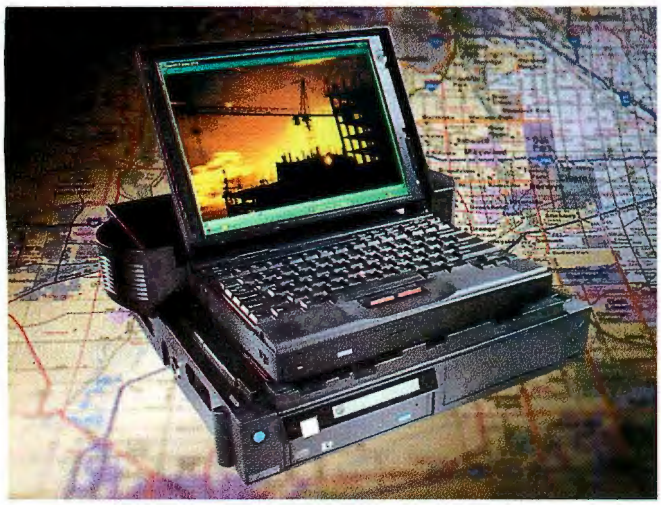
Docking hardware	MultiBay Expansion Base	DeskDock/Advanced Port Replicator	HP Docking System	IBM ThinkPad Dock II
Tested notebook	Compaq LTE 5100	Dell Latitude XPi P90T	HP OmniBook 5000CT	IBM ThinkPad 760CD
Dock type	Full docking station	Port replicator with base and monitor stand	Replicator with expansion slots	Full docking station
Dock/undock capability (as tested)	Warm/Cold	Warm/Warm	Hot/Hot	Warm/Warm
Motorized/locking mechanism	No/No	No/No	Yes/Yes	No/Yes
Monitor shelf (support weight)	Yes (55 lbs.)	Yes (100 lbs.)	No	Option
Stereo speakers	Yes	No	No	Yes
PORTS				
SVGA, parallel, serial, mouse, keyboard	Yes	Yes	Yes	Yes
SCSI-2	No	Yes	Yes	Yes
Power	90 to 260 VAC	DC power brick	DC power brick	DC power brick
Network	Ethernet (RJ-45, BNC)	Ethernet (RJ-45)	No	No
Audio ports	Yes	No	Yes	Yes
MIDI/game port	Yes	No	Yes	No
IrDA infrared port	Yes	No	No	No
SLOTS/DRIVES IN DOCKING STATION				
PCI slots	No	No	1	No
ISA slots	No	No	2 (one shared)	2
PC Card slots	2 Type III	No	No	2 (1 Type II, 1 Type III)
Drive bays	2	No	No	2

HP Hot Dock

Hewlett-Packard's new Docking System for the OmniBook 5000 isn't a full docking station because it lacks drive bays (and a monitor stand). However, it is one of the first docking setups to provide a PCI slot and therefore the capability to drive a fast graphics card. (This is an approach you'll see from numerous vendors this year.) The slot, a direct (not bridged) extension of the PCI bus on the OmniBook 5000, has two ISA slots to keep it company, one of them shared. The HP Docking System is also unusual in that it supports hot docking. We tested a prototype of the docking station with a shipping OmniBook 5000CT.

The docking mechanism is motorized. You slide the OmniBook up against it, and it grabs the notebook, drawing it onto the bus connector with a loud whir. The docking station provides a full set of indicator lights and reset, power, and eject buttons.

Pushing the eject button initiates undocking, but under software control (however, a hole allows you to force a release with an unbent paper clip if the system hangs up). Low-friction runners let the notebook slide down its ramp at surprising velocity, so you should be prepared to catch your OmniBook.



The IBM ThinkPad Dock II docking station houses ThinkPads in the 750 series as well as the 760CD shown here. Though not motorized, the docking mechanism locks.

We tested hot docking with an SMC EtherEZ 8416 Plug and Play Ethernet card in one ISA slot and an STB PowerGraph 64 graphics card in the PCI slot. Once we logged on to a NetWare network, we could quickly undock and dock at will. Network drives disappeared and reappeared in the My Computer folder as appropriate, and the display switched between external CRT and the OmniBook's LCD.

Dock for a ThinkPad

The big, black ThinkPad Dock II makes an impressive home for IBM's ThinkPad 750 and 760 notebooks. It's a full docking station with two ISA slots, two drive bays, an Adaptec SCSI bus controller, an extra enhanced IDE connection, stereo speakers, and an array of replicated ports. The whole setup locks with a single key.

The Dock II docking mechanism isn't motorized, but it does prevent surprise releases. As you slide the ThinkPad in on a carriage to join with the docking bus connector, a latch engages. To undock, you suspend or shut down the system and then press the eject button on the Dock II. Through the action of a solenoid, the latch releases.

IBM claims hot docking for the Dock II,

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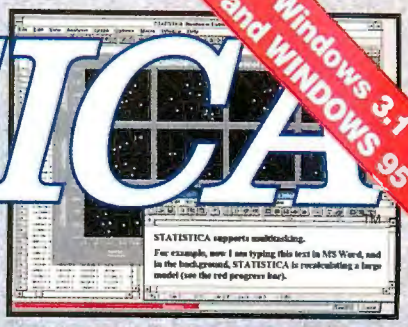
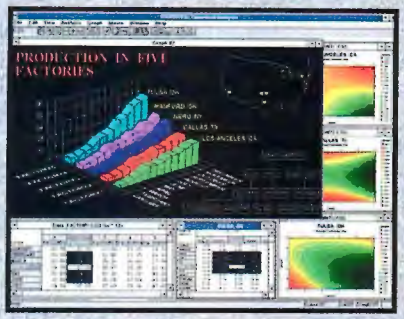
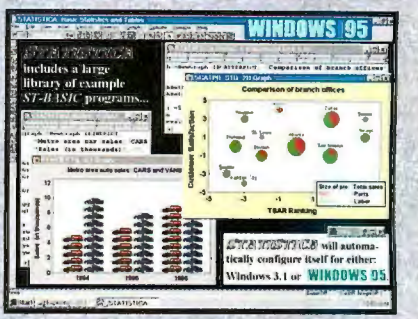
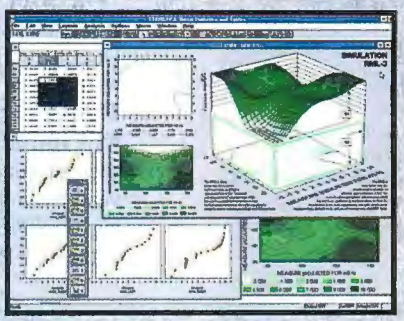
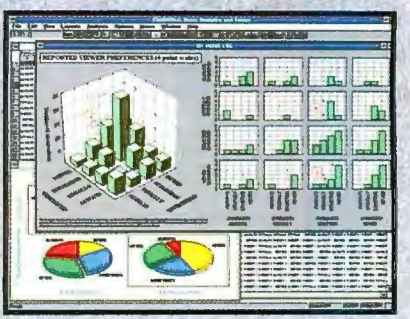
Windows 3.1 and WINDOWS 95

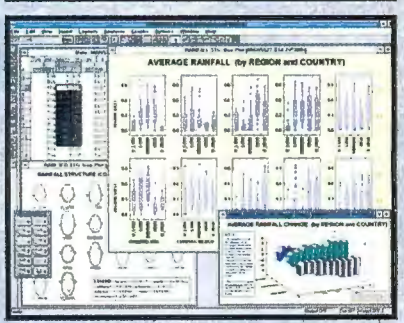


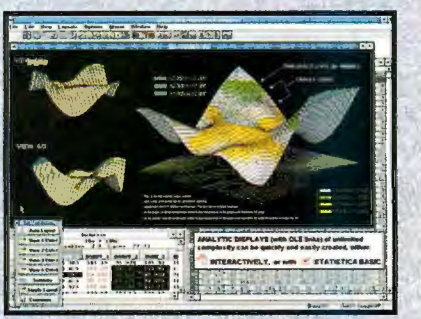


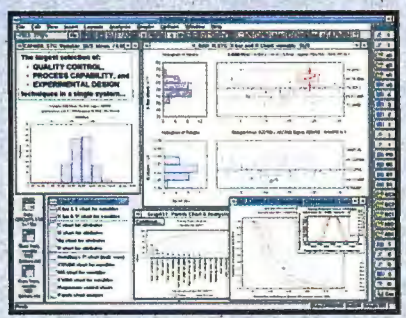


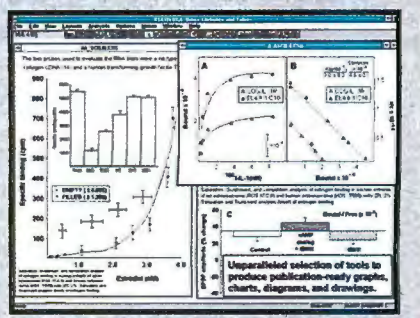


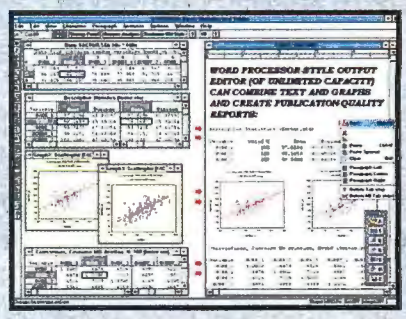


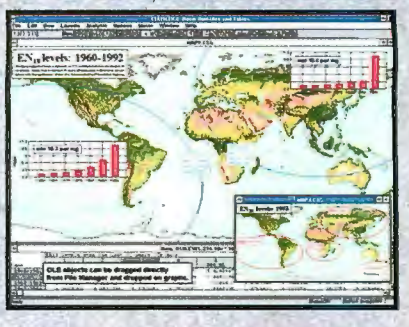












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but technically it's warm docking because the ThinkPad automatically goes in and out of suspend mode during the process. If you have drives residing in the Dock II, you'll want to cold dock anyway.

After a warm dock, you can't access any hard drives (IDE or SCSI) connected to the dock. Warm undocking isn't a good idea if you have SCSI drives attached to the Dock II. Icons for docked drives remain in the Win 95 interface. If you access these phantom icons, Win 95 locks up. Also, warm docking occasionally causes a system hang-up. Because the power switch is soft, there's then no way to shut down. As with HP's unit, you must resort to an unbent paper clip to release the notebook. An access hole lets the paper clip activate the release solenoid.

For IBM's corporate customers, one big strength is backward compatibility. The Dock II provided PnP capabilities for the ThinkPad 750 under Windows 3.1 using extra utility software, and it currently supports PnP warm docking under both Win 95 and OS/2 (see the text box "PnP Docking with OS/2" on page 93). The Dock II will also work with new PCI-bus ThinkPads that IBM will introduce in the second quarter of this year. Even better, existing ThinkPads will work in the new PCI docking station that IBM will also introduce. This is quite a feat: a docking bus with a dual ISA/PCI personality.

Where You Should Dock

If you're buying notebooks as desktop replacements, docking stations are an important consideration. The Win 95 PnP capabilities that these systems provide to differing degrees make the process more convenient. As long as you save data before each docking change, you can use all four tested systems reliably.

Differences in feature sets and pricing prevent some comparisons. The inexpensive Dell setup, as you might expect, provided the fewest capabilities, and the Compaq MultiBay Expansion Base beats the IBM Dock II in price, though their features are almost comparable. Even though its $525 price doesn't include drive bays or a monitor stand, the hot-docking HP docking platform is definitely the best toy. ■

Dave Rowell is a BYTE technical editor. You can reach him on the Internet or BIX at drowell@bix.com. Selinda Chiquoine assisted with product testing.

Product Information

DeskDock/Advanced Port Replicator (Ethernet) . . $299
Dell Computer Corp.
Austin, TX
(800) 613-3355
(512) 338-4400
fax: (512) 728-3653
http://www.dell.com
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Docking System for HP OmniBook 5000 . . . . . $525
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(503) 715-2004
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(fax back)
http://www.hp.com
Circle 1166 on Inquiry Card.

MultiBay Expansion Base $489
Compaq Computer Corp.
Houston, TX
(800) 345-1518
(713) 510-0670
http://www.compaq.com
Circle 1167 on Inquiry Card.

ThinkPad Dock II $710
(estimated street price)
IBM Personal Computer Co.
Research Triangle Park, NC
(800) 772-2227
(919) 517-1950
fax: (800) 426-4329
http://www.ibm.com
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OLE's Missing Links

KEITH PLEAS

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An emerging standard for communication between applications, OLE 2 will work better when software vendors agree on its meaning

Ask a dozen developers to define OLE and you'll likely receive a dozen different answers. The most knowledgeable ones will start by telling you about the Component Object Model (COM), but they will be relatively rare. That's because the definition and makeup of OLE have changed so much in recent years that most of the computer industry has yet to catch up with Microsoft's current OLE strategy and products.

Much of the confusion surrounding OLE can be traced to Microsoft's early evangelism. The company initially marketed OLE to users as a strategic advantage of Microsoft's Office application suite. That effort was too successful, creating the false impression that OLE was designed solely for Office.

In fact, OLE is also a standard for communication between applications from different vendors. But during our informal testing of OLE features in several applications, we found that intra-Office OLE works better than cross-application OLE. The lesson is that, as with most standards, vendors may claim OLE 2 capabilities without having *all* the specified features.

Inside the Component Object Model

The underlying object standard of OLE is COM, which defines a language-independent binary interface for objects that allows them to behave in consistent ways. COM also handles all the communications between components. While COM can be used by itself for custom development, it is more commonly the basis of an integrated OLE solution that uses a variety of OLE services.

In addition to the binary object specification itself, COM includes the following features:

COM functions: The COM function library provides a number of useful routines for software developers. In general, these functions begin with "Co" and have names like CoInitialize and CoCreateInstance.

Marshaling: COM handles the process of packaging, sending, and unpackaging interface parameters across process, machine, and network boundaries. Marshaling and unmarshaling are basically synonyms for packaging and unpackaging. The actual transport mechanism is provided by the operating system itself and is not considered part of COM. Locally, COM uses a process called "lightweight" remote procedure calls (LRPCs); remotely, it uses the industry standard Distributed Computing Environment (DCE) RPC.

Structured storage: COM provides a full-featured system for handling storage and stream objects in a robust, persistent, hierarchical manner. In general, a single structured storage object is like an entire disk volume: It has something that maps out the contents (like a file allocation table), one or more storage objects (analogous to root directories and subdirectories), and one or more stream objects (similar to files in directories). Structured storage objects can be aggregated and nested, and they can exist inside a disk file, in memory, or even as database records.

In addition to these file system-like features, structured storage also provides complete transaction processing that you can use, for example, to implement Undo operations. OLE also provides a default implementation of structured storage called compound files, from which OLE compound documents are derived.

The flexibility of COM structured storage is helpful in enabling legacy applications with OLE; they often have proprietary storage models that can be difficult to reimplement. Structured storage also offers a major improvement over dealing with file systems directly, particularly when multiplatform solutions are required. While COM structured storage is fundamental when

implementing OLE servers, it can also handle custom storage needs.

Monikers: As the word implies, a moniker is a name for a specific COM object. Like a fully qualified filename, which includes drive and path information, a moniker contains information about an object as well as the instructions for connecting to it. Monikers can be serialized into stream objects. This consistent access mechanism allows applications to automate connections to objects. COM provides built-in implementations for File, Item, and Composite monikers and allows developers to easily create their own implementations. One example is the new URL moniker, which holds a uniform resource locator that allows client applications to access server resources on the Internet using a variety of protocols.

Uniform data transfer: Uniform data transfer (UDT) is an important mechanism in any component-based software. COM insures that OLE services using the clipboard, performing drag-and-drop operations, and doing OLE automation all use compatible data formats.

Version management: Using a COM interface creates a contract between the object provider and consumer. It's important that this contract not be broken as objects evolve. COM interface version management allows adding services to objects without breaking existing applications.

On to OLE

OLE is a set of object services built on top of COM. The first service distributed by Microsoft was OLE documents. Microsoft heavily marketed this service to end users, and it's what most people still think of when they hear the term OLE.

The next OLE technology was OLE automation, initially useful only from Visual Basic. Next was OLE controls—internally, a hybrid of OLE documents and OLE automation. Now we have general-purpose, industry-specific, and even Internet-related services, as follows:

OLE documents: OLE documents (sometimes called OLE compound documents) are a form of compound document that incorporate data created in any OLE-enabled application. The most common example is probably an Excel spreadsheet object embedded in a Word document, but a virtually unlimited number of scenarios is possible. Several OLE subservices are at work here: the object linking and embedding itself (from which OLE originally got its name but which is now a historical footnote); use of property sets within the compound documents; and the ability to edit the objects in-place. Yet another service, drag-and-drop, originated with OLE documents but has recently been extended to places like the new Windows shell, so it's better to think of drag-and-drop as a separate OLE service.

Application programs that create compound documents are called *OLE containers* and applications that furnish objects are called *OLE servers*. It's possible for an application to be both an OLE container and an OLE server, which is the case with both Microsoft Word and Excel.

Linking and embedding: In addition to static information like the worksheet mentioned earlier, OLE documents can also incorporate live elements such as multimedia and external services (stock market and sports information feeds, for example). If an object is linked, it still resides outside the compound document, typically on a server where multiple users have access to a single version. What's more, when you update the source object, docu-

THE OLE EXPERIENCE

We should begin this hands-on investigation with an apology to OLE. This is complex stuff, and large tracts of it work well. If the idea is to make integration so seamless that you can't tell which application you're in—it works. It's just that a few wrinkles need ironing.

In-place Editing

In-place or *in situ* editing is like drive-through editing: You don't actually go inside the restaurant, you just stop and get what you want through a window. With in-place editing, the container application's interface changes to that of the server application that created the object you're editing.

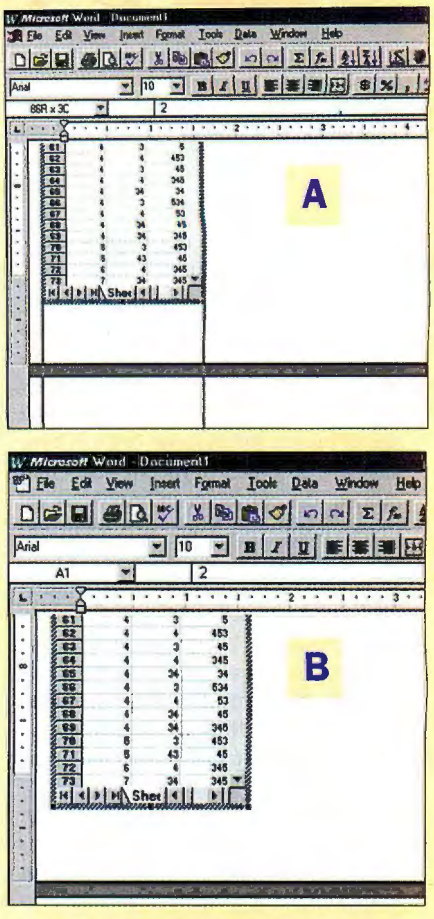
Many Windows 95 applications already support in-place editing—certainly all the Microsoft Office products do. But many others don't. For example, even though you can embed and edit in-place a Lotus Word Pro 96 document from within Office, you can't do the same with Lotus 1-2-3 release 5. Instead, Office opens a separate 1-2-3 window when you try editing a 1-2-3 spreadsheet object. The embedded spreadsheet is grayed out and its contents copied into the 1-2-3 window. When you've completed your alterations, 1-2-3 asks if you want to have your changes copied back into the object you've been editing.

Objects May Appear Larger Than They Are

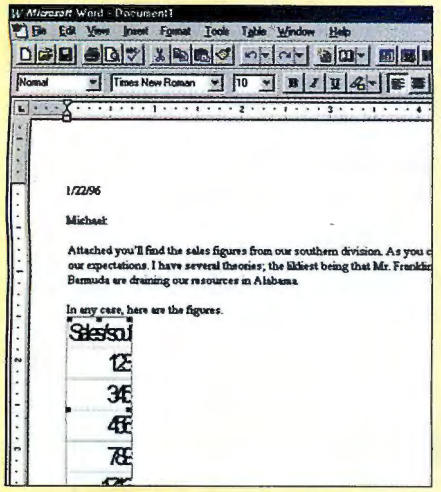
When one object is embedded in another, OLE has to pull off some complex moves. If you do some exploring, you'll find evidence that many application designers apparently did not have in mind all the activities that OLE would allow. The result is that things don't always work the way you thought they would, particularly when it comes to the way an embedded object's data gets presented.

Open a Microsoft Word 7.0 document and enter some text. Then embed an Excel 7.0 worksheet in the Word document. One click on the Excel object will generate a box outline with attached drag handles. Click and drag the handles and watch what happens (see the top screen on the next page).

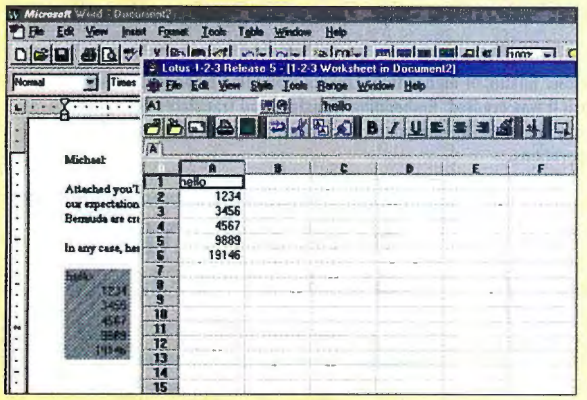
Sometimes the scaling works and the spreadsheet font looks reasonable; sometimes it doesn't. Admittedly, we're pulling some esoteric moves: How often does anyone resize an embedded spreadsheet to bizarre dimensions? But just resize it a little and double-click on it to put the spreadsheet into in-place editing mode, and the window that opens into the object will likely reveal a suddenly magnified portion of the spreadsheet. It's as if Excel knows you did some resizing on the embedded object, doesn't know the details of the resize op-



When you embed a spreadsheet that's longer than a word processor's page, you can't get it to cross the page boundary. You can drag the outline over the boundary (screen A), but it snaps back (B) when you release the mouse button.



There's nothing smooth about font scaling when you resize a contained object.



Sort-of-in-place editing. Lotus 1-2-3 grays out the embedded object, then opens a separate 1-2-3 window loaded with the embedded data.

eration, and just produces a magnified view to impress you.

Apparently, when you resize horizontally and switch to in-place editing, the system picks the closest font with the proper horizontal dimension. Unfortunately, this approach produces an altered vertical dimension. So, if you made your spreadsheet object unusually wide, in-place editing produces an edit window with a font that's unusually tall as well. The effect is orthogonal: If you resize the object so that it's tall, the edit-in-place window will be sized with a font that's wide, too.

Paging Mr. Excel

The term "logical object pagination" refers to OLE's supposed ability to display data for an object too large to fit on a page of the container application's data presentation. Try this: Create a reasonably long Excel spreadsheet, 150 rows or so. Embed the object in a Microsoft Word document, just beneath a couple of sentences on the first page. Excel (or Word, it's hard to figure out which program is responsible for this) appears unwilling to place the top of the spreadsheet object anywhere but at the start of a page. Since you've already typed a couple of lines of text, the embedded object creates an unusable hole extending from the end of the text you've typed to the end of the first page. The embedded object begins at the top of page two.

Furthermore, the spreadsheet has been "clipped" to fit onto the page; it will not cross the boundary to the next page. You'll be able to see only about 70 or so lines of the Excel sheet, though you can edit the spreadsheet in-place, and scroll bars let you get to the rest of the "hidden" data. Try hard as you may to resize the sheet onto the next page, Excel refuses. Screens A and B on page 100 show this phenomenon.

Remember the unusable hole? If you resize the spreadsheet to make it smaller—just enough to fit on the remainder of page one—the whole thing snaps back to just under the text. Blink and you'll miss this.

Where Was I?

Resizing an embedded object so it is larger than the container's viewing window area brings up annoying behavior. When you activate in-place editing for such an object, the container appears unable to track the insertion point of the contained object.

Let's return to the overly large spreadsheet object in the preceding section. If you double-click on the object to perform in-place editing, the object's window will appear, with scroll bars. But if you move the insertion point up or down so it passes outside Word's window, Word won't "track" the insertion point. In other words, the inner window scrolls properly, but the outer window doesn't. Because of such oddities, our advice is as it's always been: frequent backups. **—RICK GREHAN**

ments that include links back to the source are automatically updated, too.

Embedded objects are contained within and actually travel with the compound document. The data in such objects becomes part of the container program's data file. The original data file becomes irrelevant.

Linking and embedding also lets you convert the same object to different types. This means multiple applications can work with the same object, so it isn't necessary for all users to have the same OLE server.

Property sets: OLE documents define an extension to structured storage that provides a method for storing information about objects; this information can be distinct from the objects themselves. Property sets are extensible but in general have a defined data structure, a common format, a defined header, and built-in support for localized dictionaries. The only predefined property set is Document Summary Information, which contains relatively static attributes like author, subject, and date of creation, as well as dynamic attributes like word and page count. All major Microsoft applications of the past several years have provided this information. You can access it from the Summary Information selection on the File menu in Windows 3.1 or from the Summary tab of the document's Properties page in the new Windows shell. If you use this summary information, you may have also noticed that support for the Document Summary Information property set is integrated into the new Windows shell: From the shell, select a document and choose Properties from the context menu; you'll see additional Summary and Statistics tabs that aren't provided for other file types such as .TXT files.

Visual editing: Also called in-place activation, visual editing is the name for the process of editing a server object inside an OLE container. It includes support for what amounts to bringing up the server application inside the container. To do this, it's necessary to merge the menus of the two applications, display the OLE server's docked or floating toolbars, handle keyboard integration for hot keys and accelerators, and provide for frame adornments—for example, the top and left rulers used in most drawing applications—where applicable. This lets you remain in a familiar host application without having to activate and switch to another application.

OLE automation: While OLE documents are primarily about user involvement, OLE automation is all done under the hood. Controlling applications work with objects and with associated commands that are exposed by server applications. With automation, OLE's original linking-and-embedding paradigm starts to get lost: While a controller may obtain a pointer to an object in a server, it does so merely to get and set the server's properties and methods and not to create a persistent storage object.

It's possible to serve any object that can be created in code: result sets returned from database queries, real-time data, or—perhaps more powerfully—internally developed business objects for things like orders and invoices.

OLE controls: An important type of OLE automation object capable of reacting to external events, OLE controls work in many recent 32-bit Windows development tools. They are also part of Microsoft's plans for the Windows user interface: The next version of the Internet Explorer will be able to host OLE controls for creating Windows-based Internet applications.

Internally, OLE controls are compound document objects that are controlled via

OLE automation objects. They combine the features of both major OLE services (though this is mostly transparent to users).

OLE drag-and-drop: Available in both OLE documents and OLE controls, drag-and-drop is now also a key function in the Windows 95 user interface. Essentially, it is another OLE service. So far, Microsoft has defined three types:

Inter-window: Lets you drag objects from one application window and drop them into another—one way of embedding an object using OLE documents.

Inter-object: Lets you drag objects and drop them inside other objects.

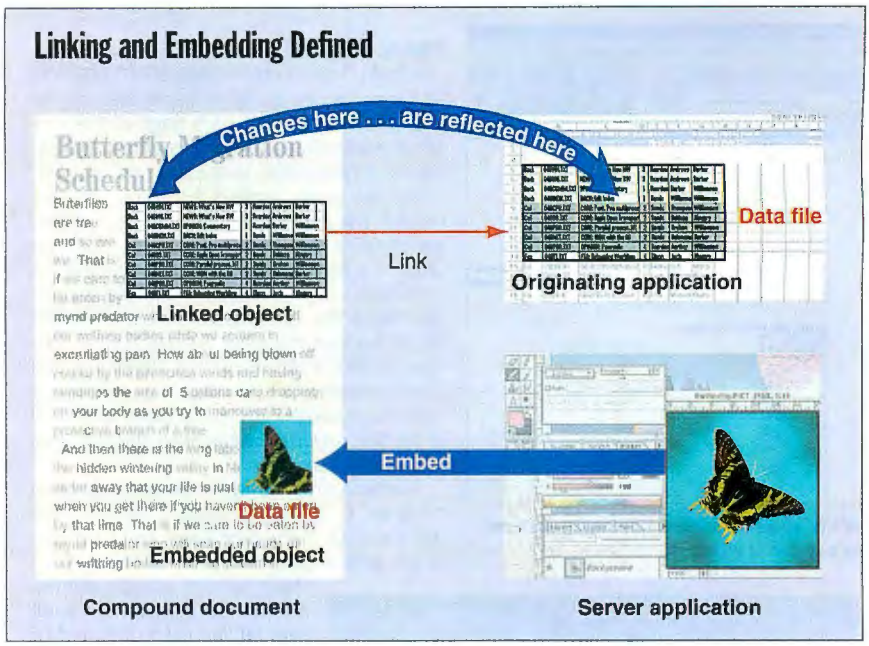
Dropping onto icons: Lets you drag objects in the Win 95 desktop and drop them onto resource icons such as printers and mailboxes. Some new OLE controls, like the RichText control that ships with 32-bit versions of Windows, support drag-and-drop operations on the desktop.

Industry solutions: Microsoft sells vertical-market OLE services. These have been codeveloped with leading companies in specific industries. These industry standards make it possible to create reusable Line-Of-Business objects (LOBjects). So far, Microsoft has released specifications for the following industries:

- WOSA/XRT (extensions for real-time market data)
- OLE for Health Care
- OLE for Insurance
- OLE for Retail/POS
- OLE for Design and Modeling

Other OLE services: In addition to industry-specific services, Microsoft has provided specifications for more general-purpose OLE transactions. Microsoft's own products are starting to incorporate these specifications. SQL Server 6.0, for example, uses OLE database technology, which is sometimes called SQL OLE. Similarly, OLE messaging is a key component in Microsoft's new Exchange mail server.

Microsoft will soon incorporate Network OLE into its 32-bit OSes. Network OLE is an extension of COM that uses remote procedure calls; this will mostly be transparent to OLE-enabled applications, which will get this new capability for free without having to make any changes. (For the latest on Network OLE, go to the FTP site listed in the box at right.)



At bottom, most OLE 2 functions involve either linking or embedding. Linking maintains a connection only from the linked object to the application in which it was created. Embedding transfers and translates the server application's data so it can be independently stored in the compound document. Drag-and-drop and clipboard transfers are fundamentally embedding operations.

OK, Everybody, on Four

Application developers' support for OLE has varied by industry. The first non-Microsoft vendors to get on the bandwagon were graphics vendors. Corel's flagship CorelDraw, for example, has been an OLE document container for several releases. Visio Inc.'s Visio, a technical drawing program, was another early OLE document container and server. Ironically, Visio was also the first shipping OLE automation server, beating Microsoft's Office applications by several months and actually doing a better job of providing a useful object model to developers.

For many software vendors, OLE's complexity was daunting at first. It wasn't until Microsoft encapsulated high-level support for OLE in Visual Basic, and in the Microsoft Foundation Classes (MFC) class library that ships with Microsoft Visual C++, that many companies were willing to integrate OLE services into their applications. Companies that sell development tools—compilers, class libraries, and so on—have had a more difficult time because they often must implement OLE support from scratch.

Thus, you can't always tell what being OLE-enabled means. When a product is labeled "Supports OLE," it may be an OLE document container or, more commonly, a server. It likely doesn't support OLE automation. Win32 applications are generally more predictable, however, due to Microsoft's requirement that an application include specific OLE functions in order to earn the Windows 95 logo. "The OLE Experience," on page 100, offers hands-on examples of the kinds of inconsistencies that may await a typical user of OLE-enabled applications.

Clearly, software vendors continue to add support for OLE. But they're doing it in inconsistent ways, preventing true integration and communication from becoming a reality. ■

Keith Pleas is an independent software developer and trainer. He is the author of the forthcoming book Visual Basic Tips and Tricks *from Addison-Wesley. You can reach him at 71333.3014@compuserve.com.*

Where to Find

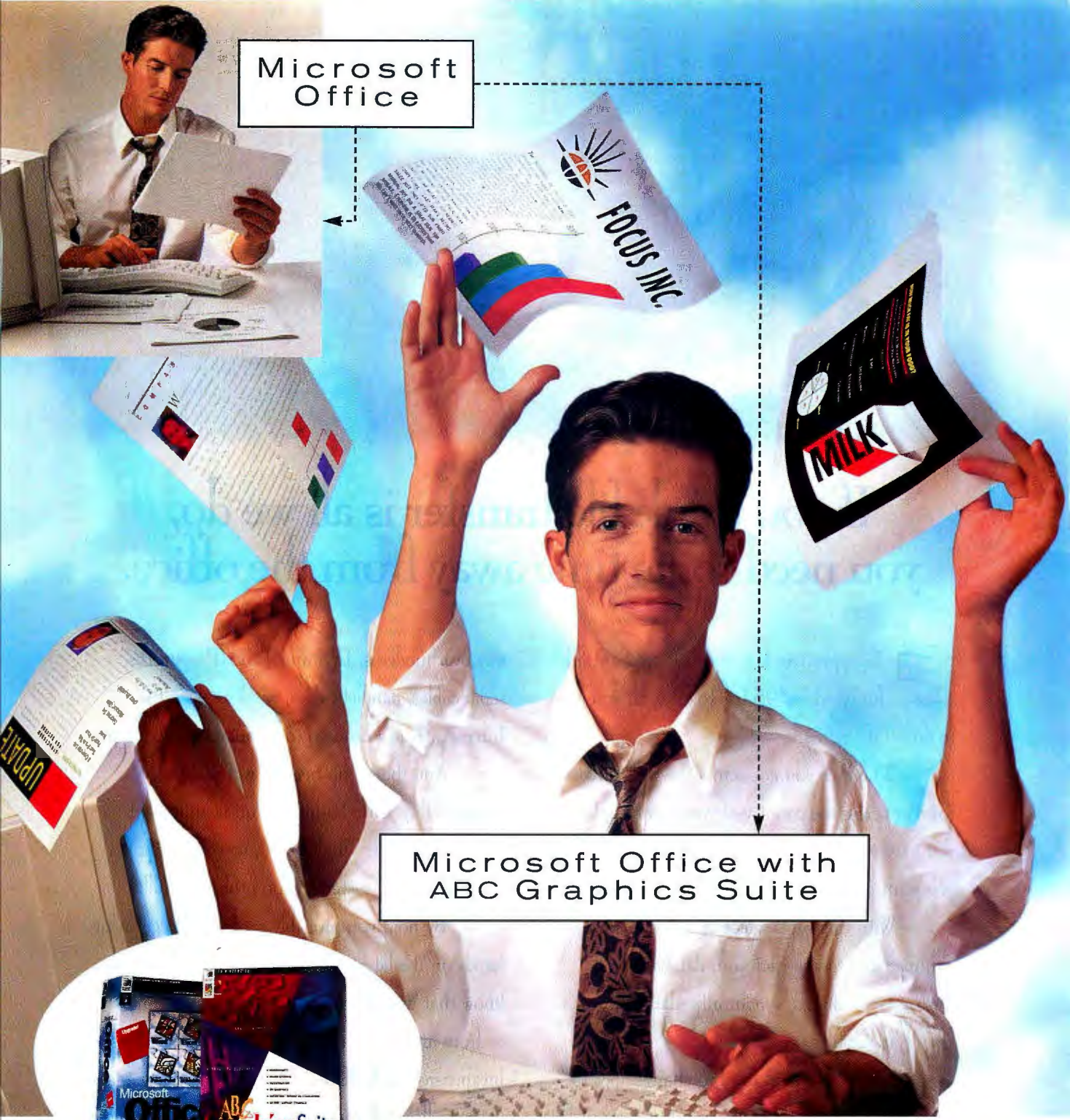
Lotus Development Corp.
Cambridge, MA
(800) 343-5414
(617) 577-8500
fax: (617) 693-3512
http://www.lotus.com

Microsoft Corp.
Redmond, WA
(800) 426-9400
(206) 882-8080
fax: (206) 635-6100
http://www.microsoft.com

Find Out More on the Internet

To read more about COM, look for Microsoft's current specification, updated in October and available via FTP at:

ftp.microsoft.com/developr/drg/OLE-info/COMSpecification/COM_Spec_DOC.ZIP



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UNDERGROUND UPGRADES FOR WINDOWS 95

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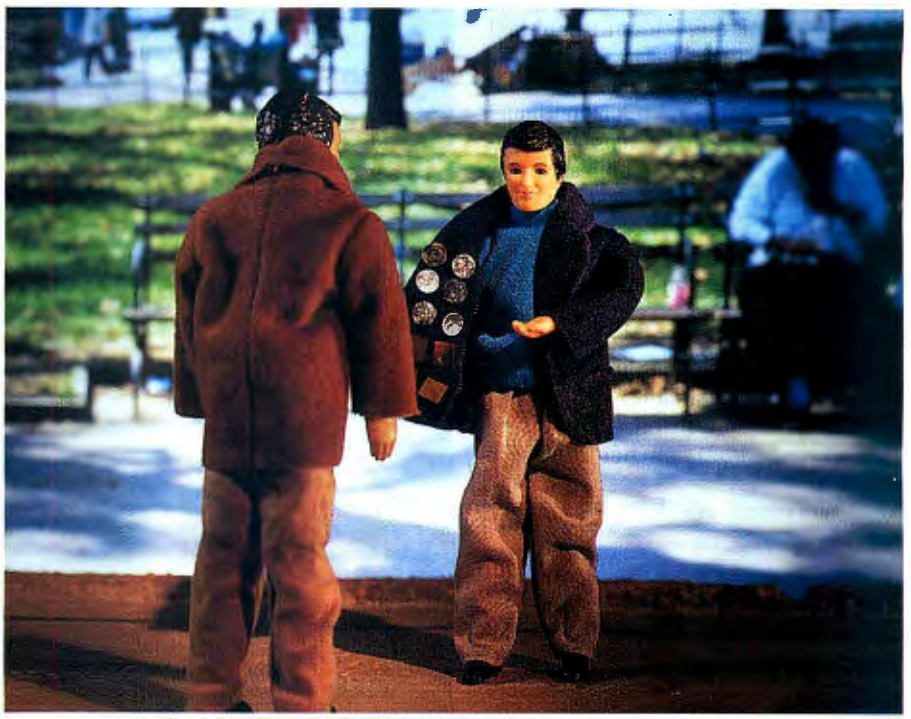


EARL RIPLING © 1996

Freeware, shareware, and low-cost utilities make Windows 95 what it should have been in the first place

Welcome to Windows 95.1. You cannot find it on store shelves or in a Microsoft brochure; it's spread out on BBSes, on-line services, and World Wide Web sites around the world. It comprises small, focused utilities that add key functionality to the Win 95 user interface (UI). Some of these features deliver what we expected from the UI back in August, when Win 95 launched. And, in fact, Microsoft itself now provides some of the feature enhancements in a freeware bundle put together by the original Win 95 development team.

Powerize 95

You've certainly got to wonder whether the Power Toys suite of utilities, which is available free of charge from the Microsoft site (http://www.microsoft.com/windows/software.htm), includes features that simply arrived too late to ship with the initial release of Win 95. The Power Toys are simple—but highly convenient—UI enhancements.

For sure, most of us expected to get on-the-fly resolution and color-depth switching as part of the original UI. That capability didn't ship with Win 95 but now arrives in the form of a Power Toy dubbed Quickres. At BYTE, we often need to switch quickly among resolutions and color depths. For instance, we might normally run Windows in 256 colors for optimum performance and switch to true-color mode to preview images or capture screens. It's a painful process that requires you to reboot Windows each time you need a new desktop configuration.

With Quickres, you just point to the icon in the notification bar (at the bottom right of the screen) and select the bit depth and resolution from the pop-up menu. The desktop adopts the new parameters instantly. It's a big time-saver.

EzDesk, a $15 shareware utility, is a perfect companion for Quickres. After switching resolutions, you usually have to rearrange your desktop layout, especially when you flip to a lower resolution (e.g., changing from 1024 by 768 pixels to 640 by 480) and find that Windows has stacked folders on top of each other to make room for everything. EzDesk lets you save multiple desktop layouts to match resolutions. You can store one layout for your 640 by 480 desktop, and another for your 1024 by 768 desktop.

Together, Quickres and EzDesk make resolution switching fast and painless. After the single-click switch in Quickres, EzDesk pops up a window, asking if you want to apply the stored layout for the new resolution. Another click arranges your desktop, and you're ready to go back to work.

Other Power Toys utilities include the following:

- TweakUI 1.0 controls additional UI settings (see the screen on page 106) not available in Win 95.
- CABfile Viewer peeks into the Windows *.CAB files (compressed files you'll find on the Win 95 installation CD and floppies) and performs normal shell operations (e.g., dragging and dropping and renaming).
- An Explore from Here right-click option launches the Explorer from a selected folder instead of from the root directory (the Win 95 default).

continued

More UI Enhancements

Apart from the Microsoft stuff, there are a few other good utilities that enhance the Win 95 interface. WinHacker 95, a shareware utility from Wedge Software, controls settings for many hidden Win 95 options. It duplicates some of TweakUI's features but adds other significant capabilities, including one-click access to the Windows Registry, customization options for the boot menu, and icon-title word wrap. It can also automatically generate icons for BMP files from the images themselves, creating convenient thumbnail views of image files.

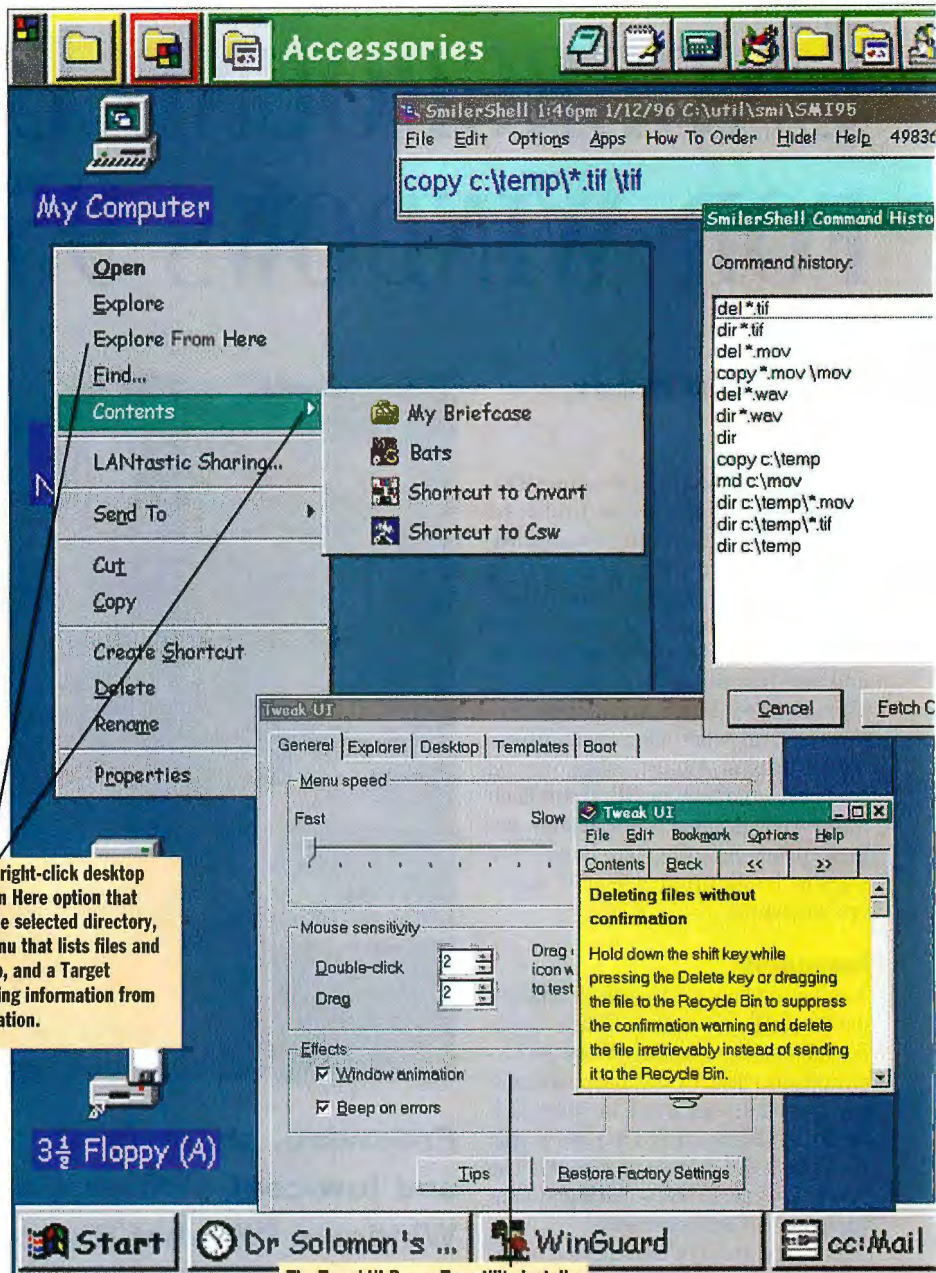
Best of all, WinHacker can tune Windows 3.x applications to run better under Win 95. The utility can increase the allotted stack space for legacy applications or, in some cases, report a different Windows version number to an application to keep it happy.

If you sometimes find it easier to shell out to a DOS prompt to run some commands or programs, you'd appreciate a Win 95 command-line utility. There are some good ones available. The popular 4DOS utilities from JP Software (renamed Take Command/32) now run under Win 95 and support an enhanced command set, customizable commands, batch-programming tools, and keystroke aliases.

We also like SmilerShell/95, a $29.95 command-line utility from Bardon Data Systems, because of its convenience and simplicity. SmilerShell places a small icon on the title bar of the active application. You just click on the icon to launch a small vertical command-line interface, where you then type in any DOS or Windows command. Or you can call up a command-history window to select previously entered commands. Like Take Command/32, the SmilerShell supports aliases, multiple commands on one line, pipes and redirection, and command-line parameters. You can save the command stack as a loadable batch or as a default set of commands on start-up.

Some smaller utilities add specific UI functions. Place a shortcut to Chris Bluethman's Shutdown 1.5 utility on the desktop, and you can shut down Win 95 with a quick double-click. Run the program from a command line (or the SmilerShell) and add parameters to restart your computer, to boot into MS-DOS mode, or to run a batch file before shutting down.

Sapphire's WinShade 1.5 saves precious desktop space by collapsing open windows to a single vertical bar. As first seen in Apple's System 7 and Corel's roll-up palettes, WinShade shrinks an application or an open folder to its smallest vertical size when you click on the title bar.



Power Toys enhances the right-click desktop menu with an Explore from Here option that launches Explorer from the selected directory, a Contents drop-down menu that lists files and folders one directory deep, and a Target Properties option for getting information from a shortcut's target application.

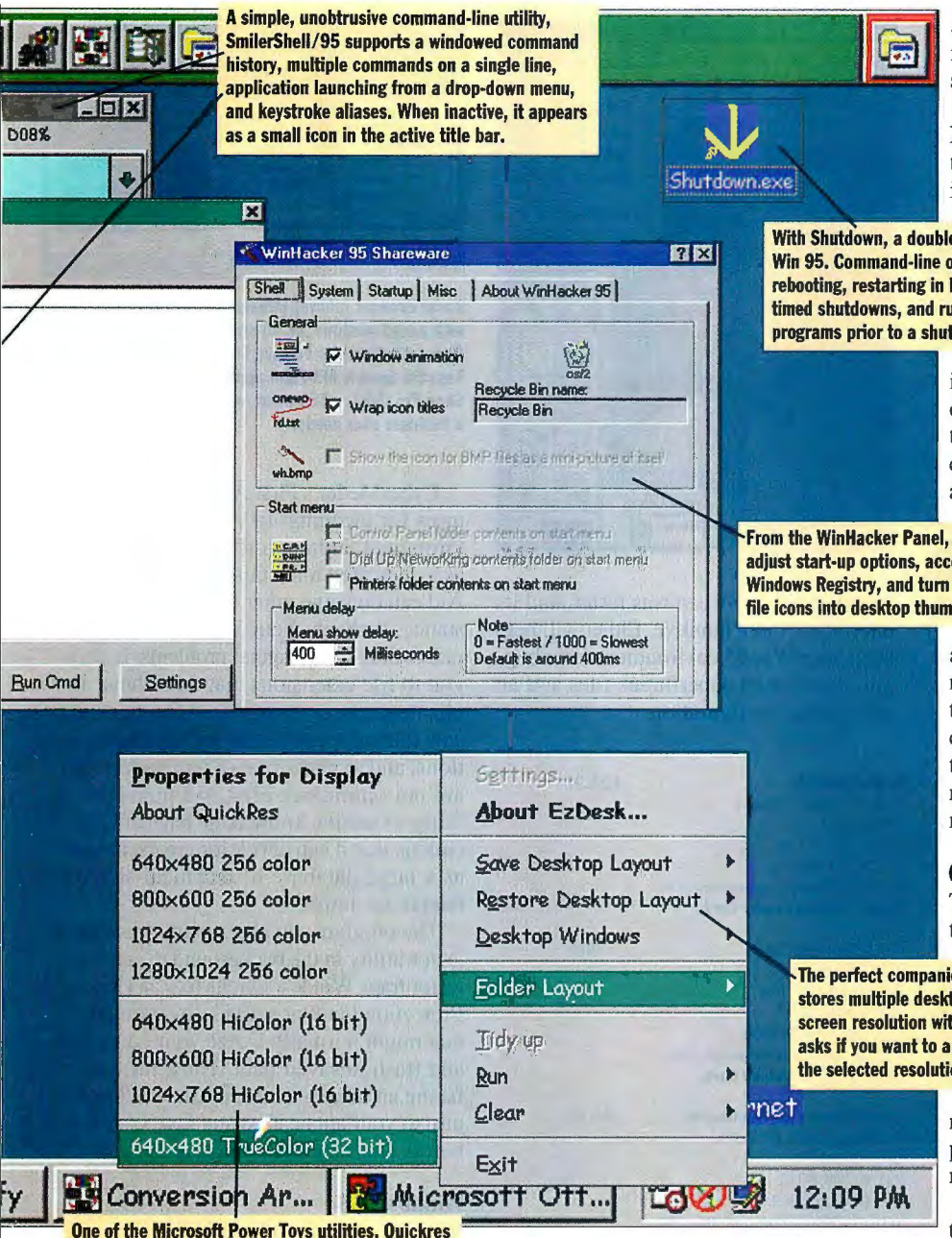
The TweakUI Power Toy utility installs in the Control Panel folder and fine-tunes menu speed, mouse sensitivity, window animation and sound, document templates, and boot parameters.

Turbo Browsing

File management in Win 95 isn't bad enough to make us long for the Windows 3.x File Manager, but it can get clunky when you're trying to perform extensive file operations. There are plenty of file management utilities out there, but we think Turbo Browser from Pacific Gold Coast is one of the best. It's inexpensive ($49.95), intuitive, and, while it effectively mimics the Explorer interface, it adds key functionality to Win 95.

Like the Explorer, the Turbo Browser utility displays computers and drives in one pane and files and folders in an adjoining frame. You can perform file operations by accessing a right-click menu, dragging and dropping, or manually entering a destination directory for file moves. As you select files, they appear in a Preview Window.

Turbo Browser supports file conversions across most of the common Windows file formats (e.g., BMP, PCX, TIF, GIF, JPEG, Photo CD, Targa, Encapsulated PostScript, and Windows Metafiles).



You can even extract ASCII text directly out of word processor documents and spreadsheets, sending the text to the Clipboard.

Turbo Browser can create and extract ZIP files across multiple directories, and a powerful search function supports fuzzy searches and Boolean operators. But the most powerful feature of Turbo Browser is its Qbar. You drag files onto the Qbuttons to create batch-file operations. For instance, you can drag files into the ConvertQ to convert multiple files at once, or drop files into the ZipQ to conveniently build an archive. Like the Windows taskbar, the Qbar can remain on-screen and work with other applications. This is another real time-saver.

The Paint Whitewash

Microsoft made some minor improvements to the Win 95 Paint applet, but not enough to make it truly useful. Aside from being a child's painting toy, MS-Paint doesn't offer much of anything to help with even low-end imaging.

Upgrading to a Win 95 image editor is expensive, requires acres of disk space, and includes more functionality than most business users require. But at just $69, Paint Shop Pro, a shareware program from Jasc, consumes about 3.5 MB of disk space (less than a megabyte for the executable) and delivers enough power to handle most imaging needs short of professional graphics applications.

Paint Shop Pro fills a couple of MS-Paint's flagrant weaknesses with its native support of over 30 file formats and its rich screen-capture functions. What's more, some of the program's fancy features compete with those of higher-end image editors. It has an impressive set of special-effects filters, including posterize, solarize, mosaic, emboss, sharpen, and various distortions. Special painting tools simulate crayon, felt-tip marker, fine-point pen, and chalk. A batch facility allows you to queue up multiple files for format conversion.

A companion browser generates thumbnails of available images on disk, and Paint Shop Pro provides adequate masking, editing tools, and zoom functions. Some high-end features, such as color separations, are not available, but the program loads quickly, conserves resources, and works well as a replacement for the paltry MS-Paint.

Clean Windows

There's just no doubt about it: Managing the disk clutter and configuration files of Windows 3.x is a nightmare. Microsoft sought to change all that with the Win 95 Registry and by requiring that all Win 95–certified applications include an uninstall component.

Certainly, these measures improve the outlook, somewhat like upgrading a patient's status from desperate to critical. But you've still got old Windows 3.x programs hanging around, which means you have both a Registry and the old INI files to keep track of. And although the Registry tracks installed applications and shared components, it does have some management weaknesses.

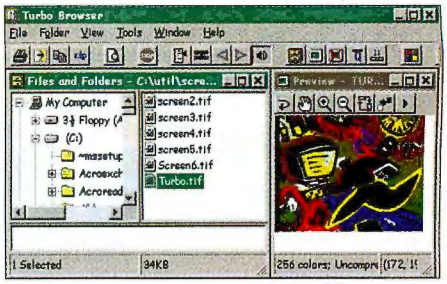
The Registry uses a counter to monitor the number of applications sharing components, such as DLLs. But the counter doesn't track legacy applications and other software that's not yet Win 95–compliant. There's also no requirement to scan for changes to an installed application's state.

In other words, you might add features through an application via a Preferences

menu that taps into a shared library. But the Registry's counters would then be inaccurate, because the Registry doesn't dynamically scan application usage. The application that originally installed the DLL could then remove it during deinstallation, and the feature you added to the dependent application would break. The bottom line: We still strongly recommend a good uninstall utility as an essential part of a Win 95 tools arsenal.

Just as there are plenty of file management utilities to choose from, the market is flush with uninstallers. BYTE editors have settled on two of these programs to handle the daunting task of keeping our Windows clean: MicroHelp's UnInstaller and CleanSweep 95 from Quarterdeck. BYTE's senior contributing editor Jerry Pournelle swears by CleanSweep, and other editors have had good experiences with UnInstaller. Both programs work well and provide all the basic functions required from an uninstaller.

After using both of these utilities in the lab, we found UnInstaller to be more thorough, but CleanSweep was faster, and its interface is more intuitive. Either will help keep your Win 95 environment from bogging down with superfluous files and an overloaded configuration.



Turbo Browser (above) streamlines file management with paned windows, an integrated file viewer, and a Qbar (at bottom) for building file management batches. Toss the anemic MS-Paint applet and install Paint Shop Pro (left), a $69 paint tool with all the power a business user needs.

CyberMedia's First Aid 95 includes features for cleaning up your Windows environment, although it's not as thorough as a dedicated uninstaller. However, First Aid can do some other cool tricks. For instance, it checks your Windows configuration and fixes potential problems. It alerts you to file extensions that don't have applications associated with them, to shortcuts that no longer point to valid applications, and to performance parameters that are not optimized. First Aid maintains a fairly extensive knowledge base of applications that it can check for errors, as well as a large database of technical-support telephone numbers.

The program can also run its Crash Protector utility in the background. Crash Protector traps Windows faults (e.g., a General Protection Fault or a divide-by-zero error) that might normally freeze your computer and trash unsaved data. Thus, instead of facing an unrecoverable crash, you can return to your application and save your data before shutting down normally.

Windows 96

You can make the Win 95 UI much more convenient with a few well-chosen utilities. Be careful, though: Keep only the ones that let you work the way you want to.

Watch out for utilities that lodge in the Startup folder and consume valuable resources. And if you download several files from the Internet, invest in good virus-protection software that dynamically scans your Windows environment, such as Norton Anti-Virus, Dr. Solomon's Toolkit, or McAfee Virus Scan. ■

Stanford Diehl was until recently the director of BYTE reviews. He currently works at New England Business Service's Peterborough, New Hampshire, division. You can reach him on the Internet or BIX at sdiehl@bix.com.

Product Information

CleanSweep 95 . . . . . $29.95
Quarterdeck Corp.
Marina del Rey, CA
(310) 309-3700; fax: (310) 309-4219
info@qdeck.com
http://www.qdeck.com
Circle 1098 on Inquiry Card.

EzDesk for Windows 95. . . . . . $15
Melissa Nguyen
Pomona, CA
(909) 629-8404
70571.637@compuserve.com
Circle 1099 on Inquiry Card.

First Aid 95 . . . . . $49.95
CyberMedia
Santa Monica, CA
(310) 581-4700
fax: (310) 581-4720
Circle 1100 on Inquiry Card.

Paint Shop Pro $69
Jasc, Inc.
Eden Prairie, MN
(800) 622-2793
(612) 930-9171
fax: (612) 930-9172
74774,570@compuserve.com
http://www.jasc.com
Circle 1101 on Inquiry Card.

Power Toys . . . . . free
Microsoft Corp.
Redmond, WA
(206) 882-8080
fax: (206) 635-6100
http://www.microsoft.com/
Circle 1102 on Inquiry Card.

Shutdown 1.5 . . . . . $10
Chris Bluethman
Stillwater, OK
72347.3306@compuserve.com
Circle 1103 on Inquiry Card.

SmilerShell/95 . . . . . $29.95
Bardon Data Systems
Albany, CA
(800) 242-4775
(510) 526-8470
72340.375@compuserve.com
Circle 1104 on Inquiry Card.

Take Command/32 . . . . . $69
JP Software, Inc.
East Arlington, MA
(617) 646-3975
fax: (617) 646-0904
75020.244@compuserve.com
Circle 1105 on Inquiry Card.

Turbo Browser for Windows 95 . . . . . $49.95
Pacific Gold Coast Corp.
Glen Cove, NY
(516) 759-3011
fax: (516) 759-3014
74777.3450@compuserve.com
Circle 1106 on Inquiry Card.

UnInstaller for Windows 95 . . . . . $29.95
MicroHelp, Inc.
Marietta, GA
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fax: (770) 516-1099
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Circle 1107 on Inquiry Card.

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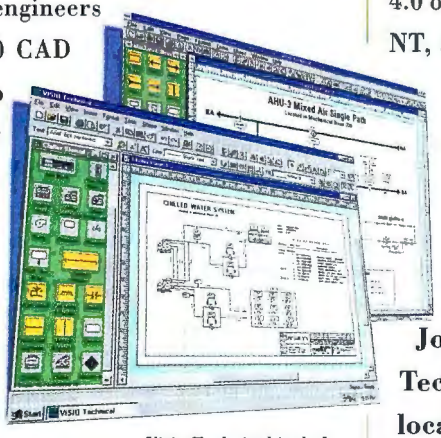

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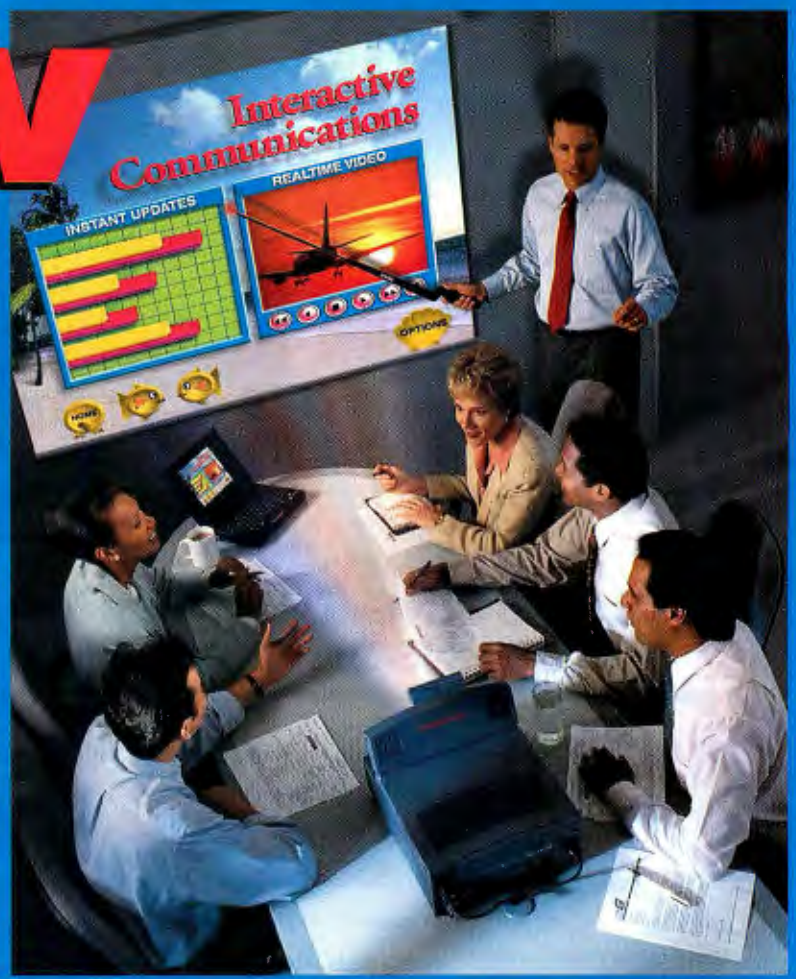

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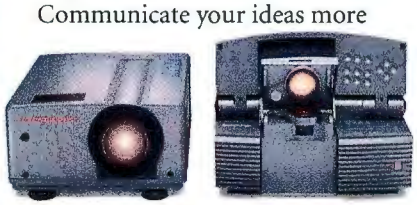

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BETTER CONNECTIONS IN WINDOWS

PAUL KORZENIOWSKI

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Windows 95's built-in communications makes you wonder if you need add-on comm software

Unlike its predecessors, Windows 95 was designed from the start with communications and network computing in mind. The operating system has many of the basic functions a user needs to connect to on-line services, LANs, and the Internet. Many tasks, such as transferring files, are now simpler, and you can switch more easily between background and foreground.

The OS includes capabilities that users could previously find only in separate, add-on packages. So, with Windows 95, you must ask whether you need a third-party communications package, or will you be content with HyperTerminal, Exchange, Internet Explorer, Briefcase, and dial-up/direct cable networking?

A Win 95 Communications Feast

HyperTerminal, a big improvement over Windows 3.1's Terminal applet, lets you transmit and receive files, and you can dial up E-mail and on-line services simply by clicking on icons. Of course, you have to enter needed information for specific services, while the third-party products come configured ready to use these services.

Microsoft Exchange enables you to view a fax and set up a fax cover page, but it doesn't let you preview a fax before sending it—a capability found in Delrina's WinFax Pro.

Microsoft's Internet Wizard walks you through setting up an Internet connection using either the Microsoft Network or another Internet service provider. The Windows 95 Plus package includes a World Wide Web browser (Internet Explorer). But a user who wants to do something else on the Internet (setting up a chat session, for instance), or wants to use a Web browser with more or different capabilities, will need add-on software, such as Delrina's Cyberjack that's included with CommSuite.

Win 95's Briefcase lets you designate files to be used on a different computer and simplifies the process of updating the originals later on. And file transfers between two computers are handled through dial-up networking and direct cable connection utilities. Windows 95 incorporates extensive support for telephone-based activities through the telephony API, or TAPI.

Who Needs What?

The casual communications user may well find Windows 95 all he or she ever needs. The frequent communicator, however, is more likely to discover the limitations and rough edges and want something better. For that user, add-on comm packages are often simpler to manipulate, are easier to customize, and support wider ranges of communications options.

The three packages we look at in this article are designed for different types of communications users, and each bundles a different set of features. CommSuite from Delrina (now a division of Symantec) tries to include virtually everything, but the package seems aimed primarily at those people with heavy faxing needs. Traveling Software's LapLink 7.0 for Windows 95 is designed for the mobile worker or executive who may be using multiple computers and needs heavy-duty file transfer and remote access. Mustang Software's QmodemPro for Windows 95 is more like the communications programs we have seen in the past, and it seems designed around the needs of those who run or access computer bulletin boards. These communications packages have clearly evolved from different directions and different strengths.

Because of these different feature sets and target users—for example, one package emphasizes desktop faxing, while the other two don't have that capability—making apples-to-apples comparisons among the different communications products is difficult. Plus, when we began our testing for this article, there were only a few products available. Even though Windows 95 began shipping last August, few vendors have ported their communications software to Microsoft's new OS.

continued

These are all 32-bit applications, rather than 16-bit, and thus users should see improved performance for I/O-intensive chores, such as downloading large files. We tested these packages with 32-bit device drivers. The vendors take advantage of Windows 95 features, such as Tab bars. Overall, the products represent a good first step toward exploiting the new OS.

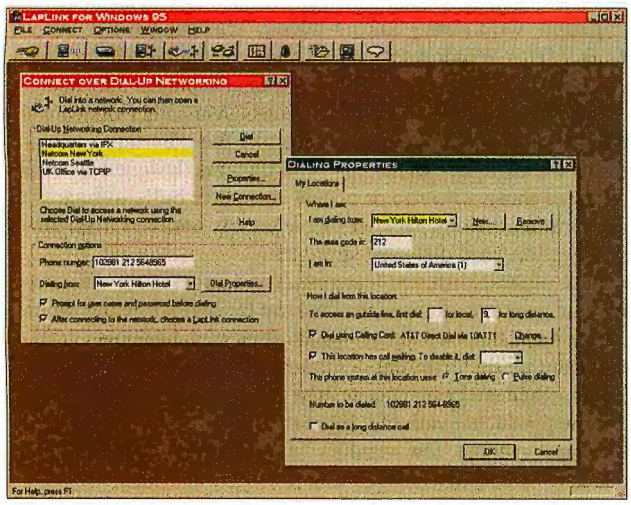
In general, these applications offer a variety of options. Setting up routine communications tasks usually means following fill-in-the-blank prompts, and the process generates icons for later use. The applications include scripting features that allow power users to automate more sophisticated calling sequences.

Jack of All Cyber Trades

Delrina's CommSuite bundles four different communications products into a single package. The strongest module is WinFax Pro, for sending and receiving faxes from a PC. Cyberjack features Internet access tools, such as Gopher software and a Web browser. WinComm Pro lets users dial into on-line data services and bulletin boards. The TalkWorks module adds voice-mail functionality.

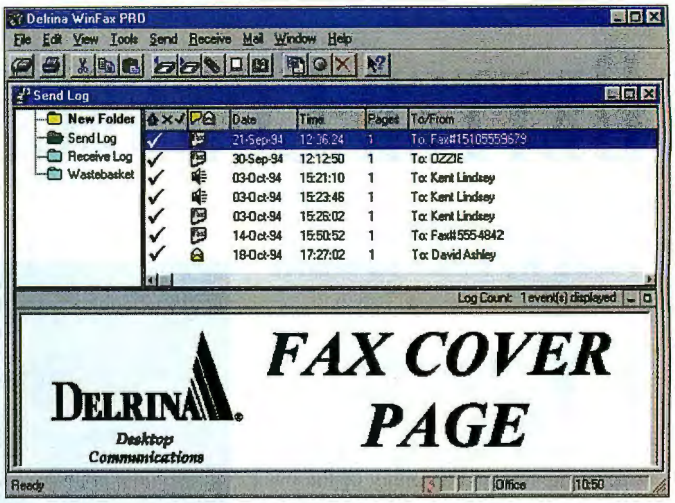
CommSuite, which was the only product actually shipping when we did our testing, includes the most comprehensive set of tools for novice users. Help menus are available on any screen, and a user can click on an icon to see a brief description of any function. An on-line tutorial walks through all the product's different modules and capabilities. The documentation was comprehensive and simple to follow.

The package supports the Windows 95 toolbar, and power users can customize the bar to automate repetitive tasks. Let's now take a look at the different modules in CommSuite.



Traveling Software's LapLink for Windows 95 simplifies and speeds up the process of transferring files over a dial-up connection.

WinFax Pro. This module is designed for heavy-duty faxing. A simple conversion program converts phonebooks, logs, and folders from earlier versions of WinFax Pro into Windows 95 formats. Once the changes are made, however, those files won't run under Windows 3.1.



Delrina's WinFax Pro is one of CommSuite's strongest modules, making it considerably easier to send faxes than if you used Microsoft Exchange's faxing function.

The package makes it simple to send and customize faxes. WinFax Pro includes 100 cover-page samples to choose from or customize. Most cover pages also allow the user to include short messages.

Because many people move faxes via their E-mail systems, the product supports Microsoft's messaging API (MAPI). WinFax lets users move faxes to the Microsoft mail system. You can drag any fax and drop it into any MAPI-compatible E-mail envelope. This capability isn't available with Microsoft Exchange.

The log for WinFax Pro includes a field that says whether a fax was delivered or not. Win 95 doesn't include this feature, so the user has to wade through a series of cryptic messages just to determine if a fax was received. WinFax Pro also provides a link from an optical character reader to Microsoft Exchange.

A fax viewer lets you clean up the dark spots on received faxes. The product can convert faxes to text with its built-in OCR. This release includes a photo capability for sending high-quality graphics in black and white. Users have other ways to send documents (e.g., via E-mail), so this feature may have limited appeal.

WinFax presents users with many different scheduling options. You can set faxes for automatic transmission at night when phone costs are lower. On the road, you can configure faxes to be sent via different calling-card options.

For the user who has to send out reports on a regular basis, there's a recurring-event feature that will fax a document at a set interval. The transmission can be on a particular day of the week (the second Tuesday of the month, for example) or on a specific date. The system can produce printed records of each fax transmission.

TalkWorks. In addition to faxing, WinFax Pro includes voice-mail capabilities if a system has an integrated data/fax/voice modem. Because Windows 95 supports TAPI, TalkWorks can discriminate among incoming calls and will hand the call to the appropriate communications module. Thus, a PC with a Sound Blaster card can become a telephone.

You can set up the voice-mail system to answer a call after a specific number of rings. A system manager could set things up to store voice-mail messages in a single inbox or assign a series of mailboxes to specific users.

The program's fax-on-demand feature lets customers call in and request that a document be sent to them. This has proved popular for automating technical support, and a small firm taking phone orders could also benefit from this feature.

The TalkWorks fax features do not use the Norton Anti-Virus software, which can be used with the other CommSuite modules. Although not necessary, this feature could ensure that unwanted viruses are not transmitted along with a fax during a binary file transfer.

WinComm Pro. This general-purpose communications program helps users connect to on-line services and BBSes. The product comes with integrated scripts for AT&T Mail, BIX, GEnie, CompuServe, Delphi, MCI, Dow Jones, and NewNet. A user can click on an icon and dial in to one of these services.

The software supports RIPscrip, which provides a graphical front end to bulletin board systems. Instead of answering Yes and No questions, a user works with dialog boxes and color. There's an image manager for graphics files, including BMP, GIF, JPEG, PCX, and TIF. (If you rely on Windows 95's built-in tools, you can view BMP and PCX files with Paintbrush, and GIF and JPEG files with Internet Explorer. You're out of luck with TIF files, though.) A handy feature called ZIP Manager uncompresses downloaded files.

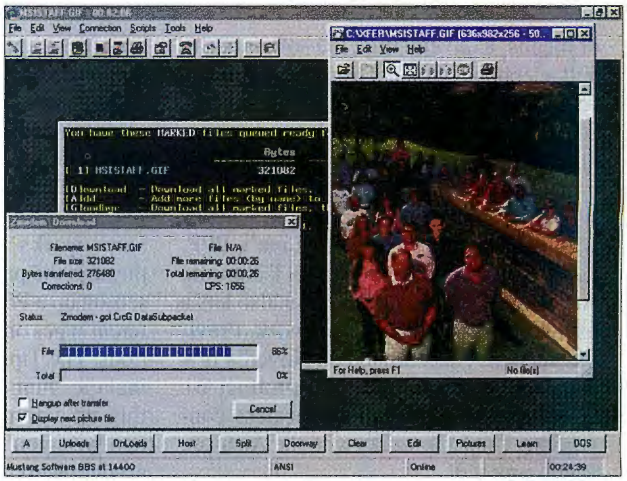
Delrina includes its own version of the Basic language with which power users can create scripts for WinComm Pro. The software can also build a script by recording keystrokes. When WinComm Pro downloads a program, it checks it with Norton Anti-Virus.

Cyberjack. This module is the most recent addition to the CommSuite package. It's designed to help people surf the Internet and provides connectivity to five types of Internet services. A Wizard feature helps you sort through different connection and setup options.

The Web browser does the things that most pre-Java browsers do. It has a pretty interface, and capture and filtering features let you grab and save images. How does Cyberjack stack up next to Microsoft Internet Explorer? In addition to the basic browsing capabilities, Cyberjack features newsgroups, file transfer capabilities, interactive chat, and Gopher.

The News component lets you post and read messages on newsgroups, as well as sort by fields and filter stories. The file transfer capability lets you move files between two computers.

A Cyberjack user can set up an interactive chat session and converse with a number of people. A different color for each chatting party helps keep track of who said what. Gopher capabilities let you leaf through text documents and enable you to work with multiple file folders. Cyberjack uses Microsoft Exchange for sending and receiving Internet E-mail.



With Mustang's QmodemPro, you can open multiple windows for file transfers, on-line dialogue, and viewers for received files in a variety of formats.

If you simply want to browse the Web, then Microsoft Explorer should be sufficient—particularly the version 2.0 upgrade available from http://www.windows.microsoft.com. But if you want more advanced Net capabilities, then you should check out Cyberjack.

LapLink 7.0 for Windows 95

Traveling Software's LapLink made its name as the premier utility for transferring files between computers. This heritage is apparent in the new release, but it's augmented with remote-control and other communication capabilities. The product will be useful for the mobile executive who often works on the road with a wide range of connections.

In MS-DOS 6.2x, Microsoft incorporated Interlink, a file-transfer utility that operated much like LapLink. Windows 95 has even more advanced capabilities. Its dial-up networking and direct-cable connection allow a LapLink-like functionality. In addition, the Briefcase feature makes it easier to keep a set of files synchronized between two computers. The problem is that none of these is very well explained or described in the help system or documentation, and getting them working can be an exercise in frustration.

Also, both computers have to be running Windows 95. If one is using Windows 3.1—say it's a 286 machine that flat-out can't run 95—then you're out of luck with built-ins. Here, LapLink is not only helpful but necessary because it includes both 32-bit and 16-bit versions. It's a lot easier to set up and get going, too.

Traveling Software has revamped LapLink to take advantage of the OS and to look like a Win 95 application, using standard dialog boxes and icons instead

WINDOWS TAPIS YOUR PHONE

For telecommunications software developers, Windows 95 is a four-letter word spelled TAPI. Microsoft's decision to incorporate the telephony API into its operating system has fundamentally changed the way most telecommunications programs operate. TAPI eases the work of telecomm-software developers, but it also makes them think about what features are important and how to implement them.

TAPI takes over many of the housekeeping chores from telecommunications programs, centralizing and standardizing these in the OS. First of all, TAPI knows about modems, and it knows what they need to know. Previously, every communications program had to have its own setup and configuration routines to determine which comm port, speed, and IRQ to use. Now, TAPI automatically determines what modem you have and configures Windows to support it. Whether it's an internal, external, or PC Card modem doesn't matter. The system configures itself pretty much without user intervention. Now each comm program simply interrogates the TAPI system; the developer doesn't have to write a configuration routine.

Scott Hunter, vice president for engineering at Mustang Software (maker of Qmodem), maintains that one of the most important things TAPI achieves is having the operating system manage the comm ports, with the result that all programs have access to them. In the old days, if you ran a communications program—Procomm Plus or Qmodem, for example—the first thing that software did was open the comm port. At that point, every other program was locked out from that port, regardless of whether it was actually being used. Hunter says this was an important technical reason (aside from marketing considerations) that Windows comm programs added faxing capability. Since the port was tied up, the user couldn't fax unless he or she either closed the program or used the program's own fax tool. Under Windows 95, several communications programs can now share the same port, with TAPI managing conflicts and scheduling.

TAPI also centralizes what Windows 95 terms dialing properties, allowing the user to set up appropriate dialing parameters and conditions for multiple locations (home, office, a remote site, a hotel room). The user only does this once, at the OS level, instead of having to reconfigure each different comm program or Web browser every time he or she moves locations.

Remember, the T in TAPI stands for telephony, which opens considerable new possibilities. Say a fax comes in; TAPI answers the phone and routes the call to Microsoft Exchange. In the original release of Windows 95, Exchange didn't support this automatic routing. But a new modem driver, Unimodem V (downloadable from http://windows.microsoft.com), adds this ability. Even without Unimodem V, however, some communications programs can enable routing.

— Russell Kay

of menus. Conveniently, the software can pull telephone numbers from the Windows 95 address book. You can connect to other machines running Windows applications and Win 95's long filenames will be truncated to DOS's 8.3 format.

As a dial-up system, LapLink 7 works with three remote servers: Shiva's PPP, LAN Rover, and Windows NT Remote Access Server. The new release also lets a user connect to a TCP/IP network. Previous versions concentrated on Novell's IPX protocol. This was the only product we tested that would support wireless connections. LapLink works with the AirShare Radio protocol.

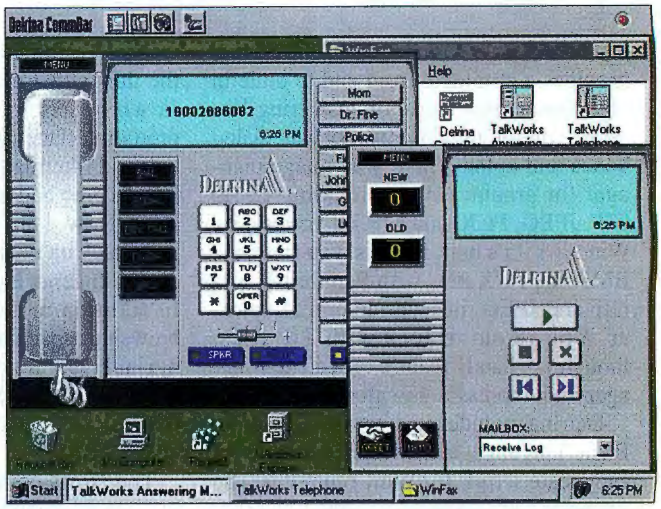
LapLink also has some security capabilities. An optional call-back feature will break an incoming connection and then redial the user's system at a preassigned phone number. While not foolproof, this makes it harder for a malicious hacker to dial into a system.

The product includes three basic communications services: file transfer, remote control, and interactive chat. The file transfer capability enables you to view or exchange files with a remote PC. LapLink's patented SpeedSync feature downloads only changes to a file rather than its entire contents, which cuts time significantly. This will be useful to people who regularly access and update specific files.

Remote control enables a user to open a program running on a remote system and transfer information between the two systems. An interactive chat facility enables two users to converse by exchanging text messages on-line in real time.

There was no on-line tutorial in the package we tested, but the program does provide help with setting up a communications session. This is especially useful because LapLink offers users a variety of connectivity options: a cable connection, dial-up, modem, network, and wireless services.

LapLink's Quickstep walks a user through the process of setting up a PC for different types of connections. The Tips section includes hints for setting up a computer—handy if you manage novice users. One tip outlines how to set up a parallel port—noting, for example, that standard printer cables don't work. Traveling Software includes the special parallel cable you need, plus another cable for connecting to serial ports. Yet a third cable, which is designed to speed up data transfer between ECP/EPP ports, can be purchased separately for $69.95.



With the TalkWorks module, CommSuite adds voice-mail and response capability to your computer system's bag of tricks—providing you also have a Sound Blaster–compatible card and microphone.

QmodemPro for Windows 95

Mustang has focused on bulletin board software. The firm's new QmodemPro for Windows 95 enables a user to set up a BBS. As part of its tutorial, the company invites users to access Mustang's own user bulletin board system.

The new package focuses on dial-up capabilities and eases users through that setup process. The software includes scripts for CompuServe, MCI Mail, Delphi, and GEnie. The process is a simple fill-in-the-blanks scenario; the scripts include the phone numbers and passwords to these systems. QmodemPro for Windows 95 comes with its own scripting language, which resembles Basic.

The communications package supports MAPI, so a user can move text from a window to another mail product, such as Microsoft Exchange. The picture viewer enables you to work with graphics files in BMP, GIF, and JPEG formats.

If you're moving from an older Windows version of QmodemPro, you have to clean up your old scripts and remove device-specific data because Windows 95 is so much more aware of hardware. In other words, for Plug and Play to work, you don't want to confuse the system with parameters and settings for older versions of Windows.

Qmodem Pro includes built-in encryption capabilities. It uses the RSA public-key algorithm to preserve the integrity and confidentiality of transmissions.

The product now relies on Windows 95 rather than having a separate fax option, which was available with previous versions of Qmodem. Thus it shares the same limitations as Windows 95.

The user manual for QmodemPro for Windows 95 is well-designed and simple to follow. However, the product's on-line help was not as easy to navigate as the help systems in the other two packages we've been working with. In this regard, QmodemPro for Win 95 assumes a high degree of understanding on the user's part.

Which One? Or None?

These three communications packages are quite different from one another, reflecting primarily the very different DOS and Windows products of their earlier incarnations. Look at your own communications needs and pick one of these products according to what you do most. If you're using Win 95, you still need to consider if you need, or want, any of these products.

Windows 95 provides extensive telecomm features for the user who occasionally has to transmit information, read or send a few pieces of E-mail, or go on-line once in a while. The communications packages from Delrina, Mustang, and Traveling Software focus on users with specific requirements. If you don't fit comfortably into one of those categories, you may want to simply try out the applications that come with Windows 95. You'll soon discover what you really need, and that need will guide you to the appropriate third-party product. ■

Paul Korzeniowski is a freelance writer in Malden, Massachusetts. You can reach him on the Internet as 0006841944@mcimail.com.

Product Information

CommSuite for Windows 95 . . . . $229
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fax: (416) 441-0333
http://www.delrina.com
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LapLink 7.0 for Windows 95. . . . $129
Traveling Software, Inc.
Bothell, WA
(800) 343-8080
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http://www.travsoft.com
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WHEN NETWORKING IS NOT WORKING

BARRY NANCE

Microsoft touts Windows 95 as network-ready, but NetWare conflicts and setup glitches are keeping it off some corporate LANs

Windows 95 must find its way into businesses, both small and large, to be successful. So far, however, many businesses are saying "no, thanks," typically because of the operating system's networking and security problems.

Sales figures proving this are hard to come by, but slow acceptance of Windows 95 in the business community is indicated by dramatically lower sales projections by market researchers Dataquest and IDC, as well as comments from companies that developed Windows 95-specific software. As Dr. Michael Cowpland, chief executive officer of Corel Corp., recently remarked, "Market absorption of Windows 95 has not yet met industry expectations. As a result, 32-bit applications like CorelDraw 6 that are designed to work on Windows 95 and Windows NT have had a slower market penetration than we originally expected."

Windows 95 and NetWare

One of the more serious networking issues is Windows 95's ability to crash NetWare-based LANs with just a few clicks in the Control Panel. For example, if you use the Network icon in the Control Panel to configure the Microsoft NetWare client for printer sharing, and if you inadvertently enable Novell's Service Advertising Protocol (SAP) on the File and Printer Sharing for NetWare Networks screen, your Windows 95 PC will broadcast LAN messages that tell other clients your PC is a NetWare file server (though people who try to log on to your PC as a NetWare server fail to get access). Oddly, Microsoft didn't release a patch until October 20, 1995, even though Windows 95 beta testers had reported this rude behavior during testing roughly six months earlier. You'll find the patch on Microsoft's Web site (http://www.windows.microsoft.com/windows/software/w95fpup.htm).

The new 32-bit NetWare Directory Service (NDS) client from Novell, still in beta testing as we went to press, fixes this problem by preventing Win 95 from emulating a NetWare server or otherwise doing file/printer sharing via IPX. Microsoft's NetWare NDS client software, however, continues to exhibit the problem. Furthermore, the Microsoft NDS client implements only a few NDS functions. Until Novell aggressively irons out the bugs in its Windows 95 client, people who use Windows 95 on a NetWare LAN will not have the same features and functions that users of Macintosh, OS/2, and Windows 3.1 clients enjoy.

In several other respects, Microsoft's NetWare client is well written and thorough in its cloning of the NetWare environment. While Microsoft's 32-bit NetWare client doesn't yet support NDS fully, it nonetheless presents virtually all the NetWare APIs that NetWare's NETX previously did. You can, in a Windows 95 command-line session, successfully run NetWare utilities such as RIGHTS, USERLIST, and NDIR. These utilities, which you'll find in your NetWare PUBLIC directory, are unaware that the "real" NETX isn't loaded.

Windows 95's internal representation of "shortcuts" to network resources is another problem on NetWare networks, especially large ones. Windows 95 shortcuts point to a specific file server through a Universal Naming Convention (UNC) machine-

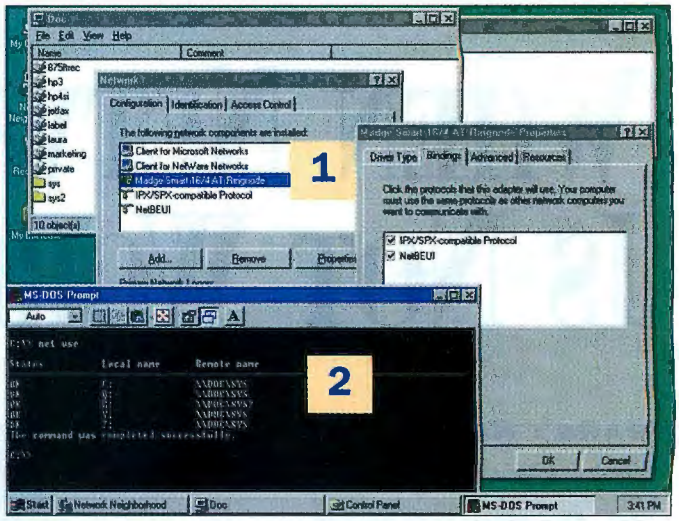
name address. When it creates the shortcut, Windows 95 resolves a NetWare drive mapping (R:, for instance, mapped to volume SYS1 on server SERVER1) into the UNC equivalent \\SERVER1\SYS1. If a LAN administrator changes the drive mapping, perhaps to achieve load balancing across multiple servers, Windows 95 ignores the change and continues to use the shortcut's embedded UNC.

Windows 3.1 behaves better; because Windows 3.1 clients refer to the server's volume through the drive mapping, rather than UNCs, they adhere to the change the next time they log in. In contrast, the administrator must manually update the shortcuts on all the Windows 95 PCs.

Windows 95's long filenames present another NetWare conflict. To use them on a NetWare server, you must apply Novell's patches to the network operating system (they're on http://www.novell.com) and then enable OS/2 namespace support on the file server. You must also use uppercase characters in log-in scripts, replace commas in scripts with the word *AND*, and avoid using log-in scripts to load TSRs—Windows 95 can't handle them.

Caution: Manager in Training

Windows 95 could also use help producing network statistics and application tracking information. LAN software, written specifically to network APIs that were available in DOS and Windows 3.1, typically doesn't work in the Windows 95 environment. Frye Computers' DOS/Windows utilities are just one example. Frye NodeTracker, Frye Utilities for Networks, and Frye Statistics Display Rack for NetWare show incomplete network diagnostic statistics under Windows 95, and the Frye Software Metering and Resource Tracking program can't reliably meter file usage. The problem isn't the quality of the programming by Frye Computing, it's the newly rewritten network driver that's part of Windows 95. To help Windows 95 client PCs become part of a managed network, utility vendors and Microsoft will have to resolve the differences between the old and new APIs.



A cascade of Windows 95's NetWare configuration problems. In window 1, the user had to choose the highlighted Madge network adapter from a pick list—Windows 95 did not recognize it. The same window shows a NetWare client entry that will disappear after the user clicks OK and the system reboots. The user tries to configure the client using the NetWare MAP command at the DOS prompt (window 2) but fails; MAP has been replaced by the less familiar NET USE, a Windows 95 command.

Lack of support for network management standards also hampers Windows 95's ability to recognize network hardware. The Desktop Management Interface (DMI) is an important standard that specifies how LAN-management agent programs can interact with desktop computers and their peripherals. It lets LAN management software integrate information from and control the function of diverse products on LAN-attached computers. Unfortunately, Microsoft didn't ship DMI support in the initial release of Win 95.

The Windows 95 registry file, which is designed to track hardware and software changes in a standardized way, is another source of network problems. Kevin Dubauskas, a software developer for Programming Resources Company in Hartford, Connecticut, knows this firsthand. Each time Dubauskas configured his new Windows 95 PC for both Microsoft Network Client and Microsoft NetWare Client (so he could access both IBM LAN Server and NetWare file servers), Windows 95 dropped the NetWare Client entry and reverted to just the Microsoft Network Client (see the screen above). Dubauskas could perform NET VIEW and NET USE commands to connect to the NetWare server, but he couldn't use the NetWare LOGIN utility nor could he get his machine to run the NetWare log-in script. Dubauskas concluded that his Windows 95 registry entries were corrupt. This suggests another challenge that developers might solve with a ScanDisk-like registry repair utility.

A few extra smarts in such a registry repair tool, when used proactively, could also help overcome installation and configuration difficulties. For instance, automatic detection of frame type (802.3, TOKEN RING, TOKEN RING_SNAP, etc.) doesn't often work properly in Windows 95. Incorrect detection typically happens on very quiet or very busy multiprotocol networks. That's because the auto-detect feature needs a steady stream of consistently formatted LAN frames to determine frame types. LAN administrators must configure the frame type manually, using

REINFORCING WINDOWS SECURITY

Security is a noted shortcoming of Windows 95 that cries out for third-party solutions. Windows 95 stores network and dial-up passwords (for NetWare, LAN Server, NT, Samba, and SLIP/PPP access) in .PWL files that anyone can view (the files are named C:\WINDOWS\<USERNAME>.PWL). Decoding these .PWL files isn't difficult. According to the Win95Net FAQ (see "Find Out More on the Internet" on page 119), at least one programmer, Frank Andrew Stevenson, has written software that decodes passwords in the .PWL files (the source code and an executable file are located at http://www.c2.org/hackmsoft/). This means anyone with physical or network access to a Windows 95 machine has access to all network passwords established on that machine.

This password caching default is inappropriate for many sites. To turn it off for Windows 95, you use Policy Editor, or you insert a value of 1 into the following registry entry:

```
HKEY_LOCAL_MACHINE\SOFTWARE\Microsoft\Windows\CurrentVersion\Policies\
  Network\DisablePwdCaching
```

To make Windows 95 password caching more secure, Microsoft released a patch (also on Microsoft's Web site) that increases the size of the encryption key from 32 bits to 128 bits. Applying the patch updates existing .PWL files and replaces the MSPWL32.DLL and NET.EXE files. The new command-line NET.EXE utility no longer uses the password cache, prompting you instead to type a password.

An excellent solution to Windows 95's security problems is avoiding them altogether, and that's what Artisoft's LANtastic for Windows 95 lets you do. LANtastic is a peer LAN, just like Windows 95, but Artisoft includes comprehensive security in LANtastic. You can even password-protect individual files and application icons. LANtastic for Windows 95 integrates well with LANtastic for DOS, Windows, Macintosh, and OS/2.

the Control Panel—clearly a job for a LAN-aware Windows 95 repair tool.

Hardware vendors also face opportunities and challenges. When we installed Windows 95 on a PC equipped with a Madge AT RingNode network adapter, Windows 95's hardware analysis and detection process failed to identify the adapter. A good installation program like the one in IBM's OS/2 Warp Connect can detect network adapters, even if they're non-Plug-and-Play. Hardware vendors need to work more closely with Microsoft to ensure that Win 95 detects their boards.

Windows 95's hardware conflicts also affect third-party application software. If you want to access a Lotus Notes server from a Windows 95 client, for example, you must configure Windows 95 to use IPX as the default protocol. If you don't, the Notes client will complain that the NetBIOS unit number is too large and it will fail to find the Notes server.

There are two solutions to this problem. The first entails using 16-bit real mode ODI drivers along with Novell's NETBIOS.EXE, and the second—if you're using 32-bit network drivers—involves clicking the checkbox labeled "Set this protocol to be the default protocol" on the Advanced tab of the Network Control Panel's IPX/SPX Compatible Protocol property sheet. To fix this, Lotus needs to enhance Notes' installation software so it automatically makes the appropriate property sheet changes under Windows 95.

In the cross-platform arena, at least two companies' AppleTalk protocol stacks—Miramar Systems' Personal MacLAN Connect and Cooperative Printing Solutions' COPSTalk—work adequately under Windows 95, albeit without support for long filenames.

Symantec has emerged as a leader in Windows 95 networking. Developers can try out beta versions of Symantec Café, a Windows 95 tool for creating dynamic World Wide Web applets. The Café package includes Sun Microsystems' Java Developer's Kit and works with Symantec's C++ 7.2 compiler. You can find it on the Symantec Web site (http://www.symantec.com).

Symantec also offers Norton pcAny-where32, a utility that provides remote control, file transfer, and general communications between Win 95 and NT computers. Norton pcAnywhere32 can automatically synchronize files on both machines, helpful to anyone working on the road through a remote connection. And Windows 95's GUI lets you access remote data by dragging and dropping from the remote machine's directory.

A Catalog of Win 95's Network Problems

PROBLEMS	SOLUTIONS
Novell NetWare Conflicts	
Server name conflict: Users can accidentally identify their client as a NetWare server	Microsoft patch, available on the Web at http://www.windows.microsoft.com/windows/software/w95fpup.htm Novell's upcoming 32-bit NetWare NDS prevents Win 95 from emulating NetWare servers NEEDED: Updated NetWare NDS client from Microsoft
NetWare and Win 95's long filenames	Add OS/2 namespace support; obtain Novell patches (http://www.novell.com)
Different log-in script conventions	Use all-uppercase characters; replace commas with AND; avoid using log-in scripts to load TSRs (Win 95 can't handle them)
Win 95 shortcuts misrecognize drives due to faulty drive mapping	None known
Weak Network Management Support	
Some network monitoring utilities don't work with Win 95 Win 95 doesn't support the popular Desktop Management Interface (DMI) standard for reporting hardware information to network software	NEEDED: Update of Win 95's network driver code to make it compatible with utility software NEEDED: DMI support
Some network monitoring utilities don't work with Win 95	NEEDED: Closer cooperation between Microsoft and hardware vendors
Incorrect or corrupted Win 95 registry file	NEEDED: Utilities to manage the registry
Inadequate Security	
Network and dial-up passwords are too easily accessible in .PWL files	Modify Policy Editor settings or registry's password section Use a peer-to-peer network (such as Artisoft's LANtastic for Windows 95) that offers tighter security

Turning Problems into Opportunities

As with all its previous operating systems, Microsoft needs the help of third-party software vendors to fill in the gaps in Windows 95. This ensures the continuing viability of the software utility industry. For despite Windows 95's single-user improvements—often achieved through outright absorption of formerly independent, third-party utilities—its networking shortcomings should make network utilities a growth market. ■

Barry Nance has been a programmer for more than 25 years. Among the books he has written are Introduction to Networking *and* Client/Server LAN Programming *(Que, 1994). You can reach him via the Internet at barryn@bix.com.*

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Find Out More on the Internet

While browsing the Internet, we found a detailed discussion of Windows 95 networking and security issues. Rich Graves (llurch@networking.Stanford.edu) maintains a list of frequently asked questions (FAQs) on the subject; the URL is http://www.dccs.stanford.edu/NetConsult/Win95Net/faq.html.

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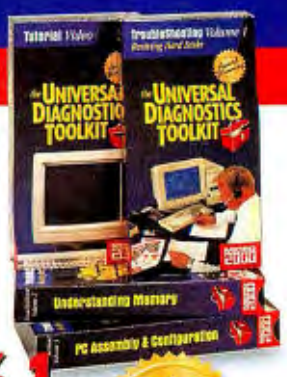

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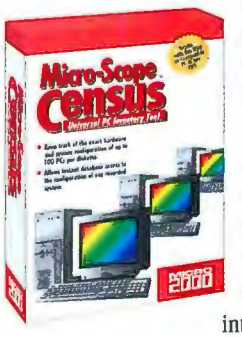

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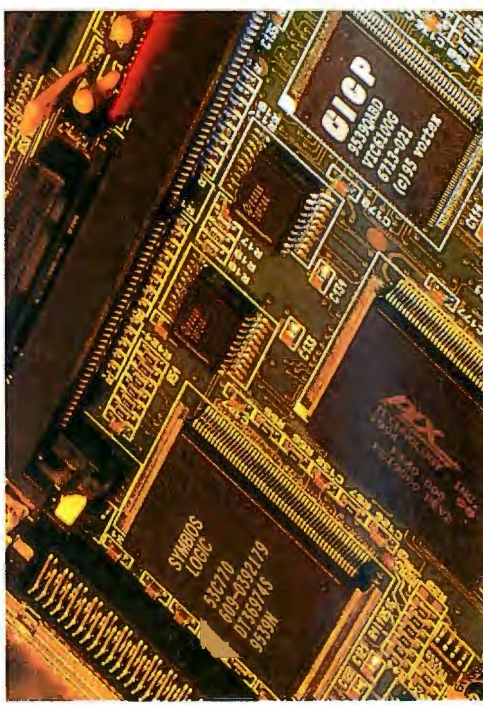

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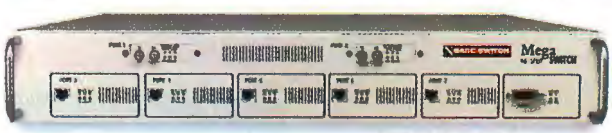

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KWP-6	6 Port	1.49	1.34	1.22

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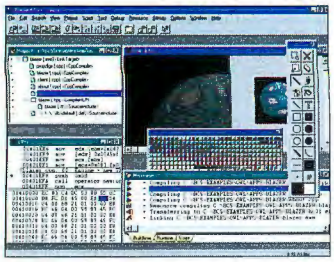

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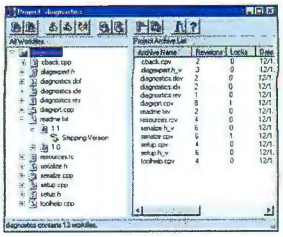

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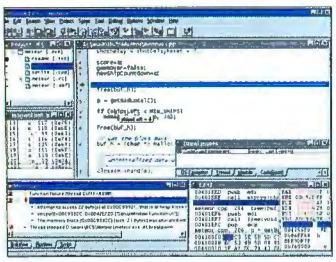

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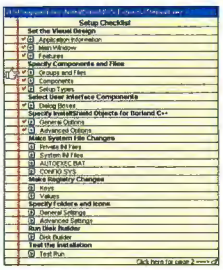

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Features supported	Borland C++ Development Suite 5.0	Borland C++ 5.0	Visual C++ 4.0
Complete support for Windows 95/NT	✔	✔	✔
Parallel 32-bit and 16-bit development	✔	✔	—
ObjectScripting (fully programmable IDE)	✔	✔	—
Visual database development	✔	✔	—
OCX container support	✔	✔	✔
VBX support for both 32- and 16-bit applications	✔	✔	—
FREE Java tools for the Internet, including GUI debugger	✔	✔	—
Windows 95 controls supported under Windows 3.1	✔	✔	—
MFC compilation support	✔	✔	✔
ANSI/ISO Standard C++ Library, including STL	✔	✔	—
Integrated 32-bit debugging and resource editing	✔	✔	✔
Point-and-click install expert with prebuilt components	✔	—	—
Automatic uninstall support for Windows 95	✔	—	—
Detects bad pointers, even outside of API calls	✔	—	—
Automatic detection, location, and diagnosis of memory bugs	✔	—	—
Full color visual differencing of source code versions	✔	—	—
Label and maintain source files for beta, release, etc. versions	✔	—	—
App*Accelerator* for up to ten times faster Java code	✔	—	—

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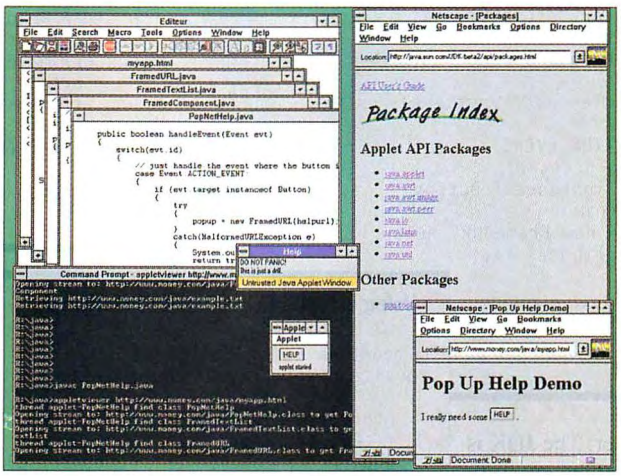
A Hot Cup of Java

Sun's language for building Web applets may be a trendy item, but in many ways it's a strange brew

ANDREW SINGLETON



Among the Java development tools are a source code editor (upper left), technical support on one of Sun's Web sites (upper right), a sample browser page with an embedded Java applet (lower right), and the command line (lower left) for running the compiler. The applet itself appears in the rectangular window in the middle of the screen. The smaller window below is the applet viewer, which lets developers preview the final product.

Java, a language created to build applications that will leap across the World Wide Web to the far corners of the globe, is a bona fide phenomenon (see "Wired on the Web," January BYTE). But can anything live up to the hype surrounding Java? We tried building a simple Java program to see just how far beyond Hypertext Markup Language (HTML) this new language can carry the Web.

The Language of Java

Java is based loosely on C++. Java programs come in the form of applets that load into a Java-enabled Web browser. The term *applet* comes from the `<applet>` tag that appears in an HTML document and tells the browser to download the appropriate Java code.

The Java source files are compiled into .CLASS files that contain portable byte code. Client machines, such as Web browsers, run the Java byte code using a virtual-machine interpreter or emulator. The virtual machine is a simple stack machine, and the programs are structured to allow clients to verify that downloaded code contains no illegal references or grammatical errors.

The client side will get even more interesting with the promised arrival of a just-in-time compiler, which will convert the verified byte code into native machine code as it loads. This should greatly improve applet performance.

The goal for Java is to create a language that's completely portable, running correctly on every computer that downloads it. But most languages have some ambiguity in their specification. For instance, a C++ compiler can implement an `int` data type as a 16-, 32-, or 64-bit binary number, depending on the host machine. This ambiguity causes porting problems, since Java defines an `int` as 32 bits on all platforms. Other sources of ambiguity in data types, expression evaluation, and syntax will be ironed out as the language specification is completed.

Java Is Not C++ Lite

There are important, intentional differences between Java and C++. To attach libraries, base classes, and referenced code, Java uses `import <packagename>`. This single statement performs both an include (to define the classes at compile time) and a load/link at run time. The imported classes can import additional classes, and so on.

Java loads all code dynamically at run time and loads the code class by class. When the Java compiler compiles a source file, each class comes out in a separate .CLASS file. All functions must be methods of some class. For instance, math functions, such as sine, are implemented as methods of the class `Math`.

Java acts somewhat like a BASIC or Lisp interpreter when handling objects. To get a new object, you simply type the statement `<variable> = new <object>`. This gives you a new object off the Java heap. There is no delete operation; a garbage collector cleans up after you. Nor is there any direct access to memory regions—you cannot allocate memory in-line, and you cannot use C-style pointers.

Inheritance in Java is implemented with the `extends` keyword (see the listing "Using `extends` to Implement Inheritance" on page 130), but there is no support for multiple inheritance. To enable algorithms that operate on multiple types, Java uses *interfaces*, or enumerated sets of methods. Interfaces are a looser link than C++ inheritance or templates, and they provide a higher likelihood of successfully implementing polymorphic classes.

The standard Java class library started out small, but it's getting bigger by the day. It implements the math and I/O functions in the standard C library; a number of data types, such as Integer, String, and Hash Table, with their attendant methods; threads; sockets; and a GUI system called AWT.

JDK

We downloaded the preliminary language specification and the Java Development Kit from the Sun Microsystems server at http://java.sun.com. The JDK is available free from Sun, and Win32 and Solaris versions are available. We also downloaded the Netscape Navigator Web browser, version 2 Beta-4, from the Netscape Communications server at http://ftp1.netscape.com. Netscape Navigator 2.0 is the first major Web browser to contain an interpreter for Java applets.

The JDK comes with a Java compiler (called javac), an experimental alpha release of the Java debugger, a Java applications interpreter, and an applet viewer that can run applets with-

Where Java Is Weak

- Browsers allow Java applets limited access to the local disk. Forget having a local configuration or a persistent database.
- Browsers do not allow applets to print.
- The Java security model allows applets to open socket connections only to their source domains. Free-ranging network software must run as a local application.
- Looks don't port. The AWT graphics class must be tailored to a particular machine and OS, and user-interface results vary widely.

The PopNetHelp Applet

```
public class PopNetHelp extends Applet
  {
  String prompt;
  String helpurl;
  // the browser calls the init() method on loading
  public void init()
  {
    // get the prompt & URL from the HTML <param>
    prompt=getParameter("prompt");
    prompt=getParameter("helpurl");
    add(new Button(prompt));
  }
  public boolean handleEvent(Event evt)
  {
    if (Event.id==ACTION_EVENT)
      // was a button pressed?
      if (evt.target instanceof Button)
      { // Pop up a frame
        try { popup = new FramedURL(helpurl);}
        catch(IOException e) {};
        return true;
      }
      else return false;
  }
}
```

Creating an Object from URL Text

```
// Make a URL object from String u
try {URL url = new URL(u);}
catch (MalformedURLException e) {};
// Console message for debugging
System.out.println("Retrieving " + u);
// Open the URL and assign it to a new variable
try {URLconnection uc = url.openConnection();
  // Read the result as a stream
  InputStream instream = uc.getInputStream();
  // make a buffer of the correct size
  byte[] buf = new byte[instream.available()];
  if (instream.read(buf)) > 0
  {
    init(buf);  // load the FramedTextList
  }
} catch (IOException e) {}
...
```

Using extends to Implement Inheritance

```
import Java.awt.*
public class FramedComponent extends Frame
{
  protected Component cmp;
  // Constructor:
  public FramedComponent(Component c)
    {
      cmp = c;
      // add the component at the top (north)
      add("North",cmp);
    }
....
```

out a Java-enabled browser. The JDK is a primitive, character-oriented environment. Fortunately, Borland, Symantec, and several other companies have announced plans to produce more sophisticated graphical development environments, hopefully with vastly improved debuggers.

The experimental debugger is a command-line program with a single output console. The user has to keep track of threads by number and keep track of objects with a 32-bit ID. The debugger includes breakpoints, but not single-stepping. When we tried the Windows version, it left hanging threads and windows. We found this debugger useless and soon resorted to the age-old debugging method of including print statements at strategic points in our code. Even when running graphical applications, Java provides a line-mode console that's convenient for debugging.

The javac compiler performed well, turning .JAVA source files into .CLASS byte-code files suitable for the Java interpreter, the applet viewer, or the beta Netscape Navigator 2.0 Java-enabled browser. It generated useful error messages about the innumerable mistakes we made in the source code, and it caught some problems with unitialized variables.

The applet viewer runs applets as they would be called in a Web browser. It needs an HTML file that includes the `<applet>` tag and parameters. The applet viewer is a more complete implementation of Java than the Netscape 2.0 beta version, and it's integrated with the debugger.

The documentation available from Sun includes the Java language specification and a complete listing of the Java library classes and methods in PostScript form. It does not include a tutorial explaining what those methods do or how they might be strung together, so we spent a lot of time looking at sample applications provided by Sun and programmers around the Internet.

The Program

We ran the Win32 version of the JDK on a Windows NT machine. We implemented a simple pop-up help applet, with the intention of using Java's object features to subclass these pop-up boxes for more-involved future applications.

To begin, we selected a list component from the Java AWT GUI library to hold the pop-up help and made a floating frame class to wrap around this component as a pop-up window (see the listing "Using `extends` to Implement Inheritance"). Rather than starting from the sometimes-restrictive confines of a browser applet, we created a short application to run under the Java command-line interpreter and call the `FramedTextList` for debugging. As an application, the frame pops up conveniently over the command-line console.

Then we ran into a snag. The size of the listbox (for setting the frame size) was coming out all wrong, and there was no indication of how it was calculated. On our Windows NT machine, the AWT components were clumsy. The floating frames just piled up in the upper-left corner of the screen. Like many sample applets, ours looked more like a high-school homework project than the work of a highly trained professional.

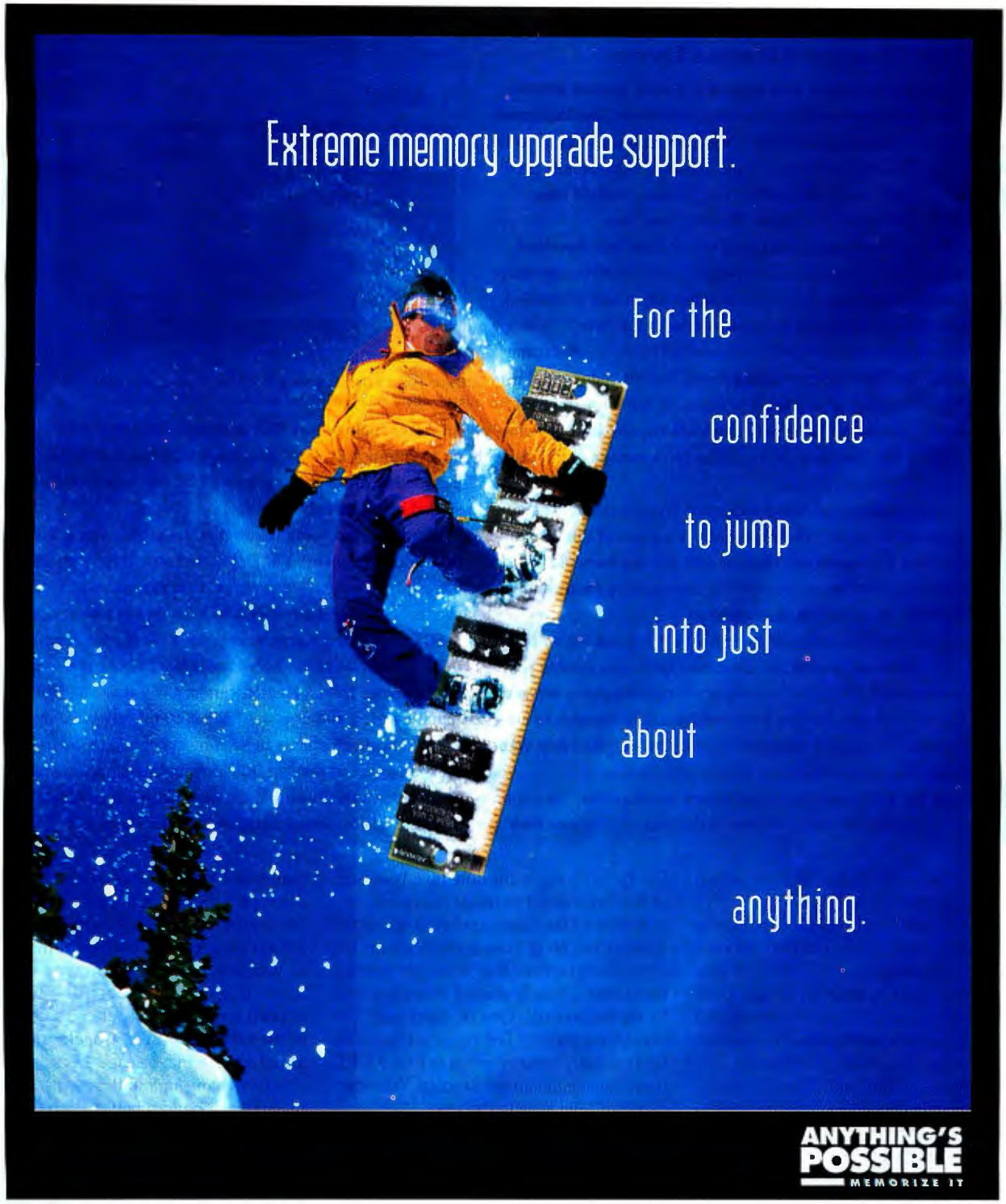
On the positive side, however, the Java memory manager lets you dispose of a frame without going back to clean up the

JAVA VS. C++ AND VISUAL BASIC

Will Java grow into a complete applications development environment? Java supporters have positioned it as an improvement over C++ for object-oriented development and as a competitor to Visual Basic for graphical development. But Java needs a native-code compiler and a graphical development environment to really challenge C++ and Visual Basic.

FEATURE	JAVA	C++	VISUAL BASIC
Components plus scripting	●	○	●
Extensible objects	●	●	○
Portable source code	●	●	○
Portable object code	●	○	○
Native-code compiler	N/A	●	○
Dynamic memory manager, garbage collector	●	○	●
Secure mode	●	○	○
Learning time	Medium	Long	Short
Mature tools and libraries	○	●	●

● = yes; ○ = no; N/A = not yet available.



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TECHNOLOGY FOCUS

OCX-Based Alternatives

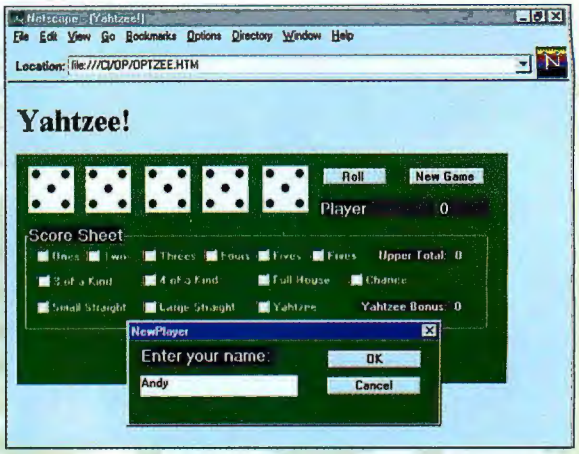
Visual Basic offers a less elegant but more mature alternative to Java for building network applications. One implementation of VB as an on-demand network language has already arrived from Object Power. The company's Openscape product is a Netscape plug-in that contains a complete interpreter for the Object Power VB clone language.

To run Openscape programs, users must first download and install the Openscape run-time code and Netscape plug-in code from http://www.opower.com. Once that's installed, the Netscape browser recognizes tags of the form `<EMBED src="MYPROGRAM.OPP" form="MYFORM">`. Netscape loads the .OPP file containing forms and VB code, and it invokes the plug-in container to interpret the form and code, handle database/server communications, and host any embedded OLE Controls (OCXes). The form springs to life inside a World Wide Web page.

Programmers use the Component Workbench to create Openscape forms. The Workbench is a clone of the VB desktop, and a programmer familiar with VB can immediately use the workbench to create .OPP files containing forms and VB code for downloading over the Web.

Openscape is designed to be a Web front end for an enterprise database system. Its run-time client uses remote procedure calls (RPCs) to communicate with database servers. Openscape is one of the first contestants in the race to create new lightweight database clients that can load into Web browsers to provide global database deployment.

At the W3 Consortium conference in December, the company showed an alpha version of its Internet Explorer Web browser running as an OLE container. OCXes can be placed on an Internet Explorer Web page with the new Insert tag, provided that the corresponding OLE server is already installed on the client computer.



Object Power's Openscape is a Visual Basic clone for building Web applications out of embedded OCXes.

Microsoft also demonstrated at the conference a VBscript OCX that implements VB. Embedded on a Web page, the VBscript control runs a program that can respond to user events and control other OCX objects on the same page.

OCX embedding raises questions. How will the required OCX code arrive at the client computer? How will users verify that it comes from a trusted vendor? Will there be fast or automatic install and uninstall? What about non-Windows users? Microsoft claims to be working on digital-signature technology for approving OCX distributions, enhancements to the Windows OS for automatic installation and uninstallation, and portable or cross-compiled OCX technology.

list object that constructed it. This would be a sticky situation in C++.

Next we added a `FramedURL` class to retrieve the text of an http uniform resource locator (URL) and insert it into the box (see the listing "Creating an Object from URL Text" on page 130). Java includes native support for socket-based networking, including a class for `URLconnection`. Java requires a "try" and "catch" operation to surround any action that might generate a run-time error. Then we built an applet, called `PopNetHelp`, to run from inside a browser, and disguised as a button (see the listing "The `PopNetHelp` Applet" on page 130). We then created a test HTML file with the following tag:

```
<applet code="PopNetHelp" width=40
 height=27>
<param name="prompt" value="HELP">
<param name="helpurl"
value="http://www.money.com/Java/
 example.txt">
[Help Button]
</applet>
```

`[Help Button]` is for non-Java browsers to display instead of the Java applet.

When we ran this assembly in the applet viewer, the Help button came up on the screen as planned. But when we pushed the button, a bunch of error messages flew by on the console. One of them was "SecurityException": The program had violated security by attempting to load a URL from outside the applet domain. When we copied all the files to the same Web server, the help text loaded properly.

We then entered the URL of the test page into a beta version of the Netscape 2.0 Java-enabled browser. After a long pause as Netscape loaded and initialized the applet, the button appeared. We pushed the button but nothing happened, except for a message at the bottom of the browser window saying, "Retrieving example .txt—0 bytes per second." The help popped up immediately after a second push of the button, however. Conclusion: A few gremlins lurk in Netscape 2.0's beta code.

After many ups and downs, Java allowed us to build a better Web front end than we could have built with HTML, and it lives up to its billing as a friendlier language than C++. However, the resulting applications are still slow and unattractive compared to more conventional software. The JDK and related documentation are crude and unfinished. Rapid improvement in all areas seems inevitable—and certainly worth waiting for. ■

Product Information

Java Development Kit . . . . . free
(downloadable from Web site
at address shown below)
Sun Microsystems Computer Co.
Mountain View, CA
(800) 821-4643
(800) 821-4642 (in California)
(415) 960-1300
fax: (415) 969-9131
http://www.javasoft.com
Circle 1154 on Inquiry Card.

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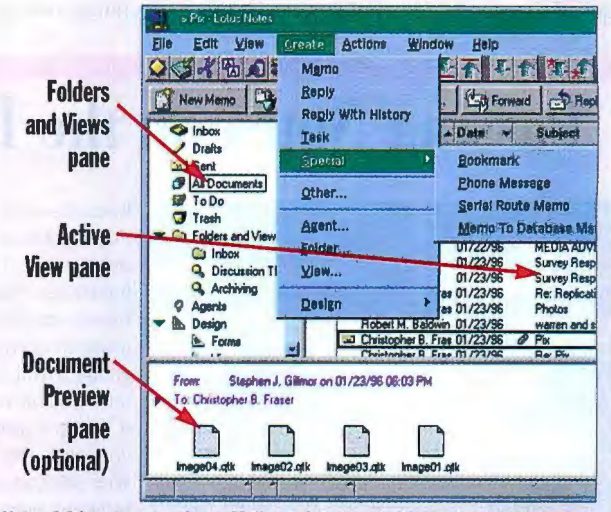
Notes 4.0: Now It's Webware

After reaffirming its dominance of the workgroup category, the groupware king takes on the Internet

STEVE GILLMOR

If you're wondering why IBM paid $3.5 billion for Lotus Development, the new Notes 4.0 may provide the answer. Lotus has given the pioneering groupware technology a compelling facelift, with a streamlined user interface and development environment. Notes also has powerful new programming, administration, and Internet tools.

What's more, advanced replication, security, and cross-platform capabilities make Notes 4.0 the standard that other groupware vendors will now have to match or beat. With the OS wars resolving in Microsoft's favor, the new battle is for control of the internetwork and intranetwork landscape—one for which Notes was already well positioned. Still, as 32-bit OSes, applications suites, and Web browsers all add groupware and work-flow features, Notes' lead is not invulnerable.



Notes 4.0 incorporates the cc:Mail user interface in its revamped Mail database, complete with an action bar and special rules-based work-flow tools (see the drop-down menus above). When a document is open, the new interface defaults to two panes, Folders and Views and Active View. Here, the optional Document Preview pane was opened for quickly browsing new mail.

Love Notes

For people who use Notes on a daily basis, the new release is a gold mine of clarity and improvements. Lotus has junked the Byzantine menu structure of the client interface, reorganizing navigation, applications-development, and administration tools into logical groups.

For example, in Notes 3.0, you had to open databases from one menu, view information about database replication and access control from another, and create a new database from a third. Notes 4.0 provides a single menu gateway to database services; you can also bring up context-sensitive menus by right-clicking on the database's icon. Choosing the Properties item brings up the new InfoBox dialog box. The tabbed window "floats" above the Workspace, letting you make interactive changes to replication settings, design and launch options, and modify other relevant properties.

Browsing Notes databases is made more intuitive by a cc:Mail-like pane interface. Double-clicking on a database icon now defaults to a two-pane view, with a hierarchical Folders and Views pane to the left and a larger Active View pane filling the balance of the screen. You can split the screen again vertically by choosing the Document Preview menu command or click on the appropriate SmartIcon. The Preview pane lets you browse documents without clearing the Unread Mark flag. We found this a great way to get a quick overview of new documents while leaving a more thorough look for later.

The Folders and Views pane displays the names of all views, folders, agents, and (if allowed) design elements of the database. As with Notes 3.0, views use selection formulas to determine what documents appear in each view. Notes 4.0 designers can set up user-sorted view columns, where clicking on the column

New and Improved . . .

User Interface Notes 4.0's new look incorporates the cc:Mail three-pane windowing system; unlimited Workspace tabs; menu grouping by Database, Mobile, Replication, and Tools; and numerous context-sensitive screen elements.

Server Administration and Internet/Web Services Graphical Administration Control panel, reorganized Public and Private Name and Address Books, database quotas, mail trace, log analysis, and integrated Web Browser and Publisher server tools.

Extended Full-Text Search You can build complex queries with point-and-click tools, and include encrypted fields and file attachments in a full-text index.

Enhanced Linking and Hot Spots You can now link not only documents, but views, databases, and Web uniform resource locator (URL) addresses.

Enhanced Replication Tools Field-level replication (which can save disk space), along with a new Replicator page, icon stacking, unlimited Workspace pages, and more.

Integrated Development Environment Programmers get a choice of predefined simple actions, expanded formulas, and LotusScript programming tools, including a debugger and class browser. The LotusScript Data Object gives read/write access to back-end databases via Open Database Connectivity (ODBC), and OLE enhancements let you publish OLE automation to external application menus.

New Design Features Navigators, action bars, layout regions, subforms, drop-down keyword lists, and conditional hiding of design and document elements.

User-Defined Views and Agents Users can resize and resort columns, create and organize documents in folders, preview documents while browsing views, and open attached files with the built-in Application Viewer.

can toggle or cycle among ascending, descending, and no sort order. This is easier to use than the old View menu, and it cuts down on the number of views needed.

Folders are new to Notes 4.0; they let you store and manage related documents without needing categories and the required Categories field. Folders can be private or shared. Users with reader access to a database can create private folders, while you must have designer access to create shared ones.

You can base the folder's design on any view or create one from scratch. Then it's a simple matter of dragging and dropping documents on a folder's icon. The dragged document remains in its original view and can be simultaneously stored in multiple folders. You can move folders themselves into other folders, but only if they are hierarchically unrelated.

Notes 4.0 provides a new front-end design type for databases called Navigators. Accessed from the View/Show menu, these graphical buttons replace the Folders and Views list in the navigation pane. Clicking on these objects triggers Notes actions (e.g., opening a view or launching a program). The designer can use Navigators to assign aliases to folders, giving users an intuitive way of dragging and dropping information onto visually descriptive icons.

The action buttons from Notes 3.0 now behave more appropriately. They remain in place in the new action bar at the top of views and documents while you scroll through your data. This allows one set of buttons for reading and another for editing documents.

Feel the Power

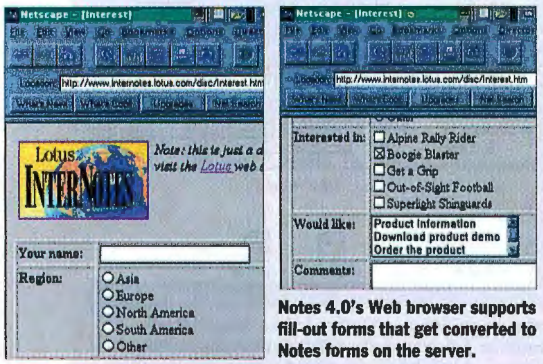
Under the hood, Lotus has reworked the scripting technology to accommodate both the average user and the advanced programmer. Notes 3.0's macros have given way to agents. The Agent Builder window serves as an introductory gateway to Notes 4.0's centralized scripting services. Harnessing an agent to process some documents is as easy as choosing Create/Agent and selecting either a time or event that triggers the agent.

The designer can access programming tools from several directions. In the navigation pane, you click on a design tool such as Forms or Views and then double-click on a component to open it in design mode. The integrated development environment (IDE) includes the Design pane, the Actions pane, and the now-familiar Properties Box. Depending on the type of Notes object that is involved, you can apply another simple action, a formula, or a script by choosing the appropriate option button.

At the intermediate level of complexity, Notes 4.0's formula language retains compatibility with release 3.0's macros, adding @Functions and @Commands that support the new design capabilities. Now you can write formulas for a variety of Notes objects, including buttons, SmartIcons, sections, hidden paragraphs, window titles, keyword fields, and subforms.

The new @DialogBox function exploits Notes 4.0's layout-region technology to create modular custom dialog boxes that

Passing Notes on the Internet



Notes 4.0's Web browser supports fill-out forms that get converted to Notes forms on the server.

Recent events have conspired to make Notes 4.0 an instant force on the Internet. The first shot fired was InterNotes Publisher, a $2500 server-based application that automates creation of Hypertext Markup Language (HTML) pages from Notes documents and views. Registered Notes 4.0 users can download the free 2.0 version of the software from Lotus's Web site (http://www.lotus.com). InterNotes Publisher allows Web users to interact with your published site, doing searches and sending data via browser forms that update Notes databases in real time.

Notes 4.0 builds in some Internet and Web features that exploit Notes' new scripting technology. The InterNotes Web Navigator is an integrated Web browser housed on the Notes server in two pieces: a central database and a server task known as the InterNotes server. The InterNotes server runs the TCP/IP network protocol and maintains either a direct or proxy connection to the Internet. Firms can minimize modem-pool and long-distance costs by placing a gateway Notes server on the Internet.

On the workstation, you retrieve a page off the Web by requesting a uniform resource locator (URL). The Web Navigator translates the HTML document into a Notes document and stores it inside the database. Once the page is in Notes, you can view it, copy it to a private folder, mail it, or paste it as a doclink in another document. The Navigator is replicable like any other Notes database, but you'll need a client version coming this summer to browse the Web via a remote PPP or SLIP dial-up.

The Navigator supports fill-out Web forms, turning them into Notes forms that submit data back to the Internet server. Responses are stored in each user's private folder in the Web Navigator database. You can create Web Tour documents that contain saved history lists of previously opened pages and generate ratings documents that display your and your coworkers' favorites.

Notes servers have supported TCP/IP since release 2.0. This release contains enhancements to make replication across the Internet easier. With Notes 4.0, you can give users and servers unauthenticated access to a server. The administrator can use the name "anonymous" in access-control lists and then assign reader access to anonymous users. This lets companies publish information on public databases.

The Notes Network Information Center (NIC) server is a home page for Notes users where you can register servers in a national name-and-address database that you can download and use to map Notes server names to IP addresses. Adding a server connection document for the remote site is as easy as clicking on Connections in the Personal Address Book's navigation pane and filling in three fields.

Notes 4.0's server pass-through feature gives administrators great flexibility in providing authenticated access to intranets behind a Notes-based firewall. To further enhance security, you can enable network data encryption on the pass-through server's TCP/IP port. Network data is encrypted only while in transit, and there is little impact on performance.

Taken together, these tools position Notes today where the competition hopes to arrive tomorrow.

float on top of the current document. Subforms are used throughout the new applications templates to store common fields and other form elements in reusable modules. For example, the standard mail Memo form lets you select from one of several letterhead subforms. You can use another computed subform to add a new Mood Stamp graphic to indicate visually the nature of the message.

If formulas don't provide the needed automation, Notes is now turbocharged with LotusScript, a cross-platform, Visual Basic–compatible scripting language with object-oriented extensions. LotusScript interfaces with Notes through predefined object classes and their associated methods and properties. They deliver capabilities beyond the scope of formulas, such as the ability to manipulate a database access-control list.

Visual Basic users will feel at home with LotusScript. An object browser window allows you to navigate through Notes classes, constants, subs, functions, and variables, as well as OLE 2 classes resident on your workstation. Activating the debug mode pauses script execution at the first line and opens the debugger window. You can set breakpoints, step through scripts, and view the name, value, and data type of a procedure's variables.

Help for the Wary

As with Notes 3.0, you implement the Help system as a Notes database. The default installation adds a slimmed-down HelpLite database, but we selected Custom Install to add the full-blown 22-MB Help file. Virtually all the printed documentation is available on-line. Unfortunately, it is scattered among similarly named categories, including How Do I...?, Tell me about..., Common tasks, What's new, Troubleshooting, and the instrument of last resort, a comprehensive index. A LotusScript tutorial introduces you to the Notes classes, but the Tell me about... view's LotusScript Notes Classes A–Z is the only rich source of sample code.

Notes 4.0 ships without its predecessor's sample applications, but with newly designed templates that take advantage of the new interface and programming tools. Some of these new features are automatically enabled during the migration from release 3.0 to release 4.0. The Mail template adds user-friendly options, such as the Out-of-Office agent to replace the kludgy vacation macros you had to manually configure in the previous incarnation.

It's in the Mail

Action-bar buttons and agents turn the Mail database into a full-fledged Grand Central Station for your communications work flow. You point and click for various send and delivery options, most notably a Prevent Copying setting that keeps designated messages from being copied to the clipboard, forwarded, or printed without permission. Work-flow tools abound. You can choose the Convert to Task action and route a message to an assistant and then track its status in the Task folder.

Mail also includes special forms, such as the Serial Route Memo, which pauses at each of multiple addresses until the contents are read and signed off on. If you come across a document you'd like someone to review, just select Create/Special-Bookmark and a doclink is automatically created and pasted into a memo, ready for addressing to a single recipient or multiple recipients. Another time-saver is the Add Sender to Address Book action, which converts the From field of a received mail memo into a Person document in your private Names and Address book.

The Lotus SmartSuite and Microsoft Office Library templates leverage OLE 2 to launch embedded documents in Review Cycle routing applications. You might use this feature to assign a list of document reviewers, specify how edits and comments are stored, and perform a "file lock" at the server to warn editors that a review is in progress. Other release 4.0 templates include the Personal Journal, Room Reservations, and Approval Cycle databases. Templates from release 3.0 continue to work without any problems, but you'll need a migration strategy to access the new features.

Managing the Network

Although Lotus recommends first upgrading the server to release 4.0, we were able to use a 4.0 client in conjunction with a 3.0 server without problems. Upgrading the workstation proved uneventful; the installation program migrated all current Workspace and connection document settings. We had to find User Preferences in the Tools menu to turn on right-double-clicking to exit a document, and we had

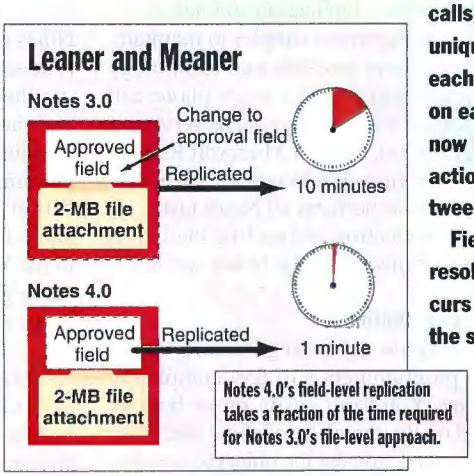
Notes Replication: Outstanding in Its Field

Lotus has optimized replication in Notes 4.0. The most visible change is field-level replication. In previous releases, any change in a document or attachment caused the entire contents of the document to be replicated. Now, only changes to individual fields are transmitted.

To further speed things up, Lotus made changes to the data structure and in Notes' use of remote procedure calls (RPCs). In release 3.0, at the start of replication, a command was sent to the server to build a dynamic list in memory of changes to documents. Release 4.0 moves these functions into the Notes NSF database structure, keeping an index of all documents and fields and their time stamps available at each end of the replication session.

Instead of sending individual Universal Notes IDs (UNIDs) via multiple RPC calls, now a single RPC call contains a list of unique IDs. More information is included in each RPC packet, with more processing done on each end. Release 4.0 servers can also now have up to four concurrent replicators in action, speeding simultaneous replication between multiple servers.

Field-level replication also helps in conflict resolution. In release 3.0, a save conflict occurs if two users edit the same document at the same time, even if they're editing different fields. Release 4.0 lets a designer tell Notes to merge conflicting edits into a single document, provided that the conflict is not with the same field.



TECHNOLOGY FOCUS

to manually configure some of the favorite SmartIcons (e.g., Scan Unread).

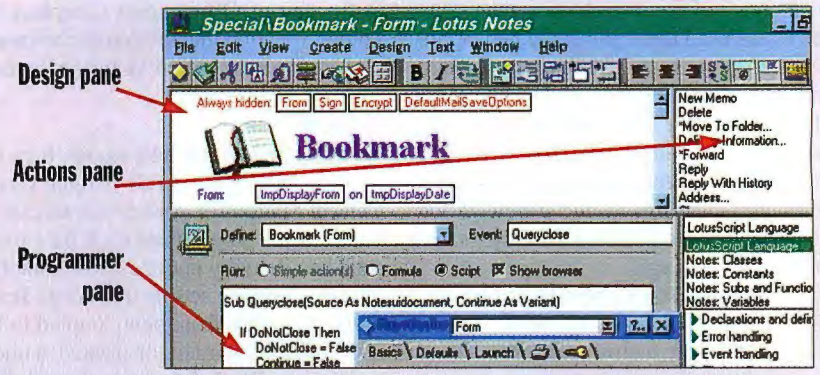
Notes 4.0 makes huge strides in its replication tools, both in terms of performance (see the Technology Focus) and interface design. The Workspace now includes a Replicator work page, where you can select and configure which databases, folders, views, and/or design elements will replicate. You change the order in which databases replicate by dragging and dropping database icons. You right-click on a database icon to immediately replicate just that database or click on the action bar to send and receive mail or replicate high-priority databases.

There are many nice touches for mobile users. The installation program creates four default location documents: office, travel, home, and disconnected. If you connect to remote databases via an Internet service provider, an Internet document is added (see the text box "Passing Notes on the Internet"). You can switch locations from the File/Mobile menu or more easily via the location indicator on the status bar.

Other innovations include icon stacking, where a single icon represents replica icons for remote and server access. You can single-click on the icon stack to switch from one replica to another via a menu, but the program is smart enough to do the right thing, automatically depending on which location document is loaded.

If you're concerned about security when using your laptop on the road, Notes now lets you encrypt local databases at one of three levels. A database's access-control list is now also locally enforced, letting assistants work with the same kind of information they would be allowed to access if they were connected to a Notes server on a LAN.

Administrators will find it easier to do their job from remote locations. The Public Address Book contains a Server Configuration document in which you can specify NOTES.INI settings for a single server, a group of servers, or for all servers in a domain. You can reach the Server Configuration view by clicking on an icon in the Administration Control Panel (ACP).



Notes 4.0's integrated development environment (IDE) features Design, Actions, and Programmer panes; the floating Properties Box (bottom) displays context-sensitive information. You can choose simple actions, formulas, or the new LotusScript tools, which let you explore the object browser window (lower right).

You launch the ACP database from the Tools menu, or you can configure the Notes client for administration mode, which loads the database on start-up. The ACP's GUI brings all of release 3.0's scattered administration tools under one coherent roof. You can click on icons to open the Notes Log, the Statistics and Events database, and the Database Catalog; register and certify users and servers; and track down mail problems with the new Send Mail Trace feature.

The Public Address Book contains new roles and groups that allow the delegation of administrative tasks without giving complete administrator access. An Administration agent automates the renaming and deleting of users on servers throughout the enterprise. Administrators can also control which users can create agents in a particular database via the enhanced access-control list.

Notes 4.0's 32-bit multithreaded architecture can take advantage of symmetrical multiprocessing, with up to six processors per server allowing as many as five times the number of users. This reduces server-to-server replication and makes enterprise management simpler to maintain. The new server pass-through technology lets remote users make a single phone call to replicate with any available server on the LAN. Also, users of Microsoft Remote Access Service (RAS) remote LAN services can now perform all Notes tasks, including replication and routing mail, as if directly connected to the Notes servers.

Flies in the Ointment

Notes still has a way to go before Visual Basic programmers will feel completely at home. You can't easily move buttons around on the screen by clicking and dragging; instead, you cut the object to the clipboard and then paste it in at a new location. The LotusScript object-oriented extensions are powerful, but you won't find much help on the subject in either the printed or on-line documentation.

Importing data from a non-Notes database source is now viable using the new Open Database Connectivity (ODBC) support, but it requires scripting instead of a wizard-type helping hand. The product still ships without any calendaring or scheduling templates or sample applications. Lotus has announced a second-quarter release of a pair of updated Notes clients that add some Lotus Organizer functions.

With release 4.0's extensive and growing support for OLE automation and OLE custom controls (OCXes), the stage is set for Lotus's component strategy. It plans to have shipped by now a toolkit of spreadsheet, word processing, project scheduling, image viewer, and other OCXes. This neatly dovetails with Microsoft's announced intention to provide OCX-creation capabilities in the next version of Visual Basic.

Hitting the Grace Notes

Notes may still have its idiosyncrasies, but release 4.0 goes a long way toward reaching the mass audience its developers envisioned. By standardizing on a BASIC familiar to millions of Visual Basic programmers, enhancing Notes' lead in replication and cross-platform development, and adding a mature groupware product to the Web equation, Lotus and IBM have taken giant steps in cementing Notes' role in the next evolution of computing. ■

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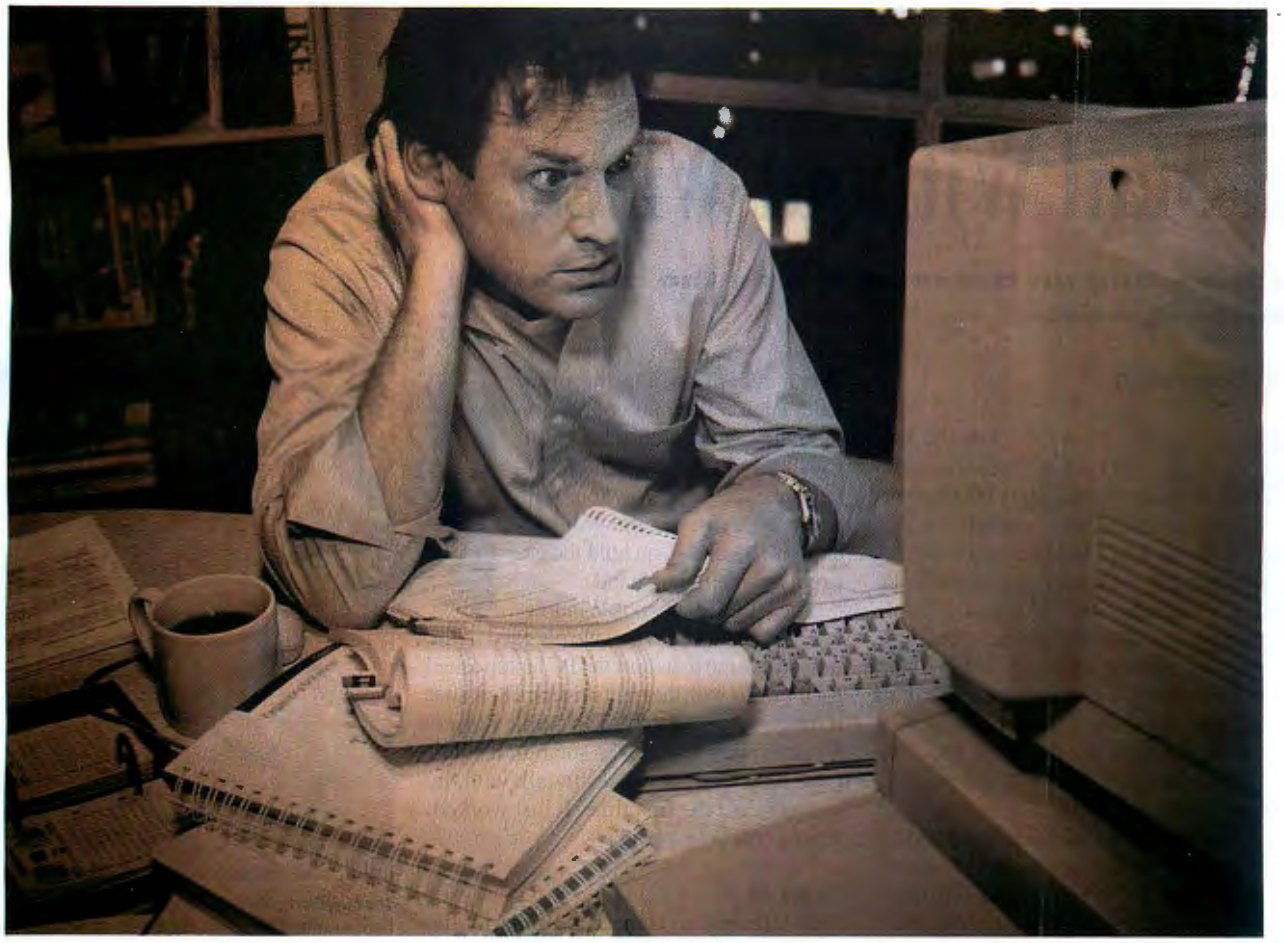
Product Information

Lotus Notes release 4.0 . . . . . $495
estimated retail price, single-processor server; desktop client, $69 ($275 with development tools)
Lotus Development Corp.
Cambridge, MA
(800) 343-5414 or (617) 577-8500
http://www.lotus.com
Circle 1193 on Inquiry Card.



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E-Mail Without Wires

Connecting on the road and on the rails with the Megahertz

PETER WAYNER

Look Ma, no wires! For the last two weeks we've been using the Megahertz AllPoints PC Card radio modem, jacked into a notebook PC. The total experience has been quite nice, if not perfect, and the modem could hardly be smaller (it weighs only 150 grams). People on the go will like the device's tiny size and having access to E-mail on the road.

The modem itself looks like a standard Type II PC Card with a black plastic battery unit, the size of a cigarette pack, attached to the end. The PC Card part fits inside the laptop, while the battery unit hangs outside. The AllPoints' telescoping antenna sprouts from a standard connector on the battery pack, so you can substitute a different antenna for better performance.

This small package is nice, but it's still far from the ultimate solution. The battery module, sticking out of the slot, makes it hard to pack the laptop in a carrying bag for fear the battery part could break off. Megahertz should have attached the battery pack with a flexible wire so you could disconnect it. This would also allow you to move the antenna around to avoid interference from the laptop and to angle for better reception. On the other side, such a flexible connection wouldn't work well with palmtops and personal digital assistants like the Apple Newton. With those systems, the integral modem package lets you hold the entire machine in one hand.

The PC Card supports Windows 95 Plug and Play. When we plugged in the modem for the first time, the PC laptop asked for the disks with the right drivers. Thereafter it functioned perfectly. The Apple PowerBook, however, was even smarter; it didn't need help from any disks to talk with the modem card the first time. It just worked. That's *real* plug and play.

CRAIG ALNESS © 1996

The Megahertz AllPoints radio modem looks like a PC Card wearing a backpack radio, with its attached 9-V battery module and 6-inch telescoping antenna.

On the Air

The AllPoints modem uses primarily the RAM Mobile Data Network, though it can also use the Cantel and other 900-MHz Mobitex networks. RAM is a wireless network (used mostly for pagers) that operates independently of cellular phone companies in most urban areas of the United States. RAM estimates that it covers 90 percent of the places where people do business in the U.S. If you're considering buying the AllPoints modem, you should definitely investigate the RAM coverage first. Farmers and others who live outside metro areas might like to use the modem, but there's a good chance that the RAM network doesn't extend to rural zones. Business travelers, on the other hand, should enjoy good access because RAM base stations are often located at airports.

Our experience with coverage was generally good. At the first place we tried the modem, we couldn't receive a signal because of a large, wooded hill between the house we were in, located at Baltimore's northern edge, and the city itself. Later we discovered that a faint signal was getting through, but it didn't register on the software's monitor. Megahertz might consider offering an integral hardware signal meter in the future, as some other company's radio modems do.

We also used the Megahertz modem while riding the train to New York City. The signal was often very strong, and we could send and receive packets for most of the journey. On New York's Upper West Side, the signal was just barely strong enough to be functional.

Good signal strength is very important when sending or receiving E-mail this way. With a strong radio signal, data packets flow quickly, and there are few errors that require

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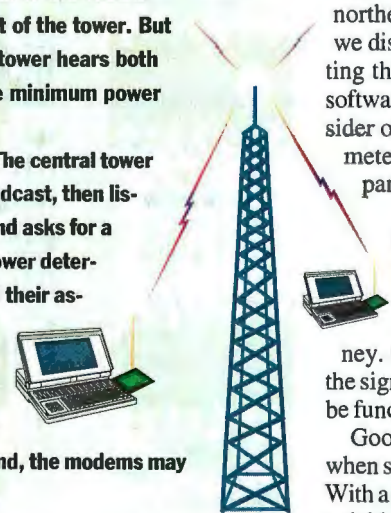
The Slotted Aloha Protocol

One of the greatest engineering challenges facing radio modems is keeping the peace on the airwaves. A radio modem one mile east of the central tower might not hear another modem one mile west of the tower. But if they both transmit at the same time, the central tower hears both signals. Worse, radio modems always try to use the minimum power needed to reduce interference.

One solution is called the Slotted Aloha protocol. The central tower pauses every *n* milliseconds, asks who wants to broadcast, then listens. Each modem waits a random amount of time and asks for a slot. Some signals get through, others collide. The tower determines who won and broadcasts a list of modems and their assigned time slots. The losers try again next time.

With few modems and light usage, polling periods are short and time slots long. As demand increases, the polling period grows so everyone can make their request. The time slots shrink and, with heavy demand, the modems may have to skip rounds.



resending a packet. A weaker signal can severely degrade throughput and multiply transmission time by a factor of 10.

Wireless E-Mail

The AllPoints modem comes with software to support basic Internet E-mail, which you must purchase for a separate monthly fee. We used Wynd, from Wynd Communications, in versions for a Canon Windows-compatible laptop and an Apple Powerbook. The Wynd software was functional but Spartan, with none of the extra features now standard on most desktop mailers.

The software does provide two neat tools for sending messages. You could mail a message to a particular phone number (e.g., 2125551234@phone) and the Wynd system would dial the number and read the message via a computerized speech synthesizer—great for sending a message to someone without a computer. Wynd can also send a fax, and you can ask Wynd not to send you long messages over the radio modem

The PC Card also came with several DLLs that you can use to build your own applications to run over the RAM network. With C code for a demonstration application, we built a chat connection between two laptops from an ordinary Internet chat application; we just replaced Winsock calls with calls to the AllPoints DLL. Programming is pretty straightforward if you have network experience.

The AllPoints radio modem PC Card is a great tool for many people who need to swap packets while out on the road. The radio E-mail connection alone could justify the cost for a sales force. A company that wants to offer flexible access to databases might also investigate writing software using the DLLs that come packaged with the modem. ■

Peter Wayner is a BYTE consulting editor who lives in Baltimore. You can reach him on the Internet at pcw@access.digex.net, on the Web at http://access.digex.net/~pcw/pcw-page.html, and on BIX as pwayner.

Product Information

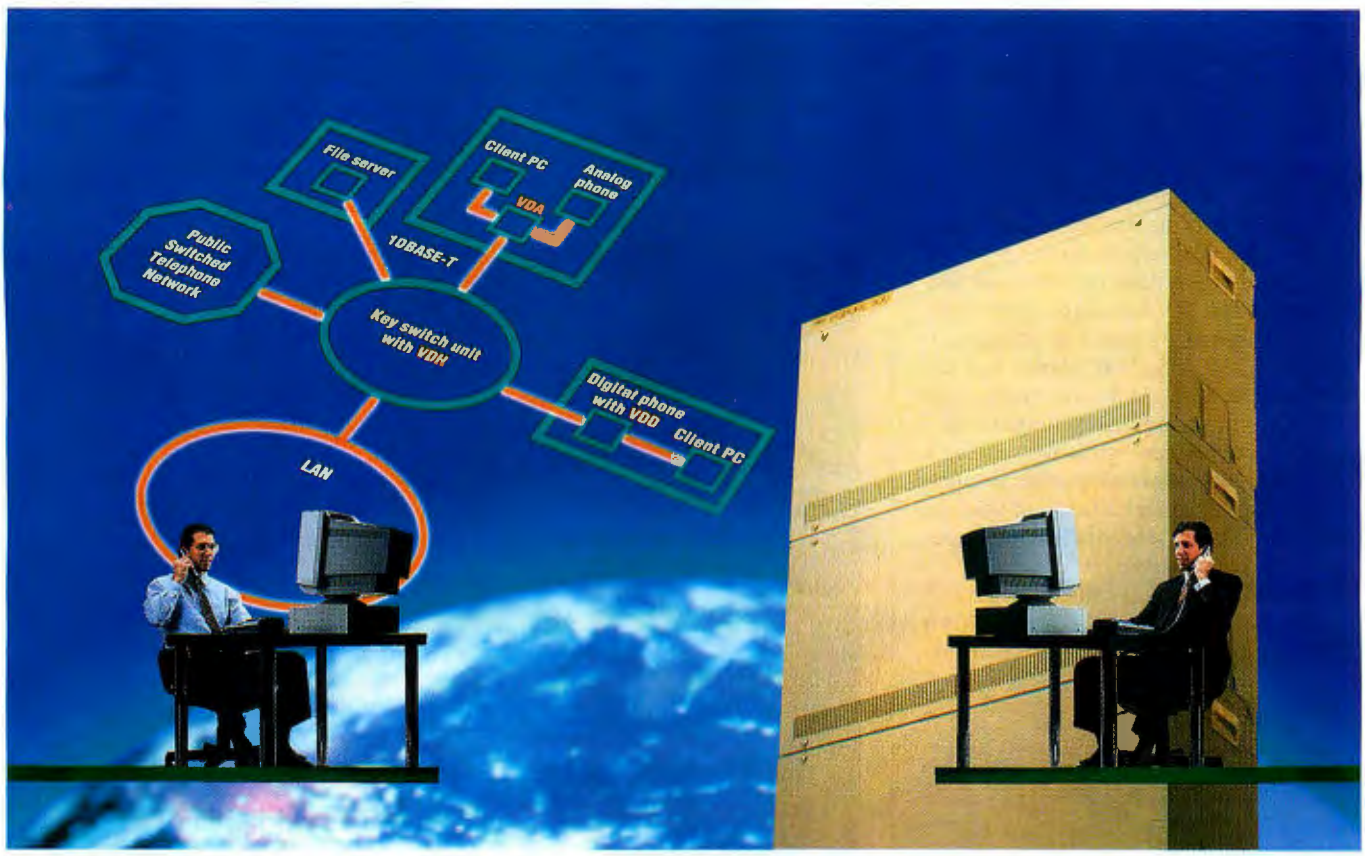
AllPoints
wireless PC Card modem $499
Megahertz
(a division of U.S. Robotics)
Salt Lake City, UT
(800) 527-8677
(801) 320-7000
fax: (801) 320-6010
http://www.megahertz.com
Circle 1096 on Inquiry Card.

The Meter Is Running

Connectivity on the go may be convenient, but it isn't cheap. Besides the $499 modem, here's what you'll pay Wynd Communications for its services. Note that charges are based on the number and the length of messages successfully sent and received—not on connect time.

- **$49 activation fee**
- **$29.95 per month, includes 200 messages of up to 150 characters; then $.05 each for additional messages**
- **$.39 per page for domestic faxes**
- **$.39 for each text-to-speech telephone message**
- **$.19 for a dial-up message (up to 1000 characters)**

Wynd Communications Corp., San Luis Obispo, CA, (800) 549-6000, info@wynd.net, http://www.wynd.net/wynd



CORELINE: PHONES AND LAN VIA THE SAME CABLES

Modern office communications demand a private switch for telephones and a LAN for connecting PCs.
The two networks have demanded different lines because they evolved from different technologies. But now there's an efficient way to combine both worlds and reduce installation costs with new multiplex technology from NEC.

Our CORELINE* system uses the same twisted pair cables to integrate a key telephone system and a 10BASE-T Ethernet LAN. NEC's integrated system offers both high-quality voice communication and full LAN speed–10Mbps. This is an improvement over conventional systems which force users to sacrifice either voice quality or data transfer speed during concurrent transmission.

The CORELINE system consists of Voice and Data Hub packages (VDH), Voice and Data Digital units (VDD) and Voice and Data Analog adaptors (VDA). Incorporated into an NEC key telephone system, CORELINE can deploy up to 72 pairs of telephones and PCs. Because it uses the same cables, CORELINE drastically reduces installation time and costs. It also permits greater flexibility for expansion or relocation.

Computer telephony integration (CTI) has emerged as a significant technology trend as we move into the next century. CORELINE is one example of our practical approach to implementing this technology.

*The name varies by countries.

Updates on the scope and depth of NEC technologies

Number 159

SDH RADIOS NEED 50% LESS SPACE, 70% LESS POWER

NEC is introducing a new generation of long-haul SDH microwave radio systems. The new 2000 Series uses sophisticated device technologies to dramatically reduce system size and power requirements.

50% smaller than our previous series, the new systems make extensive use of custom LSIs, microwave ICs and hybrid ICs. You can mount a complete system, including four transmitter-receiver units, in a standard ETSI rack.

To cut power consumption by 70%, the new systems use low-power LSIs and highly efficient power supply units. The 2000 series employs a Q3 interface, the de facto standard for network management systems.

The SDH microwave radios in the 2000 Series are ideal for long-haul trunk networks with transmission capacity of 155Mbps (SDH) or 140Mbps (PDH). The frequency menu ranges from 4 to 13GHz. NEC has already delivered 1,500 transmitter-receivers to Malaysia, the Philippines and other countries.

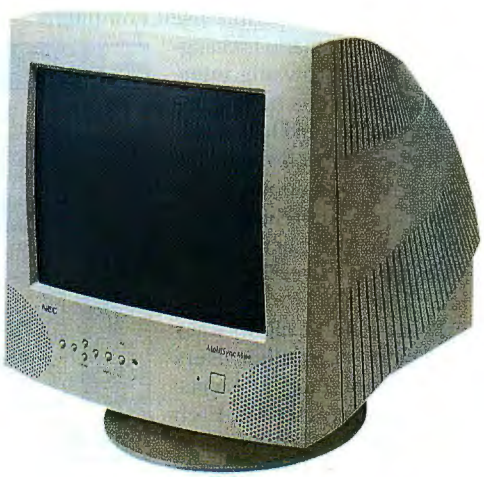
We have also totally redesigned our small-capacity microwave systems using leading-edge components. Our new 2300 and 2500 Series offer efficient solutions for low-volume trunks, spur links and subscriber networks.

NEW MultiSync® MONITORS OFFER CLEARER IMAGES

The latest advances in computer applications have created a need for a new standard in screen performance. New applications include Internet browsing, game playing, video and TV viewing. Today's monitors should have special features that enhance text, graphics, video and TV images.

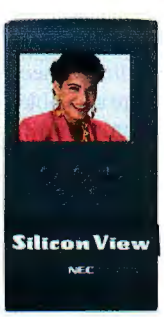
NEC's new MultiSync M-series monitors feature a revolutionary CRT specifically designed for the new computer environment. Our CromaClear™ CRT features a slot shadow mask and phosphor pattern. This creates clearer, sharper images by combining the best features of dot-trio and aperture-grill CRT technology. CromaClear CRTs also offer higher brightness and contrast for optimal video and TV viewing.

To complement their new-age functions, the MultiSync M-series monitors also feature a sleek, ergonomic cabinet, incorporating a pair of stereo speakers and a microphone.



HANDHELD SILICON VIDEO PLAYER

NEC has defined tomorrow's handheld video player. With a 2.5-inch LCD screen, the system will let users enjoy full-motion video and music just about anywhere.



NEC's Silicon View player incorporates an MPEG-1 video/audio decoder. It reproduces VHS-quality video and CD-quality sound from data stored on a memory card.

The player has no moving parts. This solves the problem of image/sound skipping due to shock. Silicon View measures 146 x 76 x 37mm and weighs 295g with battery.

Silicon View uses video/audio signals compressed from 31Mbps to 1.4Mbps. A 40Mbyte flash memory card stores four minutes of motion video and audio. One hour of recording requires 4.8Gigabits of memory.

When gigabit memories become affordable, silicon-based media will gain widespread popularity. This should happen around the year 2000.

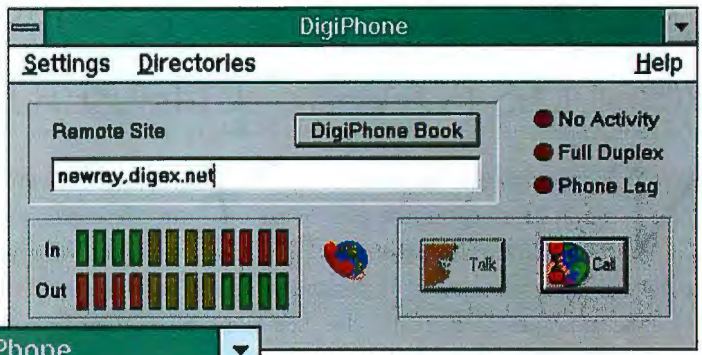
For further information, please contact:
NEC USA, Inc. 8 Corporate Center Drive, Melville, NY 11747 U.S.A. Tel 800-338-9549
NEC Corporation, The Newscope Center, Overseas Advertising Division,
7-1, Shiba 5-chome, Minato-ku, Tokyo 108-01, Japan Fax: +81-3-3798-6333

NEC

Hey Baby, Call Me at My IP Address

Now you can make "free" phone calls over your Internet connection—but the hidden cost is unpredictable sound quality

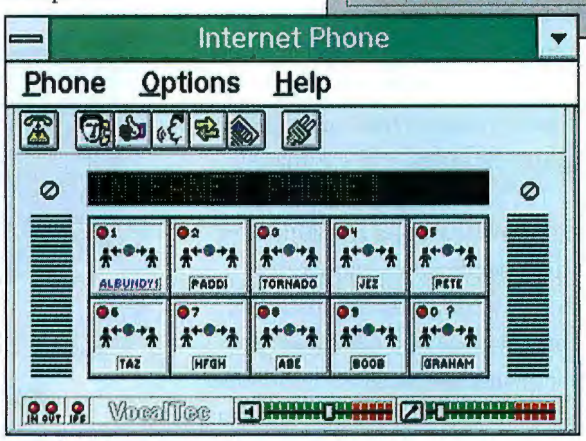
PETER WAYNER



DigiPhone's screen display is simple, yet it provides all the information you need to dial up someone's IP address instead of their phone number.

Some clever people are turning the past on its head. In the past, much of the Internet rode on top of the nation's phone system. People connected using modems that converted digital data into audible messages that could travel over voice-grade lines. That made sense. Phones were nearly ubiquitous and relatively few people used computers. Now, this scenario is changing. Web-browsing interfaces may soon be as common as TVs, and high-grade digital connections to the Internet may dominate the world. It's not surprising, then, that we can now send phone calls over the Net.

VocalTec's Internet Phone software allows users to connect to other users with the directory assistance of VocalTec's servers. Each server also offers a host of discussion topics for people with similar interests. Third Planet's DigiPhone is a simpler system that routes messages directly to a distant machine. Phil Zimmermann of PGP (Pretty Good Privacy) encryption fame is working with others to produce PGPfone, which will offer highly secure service. While all three programs offer essentially the same thing—voice communications—there are significant differences between their features and how each service is packaged.



Internet Phone's screen displays icons for people who have logged on to the central server, indicating they're on-line and available to chat.

Internet Phone and DigiPhone systems require 486 PCs running Windows 3.1 or better. The machines must have a Winsock 1.1 interface to the Internet, which may be through a PPP connection to a local Internet service provider (ISP). Connections with America Online or CompuServe are not good enough; your machine must have its own IP address. The packages also require a sound card with a microphone and speakers. Low-end sound cards offer only half-duplex communication, where the sound flows in only one direction at a time. Better sound cards can process the signals fast enough to offer full-duplex communication, so both parties can talk at once.

We tested these phone products on a 486 PC with a Sound Blaster card and a PPP connection to a local ISP. This may be the most inefficient setup possible: Voice is turned into a digital message that is immediately converted into an analog audio signal by the modem, then reconverted into a digital message by the ISP. This connection is the norm today, but it will become less common as high-speed digital connections such as ISDN become more available.

PGPfone currently runs only on the Macintosh, but a version for Windows 95 should be available by the time this article appears. We checked out PGPfone on a Mac 6100/60 using the same PPP connection to the same ISP. Internet Phone has announced a Mac version, but it was not available for testing for this review.

Internet Phone

Internet Phone evolved out of the Internet Relay Chat (IRC) servers that moderated text conversations on the Net. Its architecture is based upon a central server that keeps a list of active users looking for conversations in various topics, but when you actually call someone it's a direct connection, not routed through the server.

You log on to these servers and list your name in the discussion groups you are interested in; other people in a group can see who's on and perhaps give them a call (see the screen above for an example). In other words, you don't need to have someone in mind to use the software. You can just log on and people might call you. Discussion topics range from the sacred (country music) to the profane (sex). As you might expect, many people seemed to be trolling the waters for nothing in particular. If you enjoy speaking with someone you've never met before or talking to people from a different corner of the world, then you'll like using Internet Phone. It's like visiting an international bar.

The software itself is well-designed and functional. You can test your microphone's sensitivity (an illuminated graph on the front window tells you if your voice is being accepted), and whether your sound card can handle full-duplex conversation.

Most of our conversations were in half-duplex mode, where the software had to decide which side of the conversation was broadcasting at any time. Internet Phone handles this in two different ways. It automatically senses when the sound rises above a user-set threshold and then opens up your broadcast channel. Sometimes this automatic threshold can become problematic. If you pause, the transmission will click off until you start up again, which

can be disconcerting. So Internet Phone also offers a manual option, where you click the transmitter on to speak and off to listen. We usually preferred this mode.

Unlike DigiPhone and PGPfone, Internet Phone offers no encryption or security features. (A VocalTec representative said the company will incorporate security functions in a future release.) Version 3.1, due for release as this article went to press, includes a new way to interact with some Web browsers so that people can insert hotlinks into Web pages. Click on a link and an Internet Phone call is started.

DigiPhone

DigiPhone is not as much fun out of the box as Internet Phone. There's no central server to tell you who's on-line, so you can't join topics and look for someone to chat with. The software implements a global directory that lets you look up users by some combination of name or location. This is fine if you know someone who is listed, but it's not conducive to making new friends. To make a phone call, you type in the other party's IP address.

The DigiPhone software is more sophisticated than Internet Phone's; it allows you to add new voice-compression and encryption software. The modules that ship with the product right now aren't particularly strong, though. To use the encryption module, for example, you add a password next to the name of a friend in your personal phone list. If your friend has the same password, then the encryption will work. But the passwords are limited to five characters, so you shouldn't count on much protection. (It will stop your little sister, unless your little sister knows how to program.) Still, this encryption is better than no encryption at all.

DigiPhone allows you to change the sampling rate manually. A slower rate may generate a less accurate digital representation of speech, but it's also less likely to saturate the channel. Lowering this rate is often a good choice because it degrades the sound quality uniformly, whereas saturating the channel leads to missing packets that leave out words, phrases, or even sentences. At press time, Third Planet announced a deluxe version of DigiPhone; it's bundled with a suite of Internet programs and offers extended features, including voice mail.

PGPfone

Security is PGPfone's main advantage. Phil Zimmermann is devoted to enhancing the privacy of citizens, and PGPfone's algorithms are probably as good as those used in the secure phones that AT&T sells to the U.S. government. At this writing, there's only a Macintosh beta program

Pronounced Packet Problems

It's hard to compare the sound quality of the systems we review here because the Internet doesn't cooperate. Most people who use these products will probably find that the quality of the channel carrying the packets is the most limiting part of the technology. No matter how good the software is, it can't do much when packets get lost or delayed along the way.

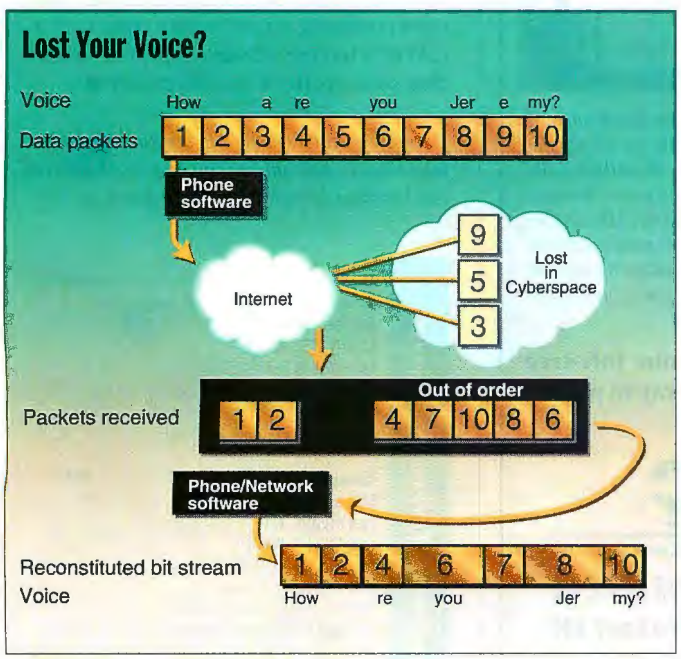
The real problem is that the Internet was never designed to handle communications, such as phone conversations, that are highly time-dependent. The network routes packets between two locations, but it can't guarantee that the packets will arrive in any predictable order or on any schedule.

If a packet disappears during a file transfer, it can be resent and the user won't notice the glitch. Most of the time, Internet connections are good enough to support a conversation, but there's no guarantee like the one you receive from the phone company when your telephone initiates a call.

For this reason, the sound quality of Internet phone calls depends on the state of the network at the particular time you call. In some telephone calls we made to Israel, voices were barely recognizable because so many packets were disappearing. The software did its best to reassemble the message with the packets that did make it through, but the speech was too clipped to make sense. Other phone calls—to Sweden, for instance—worked perfectly. The Internet is so decentralized that you simply can't count on the quality of any given connection.

For most people, for now, these phone products will be toys. It's fun to meet people from around the world and speak with them and not pay sky-high phone bills, but the sound quality is too spotty for business conversations. And it's important to remember that the calls are free only because the Internet doesn't have any mechanism for billing based on traffic. This could change in the future.

People with access to better Internet links may consider using these phones as real devices. Some corporations, for instance, maintain their own WANs that link geographically dispersed offices. If these connections are fast, then better phone connections may be possible because you're not relying upon a common resource like the Internet.



A much simplified depiction of what happens when speech is converted into digital packets that are sent through a network and received out of order, with pieces missing. Since the original was created in real time, a missing packet can't be resent, thus creating a gap in the data stream, which the recipient hears as clipped words or run-together speech.

TECHNOLOGY FOCUS

(1.0b5), but a Windows 95 version is in development. The system can also operate over an AppleTalk network or a direct-dial line if you want to pay for the call.

PGPfone employs Diffie-Hellman key exchange to create the session key for the conversation. Because this algorithm is vulnerable to a man-in-the-middle attack, in which someone inserts themselves into the data stream, the software provides a short version of the key for you to repeat over the phone line. If you and the person on the other end both see the same phrase on your screens, then no attack is in progress. AT&T's secure phones use the same approach.

You can select either Blowfish or Triple-DES algorithms to encrypt the bit stream itself. Both have no publicly known weaknesses, and it's illegal to export this software from the United States. The software lets you set encryption parameters and digitization speeds, and it is free for noncommercial use.

In our PGPfone calls, the sound quality was fairly good in half-duplex mode, but quality decreased significantly in full-duplex mode because the number of bad packets skyrocketed.

One Ringy-Dingy, Two Ringy-Dingy

For most people, none of these products can replace the ordinary telephone for everyday use. Most Internet service isn't fast enough or reliable enough yet, though this should change in the next few years. And even accepting this limitation, it's simplistic to pick any one of these products as the absolute best choice.

DigiPhone offers the nicest set of technical features, with its optional encryption and its user-adjustable sampling rate. Plus, it should be easy to incorporate new voice-compression and encryption algorithms as they become available in the future.

PGPfone offers similar features as DigiPhone but has much stronger encryption capabilities, as you'd expect. But PGPfone is still only in beta, and as yet only for the Macintosh. In its final form, we expect it will be as good as either of the two commercial products. If you care about security, this is clearly the best choice.

If you're on a private IP network, you may get reliable enough packet movement to get real use out of these products. The rest of the world, especially those looking for entertainment, might want to turn to VocalTec's Internet Phone simply because its chat servers offer a nice diversion. ■

Peter Wayner is a BYTE consulting editor who lives in Baltimore. You can reach him on the Internet at pcw@access.digex.net.

Product Information

DigiPhone . . . . $89.95 (dual license)
Third Planet Publishing, Inc.
Dallas, TX
(214) 733-4790
fax: (214) 733-4505
3pp@planeteers.com
http://www.planeteers.com/
Circle 1158 on Inquiry Card.

Internet Phone $99
VocalTec, Inc.
Northvale, NJ
(201) 768-9400
fax: (201) 768-8893
info@vocaltec.com
http://www.vocaltec.com/
Circle 1159 on Inquiry Card.

PGPfone . . . . . free
Download from Web site
http://web.mit.edu/network/pgpfone/
Circle 1160 on Inquiry Card.

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2 ☐ Computer/communications manufacturer
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
8 ☐ Departmental Management (non-IS/MIS)
9 ☐ Technical Services Support
10 ☐ Other (please describe): _____

C. My responsibilities require that I be involved with the following operating system environments: (check all that apply)
11 ☐ DOS
12 ☐ OS/2
13 ☐ Mac/OS
14 ☐ UNIX (any, including Solaris)
15 ☐ Windows
16 ☐ Windows/NT
17 ☐ NetWare
18 ☐ Other (please describe): _____

D. Please indicate which specific fields of interest are important to you: (check all that apply)
19 ☐ Mobile Computing
20 ☐ Application development
21 ☐ Client/Server
22 ☐ Internet/on-line
23 ☐ Video Conferencing
24 ☐ Multimedia
25 ☐ PC Telephony

E. Do you influence the purchase of the following products or services for your organization? (check all that apply)
26 ☐ Computers/peripherals
27 ☐ Software applications
28 ☐ Remote/wireless communications
29 ☐ LAN hardware or software
30 ☐ Internetworking hardware, software, or services

April 1996

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Valid until June 30, 1996

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1180	1181	1182	1183	1184	1185	1186	1187	1188	1189	1190	1191	1192	1193	1194	1195	1196
1197	1198	1199	1200	1201	1202	1203	1204	1205	1206	1207	1208	1209	1210	1211	1212	1213
1214	1215	1216	1217	1218	1219	1220	1221	1222	1223	1224	1225	1226	1227	1228	1229	1230
1231	1232	1233	1234	1235	1236	1237	1238	1239	1240	1241	1242	1243	1244	1245	1246	1247
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Product Category Information

To receive information for an entire category, circle the appropriate number in box above.

Hardware

Accessories/Supplies	1
Add-in Boards	2
Bar Coding	3
Communications/Networking	4
Computer Systems	5
Data Acquisition	6
Diagnostic Equipment	53
Disks & Optical Drives	7
Diskettes/Duplicators	8
Fax Boards/Machines	9
Graphics Tablets/Mice/ Pen Input	10
Keyboards	11
LAN Hardware	12
Laptops & Notebooks	13
Mail Order	14
Memory/Chips/Upgrades	15
Miscellaneous Hardware	16
Modems/Multiplexors	17
Monitors & Terminals	18
Multimedia/CD-ROM	19
PCMCIA	57
Printers/Plotters	20
Programmable Hardware	21
RAID Drive Arrays	56
SCSI/Peripheral Interfaces	59
Scanners/OCR/Digitizers	22
Security	52
Tape Drives	23
UPS/Power Management	24
Voice Technology	55

Software

Business	25
CAD/CAM	26
Communications/Networking	27
Data Acquisition	28
Database	29
Educational	30
Engineering/Scientific	31
Entertainment	32
Graphics	33
Macintosh	34
Mail Order	35
Mathematical/Statistical	36
Miscellaneous Software	37
On-Line Services	38
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Holes in the Neural Network

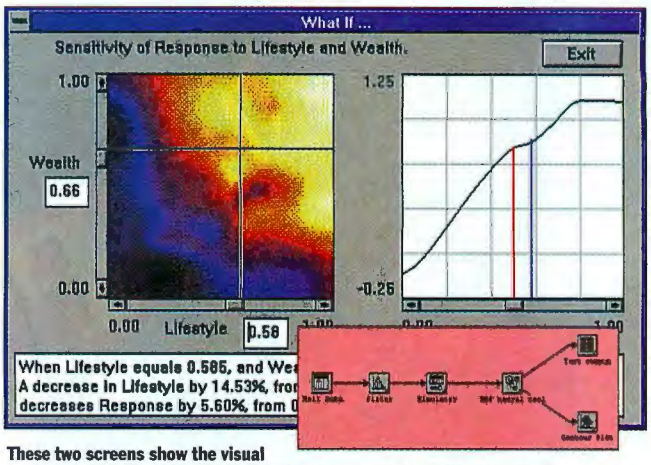
A powerful data-analysis tool arrives on the Windows desktop but needs improving to be ready for prime time

BEN SMITH

If computers were only as smart as their creators, they would all have neural-network software and could solve the world's most complex problems. However, even the fastest computers aren't as powerful as a mere fruit fly. To believe that software running on even the most recent Intel processor can do more than a rough analysis of complex data sets is like believing that the tooth fairy will bring peace in Bosnia. Yet, there's an important place for SPSS's Neural Connection 1.0 in the toolbox of statisticians.

The problems that Neural Connection addresses are old ones: data segmentation/classification, categorization, prediction, and time-series analysis. When the data falls into simple curves and clusters, more traditional statistical methods will do fine for determining curves and equations; but when data scatters wildly or the curves defy mathematical description, you need neural-network algorithms.

Neural Connection provides you with three neural-network models: a multilayer perceptron, the radial basis function, and the Kohonen network. Because the order and content of the training data are so important to the success of neural networks, Neural Connection provides tools for viewing, filtering, combining, and generating your data. Additionally, it gives you tools for looking at, formatting, and graphically viewing your results. All this is wrapped in a Windows-based GUI (see the screen). You can design your data flow by arranging and connecting the various tools in the Neural Connection work space.



These two screens show the visual programming style of Neural Connection, along with two of the graphical ways it can represent the resulting neural network.

We evaluated Neural Connection by feeding it 2000 random points on the curve for the declination of the moon. This curve is roughly predictable with just a few trigonometric factors, but in fact it's highly complex—the equation has more than 50 elements in it. A 486/50 PC cranked away, training the neural network for more than 4 hours. Neither the software nor we were happy with the results.

We then gave it a simpler problem, asking it to predict points on a sine wave. Again, Neural Connection took more than 4 hours. This time, however, the resulting neural network had some value, though we wouldn't use it for drawing a circle.

This is software for statisticians, not engineers, for discovering loose order in apparent chaos, not for developing precise empirical predictions. In an engineering context, it would be more useful in fluid dynamics than in mechanics. In theory, Neural Connection should be helpful with market analysis and research, financial research, and their associated predictive needs. If any technique is able to improve a direct-marketing campaign's cost-effectiveness by even a few percentage points, it's valuable.

Even with a real need for Neural Connection, however, it may not be the product to fill that need—not, at least, the present version. We found the GUI difficult to navigate and nonintuitive to configure. The training software, which uses the scripting language NetAgent, was bug-ridden and offered no simple escape.

The depth of neural network required for valuable work exceeds what it's reasonable to do on a PC. Serious data analysis on this scale needs a stream-oriented data flow. Engineers and statisticians with the technical expertise to build appropriate data sets for training a neural network aren't likely to be attracted by a cutesy, icon-based interface for building relatively simple data-processing paths. Finally, the software is unreasonably expensive for learning and experimentation. ■

Ben Smith is a computer consultant, a former BYTE Lab testing editor, and the author of Unix Step-by-Step *(Hayden Books, 1990). You can contact him on the Internet at ben @ronin.com.*

TECHNOLOGY FOCUS

They've Got a Lot of Nerve

Neural networks are computer hardware/software problem-solving tools that were inspired by organic nervous systems. Their technological roots lie in the field of parallel distributed processing and the opportunities of massively parallel systems, as discovered in the late 1980s.

Conceptually, building a neural network—whether implemented in hardware, software, or both—is building a behavioral model. It requires either "hand-shaping" the model by setting the connections and their attenuation or automatically training it by processing large data sets. The latter process is also called modeling. You must then evaluate and often retrain or redesign the network that results until its predictive abilities fall within the desired range. Because the interactive train-and-evaluate cycle is potentially work-intensive, genetic programming is often used to automate the process (see "Genetic Programming with C++," February 1994 BYTE).

Product Information

Neural Connection 1.0 ..... $995
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Chicago, IL
(800) 543-2185
(312) 329-3500
fax: (312) 329-3668
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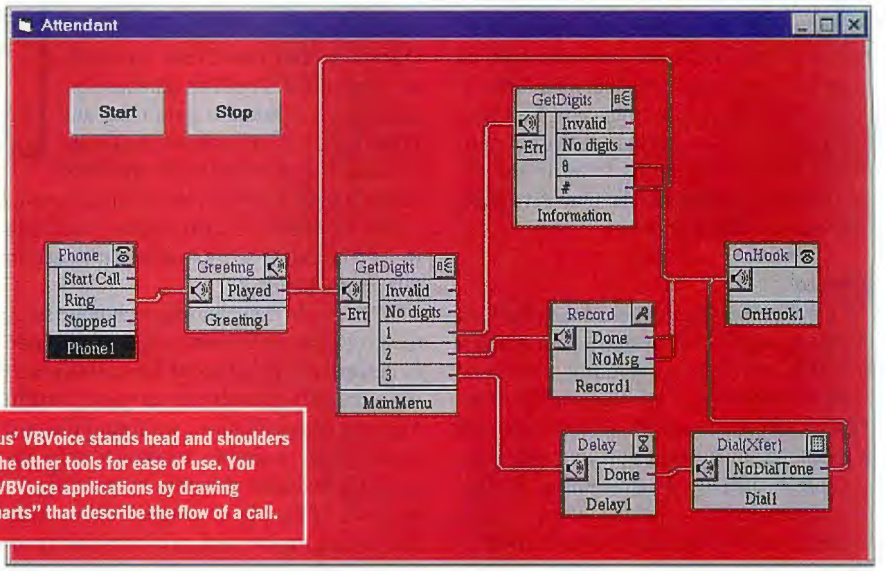
Visual Toolkits for Audio Apps

If you need to build an interactive voice-response system, these programs will answer the call

BRETT GLASS

When you make a phone call, you're more likely to get an interactive voice-response (IVR) system than a human being. Ever wonder who's designing these systems, and what tools they're using?

You may find the answers here. In this review, we compare the latest telephony components for visual programming environments such as Microsoft's Visual Basic and Borland's Delphi. Because these custom controls work in programming environments that are already a snap to use, you can crank out a voice-response system in a matter of hours, rather than weeks.



Pronexus' VBVoice stands head and shoulders above the other tools for ease of use. You create VBVoice applications by drawing "flowcharts" that describe the flow of a call.

All the tools in this survey let you create applications that answer incoming calls, make outgoing calls, receive and transmit touch tones, and play and record messages. But beyond this point, features vary greatly. If you want caller ID capability, seamless incoming and outgoing fax, a "flowchart" design interface, or other special features, look carefully at the descriptions that follow to make sure you pick the right tool for the job.

None of these products imposes any practical limit on the complexity of the IVR systems you can design. Using any of these components, you will be able to easily create a system that keeps callers informed or entertained for hours without ever connecting them to a human being. Of course, getting lost in a twisty maze of recorded messages is probably not every caller's idea of a good time.

Some Fiddling Required

We tested each set of tools with the hardware and operating system recommended by the manufacturer. All but Pronexus recommended cards made by Dialogic, while Pronexus recommended a card made by Rhetorex. (The Rhetorex hardware came with a programmer's toolkit, but it did not contain any visual components.) We used Visual Basic 4.0, running under NT, for all the components except for VBVoice and VoiceBocx, for which we used VB 3.0 running under Windows 95.

Ironically, the most difficult task was getting the hardware working. Both brands of telephony boards were unnecessarily difficult to install. The default IRQ for the Dialogic card is IRQ 3, which is reserved for the serial port (usually attached to a serial mouse) in virtually every machine.

Additionally, the Rhetorex and Dialogic boards use shared memory, a technique that—at least on the ISA bus—can consume a whopping 128 KB of valuable address space in the critical upper-memory area. This may deprive the system of valuable upper-memory blocks needed by Windows, DOS TSRs, or built-in ROMs on adapter cards. It may also cause conflicts with memory managers that can't always detect and avoid the shared RAM.

Some of the driver software uses software interrupt vectors in the range 60H–7FH as an entry point. Many software products and some VGA boards also use these vectors, a conflict that can create compatibility problems. Microsoft's Plug and Play (PnP) for Windows 95 might solve these problems, but none of the cards we tried has built-in PnP support. In the meantime, expect

Whither TAPI?

All the tool vendors covered in this roundup pledged support of Microsoft's TAPI, a telephony API for Windows. Interestingly, none of the packages we tested actually use it, though some are available in special TAPI versions. Instead, these programs use proprietary drivers to interface to the hardware.

There are pluses and minuses to this scheme. On the plus side, vendors can provide added value within their drivers. On the minus side, you can't use a telephony board that the vendor doesn't support. (Fortunately, most vendors support all the major brands.)

Ultimately, we expect TAPI will be available for every telephony board. But because it tends to make hardware look "generic," we expect the telephony industry to accept TAPI only grudgingly and to continue favoring approaches that allow greater product differentiation. For now, as long as vendors of VBXes and OCXes handle a wide range of hardware directly, there's no need to make TAPI support a prerequisite when you're looking for digital telephony tools.

TECHNOLOGY FOCUS

to fiddle with your system—perhaps for several hours—before getting a telephony board to work.

Once the boards were installed and the drivers loaded, we set to work creating a simple answering-machine program—one that just answers the phone and plays a message. We then built a more advanced program that also accepts messages. In all but one case, this took between half an hour and one hour, and we were able to "crib" code from examples supplied with the products. One product, however, surprised us by allowing us to build the answer-only machine in less than five minutes (more on this shortly).

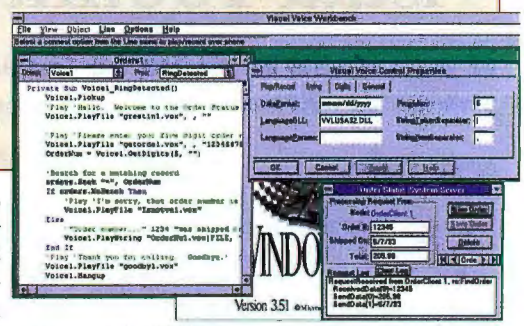
VBVoice

All the tools we survey here are capable of creating simple IVR systems, but when it comes to ease of programming, there's no contest: Pronexus' VBVoice stands alone. This product's compelling visual approach is to telephony system design what Visual Basic itself is to programming. Unlike the other products in this review, which require extensive coding in Visual Basic or C++, VBVoice lets you create your call-processing system visually. All you must do is string the unique VBVoice controls together (using "rubber band" lines) into a flowchart that dictates the progress of a call. As the call "enters" and "exits" controls on the flowchart, the voice card plays announcements to the user. Transitions within the flowchart can also trigger Visual Basic events, allowing your code to interact with the call.

VBVoice comes with a collection of controls so extensive that your VB palette will explode with a daunting array of new, unfamiliar tools. But once you've explored these, you'll be pleased with what you find. Some of the more interesting items include: A Language control, which changes the language used to handle the call; a Get-Digits control, which gets touch tones; DataFind, DataGet, and DataNew controls, which use VB's built-in database engine to manipulate a database; and PlayMsgs, which implements a complete tone-controlled voice mailbox. There's even a control that you can use to create conference calls among multiple lines (though it works only with certain telephony boards).

Visual Voice Pro

Stylus Innovation's Visual Voice Pro has the best documentation and gives you the most examples of the lot, along with a code generator to ease programming.



VBVoice's flowcharting technique frees the programmer from having to write code to control the progress of the call (though it's certainly possible to do so). Within minutes of installation, we found that we could create a simple announce-only answering-machine program by creating an instance of the phone control, connecting it to a hang-up control, and associating an announcement with the hang-up control. This first application took us only about five minutes to create, even though we were unfamiliar with the product.

A sophisticated telephony application may require a large, complex flowchart. So, to keep the form from becoming cluttered with hard-to-follow crisscrossing lines, VBVoice lets you create named connections. Instead of being shown as lines that run all the way from one control to another, these connections appear as arrows with text labels. (As in an electronic schematic diagram, two arrows with the same label are considered to be connected.) There's also a control called InConn that lets parts of your flowchart occupy different VB forms. Incoming and outgoing fax capability aren't included in the package but are available in another package called VBFax. The two products will integrate smoothly; faxes can be sent or received during a call initiated in VBVoice.

Like VoySys' VoysAccess software (described later), VBVoice lets you record messages with a PC sound card as well as with the telephony card itself. This is a useful feature, since most cards, designed for the narrow 3000-Hz bandwidth of a telephone line, record sound with much lower fidelity than good sound cards do.

The VBVoice manual contains a complete reference to the package's VB controls. Unfortunately, it doesn't provide a complete, printed tutorial, so new users may need to explore the examples on the disk to learn the tricks of using this rich environment.

The 16-bit (VBX) version of VBVoice contains drivers for several brands of telephony cards, including Dialogic, Pika, and Rhetorex. The 32-bit (OCX) version, which was in beta at the time we looked at it, will use Microsoft's telephony API (TAPI), and so it should work with any TAPI-capable card when it ships. The OCX version adds some new features, such as an outline view (useful for large applications) and OLE support.

VoysAccess

VoySys' VoysAccess is a more traditional visual component that works with Dialogic telephony boards. VoysAccess encapsulates a programmer's library that allows you to control an IVR session by manipulating the properties and methods of a single custom control. This means that you'll have to write code in Visual Basic or C++ to control the flow of a call.

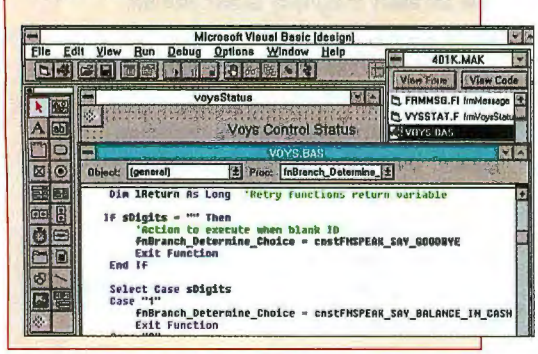
Along with the mundane functions you expect from a telephony toolbox—dialing calls, playing messages, responding to tones, etc.—VoysAccess supports caller ID on incoming calls and automatic "flash hook" call transfers (the way you transfer calls on most PBXes). However, we could find no evidence of fax capability.

VoysAccess comes bundled with VoysSmith, a waveform editor that lets you record, play, and modify waveform files via a sound card. Once you've captured a sound, you can add special effects or overlay other sound files to produce interesting announcements and sounds. The only catch: It won't work without a sound card; you can't use it to record or play messages directly through the telephony board.

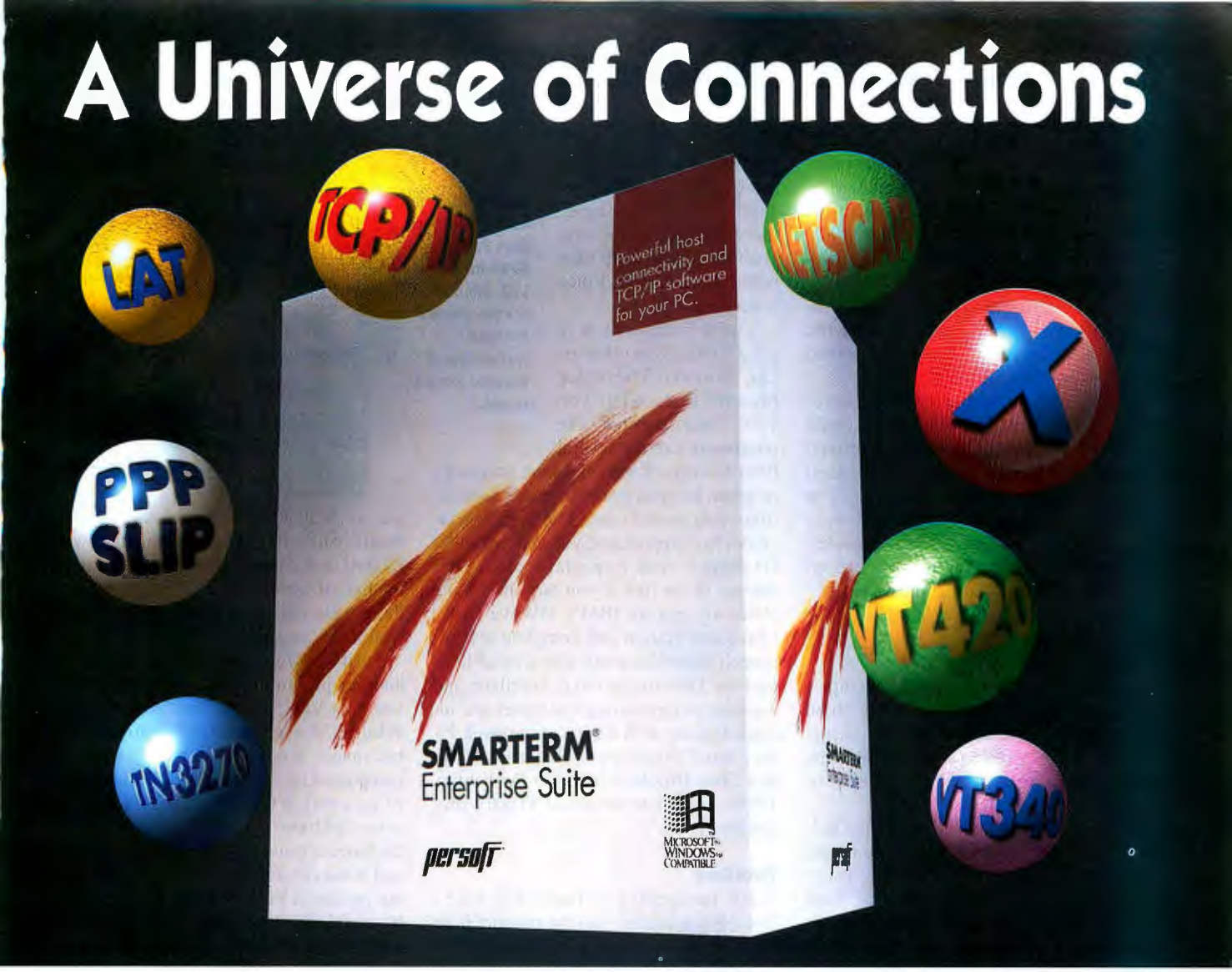
The new OCX version of VoysAccess is

VoysAccess

VoySys' VoysAccess is a single custom control that lets you control the flow of a call programmatically.



A Universe of Connections



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much easier to understand than the older VBX version, with intuitively named methods and properties. (Because of shortcomings in the design of VBXes, the older VBX version of VoysAccess had to use "action properties" to trigger actions.) While the OCX control maintains downward compatibility with programs written for the VBX, it now lets you use mnemonic method names to perform call-handling tasks.

The manual we received with VoysAccess was an incomplete draft, so we could not judge the quality of the final printed documentation. The beta disk contained only one sample application; there could be more in the finished product. Nonetheless, we were able to create a simple answering-machine application in about half an hour by modifying the sample code.

Visual Voice Pro

Stylus Innovation's Visual Voice Pro is a mixed bag: It combines the best examples and documentation of the bunch with an awkward programming interface. Visual Voice, like VoysAccess, is a single custom control that encapsulates a library of telephony routines.

We tested both the VBX and the OCX versions of this control, which are nearly identical. Both use action properties to control the handling of the call. This is not nearly as efficient as flowcharting or method-based programming and requires you to include and remember many cryptic definitions for constants.

To ameliorate this shortcoming, the Visual Voice package comes with a code-generating tool called Voice Workbench that lets you script your application in user-friendly dialogues. Voice Workbench then uses the script to write Visual Basic code that you can paste into your application. This takes some of the tedium out of using action properties. However, unless your application falls within the bounds of what Voice Workbench can do automatically, you'll still need to dictate the overall "flow" of the application by massaging the generated code, and you may need to learn what many of the Visual Voice action constants do.

Visual Voice does have great strengths in other areas, however. The Voice Monitor feature lets you view and control the progress of calls on several lines at once. A virtual phone accessory program lets you test your entire application via a sound card. The package includes fax support, and you can add caller ID support with a special toolkit. (It's thrown in for free if you buy the Visual Voice version for IBM's MWave DSP.) Voice-recognition and complete text-to-speech capabilities are also available as options. Documentation is excellent, and copious programming examples are included, along with a copy of the book *Visual Basic Telephony* by Krisztina Holly and Chris Brookins (Flatiron Publishing, 1995). A separate version of Visual Voice handles TAPI.

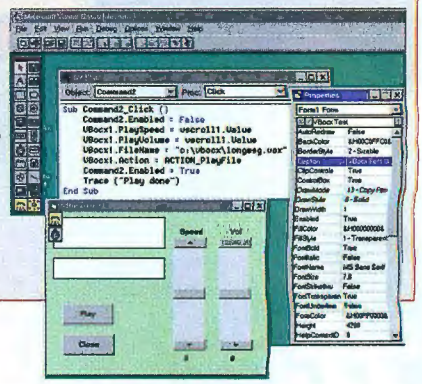
VoiceBocx

While the spelling of Parity Software's VoiceBocx implies that the product is an OCX, it is, in fact, a VBX. Like Visual Voice Pro, VoiceBocx provides conventional properties and action properties that let your application control a telephony board. Another included VBX from Parity Software, called VoiceHub Tool, acts like Visual Voice Pro's Voice Monitor.

Because you operate the control by setting action properties, this VBX is, again, more difficult to work with than an OCX with methods or VBVoice's flowcharting interface. And of the visual controls described here, VoiceBocx is the most Spartan one. We found no fax capability, nor was it clear whether the package could handle caller ID. The documentation was limited to one small, though well-written, manual of approximately 250 pages, and there were only four small sample applications on the disk.

VoiceBocx

Despite its name, VoiceBocx from Parity Software is a VBX, not an OCX. It's the simplest but least feature-rich of the products we tested.



Parity Software has put its heart into another product—Voice Operating System 5, or VOS5—which we also received. While it doesn't qualify for this review because it's not a visual programming component (it's actually a C-like language of its own), VOS5 is quite powerful. It comes with two excellent books describing the language and PC telephony in general, and it has capabilities, such as fax, that are not present in VoiceBocx. VoiceBocx may be useful as a very small, simple VBX for telephony applications, but VOS5 is clearly the more powerful product.

Enter Your Selection

Of the products we worked with for this review, Pronexus' VBVoice stands head and shoulders above the rest when it comes to productivity and ease of use. VoySys' VoysAccess has shown substantial improvements in the latest (32-bit) version, moving away from action properties to embrace a simpler, method-oriented programming model. Stylus Innovation's Visual Voice Pro uses action properties but provides the best documentation, the most examples, and the widest variety of add-on features. Parity Software's VoiceBocx is the smallest and simplest component, but it may require the most effort to use. Parity's VOS5 product is a much more powerful and robust programming environment, and it's worth a close look if you're willing to use a proprietary language to develop IVR applications. ■

Brett Glass is a computer consultant, writer, and teacher who lives in Laramie, Wyoming. You can reach him by sending E-mail to rogue@well.com.

Product Information

VBVoice
VBX, 1 line $395
VBX, 2 lines $695
VBX, 4 lines $995
VBX, 8 lines $1295
OCX, 4 lines $795
OCX, 24 lines . . .$1995
OCX, 64 lines . . .$2995
Pronexus
Carp, Ontario, Canada
(613) 389-0033
fax: (613) 839-0035
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Visual Voice
2 lines $495
4 lines $995
12 lines $1895
24 lines $2995
Stylus Innovation
Cambridge, MA
(617) 621-9545
fax: (617) 621-7862
http://www.stylus.com
Circle 1162 on Inquiry Card.

VoiceBocx
Software only, two lines $595
Software and hardware, two lines $1185
Parity Software
Sausalito, CA
(415) 332-5656
fax: (415) 332-5657
Circle 1163 on Inquiry Card.

VoysAccess
VBX software only $595
Hardware and software, SDK $995
VoySys Corp.
Fremont, CA
(800) 786-9797
(510) 252-1100
fax: (510) 252-1101
Circle 1161 on Inquiry Card.

One Gig to Go

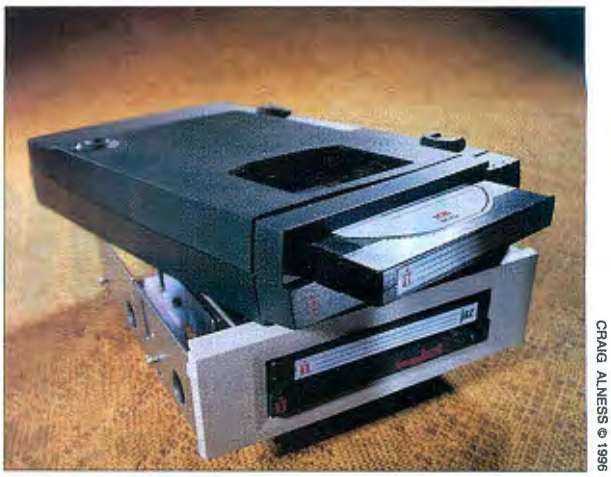
Iomega's Jaz drive provides 1 GB of fast, removable media storage

G. ARMOUR VAN HORN

Iomega's Jaz may be the ultimate floppy drive. The $499 internal version fits into a 1-inch-high, 3½-inch drive bay, and its data cartridges are roughly the size of four stacked floppy disks—but each cartridge holds just over a gigabyte of data. And where floppies are tediously slow, Jaz is faster than many hard drives. It has a rated 12-millisecond seek time, and we measured an average sustained transfer rate of 4.9 MBps during reads. We also measured the drive's sustained uninterrupted transfer rate at 3.3 MBps, which is fast enough for reading most audio/video data and cutting CD-ROMs.

Jaz uses a hard drive cartridge à la SyQuest (see the Technology Focus box below). However, Jaz cartridges are the first to use two platters. Iomega expects cartridge prices to range between $100 and $125, depending on quantity. A 540-MB cartridge should go for around $69. The stackable, plastic-cased external Jaz (which costs around $599) resembles Iomega's Zip drive and provides automatic SCSI termination. Both Jaz models have motorized cartridge ejection and a fast SCSI-2 interface.

We tested the internal model, just before the release of the hardware, with beta software. We installed it on two PCs running Windows 95. We encountered an unusual compatibility problem between the Windows 95 driver for the Adaptec 2930 PCI SCSI controller card bundled with the drive and the Award BIOS in one system (ASUS motherboard). It locked up Windows 95. The card and drive worked with an Adaptec driver already on the system, but we couldn't install Iomega's utility software without also installing the problem driver. Although Iomega's Mac software wasn't ready, we also got Jaz working nicely in an external SCSI enclosure connected to a Macintosh Quadra 700 by using Silver Linings 5.33, a hard drive utility.



CRAIG ALNESS © 1996

Two versions of Jaz: the external drive (top), and the internal version we tested. Both are SCSI drives, accept the same 540-MB and 1-GB data cartridges, and provide the same fast hard drive–level performance.

Jaz is strong on data security. Not only can you remove and lock up cartridges, you can also read- and write-protect them under password control using a provided utility. Another Jaz utility controls the drive's sleep mode. As a default, it spins down after 30 minutes of inactivity. The utilities install seamlessly into the Windows 95 interface; they show up in the menu that appears when you right-click on the Jaz drive icon.

The included data cartridge comes mostly loaded with Iomega software tools (for PCs and Macs), so your minimum investment will be $625 for an internal drive and a blank cartridge. That's between the street prices for 1- and 2-GB hard drive kits, but it's competitive for a removable-media drive. The Jaz drive's capacity and speed recommend it as a transport medium for large projects, as a mastering disk for CD-ROM production, as secure storage for sensitive data, and as an interesting approach to adding a second hard drive. ■

G. Armour Van Horn is a production artist, graphics consultant, and writer on electronic imaging and prepress issues. His studio is on Whidbey Island, Washington. You can reach him on the Internet or BIX at vanhorn @bix.com.

TECHNOLOGY FOCUS

Dust Buster

Hard disk technology is fast, but making it removable introduces the problem of media contamination. Dust in a Jaz or SyQuest cartridge can cause data errors or worse.

Iomega uses several steps to control contamination. First is avoiding most of it by sealing the cartridge. A hermetic seal (like that on a hard drive) isn't possible with a removable cartridge because the drive's read/write heads must get in and out. Jaz cartridges have a flexible metal gate that slides tightly in its channel and opens only after the cartridge is fully inserted.

To control the dust that does make it inside, the Jaz design uses air flow (from spinning at 5400 rpm), baffles, and filters to move contaminants from clean zones and trap them in "not-so-clean" zones. The heads also track across the data area when the disk first comes up to speed—for calibration, but also to plow dust from the medium and into the airstream for filtering.

Finally, the Jaz data format includes 24 bytes of error-correction code (ECC) at the end of each 512-byte block of data. That's less than the 52 bytes Iomega uses in its Bernoulli flexible-media products, but over twice as much as typical hard disks have been using.

Product Information

Jaz. . . . . $499 internal; $599 external (estimated street prices) (includes 1-GB Tools cartridge and Adaptec 2930 PCI SCSI card)
Iomega Corp.
Roy, UT
(800) 697-8833
(801) 778-1000
http://www.iomega.com
Circle 1169 on Inquiry Card.

Now there's an authoritativ of informatio

Data Communications
OpenView ADVISOR
The Independent Newsletter for Openview Users and Developers

FEBRUARY 1995
VOLUME 1, NO.1

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HP's Meta Schema: Blueprint for a Common Repository

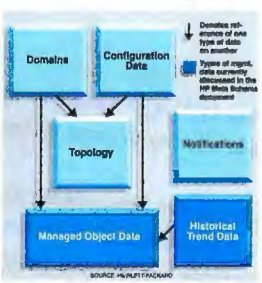
By James Herman, vice president, Northeast Consulting Resources Inc.

COVER STORY

The term common repositor is sure e of most elusive in net management today. Ev rent notion of what it means should be designed. For example repository should contain everythi event ever received by the managemen pository as essentially containing conf Hewlett-Packard's partial Meta Schema bluep in Openview gives a first glimpse at HP's proposal for solutio It also points to the vast amount of work left to be done before a working repository can become a reality.

PREMIERES FEBRUARY 1995

To understand HP's initial attempt at defining an Openview common repository requires a closer look at the need it addresses. For the past several years, Openview has provided all the basic functions required of a management platform—management protocol support via SNMP, communications protocols, and application programming interfaces for developers. But the platform has lacked open services for the integration of management data from multiple applications. Under the covers, Openview applications don't share data. Instead, network inventory, event logs, trouble tickets, and other



other sources of management data reside in separate files and system locations, many times in different formats.

For customers, this lack of integration results in having to maintain several management data files, a task that can quickly become a juggling act when it comes to keeping data files in sync. If the same data item appears in multiple locations, it must be updated repeatedly. Multiple data sources make report writing difficult and limit the scope of customization.

Openview's lack of data integration also has drawbacks for developers, who must invest significant R&D dollars in getting their applications to work with those of other vendors—for example, to tie maintenance trouble tickets to specific devices in the network inventory.

Moving to a common repository would provide users with the database functions required to enter data into the system just once and have it reflected across multiple applications. Report writing could be easily customized.

(Continued on page 16)

independent, objective source about OpenView

Introducing the OpenView Advisor— from the editors of Data Communications

Corporate networkers who've made the move to OpenView know how tough it is to find the facts on the industry's leading net management framework. And the same goes for third-party developers looking to crack this lucrative market. Despite all its support, HP hardly qualifies as an impartial source, and surfing the Internet or searching computer magazines is no way to plan an effective enterprise management strategy.

The industry's only publication devoted exclusively to OpenView

OpenView Advisor gives users and developers exactly what they need: a monthly, vendor-independent newsletter that's got the technical savvy to solve their most pressing problems. Written and edited by the staff of DATA COMMUNICATIONS and some of the top consultants in the OpenView community, each issue is packed with in-depth analyses and hard-hitting technology reviews that can't be found anywhere else.

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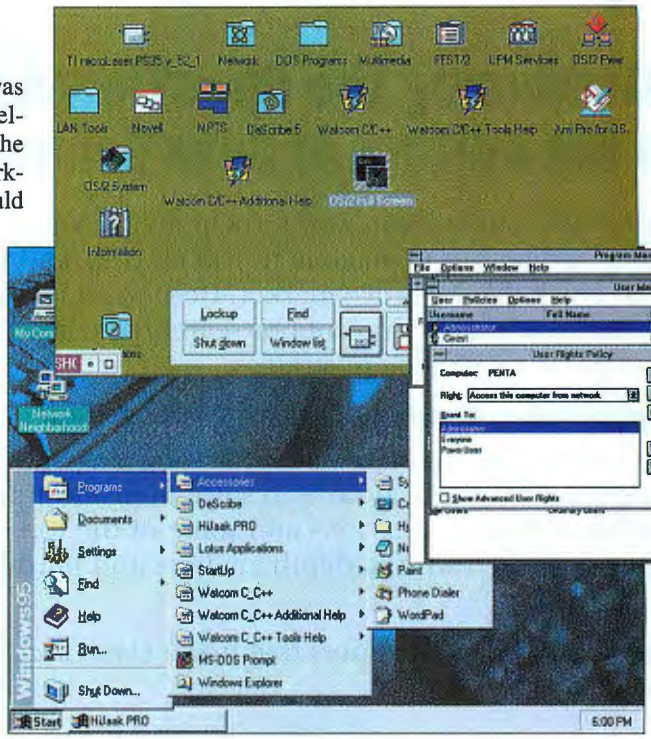
Data Communications

T50101

Big Decision: Warp vs. Windows

Which 32-bit operating system is right for you—OS/2, or one of the new flavors of windows?

TADESSE W. GIORGIS



◀ **The OS/2 Workplace Shell presents a clean desktop that users can customize for their own needs.**

This Windows NT screen shows some of the system-administration capabilities and functions of this heavy-duty OS. ▼

◀ **In Windows 95, a multilevel tree-structured menu lets you access and launch a multitude of programs or documents in a compact space.**

Until recently, IBM's OS/2 was the major 32-bit OS for Intel-based personal computers. The debut of Microsoft's Windows NT Workstation 3.1 almost three years ago should have posed some competition, but few users considered Windows NT a mainstream desktop OS. Only with version 3.51 has Windows NT Workstation finally become a serious threat in high-demand business applications.

In fact, it wasn't until the introduction of Windows 95 that many IS managers had to confront the decision of whether they should upgrade to a 32-bit OS. Because most new PCs come with Windows 95 preinstalled, the upgrade question is unavoidable. Should organizations with large numbers of 386 and 486 systems now running Windows 3.1x or OS/2 2.1x stay put, upgrade, or switch OSes?

And which of these three major 32-bit desktop OSes is best suited to everyday business applications? These are complex questions, and most users realize there are no simple, clear-cut answers. Generally speaking, both OS/2 Warp and Windows NT Workstation provide robust applications development platforms. However, both require more CPU horsepower, memory, and disk space than Windows 95, which may be the best choice for the largest number of users.

OS/2 Warp Connect 3.0

Although it's been around longer than Windows, OS/2 has carved out only a tiny market share compared to the Microsoft products, never achieving the acceptance that IBM (and many users) believe it deserves. The newest release of OS/2 Warp Connect is a solid contender in many areas.

OS/2 lets the user install just the base OS; the dual boot manager, which boots either DOS or OS/2; or the Boot Manager, which requires repartitioning the drive and designating the partitions as installable, bootable, or startable. IBM includes good documentation for installing OS/2, but the installation should be done by an experienced user if the system must be customized.

OS/2's object-oriented interface, the Workplace Shell, more closely resembles the Apple Macintosh interface than Windows NT's menu-oriented interface. The right mouse button activates a menu of settings and parameters for whatever icon, folder, or desktop area the mouse points to. There's great flexibility in setting up the desktop and customizing folder management, and users can arrange folders and other icon elements according to numerous characteristics. OS/2 also offers great context-sensitive help.

Connectivity and networkability are two crucial considerations. IBM has greatly improved the installation and setup for network interface cards (NICs), making it easier to select protocols and bind them to the installed adapter, but the process has some flaws. OS/2 automatically detects and configures most well-known NICs but is less effective for others.

In additon, the program may or may not

32-BIT OSES: HOW THEY COMPARE

NSTL RATING		VERSION	PERFORMANCE	VERSATILITY	EASE OF LEARNING	EASE OF USE	SYSTEM MAINTENANCE AND ERROR HANDLING	PRICE
★★★★	Windows NT Workstation	3.51	▲	▲	▲	▲	▲	$319
★★★★	Windows 95	4.0	▲	■	▲	▲	▲	$209
★★★	OS/2 Warp Connect	3.0	■	■	▲	▲	▲	$299

KEY

★★★★★	Outstanding
★★★★	Excellent
★★★	Average
★★	Below average
★	Poor
▲	Good
■	Fair
▼	Unacceptable

obtain media access control (MAC)–layer address information for user-added NICs. When it doesn't—and it won't for some older cards—the user has to manually edit the adapter parameter and enter the network address. And even when it does detect the NIC's 12-digit network address, it doesn't identify the network topology correctly but defaults instead to token ring. The user has to manually check and select the correct topology.

NSTL encountered several problems because this error isn't reported during the Multi-Protocol Transport Services (MPTS) installation and configuration. The system sometimes hangs when the adapter driver fails to load and the OS tries to bind the selected protocol to the missing driver. Removing the NIC doesn't fix the situation; you have to manually edit the CONFIG .SYS and PROTOCOL.INI files.

Once you're finally connected, OS/2 interfaces well with the Novell NetWare utility for OS/2, and users can map drives and make printer connections easily. IBM's LAN Distance Remote on OS/2 Warp enables mobile users and remote PCs to access corporate LANs. The OS/2 Warp Connect BonusPak, a collection of programs and utilities that IBM includes with the OS, contains Internet connection services as well as a World Wide Web browser.

Many power users think OS/2 is the most robust and strongest of the 32-bit contenders, but its minuscule market share continues to dog the product. Device drivers are a case in point. Earlier versions of OS/2 suffered from a lack of them. Today thousands of PCs will support OS/2, and a large number of peripherals vendors provide OS/2 device drivers. In fact, OS/2 ships with more printer drivers than either Windows version—but for all other peripherals, Windows has the edge.

OS/2 still provides the best DOS environment. It runs DOS faster than Windows, offers more versatility, and is easier to use. Each DOS session can have a separate memory space, and all are fully multitasked. Although DOS-exclusive environments are rare today, they can gain advantages and operating efficiency from upgrading to OS/2, which gives users a graphical interface, extends memory, and runs multiple DOS sessions concurrently.

OS/2 would likely shine in environments with a strong existing IBM presence and connections to midrange and mainframe systems—insurance companies, banks, and other financial-service companies, for example. The product's superior link capability to the Internet should encourage users planning to upgrade from earlier versions of OS/2, and even some DOS and Windows 3.1 shops. This OS also has technical merits that make it appealing to users that demand a powerful OS, such as software developers and technical workstation users.

32-BIT DESKTOP OS HARDWARE REQUIREMENTS

	OS/2 WARP	WINDOWS 95	WINDOWS NT
Minimum RAM (MB)	8	4	12
Recommended RAM (MB)	12	8	16
Minimum hard disk space (MB)	90	30	80
Full-installation hard disk space (MB)	150	55	100
Minimum processor (x86 series)	386/25	386/25	386/25
Recommended processor (x86 series)	486DX	386DX	386DX

Windows NT Workstation 3.51

This is Microsoft's most powerful OS, and many observers believe that Windows 95 is just a temporary way station on the road to widespread adoption of Windows NT. Certainly NT seems ready to take on all comers. You can now run Windows NT Workstation on symmetric multiprocessing

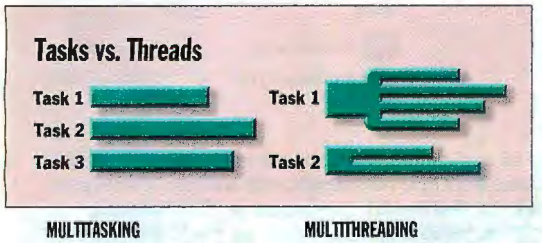
Multitasking and Multithreading

The most significant job an OS does is to manage memory efficiently and control how applications use system resources. An OS that does memory management and task scheduling permits both context switching and multitasking. *Context switching* suspends activity when one operation is pushed to the background and another is brought to the foreground; only the application in the foreground window remains active. Context switching is sufficient for many work environments and provides dramatic productivity gains over the exiting and loading of different applications in single-tasking environments.

***Multitasking*, on the other hand, runs multiple operations concurrently. It makes sense mainly in multiuser environments. Its benefits become really noticeable with long and complex tasks, such as heavy database queries, program compilation, and complex graphics processing.**

Even though all three OSes use preemptive multitasking for 32-bit applications, only OS/2 Warp and Windows NT Workstation use it for older, 16-bit applications. Windows 95 uses cooperative multitasking for 16-bit DOS and Windows applications.

For preemptive multitasking to operate effectively requires a task-scheduling scheme, where the scheduler selectively dispatches and suspends multiple concurrent tasks. Cooperative multitasking relies on applications to relinquish control of the processor so that other applications get a turn. This means the applications are in control, not the OS.



MULTITTASKING
Multiple tasks can execute in parallel, but each task is a single execution stream.

MULTITTHREADING
Each task is broken out into separate processes that execute in parallel, along with processes from other tasks.

The *multithreading* capability of today's 32-bit OSes provides more power than simple multitasking does. The OS can execute multiple tasks simultaneously, and it can run multiple processes concurrently. The kernel breaks down tasks into singular processes and runs each process as a single thread. Interprocess communications (IPC) allows the different threads to talk with each other by passing data back and forth.

The real advantage of multithreading is that it makes it much easier to do multitasking. Multithreading allows programs to multitask within themselves. Applications that can benefit considerably from multithreading include background pagination and formatting, spell-checking, complex database searches, document control, and dual-channel communications.

TECHNOLOGY FOCUS

(SMP) systems, as well as on systems that are based on a wide variety of processors besides the Intel x86 family, including Digital Equipment's Alpha, Mips, and PowerPC systems.

Windows NT Workstation has unique usability strengths that benefit the advanced user and network administrator more than the casual user. In addition to the familiar Windows 3.1x desktop tools—File Manager, Print Manager, Accessories, and Control Panel—the Administrative Tools group provides access to User Manager, Disk Administrator, Performance Monitor, and Event Viewer, all functions that simplify system administration. Control Panel also offers a facility for network adapter configuration and client setup.

Windows NT automatically detects and configures a goodly number of network cards; for those it doesn't detect, the user must manually select and configure the card. Overall, NT presented fewer problems for NSTL than did OS/2.

All network drives and NetWare printers are accessible, respectively, from the File Manager and Print Manager. Microsoft's Remote Access Service provides remote access to LANs and secure, high-speed connection services with user-selectable transport protocols. Windows NT Workstation includes a TCP/IP stack, ftp, and telnet service, but it doesn't currently come with a Web browser.

Windows NT offers good information, and the user's manual is helpful and easy to read. However, users may have difficulty getting information they need via on-line help. Finding the correct information often requires being in the right window or program. Microsoft has vowed to offer a common user interface, and in fact the Windows 95 user interface is now available as a service pack for current owners of Windows NT.

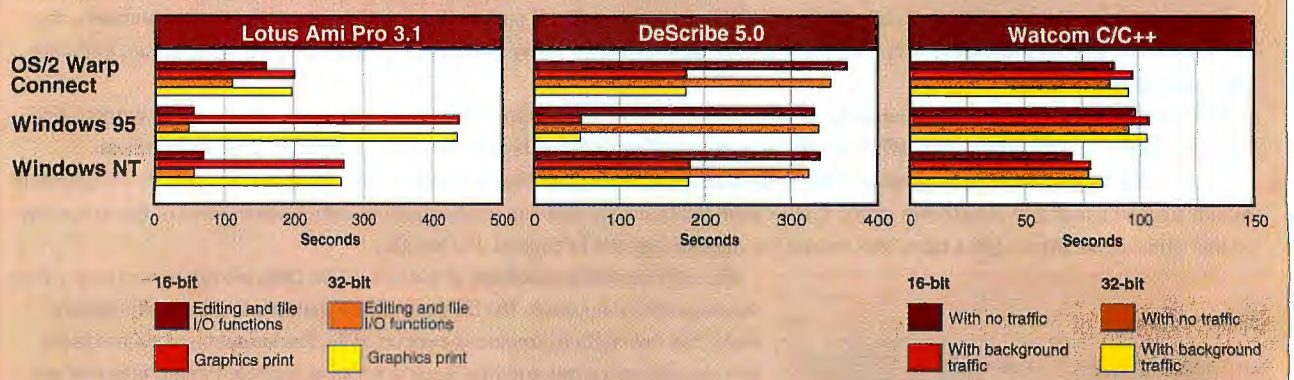
Windows NT's manuals are generally the best of the three products at presenting information in a visually appealing man-

OS CAPABILITIES AND FEATURES

	OS/2 WARP CONNECT	WINDOWS NT	WINDOWS 95
Processing Capabilities			
Preemptive multitasking	●	●	○
Multithreading capability	●	●	○
Allows coexistence of multiple OSes	●	●	●
Supports symmetric multiprocessing	○	●	○
Application and System Integrity			
Uses protected-mode operation	●	●	○
Runs multiple environment applications	●	●	○
Supports DDE, OLE	OS1	●	●
16-bit DOS and Windows Sessions			
Can run multiple DOS sessions	●	●	●
Can run multiple 16-bit Windows applications	●	●	●
16-bit DOS and Windows applications run in separate address spaces	●	●	○
DOS session can run in background	●	●	●
File and Disk Management			
Automatically detects and uses SCSI and IDE drives	●	●	●
Graphical file manager	●	●	●
Disk defragmenting, compression utilities	○	●	●
Disk mirroring, striping utilities	○	●	○
Reads from and writes to multiple file systems	●	●	○

● = yes, ○ = no; OS1 = through Windows or WIN-OS2 module.

NSTL 32-bit Desktop OS Performance Test Results



NSTL tested each OS with three different applications on a Compaq Deskpro 66M and a Dell XPS P75, each with 16 MB and then 32 MB of memory. Times shown are the average for both machines. NSTL looked for 32-bit applications that run on all three OSes—finding only the DeScribe 5.0 word processor from DeScribe (Naples, FL) and the Watcom C/C++ 10.5 Compiler from the Watcom Products Division of PowerSoft (Waterloo, Ontario, Canada). The OS/2 Warp native-code counterpart to Lotus's SmartSuite 96 for Windows 95 was not ready at test time.

In testing 16-bit applications, some anomalies appeared. Lotus's Ami Pro 3.1 (now called Word Pro) runs significantly faster on Windows 95 and NT than the Lotus Ami Pro 2.1 counterpart on OS/2. But OS/2 was twice as fast as Windows 95 in the graphics printing test. With 32-bit applications, we got different results. In the Watcom C/C++ compiler test, Windows NT and OS/2 show a significant performance advantage over Windows 95. However, Windows 95 printed the DeScribe graphics more than three times faster than either NT or OS/2.

ner, with clear, step-by-step instructions. Unfortunately, the pretty documentation is weak in guiding users through the installation process.

Windows NT has better facilities for system administration than either OS/2 or Windows 95. Windows NT is a good choice for environments with stringent data integrity, security, and fail-safe requirements. It not only provides a secure and robust environment but also scales well across different single- and multiple-processor platforms. Its extensive feature set and system-administration tools, combined with a GUI ease of use, make it an attractive choice for client/server applications.

Windows 95

After years of announcements, previews, reworking, and the industry's largest beta-test program, Microsoft finally gave birth to Windows 95 last summer. Although its market penetration may be far less than what was originally predicted for this time, this is the OS that most users will be dealing with in the near future.

Windows 95 provides the easiest-to-use system interface, a simplified installation and system-setup procedure, and a good set of learning tools. It has by far the best network adapter detection and installation and configuration capabilities. Other peripherals' setup and configuration are just as simple.

It's less impressive in the areas of disk drive preparation and management and overall system maintenance and administration. But because Microsoft targets Windows 95 to the mainstream user, these drawbacks aren't critical for most operations. Furthermore, Microsoft evidently believes users don't require much guidance; the slim manual for Windows 95 often refers the user to manuals that must be purchased separately, or it forces the user to go to the on-line documentation.

Windows 95 not only detects and configures Plug and Play network cards easily, it also detects most other network cards, with user-supplied configuration adjustment and modification. The Network Neighborhood icon on Windows 95 also provides easy connection to NetWare servers, and mapping drives is easy, although we still prefer the NetWare utility that was available with Windows for Workgroups 3.11. As with NT, Windows 95 comes with a very long list of drivers for a variety of devices, including printers, IDE and SCSI disk drives, network adapter cards, video adapter cards, sound cards, PC Card devices, and multimedia subsystems.

Windows 95 comes with HyperTerminal, which provides basic dial-out and file transfer functions, as well as links to CompuServe, AT&T Mail, and MCImail. Microsoft Plus, a companion product, adds Dial-Up Networking server capability, so users can dial into their workstations from a remote location and access shared resources (i.e., files and disks) plus the necessary tools for Internet access, including Microsoft's own Web browser, Internet Explorer. There are no advanced security features, such as callback or data encryption, but passwords are encrypted.

Windows 95, with its low resource overhead and compatibility with thousands of existing 16-bit applications, targets the broad user base that doesn't have serious security and integrity requirements. Its superior performance in everyday applications makes it an excellent platform for mainstream business and home use. ■

OS CONNECTIVITY AND CONTROL

	OS/2 WARP CONNECT	WINDOWS NT	WINDOWS 95
Network Systems Supported			
Novell NetWare 3.xx, 4.xx	●	●	●
Any NetBIOS-based network	●	●	●
Peer-to-peer networking	●	●	●
Transport Protocols Supported			
Novell NetWare IPX/SPX, TCP/IP, NetBIOS	●	●	●
LAN Manager/LAN Server NetBEUI	●	●	●
Internet Support			
Web browser	●	○	○
Gopher service	●	○	○
Mail service, telnet, ftp	●	●	●
System Administration			
Event-tracking utility	●	●	Selective
OS allows viewing of the status of services	○	●	○
Data Security			
Workstation log-in ID and password	●	●	●
User and group account management utility	●	●	○
Utility for setting access-privilege levels	●	●	●
Utility for setting user rights and security policies	●	●	○
Access audit-trail utility	●	●	○
Data Backup			
Tape backup utility	○	●	●
Selective backup/restore to multiple file systems	○	●	●
Schedule unattended backup/restore tasks	○	○	●

● = yes, ○ = no.

Product Information

OS/2 Warp Connect 3.0 . . . . . $299
IBM Corp.
Armonk, NY
(800) 426-2255
http://www.ibm.com
Circle 1170 on Inquiry Card.

Windows 95
New installation $209
Upgrade $109
Microsoft Plus $54.95
NT Workstation 3.51 . . . . . $319
Microsoft Corp.
Redmond, WA
(800) 552-9876
(206) 882-8080
fax: (206) 936-7329
http://www.microsoft.com
Circle 1171 on Inquiry Card.

Tadesse W. Giorgis has tested network OSes, management products, and peripherals at NSTL for over five years. He holds a Ph.D. in fiber and polymer science from North Carolina State University. You can reach him on the Internet or BIX at editors@bix.com.

This report contains partial results from a recent issue of Software Digest, *a monthly publication of NSTL, Inc. To purchase a copy of the full 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

13 NOTEBOOKS WITH VIDEO MUSCLE

Strengthen on-the-road video presentations with the persuasive power of multimedia. We test Pentium-based notebooks that will make your presentations bigger than life.

JIM KANE AND JOHN MCDONOUGH

Portable computing's long-standing compromise is all but gone. Today's Pentium-based multimedia notebooks have so much under the lid that they are now virtual offices that can match specifications with many high-end desktop systems. Certainly, the black line that once differentiated a desktop computer from a notebook has turned a smudgy shade of gray.

We discovered this when we tested 13 blazingly fast multimedia notebooks that include such amenities as 1-GB-and-higher hard drives, internal CD-ROM drives, 28.8-Kbps fax/modems, and big active-matrix color LCDs. They are built for maximum performance, cost from $3395 to about $7400, and weigh in at just under 7 pounds to almost 9 pounds.

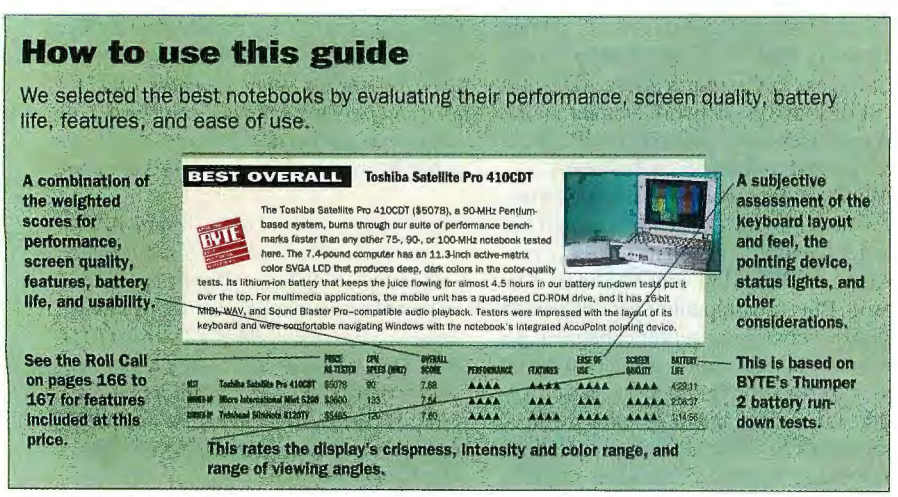
These notebooks use 75- to 133-MHz Pentium CPUs for snappy performance, and the vendors have squeezed in as much functionality as they can (e.g., you can swap CD-ROM and floppy drives). All but one have infrared ports for data transfer. For pointing devices, touchpads and eraserheads are in.

All the notebooks we tested include active-matrix color displays, and half of them have SVGA displays (800- by 600-pixel resolution). The systems have between 10.1 and 12.1 inches of screen real estate. This provides an even wider viewing area at the higher SVGA resolution. Some of the notebooks have 2 MB of video memory and a Peripheral Component Interconnect (PCI) bus or VL-Bus for faster video performance.

Most of the systems include as standard or offer as an option hardware assistance for full-motion (30 frames per second), full-screen video playback. You can plug in external monitors on all the notebooks, and IBM's ThinkPad 760CD and Zenith Data Systems' Z-Note GT have NTSC/PAL cards so that you can wow an audience by attaching a wide-screen TV.

How to use this guide

We selected the best notebooks by evaluating their performance, screen quality, battery life, features, and ease of use.



Compact and Powerful

LCD
An active-matrix color display is necessary for a sharp multimedia presentation. About half of the notebooks we tested have SVGA (800 by 600 pixels) displays, which have higher resolutions than typical notebook VGA (640 by 480 pixels) screens. Zenith and IBM claim that you can view 53 percent more information on an SVGA display when compared to standard VGA.

POINTING DEVICE
This is the first Lab Report on portable systems where there are no trackballs. The two pointing devices currently in vogue are eraserheads (e.g., on the IBM ThinkPad) and touchpads (as shown). It comes down to your personal preference when choosing a pointing device.

NTSC/PAL VIDEO OUT
The more expensive systems like IBM's ThinkPad 760CD and Zenith's Z-Note GT offer NTSC/PAL video-out support for connecting your system to a TV for large group presentations. The other systems support external monitors.

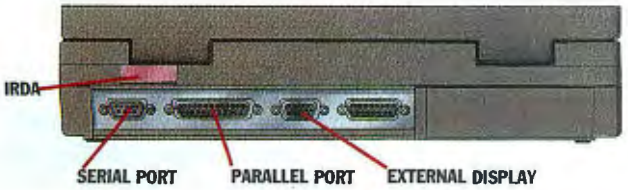
BATTERY
Notebooks with lithium-ion batteries generally outlast nickel-metal-hydride (NiMH) batteries, but they both provide more working time than the nicad batteries formerly used. Some models support an extra battery pack for those cross-country plane trips.

AUDIO/VIDEO PORTS
The notebooks have 16-bit audio with built-in speakers, so you can listen to your favorite CD or jazz up a sales presentation.

REMOVABLE HARD DRIVE
Of the 13 notebooks, 11 support hard drives with 1 GB or higher that can be removed for portability. Get ready: It will soon be commonplace for all notebooks to have 1-GB hard drives.

CD-ROM DRIVE
All the multimedia notebooks that we tested have an internal CD-ROM drive, and it pays to get a quad-speed drive rather than a dual-speed drive for multimedia applications.

Rear View



APRIL 1996 BYTE BEST MULTIMEDIA NOTEBOOKS

BEST

BEST OVERALL

Toshiba Satellite Pro 410CDT

The 90-MHz Toshiba Satellite Pro 410CDT ($5078) is the clear winner with its blazing performance, superb color quality, long battery life, and ease of use. This 7.4-pound computer has an 11.3-inch active-matrix color SVGA LCD for optimum viewing. See how it stands up to the Pentiums that have CPU speeds of 120 and 133 MHz. **PAGE 161**

DESKTOP REPLACEMENT

Twinhead SlimNote 8120TV

If you need a portable desktop, look no further. Twinhead's 8-pound SlimNote 8120TV carries all the performance, features, and multimedia capabilities you'll need to get the job done. With its fast 120-MHz CPU, loads of features, and ease of use, the SlimNote is hard to beat. **PAGE 161**

LOW COST

Micro International Mint 5200

When you can't afford much and you need high performance and quality presentations, the Micro International Mint 5200 is the way to go. At $3600, this fast 133-MHz Mint isn't too hard to swallow. **PAGE 161**

With all this computing force and these power-draining features, road warriors have to be concerned with battery life. All the portables use nickel-metal-hydride (NiMH) and lithium-ion batteries, which provide longer battery life than the once-prevalent nicad battery packs. On average, the notebooks last 2:10:31 in our Thumper 2 battery run-down tests.

The market has become so segmented that—even though there are only 13 machines—we divided them into three categories: best overall, best desktop replacement, and best low-cost system. The low-cost systems (under $5000) offer the best price/performance. A notebook in the desktop-replacement category indicates that it has enough functionality for you to take it to your office and continue working without a hitch.

To pick the best systems, we ran performance tests under Windows 95 with such commonly used applications as Word, Excel, and FoxPro that measure how fast the portables are in real-world scenarios. Because multimedia applications can be incredibly resource-hungry, we also ran our low-level InterMark benchmarks that stress system components such as the notebook's graphics and storage-subsystem components. These benchmarks report performance and indicate the CPU utilization for each. Finally, our testers check how easy the systems are to use for the nontechnical traveling salesperson, and we give each notebook a features score.

THE BEST IN PORTABLE POWER

MULTIMEDIA NOTEBOOKS

All the notebooks we tested have the mettle to dazzle clients with multimedia presentations and provide desktop-level performance for ordinary applications. In general, they have everything you'll need for a multimedia presentation: 16 MB of RAM, integrated CD-ROM drives, large hard drives, crisp active-matrix color displays, 16-bit audio, and integrated speakers. The systems with 75-, 90-, and 100-MHz Pentium processors are very fast when compared to the 486-based notebooks of the near past, but because we weight performance the most in our evaluation formula, the systems with 120- and 133-MHz CPUs usually have the advantage.

Our testing included three 133-MHz Pentium notebooks—the Chem USA ChemBook NB 5400 ($4300), Micro Express NP52P133 ($3999), and Micro International Mint 5200 ($3600). The ChemBook NB 5400 and Micro Express NP52P133 are fastest overall in our applications-based tests. The Mint 5200 matches the ChemBook in our low-level InterMark benchmarks and races through the InterMark suite faster than the NP52P133.

These three portables are strikingly similar in their internal architecture and chassis design. They accompany their powerful 3.3-V Pentiums with 256 KB of level 2 cache memory, a Peripheral Component Interconnect (PCI) local-bus architecture, and video memory to speed up graphics redraws and video clips. They have integrated CD-ROM and floppy drives, so you don't have to keep swapping them in and out as with some other notebooks.

Notebook manufacturers are shifting away from the once-ubiquitous trackball to touchpads and eraserheads fashioned after IBM's groundbreaking Trackpoint arrow controller. In fact, this is our first hands-on testing of portable systems that don't have a trackball. Eight of the notebooks have touchpads located in the middle of the wrist rests; the rest have eraserheads between the *G*, *H*, and *B* keys. Some testers find the eraserheads more intuitive at first, but others feel more comfortable with the touchpads after continued use.

Next in the Pentium pecking order are the 120-MHz Gateway 2000 Solo 5120 ($5399) and the Twinhead SlimNote 8120TV ($5495). They both put up strong performance numbers, but the SlimNote really shines with the second-best overall performance and came out on top as the best desktop replacement.

The top performer among the 75- to 100-MHz notebooks is Toshiba's 90-MHz Satellite Pro 410CDT ($5078), which does well in the CD-ROM portion of the InterMark stress tests (it has a quad-speed CD-ROM drive). This notebook has a lithium-ion battery that provides the most life in the Thumper 2 battery run-down tests (4:29). Its one drawback is a relatively small

NOTEBOOK VENDORS OPT FOR HARDWARE-ASSISTED VIDEO PLAYBACK

Some of the notebooks we tested use a little extra hardware muscle for playing video clips, which we find provides some "must-see" movie viewing for multimedia presentations. These notebooks use the hardware-assisted playback to paint full-motion (30 frames per second) video clips across the entire display instead of just in grainy quarter-size windows.

Desktop systems equipped with MPEG playback cards can effectively zoom video clips to full-screen, but the full-screen hardware-assist technology has now trickled down to notebooks (e.g., you can play your firm's latest marketing piece without the embarrassing dropped frames and blocky pixelation usually associated with software-only MPEG playback). Most of the notebook vendors offer MPEG hardware-assist technology as a standard component or an option (see the Roll Call on pages 166 to 167). To check this out, we test-drove two notebooks that can play the big picture.

IBM's ThinkPad 760CD is the first notebook with an MPEG-2 digital-video decoder chip. Developed by IBM, the decoder chip runs both MPEG-1 and MPEG-2 video, and you can also choose CD Interactive (CD-I)/Video-CD to play a CD-I movie, Video-CD, or karaoke CD. IBM officials say that it will use the chip with other high-end ThinkPads, and the company is shipping the decoder to third-party vendors. Last December, Sony, Philips, Toshiba, and other firms agreed on a common format for a high-density optical-CD technology that supports 4.7 GB of storage per side, yielding 133 minutes of MPEG-2 compressed video. IBM is hoping that this technology, called digital videodisc (DVD), will boost the popularity of its decoder chip.

You can play full-motion, full-screen MPEG movies on Hyperdata's MediaGo CD P-100 with an optional MPEG card using the bundled MPEG player. The notebook also supports such file formats as Video-CD, CD Interactive (CD-I), and karaoke CD.

We played MPEG-1 files from an IBM MPEG CD-ROM sampler, a collection of action-filled scenes from the movie *True Lies*. The visual quality of the MPEG-1 clips degraded only slightly when we enlarged a smaller window to encompass the ThinkPad's entire 12.1-inch active-matrix color display. The only problem was that the MPEG clip appeared a little more grainy when it was stretched across the screen.

Zenith's Z-Note GT can also play full-motion, full-screen MPEG graphics with its video-playback card. For testing purposes, the notebook came equipped with the card built into the system, but it is usually a $267 option. Likewise, Hyperdata Technology sent us a MediaGo CD P-100 with an MPEG card installed. Testers played a CD-I-based version of *Top Gun* on the MediaGo CD P-100, and all agreed that it was VCR-quality video.

—John McDonough

777-MB hard drive compared to other notebooks, which have 1 GB or higher. (At the time of this writing, Toshiba introduced the Tecra 700, a 120-MHz notebook with a 1.13-GB hard drive. See next month's issue for details.)

While performance rules in our evaluation, IBM's ThinkPad 760CD ($7384) and Zenith's Z-Note GT ($6198) have the most features (see the Roll Call on pages 166 to 167) that we think are necessary for a multimedia notebook. They have NTSC/PAL video-out cards, which lets you plug in a wide-screen TV for large group presentations, and hardware-assisted MPEG playback for quality full-screen video. These two also have the largest displays (12.1 and 11.3 inches, respectively) and a three-year warranty. With its lithium-ion battery, the ThinkPad 760CD powers on for a good 3 hours and 37 minutes.

The Micro International Mint 5200 is tops in our screen-quality evaluation. It has a 10.4-inch active-matrix color LCD with 2 MB of video memory. If you plug in an external display, it supports resolutions of 1280 by 1024 pixels. The Mint 5200 showed the best raw-color quality on its VGA display (640 by 480 pixels), but the notebooks from AMS, Chem USA, Compaq, Gateway 2000, IBM, Toshiba, Twinhead, and Zenith have higher-resolution SVGA displays (800 by 600 pixels). We had to set all the notebooks' resolutions at 640 by 480 pixels and 256 colors for testing so they would all be on a level playing field. The ChemBook NB 5400 (tied with NEC's Versa 4050C for the widest viewing angle), Micro Express NP52P133, and AMS PowerCD 8500 also have strong screen-quality scores.

The Hyperdata MediaGo CD P-100 ($3395) is the least expensive of the notebooks we tested. It may not be as fast or feature-rich as the other systems, but take heed: It costs less and has a faster CPU, a bigger display, and more memory than most of the notebooks we reviewed in our last notebook roundup (see "30 No-Compromise Notebooks," April 1995 BYTE).

BYTE BEST — MULTIMEDIA NOTEBOOKS

When only the best will do

BEST OVERALL — Toshiba Satellite Pro 410CDT

The Toshiba Satellite Pro 410CDT ($5078), a 90-MHz Pentium-based system, burns through our suite of performance benchmarks faster than any other 75-, 90-, or 100-MHz notebook tested here. The 7.4-pound computer has an 11.3-inch active-matrix color SVGA LCD that produces deep, dark colors in the color-quality tests. Its lithium-ion battery that keeps the juice flowing for almost 4.5 hours in our battery run-down tests put it over the top. For multimedia applications, the mobile unit has a quad-speed CD-ROM drive, and it has 16-bit MIDI, WAV, and Sound Blaster Pro–compatible audio playback. Testers were impressed with the layout of its keyboard and were comfortable navigating Windows with the notebook's integrated AccuPoint pointing device.

		PRICE AS TESTED	CPU SPEED (MHZ)	OVERALL SCORE	PERFORMANCE	FEATURES	EASE OF USE	SCREEN QUALITY	BATTERY LIFE
BEST	Toshiba Satellite Pro 410CDT	$5078	90	7.68	▲▲▲▲	▲▲▲▲	▲▲▲▲	▲▲▲▲	4:29:11
RUNNER-UP	Micro International Mint 5200	$3600	133	7.64	▲▲▲▲	▲▲▲	▲▲▲	▲▲▲▲▲	2:08:37
RUNNER-UP	Twinhead SlimNote 8120TV	$5495	120	7.60	▲▲▲▲	▲▲▲▲	▲▲▲▲	▲▲▲▲	1:14:56

A fast portable office

DESKTOP REPLACEMENT — Twinhead SlimNote 8120TV

When choosing the best desktop replacement, we weighted the notebooks' performance even higher than in the best-overall category, so it isn't surprising that the 120- and 133-MHz portables come out on top. Twinhead's 120-MHz SlimNote 8120TV ($5495) wins this category hands down with its overall score. Although it was second in performance behind Chem USA's 133-MHz ChemBook NB 5400 ($4300), the SlimNote is easier to use and has a longer battery life than the ChemBook. The 8-pound SlimNote matches its fast CPU with 32 MB of memory, a Peripheral Component Interconnect (PCI) local-bus architecture, and a voluminous 1.3-GB hard drive.

		PRICE AS TESTED	CPU SPEED (MHZ)	OVERALL SCORE	PERFORMANCE	FEATURES	EASE OF USE	SCREEN QUALITY	BATTERY LIFE
BEST	Twinhead SlimNote 8120TV	$5495	120	7.98	▲▲▲▲	▲▲▲▲	▲▲▲▲	▲▲▲▲	1:14:56
RUNNER-UP	Chem USA ChemBook NB 5400	$4300	133	7.79	▲▲▲▲	▲▲▲	▲▲▲	▲▲▲▲▲	1:02:55
RUNNER-UP	Toshiba Satellite Pro 410CDT	$5078	90	7.59	▲▲▲▲	▲▲▲▲	▲▲▲▲	▲▲▲▲	4:29:11

You don't have to spend a mint to get one

LOW COST — Micro International Mint 5200

It's scary that we call anything under $5000 a low-cost system, but comparatively speaking, these notebooks with their high performance and feature sets are reasonably priced. Micro International's Mint 5200 ($3600) gets the nod because of its great price/performance ratio. The other two 133-MHz Pentium notebooks—Chem USA's ChemBook NB 5400 ($4300) and Micro Express's NP52P133 ($3999)—are close in pursuit of the Mint 5200 when it comes to no-compromise computing at a fairly low price.

		PRICE AS TESTED	CPU SPEED (MHZ)	OVERALL SCORE	PERFORMANCE	FEATURES	EASE OF USE	SCREEN QUALITY	BATTERY LIFE
BEST	Micro International Mint 5200	$3600	133	7.64	▲▲▲▲	▲▲▲	▲▲▲	▲▲▲▲▲	2:08:37
RUNNER-UP	Chem USA ChemBook NB 5400	$4300	133	7.50	▲▲▲▲	▲▲▲	▲▲▲	▲▲▲▲▲	1:02:55
RUNNER-UP	Micro Express NP52P133	$3999	133	7.28	▲▲▲▲	▲▲▲	▲▲▲	▲▲▲▲	1:11:39

KEY

Ratings from 1 to 5: ▲ is the lowest; ▲▲▲▲▲ is the highest.

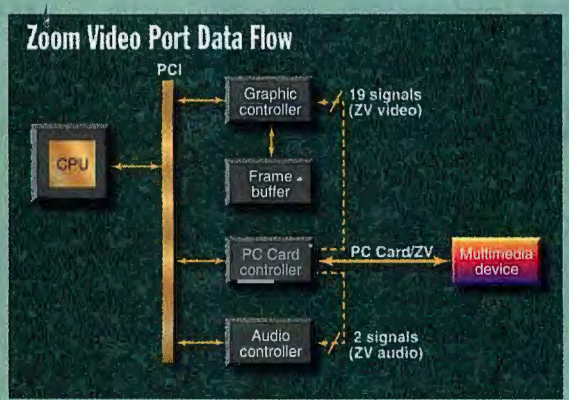
ZOOM IN ON HIGH-QUALITY VIDEO

A low-cost, high-performance multimedia solution has emerged for those who rely on their portable desktop for full-motion video and graphics presentations. Sponsored by Cirrus Logic and at the time of this writing scheduled for a vote on March 7 by the PCMCIA committee, the proposed Zoom Video (ZV) port standard lets a system transfer video and audio data on a PC Card directly into the VGA frame buffer, bypassing the Peripheral Component Interconnect (PCI) bus and the CPU. This capability frees the system to produce higher-quality video and sound, without draining the battery.

This new technology is behind a flurry of activity from such vendors as C-Cube Microsystems, Chips & Technologies, Sony, Sigma Designs, and Toshiba. They all want to give users who need full-motion video a cheap MPEG hardware solution that provides better quality at faster rates of 30 frames per second, control of audio/video synchronization, MPEG-1 (with an upgrade path to MPEG-2), encoding/decoding capabilities, extended battery life, video capture, and more.

As the driving force behind the proposal, Cirrus Logic (Fremont, CA, (510) 623-8300) offers ZV support at the system level with a VGA controller, a PC Card controller, and Video Port Manager software. With ZV-compliant controllers, vendors can implement multimedia capabilities on a motherboard without additional chips and cost.

According to Kris Narayan, Cirrus's director of marketing for portable products, about a dozen notebook vendors will incorporate these components in their systems and have them ready to go by the time you read this. He adds that if you want ZV capabilities once these notebooks come out, you just need to buy a ZV-compliant PC Card, which will cost anywhere from $60 to $250, depending on your needs (e.g., for MPEG playback, video capture, or TV tuning).



The path that the video and audio data on the PC Card takes using Zoom Video technology. (Source: Chips & Technologies.)

C-Cube Microsystems (Milpitas, CA, (408) 944-6300) supports ZV with its CL480PC chip. Using only ½ W of power, the CL480PC is a small package that fits nicely on a PC Card, motherboard, *or* docking station. Because of its low power and size, the chip offers vendors a low-cost MPEG-1 audio/video solution.

On the controller side, Chips & Technologies (San Jose, CA, (408) 434-0600) blends video acceleration with a high-performance graphics engine in its HiQVideo series of 64-bit controllers. This series provides full-screen video at 30 fps and includes a video-capture port, support for multiple video windows, and scalable video, which lets you expand your video window to any size while maintaining the 30-fps video rate. Toshiba (Irvine, CA, (714) 583-3000) will implement the HiQVideo series in its notebooks, which the company says will be available by midyear.

With all this new technology and vendors working together to give you the best possible ZV solution, on-the-go professionals can't help but see a vast improvement in the quality of their presentations. Cirrus's Narayan expects that about 40 percent of the people who buy notebooks this year will view the ZV port as a *must-have* feature. This should increase to 60 percent in 1997. —Susan Colwell

HONORABLE MENTIONS

Four of the notebooks that we tested—the **AMS PowerCD 8500, Chem USA ChemBook NB 5400, Micro Express NP52P133, and Micro International Mint 5200**—have integrated CD-ROM drives and floppy drives. The other notebooks have either an external floppy drive or a CD-ROM drive and a floppy drive that you must swap if you want to use them. The trade-off here is that the integrated systems are a little heavier and thicker than their swapping counterparts.

If you want the big picture, **IBM's ThinkPad 760CD and Zenith's Z-Note GT** have NTSC/PAL video I/O so that you can plug a TV into the notebook. This lets you entertain a room full of viewers via a wide-screen TV.

Dubious Achievement

The cooling fan in Hyperdata's MediaGo CD P-100 makes a whirring noise that is just loud enough to be annoying. The fan isn't so bad if you are working on everyday tasks, but it is really distracting if you are watching a CD Interactive (CD-I) movie or viewing a multimedia presentation.

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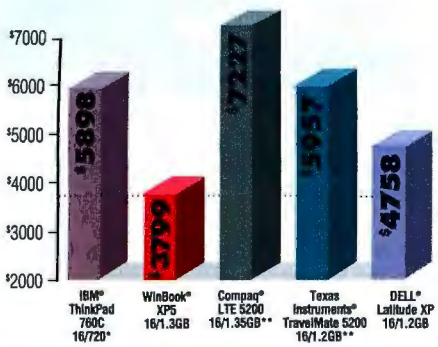

Prices quoted over 1-800 lines as of 2/6/96 for comparably equipped models with 120MHz Intel® Pentium® processor, lithium ion battery, 14.4 fax/modem, and 256K cache, from USA Flex for IBM, Dell Computer Corp., WinBook Computer Corp., Compaq Direct Plus, and Texas Instruments

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** With NiMH battery — lithium battery not available

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How We Tested

To pick the best multimedia notebooks, we ran performance tests based on widely used applications, as well as NSTL's low-level InterMark performance benchmarks to see which are the fastest notebooks. To round out our evaluation, we also measured the endurance of the portables with our Thumper 2 battery run-down tests, examined their screen quality, and decided which ones were the easiest to use and had the most important features for multimedia applications. We weighted the performance scores most heavily, followed by screen-quality, battery-life, features, and usability scores.

To be included in our test-bed of multimedia notebooks, vendors had to supply us with a notebook with a traveling weight of less than 10 pounds (including the system and its components, such as a floppy drive, adapters, and a battery pack). The notebooks had to have a 75-MHz or higher Pentium processor, at least a 500-MB hard drive, at least 16 MB of RAM, an active-matrix color display, an integrated CD-ROM drive, an integrated sound system, an integrated pointing device, and a 3½-inch floppy drive.

PERFORMANCE

We assessed the performance of each notebook with our suite of applications-based and low-level InterMark tests. Before testing, we installed Windows 95 onto formatted hard disks after wiping the notebooks' preconfigured hard disks. We restored a mirror image of the hard disks when it came time for our usability and features testing.

The applications benchmarks use popular programs such as Word, Excel, and FoxPro, which help us gauge real-world notebook performance. The Windows applications test suite includes Microsoft Word 6.0 and 7.0, Excel 5.0 and 6.0, and FoxPro 2.6. All applications execute macros that exercise common functions of each application. For example, the Word for Windows test includes file I/O, search-and-replace functions, and formatting subtests.

Our Windows-based, low-level InterMark tests exercise the Windows Graphical Device Interface (GDI), as well as all low-level graphics, CPU, FPU, memory, graphics, and the hard drive components of a computer. The GDI component determines how well a system executes basic graphics calls within Windows. We ran all the Windows-based tests in 640-by 480-pixel resolutions and 256 colors using vendor-supplied graphics drivers.

SCREEN QUALITY/ BATTERY LIFE

We focused on three aspects of screen quality: crispness, intensity/color range, and viewing-angle range. The screen-quality tests measure horizontal and vertical line placement, color and gray-scale depths, and the frequency of LCD streaking. We used Sonera Technology's DisplayMate Professional 1.0 to analyze a wide range of display capabilities.

To determine color quality, we displayed a color bar on each screen and assigned a score that ranges from one (worst) to five (best). The difference between the best and worst screens is not that great, because they are all active-matrix color displays. After plotting the viewing angle using our Heads-Up-Range-Device (HURD), we computed the group's viewing-angle scores.

We measured battery performance with our Thumper 2 system. Thumper emulates a typical word processing session. Robotic arms and optical sensors detect and control each system's power management scheme. Before testing, we completely drained and recharged each notebook's battery according to the manufacturer's instructions. We then configured each system's power management features to spool down the hard disk after 2 minutes of inactivity and shut off the backlighting after 1 minute. We allowed each system to enter standby mode during the test cycle. At intervals, Thumper's robotic arms would wake up each system so that it would run until the battery died.

USABILITY/FEATURES

We assessed the quality of each keyboard, concentrating on key placement. We worked extensively with the notebooks to see how comfortable they became after extended use, and we rated the response and feel of the keys. We also evaluated pointing devices and considered the usefulness of status indicators.

Finally, we asked each vendor to complete a lengthy questionnaire to give us a detailed description of each system's features, such as the amount of RAM provided and the service and support options. We then weighted each feature and calculated an overall features score.

BYTE's Thumper 2 tests a notebook's battery life by mimicking a word processing session and monitoring power management capabilities.

Contributors

Jim Kane, Project Manager/NSTL, *has been testing hardware and software products for NSTL for the past six years.*

John McDonough, Technical Editor/NSTL, *has been writing for high-tech publications for several years.*

Maggie Bender, Tester/NSTL, *has been testing products for the BYTE Lab Reports for the last two years.*

Susan Colwell, Technical Editor/BYTE, *coordinates the combined testing between the BYTE Lab and NSTL.*

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Price as tested	$4254	$4300	$6399	$5399	$3395	$7384
Performance rating	6.71	8.90	7.03	7.81	6.74	6.50
Features/ease of use	8.02/8.24	6.72/6.98	8.38/8.83	5.57/7.62	5.81/7.17	8.81/8.14
Screen quality	8.35	9.28	5.89	7.41	7.87	6.20
Battery life (hr:min:sec) as tested	1:06:12	1:02:55	2:16:15	3:15:52	0:59:09	3:24:50
MICROPROCESSOR						
CPU/MHz	Pentium/90	Pentium/133	Pentium/90	Pentium/120	Pentium/100	Pentium/90
Voltage	2.9	3.3	3.3	3.3	3.3	2.9
SYSTEM RAM						
RAM as tested/max. RAM (MB)	16/40	16/32	16/72	16/40	16/64	16/40
Memory speed (ns)	70	70	70	70	60	70
Memory architecture	Paged or interleaved	DIMM	Fast-paged	Direct-mapped	DIMM	Paged
SYSTEM BIOS						
BIOS vendor	Phoenix PnP	SystemSoft	Compaq	SystemSoft	AMI	IBM
Flash ROM-upgradable	●	●	●	●	●	●
System ROM BIOS shadowing	●	○	●	●	○	●
Video ROM BIOS shadowing	●	○	●	●	○	●
VIDEO						
Screen manufacturer	NEC	Samsung or Hitachi	Compaq	Mitsubishi	Hitachi	DTI
Graphics accelerator manufacturer/model	Cirrus Logic GD-7543	Cirrus Logic GD-7543	Cirrus Logic GD-7543	Chips & Technologies 65548	Chips & Technologies 65548	Trident Cyber 9320
Diagonal screen size (inches)	10.4	10.4	10.4	10.4	10.4	12.1
Max. display resolution (pixels)/total colors	800x600/65,000	800x600/16.8 million	800x600/65,000	800x600/256	640x480/64,000	800x600/64,000
Graphics memory as tested/bus width (bits)	2-MB VRAM/64	2-MB VRAM/24	1-MB DRAM/32	1-MB DRAM/32	1-MB DRAM/32	1-MB VRAM/32
External VGA display support	●	●	●	●	●	●
Max. ext. display resolution (pixels)/total colors	1280x1024/16 million	1280x1024/256	1024x768/256	800x600/256	1024x768/64,000	1024x768/64,000
Simultaneous int. and ext. display/ key-activated toggle for display selection	●/●	●/●	●/●	●/●	●/○	●/●
MASS STORAGE AND FLOPPY DRIVES						
Hard drive manufacturer and model	Toshiba HDIB 2810	Toshiba MK2720FC	Compaq 810	IBM	Seagate ST-9655	IBM DPRA-21215
Hard drive interface type/ average access time (ms)	PCI/10	IDE/13	IDE/15	IDE/13	IDE/12	IDE/8.1
Hard drive controller cache (KB)	8	N/A	N/A	N/A	128	64
Hard drive formatted capacity/ largest available (MB)	800/1200	1300/1700	808/1300	810/1200	810/1300	1144/1200
Removable hard drive	●	●	●	●	●	●
Standard 3½-inch floppy drive	●	●	●	●	● (external)	●
I/O PORTS (BUILT-IN)						
Number of nine-pin serial ports	2	1	1	1	1	1
Number of 25-pin serial ports	N/A	N/A	1	1	1	N/A
UART type	16550	N/A	16550	16550	16550	16550a
Centronics parallel port	1-EPP	1-EPP	1-EPP	1-EPP	1-EPP	1-EPP
Pointing device	Touchpad	Glidepad	EasyPoint II	Glidepad	Trackpoint	Trackpoint II
External keyboard port	●	●	●	●	●	●
Type II/Type III	2/2	1/1	2/1	2/1	2/1	2/1
SOUND						
Integrated sound	●	●	●	●	●	●
Built-in microphone	●	●	●	●	●	●
Ext. microphone port	●	●	●	●	●	●
Ext. speaker port	●	●	●	●	●	●
PASSWORDS						
Power-on/keyboard/setup utility	●/○/●	●/○/●	●/●/●	●/●/○	●/○/●	●/●/●
ADDITIONAL FEATURES						
MPEG hardware/software	Optional/●	●/●	Optional/○	○/○	●/●	●/●
Embedded/overlaid numeric keypad	●	●	●	●	○	●
Wattage	42.5	50	15	40	50	35
Switchable voltage	●	●	●	●	●	○
SOFTWARE						
DOS disks included	●, or Windows 95	N/A	○	N/A	●	●
Microsoft Windows 95 disks included	●, or DOS/Windows 3.1	●	●	●	Optional	●
BATTERY						
Battery type	NiMH	NiMH	NiMH	Lithium-ion	NiMH	Lithium-ion
Supports multiple battery packs/hot swapping	●/●	○/○	●/●	○/●	●/●	●/●
Recharges while system is on	○	●	●	●	●	●
External battery charger (for secondary battery)	●	○	○	●	○	●
Additional battery	●	●	○	○	Optional	●
MISCELLANEOUS						
Traveling weight (lbs.)[1]	7.1	7.1	7.7	6.7	7.8	8.84
Docking station/expansion chassis	●/○	●/○	●/●	●/○	○/○	●/●
14.4-Kbps fax/modem	●	●	○	○	●	●
Standard warranty length (years)/coverage	Lifetime/P,L,F,R	1/P,L,R	3/P,L,F,R	1/P,L,R	1/P,L,R	3/P,L,R
VENDOR INFORMATION						
Phone	(818) 814-8851	(510) 785-8080	Call local Compaq dealer	(605) 232-2023	(909) 468-2933	Call local IBM dealer
Toll-free phone	(800) 886-2671	(800) 866-2436	(800) 345-1518	(800) 846-2000	(800) 786-9343	(800) 426-2968
On-line address	http://www.amsnote.com	http://www .chemusa.com	http://www.compaq.com	http://www.gw2k.com	N/A	http://www.pc.ibm.com
Inquiry number	1194	1195	1196	1197	1198	1199

= BYTE Best.

● = yes; ○ = no; N/A = not applicable.

Warranty: P = parts; L = labor; F = freight to repair center; R = return to customer.

[1] The traveling weight includes the system and its components, such as a floppy drive, adapters, and a battery pack.

MICRO EXPRESS NP52P133	MICRO INTERNATIONAL, INC. MINT 5200	NEC TECHNOLOGIES, INC. VERSA 4050C	TEXAS INSTRUMENTS, INC. EXTENSA 550 CDT	TOSHIBA AMERICA INFORMATION SYSTEMS, INC. SATELLITE PRO 410CDT	TWINHEAD CORP. SLIMNOTE 8120TV	ZENITH DATA SYSTEMS Z-NOTE GT
$3999	$3600	$4774	$3599	$5078	$5495	$6198
8.12	7.89	6.30	5.73	7.48	8.65	7.06
7.02/6.98	6.98/6.98	6.93/7.31	7.49/8.00	7.38/7.69	8.05/7.79	8.58/8.50
8.91	10.0	9.43	7.22	7.12	7.79	4.70
1:11:39	2:08:37	2:56:23	2:00:14	4:29:11	1:14:56	2:10:31
Pentium/133	Pentium/133	Pentium/90	Pentium/75	Pentium/90	Pentium/120	Pentium/90
3.3	3.3	3.3	5	2.9	2.9	3.3
32/32	16/32	16/40	8/40	16/40	16/40	16/40
70	60	70	70	60	70	70
EDO	DIMM	Interleaved	Paged	Paged or interleaved	Paged or interleaved	Paged
SystemSoft	SystemSoft	Phoenix	Phoenix	Toshiba	Phoenix	Phoenix
●	●	●	●	●	●	●
●	●	●	●	●	●	●
●	●	●	●	●	●	●
Sanyo Cirrus Logic GD-7543	Samsung or NEC Cirrus Logic GD-7543	NEC Chips & Technologies 65545	Samsung Cirrus Logic GD-7543	Sharp Chips & Technologies F65548	Sharp Cirrus Logic GD-7543	NEC Chips & Technologies 65548
10.4	10.4	10.1	10.4	11.3	11.3	11.3
640x480/64,000	640x480/256	640x480/16.8 million	640x480/64,000	800x600/64,000 TFT, 256 DSTN	800x600/64,000	800x600/262,144
1-MB VRAM/16	2-MB VRAM/32	1-MB VRAM/32	1-MB DRAM/32	1-MB DRAM/32	1-MB DRAM/32	1-MB DRAM/64
●	●	●	●	●	●	●
1280x1024/256	1280x1024/256	1280x1024/256	1024x768/256	1024x768/64,000	1024x768/256	1280x1024/256
●/●	●/●	●/●	●/●	●/●	●/●	●/●
Toshiba PCI/10	Toshiba MK2720FC PCI/13	Toshiba MK1926 FCV EIDE/13	Seagate ST9655AG EIDE/16	Toshiba EIDE/13	Toshiba MK2720FC IDE/15	Toshiba MK2770 IDE/13
64	N/A	128	128	32	128	128
810/1300	1300/1300	810/810	524/1200	777/777	1300/1300	1300/1300
●	●	●	●	●	●	●
●	●	●	●	●	●	●
1	1	1	1	1	1	1
1	N/A	N/A	N/A	1	1	1
16C550	16550	16550	16550	16550	16550	16550
1-EPP	1-EPP	1-EPP	1-EPP	1-EPP	1-EPP	1-EPP
Trackpad	Glidepoint	Glidepad	Glidepad	AccuPoint	Touchpad	Handi Point
●	●	●	●	●	●	●
2/1	2/1	2/1	2/1	2/1	2/1	2/1
●	●	●	●	●	●	●
●	●	●	●	●	●	●
●	●	●	●	●	●	●
●	●	●	●	●	●	●
○/○/○	●/○/●	●/●/●	●/●/●	●/●/●	●/○/●	●/●/●
●/●	Optional/○	○/●	●/○	○/○	Optional/●	●/●
●	●	●	●	●	●	●
24	50	40	36	30	47	40
●	●	○	●	●	●	●
●	●	●	○	●	○	●
●	●	●	○	●	●	●
NiMH	NiMH	Lithium-ion	NiMH	Lithium-ion	Lithium-ion	NiMH or Lithium-ion
●/●	●/●	●/○	●/○	○/●	●/●	●/●
○	●	●	●	●	○	●
○—internal	○	Optional	Optional	Optional	○	Optional
Optional	○	Optional	Optional	Optional	●	Optional
7.7	8.2	6.6	6.5	7.4	8	8.8
●/○	○/●	●/●	○/○	○/●	●/○	○/○
●	○	●	●	Optional	○	Optional
2/P,L,F (first 4 months),R	1/P,L,R	3/P,L,F,R	1/P,L,F,R	3/P,L,F,R	1/P,L,F,R	3/P,L,F,R
(714) 852-1400	(713) 495-9096	(508) 264-8000	(817) 771-5856	(714) 583-3000	(408) 945-0808	(708) 808-5000
(800) 989-9900	(800) 967-5667	(800) 632-4636	(800) 848-3927	(800) 334-3445	(800) 995-8946	(800) 555-0331
microxprs@aol.com	http://www.pcmint.com	http://www.nec.com	http://www.ti.com	http://www.toshiba.com/tais/csd	slimnote@twinhead.sj.ccmail.compuserve.com	http://www.zds.com
1200	1201	1202	1203	1204	1205	1206

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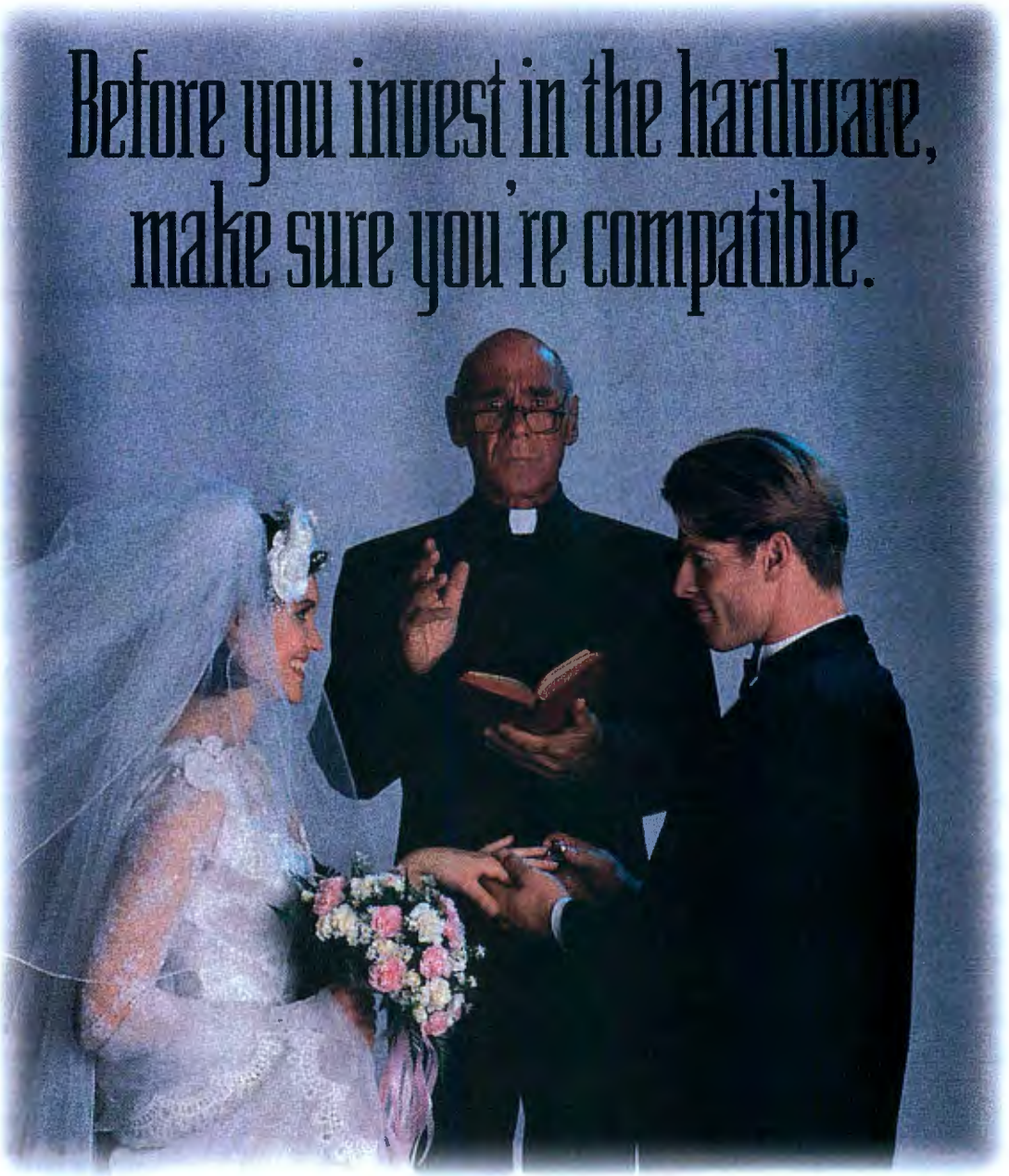

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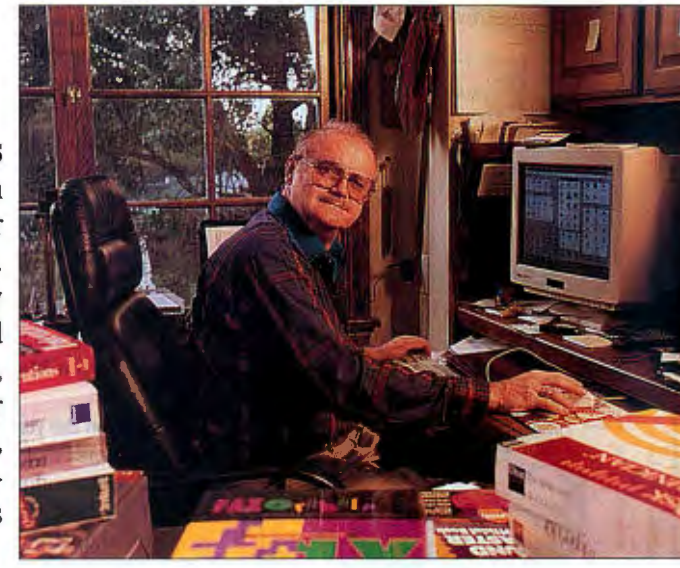
JERRY POURNELLE

The Fragrant and the Foul



AMY ETRA © 1996

Spring comes early at Chaos Manor—the Orchids and Onions are blooming

It's User's Choice Award time at Chaos Manor. Most awards are chosen so they'll be in the January issue, but I perversely insist that a year ends in December, so this is the earliest I can do this. The ground rules are simple: a product or company gets a User's Choice Award if I used it in 1995 and believe it deserves one. I used to have categories, but that was when I could pretend I had seen all or most of the computer products from a year. Clearly, I can't see everything now, so I can't say that something is "best," but I can say it works, I like it, and it's probably up there with the best.

This is also the issue for my Orchid and Onion Parade, but in future I'll move that to the January issue. There's so much to cover that few products will get the space they deserve.

My daughter Jennifer is managing editor at the University of California Institute on Global Conflict and Cooperation. They hold conferences where scholars and officials from nations in dispute talk to each other. There's more to it, but that's the general idea. Last December, Jennifer went to the Middle East to set up a conference involving Israel, Jordan, and 25 other countries. She discovered that electronic communications in and out of Israel and Jordan are almost impossible, partly due to technology, but mostly due to politics. Demonstrating the Internet and World Wide Web was a nightmare.

The conference generates two Orchids. The first one goes to Sean Conley of CompuServe technical support for arranging CompuServe accounts. Because of political complications, CompuServe was the only live on-line system working, and many discussants had never seen an on-line discussion.

The second Orchid goes to Bob Rosenschein of Accent Worldwide. He arranged for demonstrations of the Internet With An Accent multicharacter-set Web browser and provided free copies to conference participants. I don't know how much the conference helped further peace in the Middle East, but it surely did some good.

Accent Professional 2.0 also gets a User's Choice Award. It's a multicharacter, multilanguage word processor that handles Hebrew and Arabic as well as dozens of other languages and alphabets. As I've said before, not everyone needs this, but if you do need it, you need it bad.

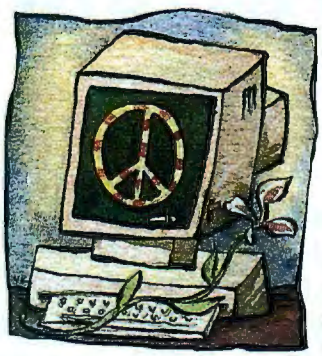
A big Orchid to IBM for using its clout to bring about standards for the new digital videodisc (DVD) standard. There were several proposed formats, but IBM seems to have knocked enough heads together to get agreement on one—remember Beta versus VHS? When the CD-ROM technology first appeared, I said it would change the world by making high-quality data available to everyone at low cost. Digital CD–size videodiscs with their huge storage capacities as well as multimedia continue that information revolution.

A large and smelly Onion to AT&T for not only wrecking their Safari laptop, but also running NCR into the ground. Now they're liquidating 10 percent of the company in hopes of getting healthy enough to break themselves apart, not even preserving the Western Electric name. Meanwhile, many of their phone stores are staffed by surly louts who know little about the equipment and can't even be polite. I went to my local AT&T phone store intending to buy

ILLUSTRATIONS: VALA KONDO © 1996

my wife a cellular phone for Christmas. This was a vast mistake. Eventually, I got Roberta a Motorola flip phone at Circuit City, where they understand what to do with a customer.

My largest Onion goes to all the government officials who either don't understand the notion of freedom or pretend not to. The Department of Justice finally told Phil Zimmermann they won't prosecute him for releasing PGP to the general public. This might have been taken for good will if they hadn't spent years harassing him to the point of impoverishment.



Meanwhile, the White House demands legislation making it easier for government agents to tap an astounding proportion of the nation's telephones by punching a few buttons on a desktop computer. Of course, they'd never do that without getting a warrant—and I am Marie of Romania.

This has been the year of the Internet and the Web, and many of my awards go to communications products. The User's Choice Award for modems goes to U.S. Robotics. Now that I'm regularly connecting to the Internet at 28.8 Kbps, I've had many chances to compare modems. If you're going someplace with noisy phone lines and you absolutely must have a 14.4-Kbps (and would like a 28.8-Kbps) connection, you won't do better than to carry a U.S. Robotics external modem in your checked luggage.

I also use Megahertz PC Card Data/Fax Modems in my portables (they're the ones with XJack, so you don't have to carry a special cable). Megahertz is now the mobile communications division of U.S. Robotics. Their PC Card modems run cool enough to use, and they're often reliable at 14.4 Kbps unless the lines are really noisy. Every PC Card modem I've tried has problems at 28.8 Kbps; but when I carry a U.S. Robotics external modem, I get reliable and fast communications every time.

We've had great success with Xircom's Performance Series CreditCard Ethernet Adapter IIps cards, and they get a User's Choice Award. A User's Choice Award also goes to the Garrett Communications Magnum H80-B Personal Hub. This is a paperback-size box with one thin-wire and eight 10Base-T connectors. Plug in its little power supply and hang it on a wall somewhere, and problems of Ethernet connectivity go away. It also has diagnostic lights. We use it to connect portables and test machines to the Chaos Manor Ethernet, and it has not failed us. If you use thinwire Ethernet, get a Magnum H80-B Personal Hub so you can connect 10Base-T into it.

I am pleased to say that the competition in monitors is fierce, meaning that really good ones are available at reasonable prices. The User's Choice Award for this year goes to the ViewSonic Professional Series PT-810, a 21-inch monitor that takes most of the visual sting out of working with Windows 95. The screen is bright, easy to see in daylight, and large enough that I can keep a bunch of windows open, see everything, and get my work done. I don't understand how I ever got along without a big monitor, and I will not willingly part with it.

ViewSonic also gets an Orchid for its Optiquest V775 17-inch monitor. It has a nearly flat screen and is very usable for word processing. A story goes with this. Last week, I took a new V775 with me to the beach house. When I got it set up, everything worked, but the screen was dim. I called ViewSonic, who instantly offered to replace it, but I'd still be stuck at the beach with no monitor.

I made one more try: I swapped the video cable end for end and reseated the video card. That did it: the screen came up bright and perky. In fact, the V775 is one of the most daylight-visible monitors I've ever worked with.

The User's Choice Award for computers goes to Gateway 2000. We have several Gateway machines, some of them for a long time. I recently replaced Roberta's Gateway 386 with a Gateway 486DX2. SuperCow, a VL-Bus 486DX2/66, has been our test-bed for Windows software and hardware for two years, as well as the "portable" I carry to the beach house. I guarantee you we have used that machine hard without any problems.

Our most recent Gateway machine is the P5-133. It has a 1.6-GB Western Digital Caviar IDE hard drive, a six-speed CD-ROM drive, and a built-in modem that appears from the FCC number to be (and works like) a U.S. Robotics modem. It came with a Matrox video board and an Ensoniq Soundscape wave table. The Soundscape is compatible with Sound Blaster and plays all the games I've tried without setup problems. Finally, there are

Altec-Lansing speakers complete with a woofer. The result is great sound.

The Gateway P5-133 is a screaming games machine. You may buy it for business use, but games are a great way to test a system to its limits. Honest. You can tell your accountant that no business software uses every ounce of performance the way games do. I've run Doom, Wing Commander III, Mission Critical, This Means War, and several other resource-hogging games on the P5-133 (which we've dubbed RacingCow), and none of them faze it. They all run in Win 95, too.

Networking the new machine was simple: insert an Intel EtherExpress card and let Win 95 do the work. It took several restarts, but the P5-133 shuts down and starts up *fast* compared to the other machines around here. When I finish getting everything set up, RacingCow will become my main machine; and a User's Choice Award goes to the Gateway 2000 P5-133.

Speaking of games, the User's Choice game of the year is Mission Critical, which I reviewed last month. It's both role-playing and strategic, and I think it's wonderful.

That's the game of the year, but other games also deserve User's Choice Awards. The game of the month is This Means War from MicroProse Software; it's a tactics game that doesn't take itself too seriously but has got me hooked. On the arcade side, Microsoft Windows 95 Plus is worth buying just to get the pinball game. If you really like pinball, however, you need Full Tilt Pinball from Maxis, a CD-ROM with three neat, time-wasting pinball machines.

Games need joysticks. I've found two I like. My personal favorite is Logitech's WingMan Extreme. The handle fits my hand nicely, and I like the action. There are a lot of joysticks around Chaos Manor, and Alex took over a peach crate full for Larry Niven to try. He played Descent (another of those downloadable heroin-ware games; the first dose is free) with them all and has now bought a PC Optix.

I understand why. While I like the feel of the WingMan Extreme somewhat better, the PC Optix has smoother and more precise action because it uses an optical sensor rather than the mechanical systems employed by most joysticks. Both of them deserve a User's Choice Award.

Two must-have utilities get User's Choice Awards. V Communications' System Commander lets you boot up your system in any OS you like. PowerQuest's Partition Magic, which eliminates the evil FDISK program forever, lets you change disk partitions among your OSes on the fly. It works like magic. *continued*

The User's Choice Award for personal digital assistant (PDA) goes to Psion for the Series 3A palmtop. This isn't perfect, but it works well enough to be useful and comes with neat software. Every year there is a new spate of PDAs, and most of them end up gathering dust because they're too heavy to carry for what they can do. The Psion is still too heavy to carry in your pocket, but it does a lot and will fit into any kind of carry bag.

For me, the big problem with PDAs is that I have totally lost the art of two-finger typing, and no PDA keyboard is large enough for a touch-typist. However, two-finger typists will find the Psion keyboard just right. I've seen old hunt-and-peck journalists bang out a whole story on it.

The Psion isn't as powerful as Hewlett-Packard's OmniGo, but it's a lot cheaper if you lose it. If you want to try a PDA, this is a good one to experiment with.

The bribe of the year comes from Golden Bow Systems, who sent a month's supply of Christmas chocolate along with the latest version of their software. I've relied on their Vopt defragger for years. Version 5.0 understands Win 95. You exit and run it in DOS; but I don't trust a disk-optimization program running in a multitasking environment. Vopt 5.0 understands long filenames and has a neat feature for finding and deleting empty files.

Disk fragmentation can slow your system something awful. There are many disk-optimization programs, but I've always liked Vopt's cautious manner, and I've never lost any data using it. If you're still using DOS or Windows, you really need Vopt. If you're using Win 95, you should have the Norton Utilities for Windows 95, which has an on-the-fly defragger that operates when no one is using the system. I guess it's safe; most Norton Utilities are.

On the other hand, last week something weird happened to one of my optical disks. I had to wipe it and start over. I keep wondering if the Windows 95 Plus "software agent" went off and did something to it in the middle of the night. Whatever happened, if you want to be sure that defragging your disks won't lose any data, Vopt is what you need. I'd recommend it even if they hadn't sent the chocolate.

Quarterdeck's CleanSweep gets the User's Choice Award for uninstaller software. In these days of fatware, your hard disk can fill up with unwanted files that come onboard with new software and stay long after you've deleted it. CleanSweep finds many needless files, and it's conservative about removing them. Erasing files can be chancy; some of them may be needed by programs you don't use often. CleanSweep compresses them and keeps an archive you needn't erase until they're useless.

Quarterdeck developed QEMM, the DOS/Windows memory manager I recommend; it works well with Win 95, too, and does a better job than the emm386.com that comes with MS-DOS 6.22 or Win 95. With

QEMM you also get Manifest, a good memory-use display program.

QEMM and some other programs, including a disk cache that replaces Microsoft SmartDrive, are bundled into a package called GameRunner3, which also includes cheats for certain games. While there are a few games that don't work with QEMM installed, none I know of will work with emm386.com either; to run them, you must reboot in DOS with a very clean CONFIG.SYS and AUTOEXEC .BAT. The User's Choice Award for memory managers goes to QEMM, but if you spend much time playing games, the GameRunner3 package that includes QEMM is worth having.

Quarterdeck also has WebAuthor for Word for Windows 6.0, the best Hypertext Markup Language (HTML) Web-page creation tool I know of. The manual is helpful, and I was able to create some Web-page stuff within an hour of getting WebAuthor installed.

My problem was installation. The symptom is an inability of the installer to find a path; if you get past that, WinWord can't find the WebAuthor tool. The cure in both cases is the same: go to the Windows root directory, find the file winword6.ini, and be sure that STARTUPPATH=C:\WINWORD\STARTUP is somewhere in that file. WinWord is supposed to create that path statement on installation, but other installations may subsequently clobber it.

Once installed, WebAuthor appears on the WinWord Tools menu, and you're on your way to creating good Web pages. Alas, WebAuthor won't work with Word 7, which comes installed on many new machines, including the Gateway P5-133 and our wonderful new Intergraph Dual Pentium Pro 150 (possibly the fastest desktop in the world). However, Quarterdeck is shipping me the beta copy of a version that will work with Word 7 and run on Windows NT, so it may be available by the time you read this.

Also, Quarterdeck's WebCompass won BYTE's Best of Show Award at the fall Comdex. This complex program works with your Web browser to search the Web, organize the results into databases, and make abstracts. Searches can run as you watch or overnight. I haven't used this a lot, but I expect to when we get our Internet setup done right.

On that score: while the IBM Advantis Internet service provider is reliable, it's also expensive, as are all by-the-hour services. We recently got an Earthlink Total Access account at a flat rate of $19.95 a month; it has become the official Chaos Manor Internet service. They're growing

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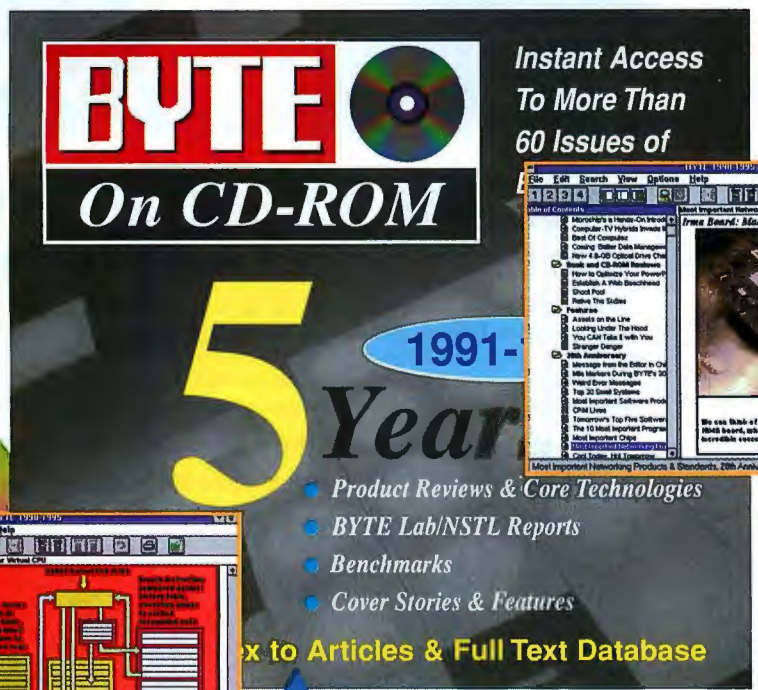

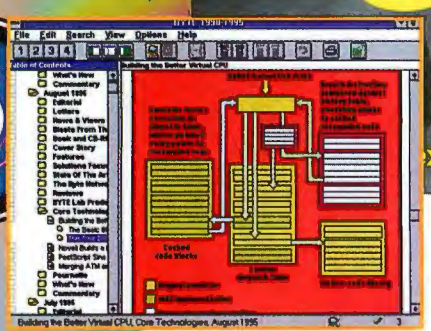

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so fast that there can be temporary congestion problems. Have faith. Most times the connection is nearly instantaneous, and I haven't had as many problems with Earthlink as I have with any other (except IBM Advantis, which always works).

Earthlink Total Access comes with the Eudora Lite mail handler and Netscape Navigator, with an 800-number connection to upgrades when available. Both programs are pretty good, but if you do a lot of Internet crawling, I recommend upgrading to Eudora Pro; and if your system can run it, get the latest 32-bit version of Netscape Navigator. It has good multithreaded multitasking.

Earthlink also offers pointers to a lot of software, including Forte's Free Agent newsgroup reader. I find Earthlink Total Access with Netscape Navigator a great deal better than my older services with Mosaic. But be warned: if you plan to do much with the Internet, get a fast machine capable of multitasking so most of it can happen in the background. No matter how good your service provider and software, you will waste an astonishing amount of time simply waiting for things to happen on the Internet.

The User's Choice Award for Internet service provider goes to Earthlink Total Access, and for Internet browsers to Netscape Navigator.

If you do important work with small computers and don't have an uninterruptible power supply (UPS), you are a gambler; and if you have a switching UPS, you may regret it.

I have both switching and on-line UPS systems. The other day we had power failures, and I made a discovery. If you have not paid attention to your switching UPS systems, they probably won't work when you need them. I also have several Clary OnGuard on-line UPS systems, mostly hidden in closets—one is under a pile of boxes in the cable room. Once again, Clary gets my User's Choice Award for UPSes because I can truthfully say that I have never lost a byte of data to power failures on systems that are protected by a Clary OnGuard UPS.

Some readers tell me I write too much about Windows and Win 95 and not enough about the Mac. I plead guilty. It's not that I don't like the Mac, indeed I own four, but there aren't enough hours in the day to do everything I want to do.

While we were at MacWorld Expo, Apple announced the highest fourth-quarter revenue and the greatest fourth-quarter loss in its history, the resignations under

fire of about five vice presidents, and the impending liquidation of a good part of the company through layoffs. It was the largest MacWorld Expo yet, but there was open speculation in the pressroom that it might be the last one.

I don't believe that. Apple hasn't been well managed, but they have several things going for them. First, they have a good system. Macs have their peculiarities, but the Mac environment, once learned, is quite consistent and a great deal more accessible to software developers than are the "hooks" into Windows or NT.

Second, Apple has a core of fanatic loyalists; with luck, enough to help the company weather the storms to come.

Third, they have a good chunk of the education market.

Fourth, there are some excellent development tools. In particular, there's Allegiant Technologies' SuperCard, a programming language and environment that's about as powerful as Visual Basic for Windows. However, it's a lot easier to learn and, because of the Mac environment, easier to integrate into the Mac system. SuperCard on a Power Mac will let you do amazing things in a short time without a steep learning curve. SuperCard gets the User's Choice Award for the most useful Mac software of 1995.

While it was criminal of Apple to neglect software to integrate the Mac into the mostly Intel-based corporate environment, third parties like Farallon are doing this, giving Apple opportunities for increased penetration into that vital market.

There will always be an Apple Computer, and I for one am glad of it. Microsoft desperately needs the competition.

Finally, a User's Choice Award to version 2 of my wife's reading program, The Literacy Connection. It's not because she's family. This thing works. Version 1 needs a literate person to be a tutor. Version 2, for the Mac only, works by itself: the Mac talks to the student. The voice is Agnes, a Mac sound tool that can pronounce English words from text, and if there's anything that good on a DOS or Windows machine, I don't know about it. This is one of those amazing programs that you can do with SuperCard on a Mac.

The book of the month is *The Web Page Design Cookbook* (Wiley, ISBN 0-471-13039-7), an excellent tutorial guide.

Next month, the Diamond Flower Dual Pentium with OS/2, the astonishing Intergraph Dual Pentium Pro 150, and more about the Internet. ■

Jerry Pournelle is a science fiction writer and BYTE's 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.

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CleanSweep 95 ($39.95), **GameRunner3** ($39.95), **QEMM 8** ($99.95), **WebAuthor for Word for Windows 6.0 version 2.0** ($69.95), **WebCompass** ($139.95), Quarterdeck Corp., Marina Del Rey, CA, (800) 354-3222 or (310) 309-3700, fax (310) 309-3215, http://www.qdeck.com. **Circle 1173 on Inquiry Card.**

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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 1178 on Inquiry Card.**

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Optiquest V775 ($895), **Professional Series PT-810** ($2495), ViewSonic Corp., Walnut, CA, (800) 999-8583 or (909) 444-8843, fax (909) 869-7958, http://www.viewsonic.com. **Circle 1181 on Inquiry Card.**

Partition Magic 2.0 (DOS/Win 95, $49.95; DOS/OS/2 Personal License, $69.95; DOS/Windows/OS/2 Professional License, $495.95), PowerQuest Corp., Orem, UT, (800) 379-2655 or (801) 226-8977, fax (801) 226-8941, http://www.powerquest.com. **Circle 1182 on Inquiry Card.**

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Performance Series CreditCard Ethernet Adapter IIps (for 10Base-T, $179; for 10Base-T/10Base-2, $239), Xircom, Inc., Thousand Oaks, CA, (800) 438-4526 or (805) 376-9300, fax (805) 376-9311, http://www.xircom.com. **Circle 1185 on Inquiry Card.**

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U.S. Robotics Corp., Skokie, IL, (800) 342-5877 or (708) 982-5010, fax (708) 933-5800, http://www.usr.com. **Circle 1190 on Inquiry Card.**

Vopt 5.0 ($59.95), Golden Bow Systems, Inc., San Diego, CA, (800) 284-3269 or (619) 298-9349, fax (619) 298-9950, 75471,1007@compuserve.com. **Circle 1191 on Inquiry Card.**

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How to Make Pentium Pros Cooperate

Intel's Pentium Pro has support for a four-processor configuration, which lets you do jobs that are too big for a single processor

JOHN HYDE

As the decade has progressed, so have the power and capacity of desktop computers. As a consequence, they're assigned ever-larger jobs. While Intel's Pentium Pro processor has remarkable computational prowess at 200 MHz, certain jobs are so big that a single processor can't handle them in a reasonable amount of time.

However, you can deal with such work by using extra processors to divide and conquer the job. These multiprocessor systems require special support from the hardware and OS, so that each processor can share resources without conflict. Intel kept this strategy in mind while designing the Pentium Pro processor: Its bus has built-in support for a four-processor system.

Implementing a four-way multiprocessing environment isn't easy. For multiple processors to work in concert and share resources effectively, you must resolve many issues (e.g., how they interact during system reset, system initialization, and the OS boot). The Pentium Pro mechanism uses a combination of embedded hardware, processor-resident microcode, and firmware to produce a reliable yet extensible multiprocessor building block.

Bus Organization

To achieve this goal, Intel bused together all four processors' signals (as shown in the figure "A Multiprocessor System Bus"). This design uses two of the five buses: the arbitration bus and the advanced programmable interrupt controller (APIC) bus. (The other three are the control, data, and address buses.) The reset operation makes heavy use of both these buses. We'll show how they assist in establishing the multiprocessing environment.

During reset, some power-on circuitry pulls one of the arbitration lines low. The board's hardware for the arbitration bus implements a rotating bit pattern on these bus lines, which creates a unique configuration for each processor. This configuration defines a processor's ID, which is used for all subsequent bus transactions. During normal (i.e., nonreset) processor operation, the processors use the arbitration lines to control access to the control, data, and address buses.

The APIC bus supports delivery of targeted or broadcast interrupt messages in a multiprocessor-system environment. During a reset operation, the processors send interprocessor interrupts (IPIs) to each other using the APIC bus. I/O devices or processors can place IPI messages onto this bus to be received by one or more processors. System software sets up the interrupt priorities for these messages, and the OS can use various delivery schemes for them. All APIC devices communicate using a three-wire bus.

This APIC bus differs slightly from the two-processor Pentium design described in the article "Pentium Chip's Dual Personality" (December 1994 BYTE). There, one of the lines served as an APIC enable, another acted as a chip select, and the third handled a clock signal. Here, two of the wires are wired-OR data lines, and the third wire is a common clock signal.

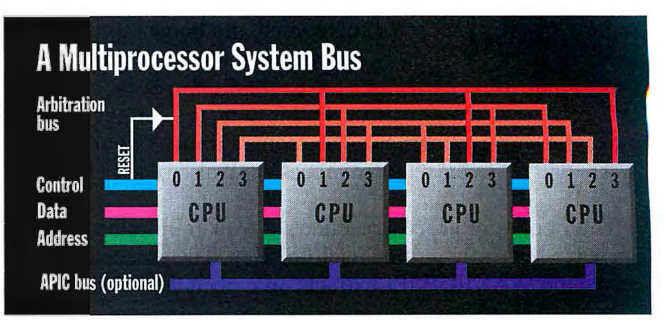
Dueling Processors

All processors must be connected to the APIC bus. The systems designer also provides an APIC clock signal. This bus is required for a hardware reset of the multiprocessor environment, even if it's not used after reset. (Intel strongly recommends that a multiprocessor system use the APIC interrupt scheme.)

A processor first checks that the APIC bus is not busy before initiating a data transfer; it then drives the APIC data lines low during a common clock phase to initiate the transfer. If two or more processors try to initiate an IPI message during the same clock, the processors negotiate by driving their unique arbitration ID (derived from the processor ID) onto the data lines.

The processor with the highest-priority ID wins the arbitration, and the losing processors back off and wait for the APIC bus to fall idle. All devices now increment their arbitration ID. This puts the winner at the end of the priority queue for the next arbitration cycle. This round-robin scheduling algorithm guarantees that one—and only one—device sends IPI messages on the APIC bus at any time. It also ensures that each device has equal access to the bus bandwidth.

Following this arbitration sequence, an APIC device



The basic multiprocessor Pentium Pro schematic. The arbitration bus and advanced programmable interrupt controller (APIC) bus are used to set up the processors during the system boot.

drives more serial bits onto the two data-bus lines, so that all the other devices on the APIC bus receive this IPI message. The APIC bus supports four categories of messages, as determined by the serial bits. Each message also has multiple subtypes to match the needs of various priority schemes. During reset, BOOT IPI messages are used, and WAKEUP and INIT IPI messages may be used.

Once a RESET signal is recognized, all the processors execute identical microcode (as shown in the figure "Which Processor Takes Control?"). Each processor checks its INIT pin. If low (which is recommended), the processor executes a built-in self test (BIST). A processor executing a BIST drives the reset-not-complete pin active, which prevents other processors from moving to the next phase until all the processors have completed BISTs.

The final parts of the reset stage set the processor's CS register to 0FFFF:0F000h and the EIP register to 0FFF0h. This forces the first code fetch from the RESTART vector at 0FFFF:FFF0h, or just below 4 GB. The systems designer can arrange for the Pentium Pro processor to start execution at 0F:FFF0h, or just below 1 MB. Intel provides this 286-compatible alternate scheme so that systems with more than 4 GB of memory need not have a "hole" in the address space to accommodate the RESTART vector. The microcode also clears the bootstrap processor (BSP) register. As its name implies, the BSP is a machine-specific register that identifies the bootstrap processor.

The next stage of initialization involves selecting a bootstrap processor from the available processors. All the processors are eligible to become the single bootstrap processor, rather than defining that a processor with, say, an ID of 0 becomes the bootstrap processor. This eliminates a single-point failure situation, where a system boot sequence stalls because that particular processor fails to operate. The processors continue to execute from microcode and implement a multiprocessor boot protocol.

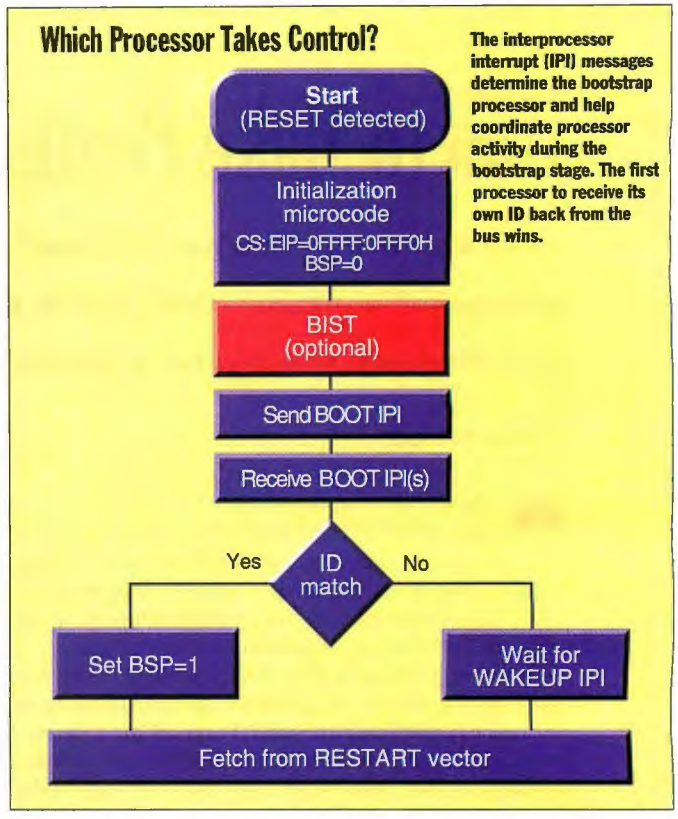
Each processor broadcasts a BOOT IPI onto the APIC bus—note that the APIC bus serializes these requests—and each processor receives *n* BOOT IPIs. Each processor checks these incoming APIC IPIs. If the first one received has the same ID as the processor itself, this processor becomes the bootstrap processor.

Simply put, the fastest processor wins this arbitration round, and it sets the BSP register to 1. If the first ID doesn't match, that processor executes a wait loop in microcode. This essentially puts the losing processors to sleep because they don't perform external bus accesses. The bootstrap processor fetches code pointed to by the RESTART vector and starts executing the system firmware. This code is typically the system BIOS.

Design Issues

There might be a hardware reason why a systems designer would *want a specific* processor to serve as the bootstrap processor, rather than one randomly chosen by the bootstrap algorithm. DOS-compatible hardware, for example, might be connected only to a particular processor. In this case, the current bootstrap processor, if it isn't handling the compatibility signals, sends a WAKEUP IPI to the required processor. It also sends an INIT IPI to itself.

The bootstrap processor enters a wait-loop microcode sequence, effectively putting itself to sleep. The processor that receives the WAKEUP IPI extracts an embedded RESET vector from this IPI message and starts executing firmware code. This new RESET vector lets the awakened processor execute different firmware from the bootstrap processor. The original bootstrap processor clears its BSP flag, and the awakened processor sets its BSP flag to 1. This sequence transfers the responsibility of booting the OS to the newly anointed bootstrap processor.



The interprocessor interrupt (IPI) messages determine the bootstrap processor and help coordinate processor activity during the bootstrap stage. The first processor to receive its own ID back from the bus wins.

The BIOS typically executes a system self test, and the other processors may be turned on for testing purposes using WAKEUP IPIs. The initiating processor can remain active to perform multiprocessor testing or can turn itself off by sending itself an INIT IPI. Following the successful completion of the power-on self tests (POSTs), the systems programmer should switch off all the processors except one. He or she must take care while switching processors on or off: The last processor left on must have its BSP flag set (indicating that it's the bootstrap processor).

Each processor in a multiprocessor system must be initialized consistently. They must, for example, have a common view of the system memory map that defines which areas are cacheable, noncacheable, I/O, and so forth. Other multiprocessor initialization, such as system management mode and machine check architecture, should be completed at this stage.

The bootstrap processor interrogates the system hardware and builds a table that describes the hardware configuration. This standardized table contains information about each processor, expansion buses, I/O APIC descriptions, I/O interrupt assignments, and local interrupt mappings. The OS may use this resource list to support plug and play. Full details of this table and its parameter passing are described in *The Multiprocessor Specification*, which is available from Intel's World Wide Web site (http://www.intel.com) or by contacting the Intel Literature Center at (800) 548-4725 and requesting packet #242016-004.

The last act of the bootstrap processor is to load the OS and pass control to it. The OS is now in control and turns on the sleeping processors as required. ■

John Hyde is the technical manager for Intel's Enterprise Server group. You can contact him on the Internet or BIX at editors@bix.com.

How Copland Communicates

Apple Computer's new network service API follows X/Open standards and blazes the trail to the next Macintosh OS

TOM THOMPSON

Apple's second-generation Power Macintoshes do more than adopt the industry-standard Peripheral Component Interconnect (PCI) bus. These systems also have a completely revamped communications infrastructure that alters how network and serial I/O operate. This change takes advantage of the performance benefits offered by new hardware, such as the DMA channels. This gives Power Macs the capability to handle high-performance network connections, such as asynchronous transfer mode (ATM) and Fast Ethernet.

The new architecture also provides a set of APIs that are transport-independent. Because the gritty low-level transport details are hidden behind these standard interfaces, properly written network applications should be able to function regardless of the underlying network protocols. For instance, the same database client application, without modification, can access a server database through any number of network protocols: AppleTalk, TCP/IP, Token Ring, or IPX.

In addition, the architecture will allow applications to take advantage of new network technologies, such as infrared and wireless PC Card adapters, when they become available. You need only add a snap-on software module to provide low-level support for a new network service.

The combined flexibility and standardized network interfaces garnered this communications architecture the name Open Transport. Initially it was available only on Power Macs equipped with a PCI bus, but the version 1.1 release, which appeared early this year, delivers the same capabilities across the entire Mac product line.

Building a Better Black Box

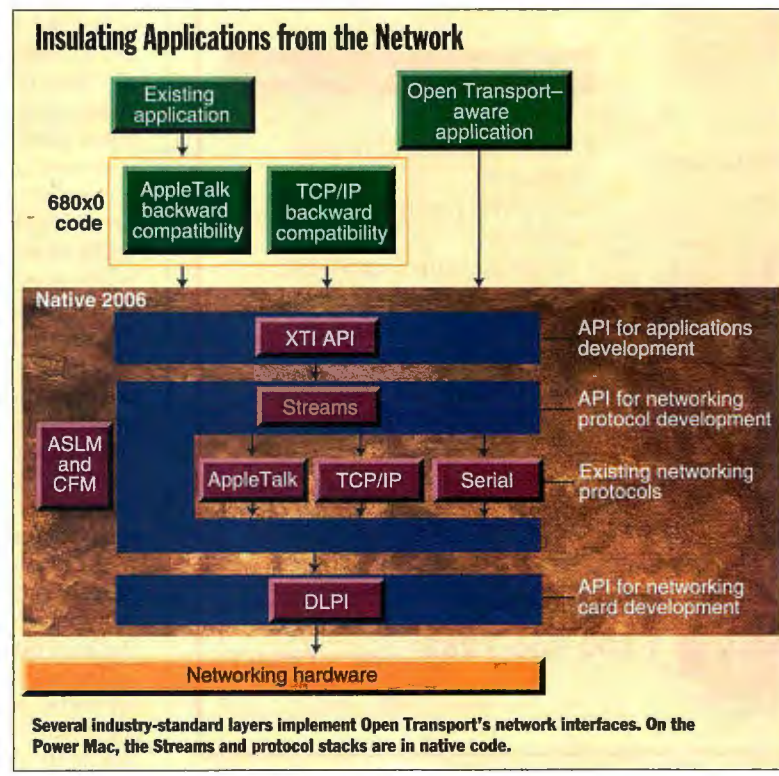
Open Transport is part of Apple's plan to uncouple the Mac OS from AppleTalk. This will allow it to provide such network services as peer-to-peer file sharing, remote access, and printing services with any network-protocol stack.

The ultimate goal is to make the next-generation Macintosh OS, code-named Copland (see "Copland: The Abstract Mac OS," July 1995 BYTE), completely transport-independent. Macs could then be better team players within any large network, regardless of protocol. Since Open Transport will be Copland's communications architecture, it thus serves as a bridge to help developers tackle these conversion issues now, rather than later.

Open Transport provides a set of cross-platform, standards-based APIs for network and communications protocols. Three standard APIs address the developer's needs at different implementation levels. At the highest level, applications designers use the X/Open Transport Interface (XTI), a Posix-compliant API, to write network-aware programs. XTI offers a set of protocol-independent functions that establish a network connection, send and receive data packets, and close a network session.

The next level serves as a foundation where developers build the network protocol stacks. This level uses a port of a Unix System V release 4.2–compatible Streams environment. The different protocol stacks operate within the framework Streams provides, as shown in the figure "Insulating Applications from the Network" below.

Protocol stacks are written as message-passing modules. Each module is single-threaded, shares the same address space with other modules (typically the kernel space),



Several industry-standard layers implement Open Transport's network interfaces. On the Power Mac, the Streams and protocol stacks are in native code.

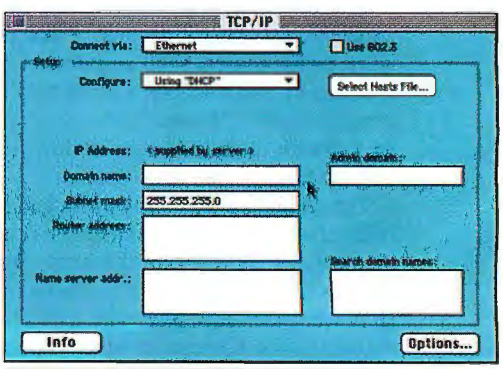
and handles messages asynchronously. To conserve system resources, protocol stacks are loaded only on demand. On PowerPC-based Macs, the Code Fragment Manager (CFM) dynamically loads and links the protocol modules; on 680x0-based Macs, the Apple Shared Library Manager (ASLM) handles this task.

Finally, at the lowest level, Open Transport conforms to the X/Open Data Link Provider Interface (DLPI) standards. DLPI describes the format and order of the messages exchanged between the protocol modules and the device driver. Thanks to the PCI-bus interface standards, a new network card is electrically plug-and-play-compatible with a PCI Power Mac. Furthermore, through Open Firmware, Power Macs equipped with PCI slots can automatically locate, load, and configure the new driver into the appropriate level of the Open Transport environment.

The initial release of Open Transport offered revised AppleTalk and TCP/IP protocol stacks. The latest release, 1.1, adds stacks for ATM and Token Ring, and the AppleTalk and TCP/IP stacks have enhanced support for remote connections using PPP. The TCP/IP stack now implements Ethernet version 2 and IEEE 802.3 framing. This stack also sports new features, including support for DHCP for IP-address configuration, IP multicasting for use as an MBone client, and simultaneous TCP connections. Open Transport's DHCP has been tested against a variety of servers, including Windows NT Advanced Server, Hewlett-Packard's HP-UX, and Sun's Solaris.

A New Look

Open Transport's user interface has been revamped to support some of the new features brought about by the changes in the underlying architecture. Formerly, you used a Network Control Panel to choose an AppleTalk network interface, such as the LocalTalk port or an Ethernet card. A MacTCP Control Panel let you adjust the various TCP settings. Such settings determined which interface to use (LocalTalk, TCP, or a third-party PPP implementation), whether to get an IP address from a server, and the correct IP addresses for a gateway and domain servers. An optional MacTCP Adminstration Panel allowed a system administrator to preconfigure the IP addresses for users.



In expert mode, the TCP/IP Control Panel lets you configure a number of TCP settings.

With Open Transport, you now have two configuration applications: AppleTalk and TCP/IP. Since users expect to change settings from Control Panels, the file types for these applications have been modified so that they appear as Control Panels in the Control Panels folder. Both AppleTalk and TCP/IP offer three different levels of network administrative control: basic, expert, and administrator. You choose the level from the User Mode selection under the Edit menu.

The basic, or novice, level offers only a minimum of choices: typically, selecting the network connection and, perhaps, how the system establishes a network address (e.g., using DHCP to obtain an IP address). An advanced, or expert, mode enables you to

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tinker with the majority of the protocol's configuration settings.

TCP/IP's advanced settings let you specify domain names, the name server's IP address, the HOSTS file, a subnet mask, and other TCP esoterica (see the screen on page 180). You can also request that the protocol stack be loaded on demand.

The administrator mode is identical to the expert mode, but it allows the system administrator to lock specific settings. To prevent other users from tampering with these settings, entering this level requires a password.

Connection Issues

Of course, Open Transport would face marginal acceptance if existing network applications that used the old network services broke under the new architecture. To this end, Open Transport provides limited backward compatibility. A compatibility layer of 680x0 code intercepts calls made at the driver level for AppleTalk (the .ddp-driver API) and TCP (the .ipp-driver API). These driver calls are translated into equivalent Open Transport XTI calls and then routed to the corresponding protocol stack. Incoming packets undergo a reverse process.

Unfortunately, applications that use undocumented API calls or that rely on information in private data structures will break. Another problem area is performance: Applications that use the old interfaces suffer a performance hit, even though the new protocol stacks are in native code. The data packets sent using the old interfaces must pass through a 680x0 compatibility layer, a context switch, the native protocol stack, and possibly another context switch if the device driver isn't in native code. File sharing in particular shows poor performance, because the File Sharing Extension still uses 680x0 processor code and communicates via the old AppleTalk APIs.

On the other hand, up-to-date applications that use the Open Transport APIs can benefit from the speedy native protocol stacks and drivers. Apple has measured a claimed sustained-throughput speed of 112 Mbps for standard 155-Mbps ATM cards.

The road to transport independence hasn't been glitch-free. The initial 1.0 release offered excellent AppleTalk support, but the TCP/IP stack had a number of problems, which created trouble for Internet and IP network applications that worked fine with the MacTCP implementation. In some instances, users tossed the Open Transport TCP libraries and dropped the old MacTCP Control Panel back into their System Folder. Remarkably, this trick worked and solved the worst of the TCP problems. It's a tribute to the Mac OS's design that this work-around functioned at all.

Open Transport got off to a rocky start, but by release 1.0.8, the TCP/IP stack problems were corrected, and IP applications began working reliably. In addition, a problem with obtaining an IP address from a DHCP Windows NT server was resolved. A patch to the DMA serial driver fixed most serial I/O problems. Release 1.1 fixes more bugs, and its performance tuning improves Ethernet throughput. The addition of FDDI, ATM, and Token Ring support was also welcome.

Fundamentally changing the communications infrastructure of an OS while trying to retain some backward compatibility is not easy, as Apple has learned. But it was clearly a necessary step if the Macintosh was to remain a viable part of future high-speed networks. More important, problems that are dealt with now should mean fewer problems with Copland when it ships. ■

Tom Thompson is a BYTE senior technical editor at large. He writes extensively on Mac-related and general computing issues. You can contact him by sending E-mail to tom_thompson@bix.com.

Windows NT Event Logging

Windows NT has a well-defined error management system

TERRY FREDERICK

One of the most important functions of any mainframe applications software is the reporting of processing errors. Error reporting is a critical tool computer operators can use to ascertain the health of their systems.

Windows NT programmers can use an error-reporting API that categorizes errors by application, severity, category, and event. Contrast this with most OSes, where error reporting is inconsistent, virtually up to the idiosyncrasies of the programmer. NT also provides tools to analyze errors. Remote procedure calls (RPCs) manage these tools. Thus, networked operators can examine errors occurring on remotely located computers.

Additionally, NT has a set of APIs to read and manage the error logs. These APIs let the NT programmer build sophisticated error-monitoring and analysis tools that are consistent across applications. In this article, we will demonstrate the various APIs that generate error messages and describe how NT monitors events.

Quick Start

It's often worthwhile to get your code up and running as soon as possible. Here is a quick-and-dirty subroutine that will send an error to the NT error event log:

```
#include <windows.h>
#include <stdio.h>
void SendLogMessage (char *szMsg)
{
 HANDLE  hSource;
 char    *szList[1];
  szList[0]=szMsg;
  hSource = RegisterEventSource(NULL,
"MYPROGRAM");
  if (hSource != NULL)  {
     ReportEvent(hSource,EVENTLOG_INFORMA-
TION_TYPE,
         0,ERROR_MESSAGE,NULL,1,0,szList,NULL);
     DeregisterEventSource(hSource);  }
}
void main (argc, argv)
int     argc;
char    *argv[];
{ SendLogMessage("This is a generic informa-
tion message");
}
```

`RegisterEventSource` is similar to an `open()` function; it returns a handle you can use to send messages to the event log. The parameter "`MYPROGRAM`" identifies which subsystem is sending the error. If "`MYPROGRAM`" is unknown to the event logger, the logger will default to reporting the message to the application log.

This program gets your message to the log, but it defeats the nifty features of NT's error logging. Because "`MYPROGRAM`" is an unknown subsystem to the event logger, you can't set up a filter to display only the "`MYPROGRAM`" errors. Also, the event type is always `EVENTLOG_INFORMATION_TYPE`, the category is always zero, and the event ID is zero (the second, third, and fourth arguments).

The first enhancement you should make is to identify your application name to the event logger. You do this by adding entries into the registry in the event log area (see the listing below). Note: You must be logged on as administrator to execute this program and change the registry.

After executing this code (you will need a `main()` routine to call `InstallSource()`), you can execute the regedt32 program, select the HKEY_LOCAL_MACHINE window, then the SYSTEM group, CurrentControlSet,

How to Add Entries to the Event Log

```
void InstallSource()
{
HKEY hk;
int disposition, allowed;
char szName[256];

strcpy(szName,"SYSTEM\\CurrentControlSet\\
Services\\
    Eventlog\\Application\\");
 strcat(szName,"MYPROGRAM");
 if (RegCreateKeyEx(HKEY_LOCAL_MACHINE,szName,

0,NULL,REG_OPTION_NON_VOLATILE,KEY_ALL_ACCESS,
     NULL,&hk,&disposition))
 {  printf("Unable to create registry key");
    return;
 }
 strcpy
(szName,"%SystemRoot%\\System\\MYDLL.DLL");
 if
(RegSetValueEx(hk,"EventMessageFile",0,
REG_EXPAND_SZ,
      (LPBYTE)szName,strlen(szName)+1))
 {  printf("Unable to create/set registry
      value (message DLL name)");
   return;
 }

allowed=EVENTLOG_ERROR_TYPE|
EVENTLOG_WARNING_TYPE|
   EVENTLOG_INFORMATION_TYPE;
 if
(RegSetValueEx(hk,"TypesSupported",0,REG_DWORD,
     (LPBYTE)&allowed,sizeof(DWORD)))
 { printf("Unable to create/set registry value
(message types)");
   return;
 }
 RegCloseKey(hk);
}
```

Services, Eventlog, Application, and finally (whew!) MYPROGRAM to verify the entries did get created and look reasonable. The value for TypesSupported should be 7.

Meaningful Messages

Having defined your application for the event log, you can look in the event viewer and set a filter under the view menu to display only "MYPROGRAM" errors. However, there is more in this `InstallSource()` subroutine than merely declaring your application name.

Why did we add a value under the MYPROGRAM area called "`EventMessageFile`" and give it a value of "`MYDLL.DLL`"? We also added a value called TypesSupported, containing the flags `EVENTLOG_ERROR_TYPE`, `EVENTLOG_WARNING_TYPE`, and `EVENTLOG_INFORMATION_TYPE`. Obviously, the TypesSupported flags represent the types of errors that can be reported within the MYPROGRAM subsystem, but what is "`MYDLL.DLL`" and what does it represent?

One of the banes of error logging is the inability to change error messages after the programmer has compiled the code and sent it to production to be installed. Imagine an error-reporting system that separates the error messages from the application program, so that the error messages can be changed to accommodate understandable English rather than the jargon that programmers often produce. (We especially like the message we've seen from many different programmers: "Invalid error code.") Or imagine being able to change messages to another language entirely, without changing one line of code.

The NT developers created the concept of a message DLL. Such a DLL contains "almost" no code and is simply a shell to hold message strings. The message strings are generated outside the DLL and can be implemented in a manner similar to other resources (e.g., dialog boxes and ICONs). In other words, the resource compiler binds the messages into the DLL. The complete DLL code looks like this:

```
#include <windows.h>
BOOL WINAPI DllMain(HINSTANCE hDLL,
    DWORD dwReason, LPVOID lpReserved)
{ return(TRUE);
}
```

A message compiler included in Microsoft Visual C++ generates the resource file used to create the noncode contents of the DLL. The input source to the message compiler follows a simple format to represent the error message. It contains the error code's symbolic name, the error code, and the error text. Dynamically generated error messages are also supported.

Here's a simple example of the message file:

```
MessageId=1
SymbolicName=TEST_ERROR_1
Language=English
This is error event code 1.
.
MessageId=2
SymbolicName=TEST_ERROR_2
Language=English
This is event code 2.
.
MessageId=999
SymbolicName=ERROR_MESSAGE
Language=English
%1
.
```

The output from the message compiler is an `.h` file that you include in your application program. This `.h` file contains the symbolic names of your error message along with the associated error code. An `.rc` source file and a `.bin` file with the actual messages to be input to the DLL compiler are also generated.

If you save the preceding source in a file called `mydll.mc`, you can create the `.h`, `.rc`, and `.bin` files with the command `mc mydll.mc`.

To generate the `MYDLL.DLL`, simply create a new project in Visual C++ of type DLL, add the message DLL source and the output `.rc` and `.bin` files from the message compiler, and then build the DLL. You should then copy the generated DLL to the system DLL directory, and the `.h` file to your applications directory for inclusion in your application. (A help file that describes all the features of the message compiler is found in the Visual C++`msdev\bin` directory and is called `mc.hlp`.)

The listing below is the complete source to a console application that registers itself to the event logger and then sends messages based on our sample message file.

Last Log

As NT moves into the applications server environment, NT programmers can do it right and generate consistent error reports that easily plug into error management systems. We hope we've shown that the NT event-logging system can be something useful, not something to ignore. ■

Terry Frederick is a consultant working for Sprint. He has 27 years of programming experience. You can reach him at terryf@sound.net.

Event-Logging Application

```
#include "mydll.h"
#include <windows.h>
#include <stdio.h>
void SendLogMessage (HANDLE hSource,
  DWORD errcode, WORD errtype, char *szMsg)
{ char    *szList[1];
  if (szMsg!=NULL)
  { szList[0]=szMsg;
    ReportEvent(hSource,errtype,0,errcode,
     NULL,1,0,szList,NULL);
  }
  else
    ReportEvent(hSource,errtype,0,errcode,
      NULL,0,0,NULL,NULL);
}

void main (argc, argv)
int     argc;
char    *argv[];
{ HANDLE  hSource;
 InstallSource();
 hSource = RegisterEventSource(NULL,
   "MYPROGRAM");
 SendLogMessage(hSource,TEST_ERROR_1,
    EVENTLOG_WARNING_TYPE,NULL);
 SendLogMessage(hSource,TEST_ERROR_2,
    EVENTLOG_ERROR_TYPE,NULL);
 SendLogMessage(hSource,ERROR_MESSAGE,
    EVENTLOG_INFORMATION_TYPE,
    "This is a generic information message");
 DeregisterEventSource(hSource);
}
```

Marrying ISDN to the OS

Dial-up connectivity is easier when the operating system knows the score

JEFFREY FRITZ AND
SALVATORE SALAMONE

Remote LAN access is wonderful. It allows access to Internet and LAN resources no matter where the user is located. However, remote LAN access has been hindered because computer operating systems and network operating systems (NOSes) have not been made fully aware of the wide-area network connection.

WANs have peculiarities not found in LANs. For example, to reduce communications charges, it is preferable to not keep a connection in place when the user is not accessing the network. Therefore, network devices are customarily programmed to drop calls when there is no user data to send across a WAN link. However, network traffic, such as keep-alives and routing updates, must still pass over the WAN even when no user data is present.

WAN equipment vendors attempting to deal with this dilemma have met with only limited success. Spoofing, a technique used by network devices to trick a NOS into thinking that a connection is in place when it really is not, is far from the ultimate WAN solution (see "Network Spoofing," December '94 BYTE). The reason is that the right place to deal with WAN-related issues is not in network hardware devices, such as bridges or routers, but in the OS or the NOS. If the operating system is smart enough to realize it is dealing with WAN connections, it can then control the calling patterns and adjust keep-alives and updates accordingly.

Wanting to support WANs in a better fashion, vendors such as Microsoft and Novell have begun incorporating ISDN into their OS and NOS. Users should benefit from both vendors' efforts. Specifically, remote users dialing into a network or the Internet over an ISDN link should be able to more easily set up the connection. And managers who are connecting LAN-based users in remote offices to corporate backbones will not have to worry about interoperability problems arising from incompatible, proprietary spoofing implementations.

A Window of Opportunity

Microsoft wants to make ISDN as easy to use as installing a modem. "By making ISDN an integral part of the operating system, we will remove another barrier for ISDN adoption," says Bill Shaughnessy, ISDN product manager.

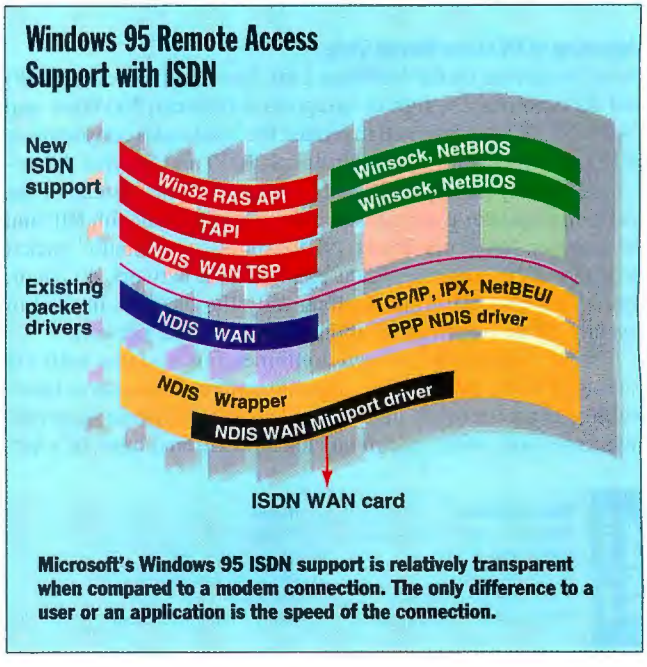
Last year, the company developed a related architecture for Windows NT. It's called the network driver interface specification (NDIS) packet driver WAN Miniport ISDN architecture. Now, the company has ported this to Windows 95 (see the figure "Windows 95 Remote Access Support with ISDN"). Win 95 users can get ISDN capability by downloading free software from on-line locations, such as Microsoft's Web site (http://www.microsoft.com/support/). The upgrade software will also be bundled with ISDN products from several vendors.

Windows 95 supports the Internet Engineering Task Force's Point-to-Point Protocol (PPP). PPP allows network protocols, such as TCP/IP, IPX/SPX (Novell), and NetBEUI to operate over ISDN WAN links. Microsoft has developed PPPMAC, an NDIS 3 PPP driver that installs in the network control panel. To network protocols, PPPMAC looks like a network (LAN) driver. However, behind the scenes it is responsible for getting bits to the other side of the ISDN remote connection.

Windows 95's ISDN support is relatively transparent. From an application or user point of view, nothing changes except for the connection speed. Applications continue to create connections, using Remote Access Service (RAS), an API, or a Winsock. When the user creates a new connection in the Dial-Up Networking folder, he or she simply chooses the ISDN adapter instead of a modem in the dialog box.

Third-party product integration is relatively straightforward. Using the built-in ISDN protocol stack, the vendor's driver talks directly to the WAN Miniport architecture. This eliminates the need to use third-party IP protocol stacks, like Chameleon or LAN Workplace for Windows.

continued



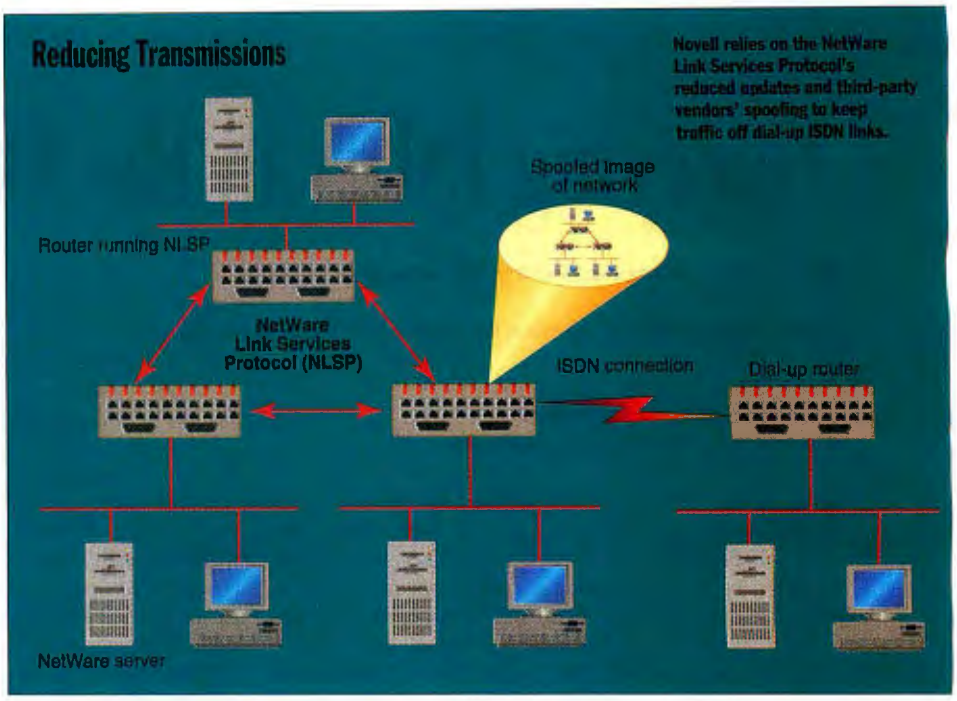
Microsoft's Windows 95 ISDN support is relatively transparent when compared to a modem connection. The only difference to a user or an application is the speed of the connection.

Native ISDN support also means vendors will be able to release products in shorter development cycles. This will result in ISDN products coming to market faster and at lower cost than would be possible if vendors had to write their own device drivers.

That's because an independent hardware vendor needs to create only an ISDN WAN Miniport driver for its product. The driver uses the Windows API to send information to the RAS. The RAS makes the telephony API (TAPI) calls to create the connection. A TAPI Service Provider, called the NDIS WAN, then passes the TAPI calls to an NDIS WAN Miniport via the NDIS Wrapper. Once the connection is made, PPPMAC sends and receives data to the NDIS WAN Miniport. Therefore, the RAS becomes the interface for all ISDN remote LAN access.

Unfortunately, the first Windows 95 ISDN release leaves out some features usually found in ISDN network devices. Multilink PPP (MP), for example, is not supported. MP aggregates multiple B channels for increased WAN bandwidth. This means that, at least initially, Windows 95's ISDN is limited to a bandwidth of 64 Kbps (the bandwidth supported by one ISDN B channel). However, Microsoft says it intends to include MP in a future release.

Additionally, the first Windows 95 ISDN release supports only Microsoft's proprietary compression algorithm. Users can access devices that do not use Microsoft's compression technology, but the connection will default to no compression. However, Microsoft is likely to support any future Internet Engineering Task Force standard compression algorithm for PPP over ISDN. Spoofing is also missing from the initial release. Microsoft says it plans to incorporate a similar feature, called suspend/resume, in a future version of Windows 95 ISDN.



Managing WAN Links Novell Style

Novell is relying on the NetWare Link Services Protocol (NLSP) and APIs to make a tighter integration between NetWare and ISDN. NLSP was designed to reduce the bandwidth consumption of IPX Routing Information Protocol (RIP) and Service Advertising Protocol (SAP) broadcasts over a network. Instead of the traditional updates every 30 seconds as is common with RIP and the constant SAP broadcasts, NLSP sends out a "hello" packet once every 10 minutes. When changes in a network do occur, routers running NLSP pass along only the changes instead of sending all the information about the state of the network.

Novell's approach—which combines few updates with the passing of fewer bits of information in each update—saves bandwidth over any network link, be it a backbone Ethernet network, an internetwork with sites connected by dedicated lines, or a network where sites are connected by dial-up ISDN links.

While NLSP is a significant improvement over traditional RIP and SAP, you still don't want to pay phone charges just to pass along "hello" packets when nothing has changed. Bringing up a link every 10 minutes translates into 144 calls every day. For that reason, Novell still relies on third-party vendors for spoofing to summarize the topology behind a link and to propagate the changes once a connection is made by a user's initiative (see the figure "Reducing Transmissions" above).

NLSP will evolve to be more ISDN-aware, according to Mark dela Vega, a product line manager in Novell's Internetworking Products Group. He sees NLSP keeping an ISDN link down until some type of synchronization between sites is necessary.

Another area where Novell helps integrate ISDN with the NOS is through its Open Data-Link Interface for Wide-Area Networks (ODI WAN) specification. This specification gives WAN adapter developers a way to tap Novell's configuration and connection-management software.

ODI WAN plays a role similar to that of a driver for a traditional network adapter card except that it works for WAN connections. Basically, ODI WAN is an interface layer between a WAN adapter, the LAN communications protocols (IPX/SPX), and the WAN protocols. To integrate with the NetWare environment using ODI WAN, a developer need only write a driver and a configuration database module for its WAN adapter.

Such steps by Novell, and Microsoft's introduction of ISDN support into Windows 95, will eventually lead to full WAN integration into their operating systems. Over time, this will reduce the complexity and cost of ISDN products. ■

Where to Find

Microsoft Corp.	**Novell**
Redmond, WA	Orem, UT
(800) 426-9400	(800) 453-1267
(206) 882-8080	(801) 222-6000
fax: (206) 936-7329	fax: (800) 668-5329
http://www.microsoft.com	http://www.novell.com

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WHAT'S NEW Hardware

PREVIEW PENTIUM PRO WORKSTATIONS

Two Drives Are Better Than One

Sys Technology offers a line of Pentium Pro workstations for prices that may cause Gateway to sell off some cattle. The single-CPU Performance Pro 200 comes with the P/I-P6RP4 motherboard by AsusTek (runner-up of BYTE's Best System award at Computex Taipei) and the same high-quality components found in many of the 150-MHz Pentium Pro systems from leading U.S. vendors. But the Sys machine one-ups many of its competitors with two Quantum 1.28-gigabyte EIDE hard drives, a V.34 modem, Sound Blaster 16 with SCSI-2, and a 200-MHz CPU. The Performance Pro 200 comes with a smaller monitor (15-inch versus 17-inch), but you still get a lot of bang for your buck.

CRAIG ALNESS © 1996

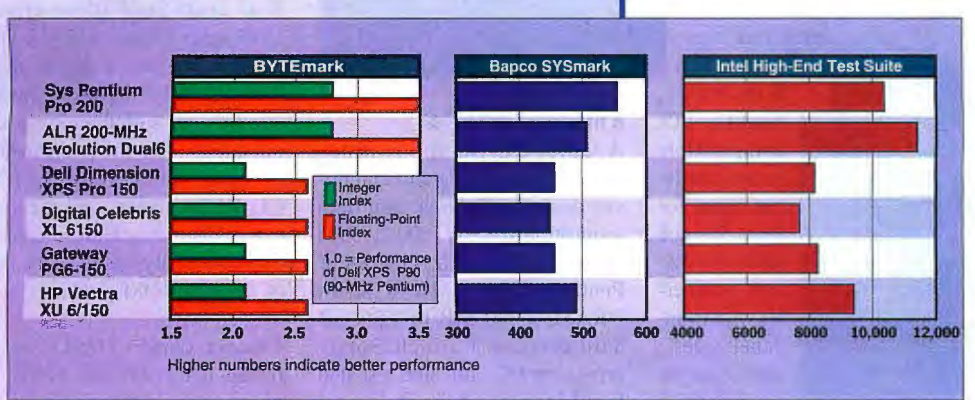
Performance Pro 200
$6435 as tested
Sys Technology, Inc.
Cypress, CA
(800) 613-9963
(714) 821-3900
fax: (714) 821-9592
http://www.systechnology.com
Circle 1021 on Inquiry Card.

The AsusTek P/I-P6RP4 motherboard is similar to Intel's Aurora motherboard in that it uses Intel's 82450KX (Orion) chip set and has four PCI slots, three ISA slots, and a ZIF CPU socket. The P/I-P6RP4 hosts a proprietary MediaBus extension on one PCI slot for AsusTek's optional multifunction multimedia cards, and it accepts 150-, 166-, 180-, and 200-MHz Pentium Pros, thanks in part to its upgradable voltage-regulator module.

The Performance Pro 200's chassis is a compact mini-tower with two 5¼-inch and one 3½-inch drive bays available for expansion. The system can hold as much as 512 MB of 60-nanosecond-or-faster 72-pin DRAM SIMMs, with support for ECC. The problem I see here is that with all four RAM banks filled, only the lowest ISA slot can hold a full-length ISA card. Our review system had 64 MB of 60-ns parity RAM.

Pentium Pro PCs will appeal to engineers using 32-bit OSes, so we ran all the benchmarks under Windows NT. The Sys machine's BYTEmark scores (strictly CPU and FPU) equal those earned by ALR's 200-MHz Evolution Dual6; ALR's dual-CPU architecture translated into faster performance in Intel's High-End Test Suite, but the Performance Pro 200's superior hard drive system drove its SysMark scores to top the charts. Next time I go system shopping, I'm going to call Sys Technology.

—Selinda Chiquoine



QUAD-INTERFACE LINE-IMPACT PRINTER

Mannesmann Tally's latest mission-critical line-impact printer, the T6045 FourPlex I/O ($5225), includes IBM twinax and coax, RS-232, and IEEE 1284 parallel interfaces. All the interfaces are live at all times, and the printer automatically determines which interface is in use.
Contact: Mannesmann Tally Corp., Kent, WA, (800) 843-1347 or (206) 251-5524; http://www.tally.com.
Circle 1024 on Inquiry Card.

ULTRASPARC WORKSTATION

The UWS1/140 workstation from Integrix includes a 143-MHz UltraSparc-compatible processor, 32 KB of L1 cache, 512 KB of L2 external cache, a 10Base-T Ethernet interface, three SBus slots, two serial ports and one parallel port, Fast SCSI-2, and audio interfaces for a microphone, line-in/line-out, and headphones. On-chip multimedia support includes 2-D and 3-D graphics, MPEG video compression/decompression, and image, video, and audio processing. Hardware options include a floppy drive, a CD-ROM drive, accelerated graphics, additional SBus slots, and 100Base-T Ethernet, Fast Ethernet, FDDI, and ATM connectivity.
Contact: Integrix, Inc., Newbury Park, CA, (800) 300-8288 or (805) 375-1055; sales@integrix.com.
Circle 1025 on Inquiry Card.

KEYBOARD WITH TOUCHPAD ▼

The GlidePoint Wave Keyboard ($129) combines the GlidePoint stationary pointing device, which translates finger movement across a touchpad into cursor movement on the screen, and a split 108-key layout with Windows 95 keys, a built-in wrist rest, and extra backspace, tab, and mouse keys.
Contact: Cirque Corp., Salt Lake City, UT, (800) 454-3375 or (801) 467-1100.
Circle 1028 on Inquiry Card.

HIGH-SPEED RAID SUBSYSTEM

Based on Mips Computer Systems' 32-bit R3000 RISC CPU, the LANForce R2000 RAID Subsystem supports up to 512 MB of read-and-write data cache and RAID levels 0, 1, 1+0, 4, and 5. The subsystem (from $5395) offers storage capacity of more than 1 terabyte, a data transfer rate of up to 20 MBps, and access times as low as 6 ms. You can choose between a rack-mounted enclosure or a deskside enclosure, each with up to seven hard, tape, magneto-optical, or removable-cartridge drives. The LANForce R2000 supports NetWare, Windows NT, SCO Unix, DOS, and OS/2.
Contact: Procom Technology, Inc., Irvine, CA, (800) 800-8600 ext. 414 or (714) 852-1000; http://www.procom.com.
Circle 1027 on Inquiry Card.

WHAT'S NEW Hardware

SVGA LCD PANEL

An active-matrix 800- by 600-pixel LCD panel, the Impact 400 ($6295) is compatible with SVGA, VGA, and XGA formats. The panel's source-recognition system can identify most computer and video sources and set itself up accordingly. A built-in RGB video interface can handle full-motion video projection, or you can easily connect composite video and S-video using an external video adapter. With Impact 400's BatMouse infrared remote mouse, you can control the computer from anywhere in the room.

Contact: Ask LCD, Inc., Lyndhurst, NJ, (800) 275-5231 or (201) 896-8888; ASKPLAVIN@aol.com.

Circle 1039 on Inquiry Card.

NFS FILE SERVER

The FastFile Pro's multiprocessor architecture incorporates a 100-MHz Pentium processor fully dedicated to NFS file transfer. Up to four dedicated PCI RAID processors handle RAID functions such as parity generation, hot swap, and reconstruction. A typical FastFile Pro configuration delivers 250 GB of storage in a choice of RAID levels 0, 1, 0+1, RAID 3 equivalent, 5, or just as plain old disks. You can configure each of the system's four RAID controllers with up to 21 hard drives in 1-, 2-, 4-, or 9-GB capacities. By adding external devices with 126 volumes in total, the FastFile Pro can achieve maximum storage capacity as high as 8 terabytes. The FastFile Pro's operating system, AerReal, is compatible with all Unix flavors and can link it with hardware platforms from Sun, Silicon Graphics, IBM, Hewlett-Packard, and DEC, as well as other NFS-compatible systems. A tower system with 16 MB of RAM; two 1-GB hard drives; a 7-GB native, 8-mm tape drive; a CD-ROM drive; a monitor; a keyboard; redundant power; an Ethernet interface; and software starts at $18,995.

Contact: Falcon Systems, Inc., Sacramento, CA, (800) 326-1002 or (916) 928-9255; http://www.falcons.com/sdd.

Circle 1023 on Inquiry Card.

OS/2 PENTIUM SYSTEMS ▼

The Einstein Series consists of the Archimedes, a desktop system; the Galileo, a mini-tower; the Pythagoras, a full tower; and the Heisenberg, a 133-MHz dual-Pentium tower. All systems include Intel Advanced/EV Endeavor system boards; Intel 75-, 100-, 120-, or 133-MHz Pentium processors; 16 MB of RAM (expandable to 32 MB) and 256 KB of cache memory; Sound Blaster audio with an MPC-II-compatible joystick interface; two PCI IDE connectors (two dedicated ISA, three dedicated PCI, and one shared); single-chip I/O (e.g., two 16C550 UARTs and one ECP port); a keyboard; a mouse; a 3.5-inch floppy drive; and OS/2 loaded. Prices run from $1599 to $2109.

Contact: Indelible Blue, Inc., Raleigh, NC, (800) 776-8284 or (919) 878-9700; http://www.indelible-blue.com/ib.

Circle 1031 on Inquiry Card.

PCI EXPANSION BOX

A general-purpose bus expansion box, the PXB-7 ($1995) adds seven PCI slots to a PC—six wired for 32-bit DMA bus mastery and one wired as a "slave." The desktop or rackmountable expansion box supports SCSI, Ethernet, multiple I/O, and multiple video cards; has room for three 5¼-inch and two 3½-inch peripherals with front-panel access; and can be daisy chained to a maximum of 139 PCI slots.

Contact: Magma, San Diego, CA, (800) 285-8990 or (619) 457-0750; sales@magma.com.

Circle 1037 on Inquiry Card.

A RUGGED LAPTOP ▲

A laptop PC for applications such as field testing and diagnosis, communications, and data acquisition, the FW7600 ($7995) includes a 100-MHz 486DX4 or Pentium CPU; 1 MB of 32-bit DRAM; a 340-MB to 1.36-GB hard drive; a 3.5-inch floppy drive; one PC Card slot; a sealed Field MousePad input device; and a color 10.4-inch dual-scan LCD. Hardware options include an environmental package (for protection from rain and electromagnetic interference), a CD-ROM drive, and three full-size ISA or PCI slots.

Contact: FieldWorks, Inc., Eden Prairie, MN, (612) 947-0856.

Circle 1029 on Inquiry Card.

PERSONAL CD-ROM TOWER

With Short Stack (three drives, $995; four drives, $1295), you get simultaneous access to up to four CD-ROM drives, allowing you to work within multiple applications. The tower enclosure supports standard-height IDE CD-ROM drives, and the system's Sound Selector, a Windows 95 utility, displays the title of the CD-ROM media present in each drive.

Contact: Gradco (USA), Inc., Irvine, CA, (714) 206-6100.

Circle 1026 on Inquiry Card.

SPLIT-KEYBOARD MULTIMEDIA NOTEBOOK

The SENS810 (call for prices) comes with an Intel Pentium CPU running at clock speeds of up to 120 MHz; a PCI bus with bus mastering; a removable hard drive (540 MB to 1.6 GB); 16 MB of EDO memory and 256 KB of pipeline burst-mode L2-SRAM cache; an 11.3-inch color active-matrix or dual-scan display; SVGA and XGA support; a DCI full-motion-video local bus accelerator; NTSC/PAL TV presentation; stereo speakers; 16-bit stereo sound; a DSVD cellular 28.8/14.4 fax/modem; full-duplex speakerphone capability; and an IRDA-compatible infrared port. The notebook also comes with a split-design adjustable keyboard, which you can configure for Windows 95, and a Touchpad pointing device. You get 5.5 hours of primary battery life or, when you add the optional second battery pack, more than 10 hours of uninterrupted computing time, Samsung says. Options include an internal quad-speed CD-ROM drive.

Contact: Samsung Electronics America, Inc., Ridgefield Park, NJ, (800) 726-7864 or (201) 229-4000.

Circle 1022 on Inquiry Card.

MULTIMEDIA STORAGE SYSTEMS

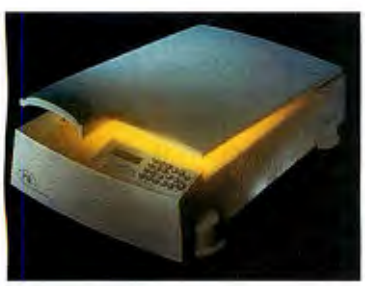
With the PSS-PD series of storage devices ($699 to $999), you can read information off a CD-ROM, edit or combine it with data on a hard drive, and then write it back to a rewritable optical disk. Functioning as a quad-speed CD-ROM player, the PSS-PD system provides 600-KBps data transfer and supports most CD formats. Functioning as an optical drive, the unit provides expandable storage using rewritable, removable 650-MB phase-change optical cartridges. As a logical drive, you treat the PSS-PD system as if it were another hard drive connected to your system. As a backup system, with the included PSS Backup Software, the PSS-PD products provide data archiving on removable 1.3-GB (650-MB native) optical cartridges.

Contact: Parallel Storage Solutions, Elmsford, NY, (800) 998-7839 or (914) 347-7044.

Circle 1034 on Inquiry Card.

MULTIFUNCTION MACHINE

ScanMedia ($895) integrates a flatbed color scanner, a plain-paper Group 3 fax module, and copier capabilities. The scanner supports 30-bit color and 10-bit



gray-scale operation, as well as 300- by 600-dpi optical and 2400- by 2400-dpi interpolated resolutions. ScanMedia can transmit faxes at 14.4 Kbps, receive faxes at 9600 bps, and send incoming faxes to a printer or store them in a 1-MB image buffer. The photocopier resolution is 300 dpi, depending on the printer, and you can reduce and enlarge images by as much as 200 percent.

Contact: Pacific Image Electronics, Inc., Torrance, CA, (800) 909-9996 or (310) 214-5281; pieus@earthlink.net.

Circle 1033 on Inquiry Card.

VOICE/FAX MODEM CARD WITH SPEAKERPHONE

The SmartLink ConferencePal V.32 terbo voice/fax modem with speakerphone ($149) automatically distinguishes between data, fax, and voice transmissions. The modem transfers data at up to 19.2 Kbps or, by adding V.42bis MNP 5 data compression, up to 76.8 Kbps. It supports broadcast fax and fax-on-demand. The ConferencePal can record digitized greetings and voice messages for up to 10 personalized mailboxes and lets you access the answering machine/voice-mail system locally or remotely.

Contact: Archtek America Corp., City of Industry, CA, (818) 912-9800; http://www.archtek.com.tw.

Circle 1030 on Inquiry Card.

PORTABLE CD-ROM DRIVE

The Portable CD with Sound ($449), which combines a quad-speed CD-ROM drive and a Windows-compatible 16-bit stereo sound card, lets you add multimedia capabilities to your 386, 486, or Pentium PC. You connect the drive to your desktop or laptop PC's parallel port and plug your printer into the back of the Portable CD with Sound. Your printer can print normally, even when you are using the CD-ROM drive.

Contact: Addonics Technologies Corp., Fremont, CA, (800) 787-8580 or (510) 438-6530; http://www.addonics.com.

Circle 1032 on Inquiry Card.

POWER MAC IMAGE GRABBER FOR SCIENTIFIC USERS

A frame grabber for Power Macs with PCI bus slots, the DT3155-PM ($995) operates as a bus master, continuously transferring unlimited consecutive frames to the system display or acquiring sequences of images up to the amount of the system's memory. The package includes NIH Image software, an image-processing and analysis application that provides functions such as object measurement and intensity analysis.

Contact: Data Translation, Marlboro, MA, (800) 525-8528 or (508) 481-3700; http://www.datx.com/.

Circle 1035 on Inquiry Card.

MONITOR TELEPHONE TRAFFIC

With Whozz Calling? you can monitor four phone lines and transfer call data to a printer, computer, or on-board memory. Using caller ID technology, Whozz Calling? ($495; with memory, $595; with memory and modem, $695) can capture callers' names and numbers. You can use the information to identify sales prospects, provide better customer service, bill clients, and build customer databases.

Contact: Zeus Phonstuff, Norcross, GA, (800) 240-4637 or (770) 263-7111.

Circle 1038 on Inquiry Card.

PC CARD DATA ACQUISITION PRODUCTS

The DASCard PIO-12 ($199) features parallel digital I/O of up to 12 bits, so you can collect, output, and analyze data in the field on your notebook. The DASCard 232 ($229) lets you add an RS-232 port to a notebook computer. The DASCard 422/485 ($229) lets you add either an RS-422 or RS-485 port.

Contact: Keithley MetraByte, Taunton, MA, (800) 348-0033 or (508) 880-3000; http://www.metrabyte.com.

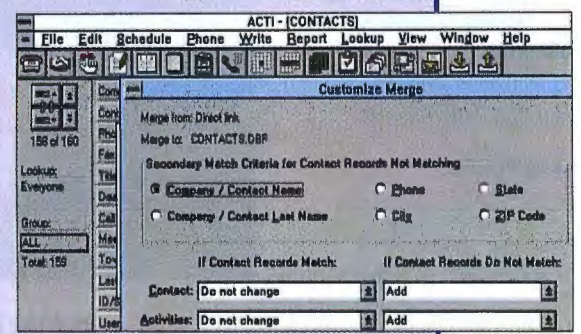
Circle 1036 on Inquiry Card.

WHAT'S NEW Software

PREVIEW PDA CONTACT MANAGEMENT

Psion and Act!: A Marriage of Convenience

The new version of Act! for the Psion Series 3A provides powerful contact-management capabilities for the hand-held device. Act! for Psion lets you view and sort your contacts' histories in various ways to get a better overview of your appointment planning. It also lets you create templates for correspondence, such as faxes and thank-you letters. In addition, the program's links to the Windows version keep your contacts and appointments in sync between the Psion and your PC.



Act! for the Psion closely mimics the user interface of Act! 2.0 for Windows and, using a modem or the Psion serial link, you can easily exchange data between your PC and the Psion. Longtime Psion users may find that exporting data from the Psion's integrated database application into Act! will require them to do some data massaging. Furthermore, because Act! for Psion associates individual appointments with contact files, the program can't import files from the Psion device's built-in Agenda application.

Act! for Psion
$99.95
Symantec Corp.
Cupertino, CA
(800) 441-7234
(503) 334-6054
fax: (408) 253-9600
http://www.symantec.com
Circle 976 on Inquiry Card.

After I'd exported my data from the Psion's Data database into Act! for the Psion, I was able to populate an Act! for Windows database in about two minutes. However, the link between the desktop PC and the hand-held device could be tighter: When you want to add new contacts from the Psion to an existing database on the PC, you first have to do a customized merge (see the screenshot above). In this scenario, the program must copy all the data from the Psion to the desktop before it can determine which contacts are old (and don't need to be copied) and which contacts are new. I find Palm Computing's one-button hot synchronization feature, as seen in the Pilot hand-held device, faster and easier. And Symantec hasn't determined if it will add a link to Act! for the Macintosh, which I also use.

These small complaints aside, I like Act! for the Psion. It is much more powerful than the Psion's Data program, and it integrates both contact management and appointments seamlessly. — Dave Andrews

NETSCAPE FOR SOLARIS SPARC AND X86

The Netscape family of servers and browsers are now available for Solaris Sparc and X86 environments. A network Web browser, Netscape Navigator 1.12 (10-user license, $235) provides a single GUI for accessing Internet resources. The Netscape Communications Server 1.12 ($1149) maintains security while you publish on the World Wide Web and other TCP/IP-based networks. In addition to the features of the Netscape Communications Server 1.12, the Netscape Commerce Server 1.12 ($2449) helps you conduct secure financial transactions over global networks. The Netscape Proxy Server 1.12 ($2249) provides network security for TCP/IP networks, and the Netscape News Server 1.12 ($2249) allows organizations to create public and private discussion groups for employees and customers.
Contact: SunExpress, Inc., Chelmsford, MA, (800) 873-7869 or (508) 442-0005; http://www.sun.com/sunexpress/.
Circle 981 on Inquiry Card.

CREATE CUSTOM CDs

With Alchemy ($2995), you can create custom CDs from common PC files. Running under Windows 3.x and Windows 95, the program imports files in native format and retrieves data by Boolean searches, Query by Example, or filename. Built-in compression squeezes up to 3 gigabytes of data on a standard 74-minute CD-R. For production-level imaging, you can combine Alchemy with Data Grabber ($3995), an automated parser and extractor that works on ASCII files, including PRINT and COM files from mainframe computers.
Contact: Marcan, Inc., Bellevue, WA, (800) 635-7477 or (206) 635-7477; marcan@halcyon.com.
Circle 988 on Inquiry Card.

FLEXIBLE SECURITY FOR WINDOWS AND DOS

Fortres 101 protects stand-alone and networked Windows or DOS systems from unauthorized use. The program provides flexible security over operations such as boot process, file manager, icon and group additions/modifications, system files, and DOS prompts. Fortres 101 can also ensure that PCs in unsupervised computer labs and those used by several people have the same setup each time the computer boots up.
Contact: Fortres Grand Corp., Plymouth, IN, (800) 331-0372 or (219) 935-3868.
Circle 987 on Inquiry Card.

WINDOWS MAPPING AND MARKETING SOFTWARE

A multiple CD-ROM package, ProfitZone ($35,000) combines electronic mapping software with a database of more than 10 million businesses. Maps are searchable at the street level. Hot links provide instant updating of information even in midsearch. The business database offers company names, addresses, telephone numbers, stock exchange information, sales volume, Fortune company indicators, SIC code numbers, headquarters vs. branch locations, and executive contact names and titles.
Contact: Database America Companies, Inc., Montvale, NJ, (800) 711-4913 or (201) 476-2000; Profitzone @databaseamerica.com.
Circle 982 on Inquiry Card.

MANAGE YOUR PAPER

Now you can organize your paper and electronic information by putting a "file cabinet" in your Windows PC. PaperMaster 2.0 ($169) stores paper from virtually any source into personalized file cabinets, drawers, and folders. You can search for keywords in titles, annotations, and document contents; rank matching documents in order of relevancy; and list the keywords found within each document. PaperMaster also lets you E-mail a document you are viewing as an attachment, combine individual pages from multiple sources into one document, and display miniature representations of documents in the inbox or in a folder window.
Contact: DocuMagix, Inc., San Jose, CA, (800) 362-8624 or (408) 434-1138; http://www.documagix.com.
Circle 984 on Inquiry Card.

NETWORK LICENSE TOOLKIT

A floating-license toolkit for PC and Unix applications, LicenseServ helps you implement network licensing schemes over networks that use TCP/IP or IPX/SPX protocols and have multiple servers. The program supports various licenses, including floating/concurrent, node-locked, site, group, personal, machine-based, and version-controlled. LicenseServ (PC platforms, from $2500; Unix and VMS platforms, from $5000) eliminates the need for hardware keys or dongles and allows upgrades and changes via phone, fax, or E-mail.

Contact: Central Design System, Inc., Santa Clara, CA, (800) 366-2374 or (408) 327-9800; info@cdsi.com.

Circle 990 on Inquiry Card.

INTERNET MAIL CLIENT FOR TCP/IP

An Internet mail client for TCP/IP and corporate networks, Pronto Mobile ($99) allows remote users to quickly screen and prioritize large volumes of E-mail. The program's messaging capabilities include MAPI and POP3; support for encrypted binary files and attachments; multilingual spelling checker; customizable toolbar, fonts, and headers; and drag and drop of messages into multilevel folders.

Contact: CommTouch Software, Inc., San Mateo, CA, (415) 578-6580; http://www.commtouch.com.

Circle 985 on Inquiry Card.

GEAR DESKTOP BUNDLE ON CD-ROM

The Gear Multi-OS Desktop Bundle CD-ROM (English, German, and French versions, $299; Kanji version, $349) includes Gear CD-Recordable software for Windows 3.1, 95, and NT; Mac OS and Mac OS for Power Macintosh; and OS/2 Warp. The bundle features interleaving, archiving, a scripting language, error-code reporting, verify-after-write, jukebox and transporter support, DDP premaster output, and sector-level layout.

Contact: Elektroson, Inc., Bala Cynwyd, PA, (800) 606-6116 or (610) 617-0850; sales@elektroson.com.

Circle 991 on Inquiry Card.

BUSINESS IN A BOX

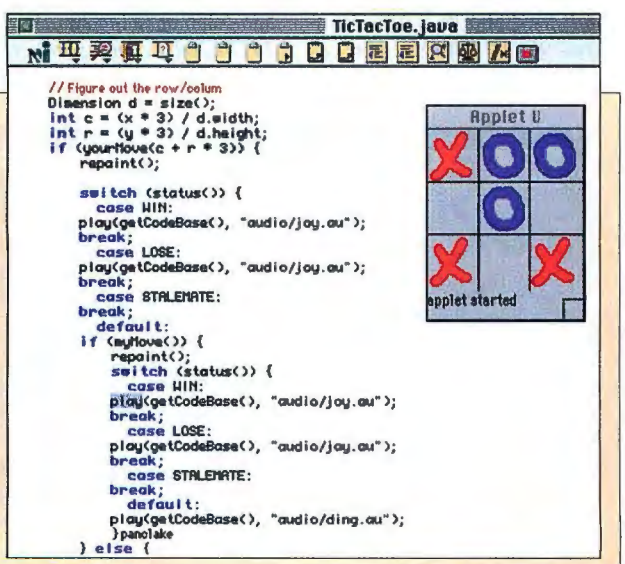
A Windows-based business solution, Total Management ($395) includes general ledger, accounts payable, accounts receivable, project and time management, order entry and invoicing, office automation, inventory control, purchase orders, check reconciliation, payroll, contact management, telemarketing, E-mail, network services, and electronic communications. The source code is available in a self-documenting CASE form that lets you expand upon, enhance, or modify it to your needs.

Contact: All Star Software, Inc., Evansville, IN, (800) 553-5783 or (812) 476-5049; 76702.2745@compuserve.com.

Circle 992 on Inquiry Card.

JAVA FOR THE MAC

Roaster ($299) lets Macintosh developers work in the Java language. The package includes a Java source code compiler; a Java class disassembler; a Java debugger; a code editor; search and replace features, including regular expression matching and batch search capabilities; QuickCode Pro technology; multiple clipboards for organizing code snippets; macro capabilities; and bookmark tools. The project window lets you organize class files for easy access without searching through directories. With the make feature, you can recompile specific files before you run them, jump to any method within a class in the window, represent packages hierarchically, and open more than one project window at a time and drag source files between projects.



Contact: Natural Intelligence, Inc., Cambridge, MA, (800) 999-4649 or (617) 876-7680; http://www.natural.com.

Circle 977 on Inquiry Card.

Software Update

An electronic software distribution product, **WinInstall 5.1** identifies software setup modifications made to the registry and automatically builds the appropriate instructions to properly install and uninstall 32- and 16-bit applications for Windows 95 and NT. From $495 for a 50-seat license.

Contact: OnDemand Software, Inc., Naples, FL, (800) 368-5207 or (941) 261-6678; http://www.ondemand.com.

Circle 995 on Inquiry Card.

A 32-bit native Windows 95 add-on to your current fax application, **3D Fax 2.0** can encode and transmit up to 32 KB of compressed data in Standard mode or 110 KB of compressed data (up to 200 pages of text) in Professional mode on a single page; exchange binary files and send editable or executable files via PC fax; and compress and encode PC files into special digital codes. Standard version, $99; Professional version, $199.

Contact: InfoImaging Technologies, Inc., Palo Alto, CA, (800) 966-1140 or (415) 960-0100; http://www.infoimaging.com.

Circle 999 on Inquiry Card.

Enhancements to **NeuralWorks Predict 1.9**, a tool for developing and deploying on-line solutions, include support for Windows NT and 95; the option to write trained networks in FlashCode for Visual Basic and FORTRAN; an improved advanced-mode dialog, which collects the most often used settings; duplicate record compression; and revisions to the selection scheme for training, testing, and validating data sets. $1995.

Contact: NeuralWare, Inc., Pittsburgh, PA, (800) 635-2442 or (412) 787-8222; http://www.neuralware.com.

Circle 1002 on Inquiry Card.

WHAT'S NEW Software

DRAG-AND-DROP EVERYWHERE IN WINDOWS 95

With WinZip 6.0a ($29), you can drag-and-drop in order to bypass menus and dialog boxes for many common tasks. The program handles compression formats found on the Internet, supporting ZIP, TAR, gzip, and Unix compressed files or, optionally, ARC, ARJ, and LHA files via external programs.
Contact: Niko Mak Computing, Inc., Bristol, CT, (800) 242-4775 or (203) 585-5376; http://www.winzip.com.
Circle 983 on Inquiry Card.

MULTILINE FAX-ON-DEMAND

A Windows 95 version of Ibex Technologies' multiline fax-on-demand and fax broadcast system, Fax-It-Back ($1495) allows callers to request documents by phone and automatically delivers them via fax. Working with one to four U.S. Robotics Sportster voice/fax Vi modems, the program can also perform high-volume, multiport fax broadcasting simultaneously with fax-on-demand operations. You can enter documents by faxing them directly to Fax-It-Back or by converting Windows documents to fax format using the Windows 95 print-to-fax driver.
Contact: Ibex Technologies, Inc., El Dorado Hills, CA, (800) 289-9998 or (916) 939-8888; http://www.ibex.com.
Circle 993 on Inquiry Card.

WEB DEVELOPMENT FOR BUSINESS-CRITICAL APPLICATIONS

The Web Element provides a portable, custom Web browser and development capabilities for Internet and intranet developers. Available initially for Windows and Solaris, the Web Element (about $45 per user with a 500-user deployment license) lets you embed Web browsers into business-critical applications and integrate Web components into your distributed applications.
Contact: Neuron Data, Inc., Mountain View, CA, (800) 876-4900 or (415) 528-3450; http://www.neurondata.com.
Circle 989 on Inquiry Card.

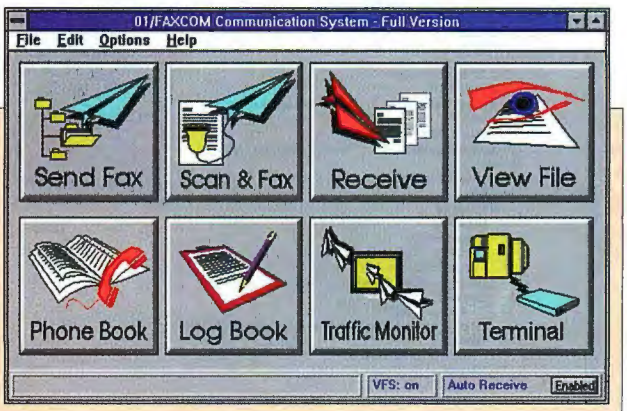
MULTIMEDIA AUTHORING FOR WINDOWS 95/NT

With MediaForge 2.0 for Windows 95/NT ($1495), you can create multimedia products using script manipulation; dynamic linking; MIDI, WAVE, and CD sound; smooth path animation; and OLE controls. The program provides an object editor, a Visual Basic editor, and more than 100 special effects.
Contact: Strata, Inc., St. George, UT, (800) 678-7282 or (801) 628-5218; http://www.strata3d.com.
Circle 979 on Inquiry Card.

WORD PROCESSING AND TRANSLATION

Accent Duo With Translation ($149) combines Accent's multilingual word processor with Globalink's Language Assistant translation software. The combination of bilingual word processing and translation speeds conversion of entire documents and parts of documents from English/German, English/French, English/Italian, and English/-Spanish. You can edit the document in either or both languages.
Contact: Accent Worldwide, Inc., Newport Beach, CA, (800) 535-5256 or (714) 223-0620; 74774.264@compuserve.com.
Circle 986 on Inquiry Card.

INTEGRATE FAX AND CONTACT MANAGEMENT



01/Faxcom combines fax and data services with a contact manager, an OCR engine, and a graphics editor. Data communications features include automatic dialing, support for popular file transfer protocols, and an unattended mini-host with user passwords, greeting messages, dial-back action, and call logging. The OCR engine is up to 98 percent accurate, the vendor says, and can correctly identify fonts, attributes, underlines, and tables. The graphics editor lets you work at the pixel level as well as cut, paste, rotate, and import/export common graphics file formats.
Contact: 01 Communique Laboratory, Inc., Mississauga, Ontario, Canada, (800) 668-2185 or (905) 795-2888; 72762.53@compuserve.com.
Circle 978 on Inquiry Card.

Software Update

WGS Linux Pro 3.0, a 32-bit multiuser, multitasking, multimedia network operating system, includes a primary WGS Linux Pro 3.0 CD with X Window GUI, graphical administration tools for systems configuration, Web server setup, FTP setup, multiple-user account management, and three supplementary CDs with the latest Linux offerings. $99.
Contact: WorkGroup Solutions, Inc., Aurora, CO, (800) 234-7813 or (303) 699-7470; http://www.wgs.com.
Circle 997 on Inquiry Card.

TeleMagic Enterprise 2.0, a system for workgroups needing to share contact information, contains a three-level relational database; multimedia communications features, including fax software, a data-synchronization module, and telephone integration; a Write interface with mail merging; expanded reporting, labeling, and envelope support; and branch scripting and sales forecasting modules. Single user, $500; 1-5 user network, $1300; 1-10 user network, $2300.
Contact: TeleMagic, Inc., Dallas, TX, (800) 835-6244 or (214) 733-4292.
Circle 1000 on Inquiry Card.

Publishing software for the World Wide Web, **InContext Spider 1.1** provides 28 quick-start templates for home pages and more than 200 images of clip art that you can use on your Web site; full support for HTML 2, HTML 3, and Netscape Navigator and Microsoft Internet Explorer extensions; bubble help; drag-and-drop links and images; and right-mouse-button access to common editing functions. About $79.
Contact: InContext Corp., Bethesda, MD, (800) 279-6564 or (301) 571-9464; http://www.incontext.ca.
Circle 1001 on Inquiry Card.

BYTE

BUYER'S GUIDE

Essential Products and Services for Technology Experts

Mail Order

Top mail-order vendors offer the latest hardware and software products at the best prices.

194

Hardware/Software Showcase

Your full-color guide to in-demand hardware and software products, categorized for quick access.

218

Buyer's Mart

The BYTE classified directory of computer products and services, organized by subject so you can easily locate the right product.

226

You'll find it in the heartland of America.

...in the hot and dusty cab of a giant combine, using a GPS and recording crop yields

You'll find it in demanding environments

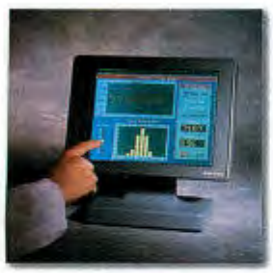
...such as hospitals supplying critical Point-Of-Care information at the touch of a finger

When faced with selecting a PC for control or data processing systems, designers usually must choose between a desktop system, notebook or an expensive single board industrial computer.

DATALUX now offers an alternative with the essential PC system components in a series of unique packages that both save space and are easy to integrate.

THE DATABRICK from DATALUX

A **tough, *compact PC*** solution that offers the modularity of a desktop system and the ***small size*** of a notebook.



Stand-Alone LCD Monitors
DATALUX is in its 4th year of LCD monitor manufacture and is an industry leader. Its new LCD Monitors use brighter 10.4" diagonal Dual-Scan or TFT Color panel in a rugged, sealed, yet attractive housing with a selection of 8 wall or base mounting options. Resolution is 640 x 480. The monitors can be driven directly from a Databrick or through an ISA bus controller. No external power is required. An integrated resistive **Touch Screen** is optional with input through one of the Com Ports. Monitors may be extended to 50' from the CPU.

Keyboards
The Space-Saver keyboard is the smallest full function 100 key keyboard available. With standard left right spacing touch typing is easy yet the overall size is only 6" x 10.75".
It is available in a flat, panel mount or desktop model. The Glidepoint® pointing device is available as an option.

FAX BACK DATA SHEETS (540) 662-1675

Databrick Vertical Systems
The new DATALUX Databrick Vertical System (DVS) combines the Databrick, LCD Monitor and the Space-Saver Keyboard in a unique enclosure for Wall, Swing Arm, or Pedestal Mounting. The all aluminum housing provides compactness and security. The monitor screen tilts to accommodate the height of the user. A variety of options include bar code and mag stripe readers, speakers, or a small printer. The DVS measures 13.5" x 19.6" x 3.2".

Databrick
The Databrick is the heart of the DATALUX system. In performance and features it is more like a desktop unit, in size comparable a notebook (10.25" x 4.8" x 2"), yet more rugged and more easily mounted than either.

Specifications:
486DX2/66 or DX4/100 CPU
2-64 Meg Standard SIMM DRAM
Internal or External FDD
Internal HDD to 540 Meg
SVGA CRT and LCD Video Ports w/1Meg
2 Serial, 1 Extended Parallel Port

Options:
2 slot PCMCIA
10Bt Ethernet LAN
Com Ports 3 & 4
DC-DC Power converter

DVS shown here on Rolling Stand

DATALUX

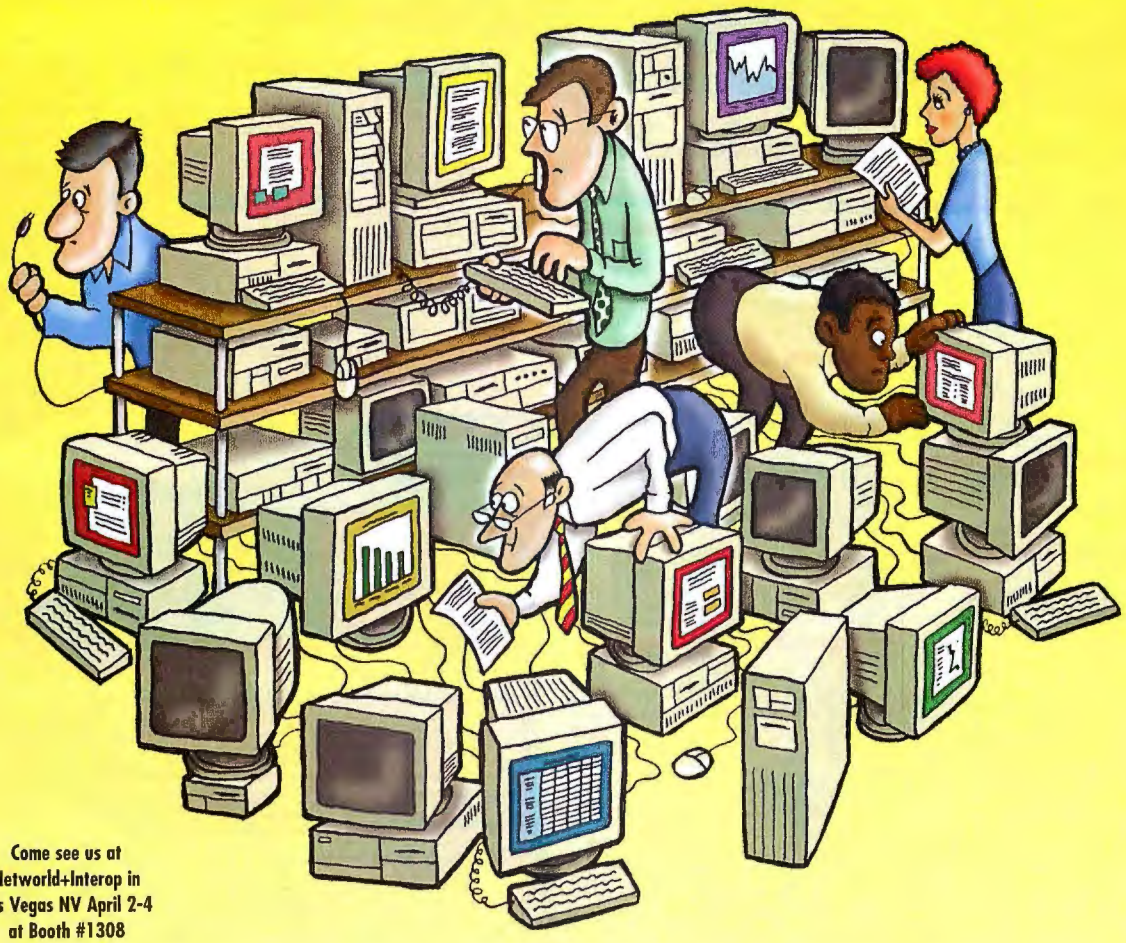
http://www.datalux.com

Datalux Corporation
155 Aviation Drive
Winchester, Virginia 22602
Phone: (540) 662-1500
Fax: (540) 662-1682
Toll Free: 1-800-328-2589
(1-800-DATALUX)

Datalux International, LTD
Euro House Curtis Road,
11 Old Water Yard
Dorking, Surrey
UNITED KINGDOM RH41EJ
Phone: 44+(1)306-876718
Fax: 44+(1)306-876742

Circle 121 on Inquiry Card.

Lost in the Maze?



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Our Commander products let you control and operate all of your computers through one keyboard, monitor and mouse. Get rid of all of those costly, space eating peripherals, and suddenly your network isn't quite so scary anymore. And since there's a whole family of Commanders, one is right for you. Whether you need fast, easy, access to a few PCs, or you manage a multiplatform server room, system control is right at your fingertips. Today's configurations are more challenging than ever - but they shouldn't make you feel like a laboratory experiment! For simple, consolidated control of all your system resources, give us a call.

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4912 Research Drive Huntsville, AL 35805 USA
1-800-932-9239 (205) 430-4030 fax
http://www.cybex.com

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MEMORY

FOR PC's, WORKSTATIONS, PORTABLES & PRINTERS

FOR MEMORY PRODUCTS NOT LISTED, CALL FOR PRICING & AVAILABILITY

AST MEMORY

MODEL	MEMORY	AST PART#		PRICE
Bravo LC Series, Bravo MT, Bravo MS			72 Pin	$174
MS-L, Advantage Pro DX33,SX25			72 Pin	330
			72 Pin	619
			72 Pin	1399
Premmia LX P/60, MX4/66d, 4/100T, P/60			72 Pin	365
			72 Pin	620
			72 Pin	1325
			72 Pin	2595
				365
				620
				1325
			72 Pin	2595
			72 Pin	376
	2Meg	500780-001	64 Pin	388
	4Meg Kit	500780-001	64 Pin	398
	2Meg	500780-003	64 Pin	59
		500780-004	64 Pin	195
	4Meg	501595-001/501598-001		378/699
	16Meg	501567-001/501568-001		958/2298

ZENITH MEMORY MODULES

MODEL	MEMORY	ZENITH PART#	PRICE
Z386/33, 25, 20, 33E	1Meg	ZA3800ME	$59
Z386/33, 25, 20, 33E, 486/25E	4Meg	ZA3800MK	180
Z386SX	1Meg	Z-605-1 KIT	119

MAGNAVOX

286/386SX-16, 386SX-20, 486SX-20 & 386-33 all are 72 PIN SIMM

1MEG-$59 4MEG-$180 8MEG-$349 16MEG-$659

IBM PS/1, PS/2 MEMORY MODULES

IBM PART NO.	FOR MODEL NO.	PRICE
30F5360 (2Meg)	30-286, 25-286, 80 MTHR BD	104
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6450908 (2Meg)	70-A21, A-61, 9-21, 9-61, 35SX, 35LS, 40SX Val Pt.3257	90
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	55SX, 55LS, 65SX, 40SX, 35SX, 35LS	175
	P/S1 & P/S1/386SX-2121	109
	P/S1 & P/S1/386SX, Model-2121	189
	PSI Expert, Consultant, Willow	175
	Value Point Performance, PC Server 4/66	175
	Aptiva 310, 330, 350, 510, 530, 710, 730	189
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	Value Point Performance, PC Server 4/66	339
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	56, 57, 57SX, 90, 95, P-75, 57SLC	90
6450128 (4Meg)	Value Point 77 486DX2, 466SX SVR 85 57SX, 90, 95, P-75, 57SLC, 56,56SLC, P/S1	175
	386SX, Mod-2123, 2133, 2155, Val Pt 77 486C52, 486SX, 486DX2 SVR85	
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56G0064 (16Meg)	Thinkpad 755, 360, 355, 340, 450	629
6189998 (4Meg)	Thinkpad 500, 510CS (3.3Volt)	209
6189099 (8Meg)	Thinkpad 500, 510CS (3.3Volt)	389
6189113 (16Meg)	Thinkpad 500, 510CS (3.3Volt)	869
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79F1000 (4Meg)	LX40, N33SX, PS Note, Thpd 350, 350c	189
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Aero 4/25, 4/33L	4Meg	190532-001	184
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		—	—	96	—	179	—	349	669	1249
		159	219	—	—	—	—	—	—	—
		—	139	—	229	—	—	—	—	—
		69	99	—	169	—	379	599	—	—
		89	—	208	—	327	—	—	—	—
		89	—	208	—	327	—	—	—	—
		—	119	—	233	—	—	—	—	—
		—	109	—	189	—	—	—	—	—
		—	109	—	189	—	—	—	—	—
		69	89	—	169	—	349	—	—	—
		—	—	—	—	—	—	—	—	—
		69	—	—	169	—	349	—	—	—
		—	89	—	175	—	349	—	—	—
		—	89	—	175	—	349	—	—	—
		—	—	—	—	—	—	—	—	—
		55	—	—	169	—	349	—	—	—
		—	89	—	175	—	349	—	—	—
		109	—	—	289	—	469	837	—	—
		—	—	—	—	—	—	—	—	—
		—	—	—	169	—	350	—	—	—
		—	—	—	—	—	—	—	—	—
		—	99	—	199	—	—	—	—	—
		119	199	236	—	—	—	—	—	—
		—	139	—	—	—	—	—	—	—
		—	99	—	—	—	—	—	—	—
		—	125	—	—	—	—	—	—	—
		135	189	—	—	—	—	—	—	—
		—	139	—	227	—	—	—	—	—
		—	159	—	269	—	—	—	—	—
		—	129	—	229	—	—	—	—	—
		—	125	—	195	—	—	—	—	—
		99	—	—	—	—	—	—	—	—
		89	129	—	229	—	—	—	—	—
		89	129	—	—	—	—	—	—	—
		89	149	—	245	—	—	—	—	—
		109	—	—	279	—	—	—	—	—
		85	—	—	—	—	—	—	—	—
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MC4110	1.05GB	9MS	SCSI-2	650-775
MC4221	2.05GB	8.5MS	SCSI-2	589-714
MC1936	3.0GB	11MS	SCSI-2	850-999
MC3243	4.3GB	8MS	SCSI-2	969-1094
MC1991	9.0GB	11MS	SCSI-2	1989-2244
MC2217AV	1.75GB	10MS	SCSI-AV	875-1823
MC4221AV	2.05GB	8.5MS	SCSI-AV	699-824
MC3243AV	4.3GB	8.5MS	SCSI-AV	1059-1200
MC1991AV	9.1GB	10MS	SCSI-AV	2119-2264

digital

FACTORY NEW-2 YEAR WARRANTY				INT-EXT
DSP3210	2GB	9.5MS	SCSI	$799-949

CONNER

FACTORY NEW-2 YEAR WARRANTY				INT-EXT
CFS635A	635MB	14MS	IDE	$165-335
CFS850A	850MB	14MS	IDE	190-340
CFS1081A	1.1MB	14MS	IDE	220-370
CFS1270A	1.3GB	14MS	IDE	249-399
CFS1621A	1.6MB	14MS	IDE	289-339
CFP1080S	1.06GB	11MS	SCSI-2	255-380
CFP2105S	2.1GB	9MS	SCSI-2	609-734
CFP2107S	2.1GB	9MS	SCSI-2	630-764
CFP4207S	4.2GB	9MS	SCSI-2	939-1064

IF YOU FDISKED YOUR DRIVE AND NEED IT RECOVERED. WE CAN DO IT. CALL FOR DETAILS

NEC

FACTORY NEW-3 YEAR WARRANTY				INT-EXT
D3727	1.1GB	11MS	IDE	$245-395
D3747	1.6GB	11MS	IDE	259-409
D3827	1.1GB	11MS	SCSI	225-350
D3847	1.6GB	11MS	SCSI	279-404

FUJITSU

FACTORY NEW-5 YEAR WARRANTY				INT-EXT
M1614T	1.1GB	11MS	IDE	199-349
M1606T	1.1GB	9.5MS	IDE	235-385
M1606S	1.1GB	13MS	SCSI	235-360
M2915S	2.1GB	9.5MS	SCSI	642-767
M2932S	2.1GB	10MS	SCSI	579-704
M2934S	4.3GB	10MS	SCSI	699-1024

HEWLETT PACKARD

FACTORY NEW-5 YEAR WARRANTY				INT-EXT
C3725S	2.1GB	9.5MS	SCSI	669-794

WIDE SCSI HARD DRIVES

CONNER

FACTORY NEW-5 YEAR WARRANTY				
1060W	1.0GB	9MS	3.5X1"	$699
2107SW	2.1GB	8.5MS	5400RPM	779
2107W	2.1GB	8.5MS	7200RPM	779
4207W	4.2GB	9MS	7200RPM	1189

Seagate

FACTORY NEW-5 YEAR WARRANTY				
ST31230W	1.0GB	9MS	3.5X1"	$536
ST32430W	2.1GB	9MS	3.5X1"	792
ST32550W	2.1GB	8MS	3.5X1"	899
ST15230W	4.2GB	9MS	3.5X1"	1042
ST15150W	4.3GB	8MS	3.5"	1346
ST410800W	9.0GB	11MS	5.25"	2279

Quantum

FACTORY NEW-5 YEAR WARRANTY				
XP32150W	2.1GB	8MS	3.5X1"	$840
VP32210W	2.2GB	8.5MS	3.5X1"	728
GP3430W	4.3GB	8.6MS	3.5"	1079
XP34300W	4.3GB	8MS	3.5"	1259

MICROPOLIS

FACTORY NEW-5 YEAR WARRANTY				
MC4221W	2.05GB	8.5MS	LP3.5	$745
MC3243W	4.3GB	8.5MS	3.5	1088
MC1991W	9.10GB	10MS	FH	2099
WIDE AUDIO VISUAL TUNED DRIVES				
MC4221WAV	2.05GB	8.5MS	LP3.5	$799
MC3243WAV	4.30GB	8.5MS	3.5	1139
MC1991WAV	9.10GB	10MS	FH	2199

TAPE BACKUPS

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C1534A 2.0GB TAPE INT.EXT	$652-762
35470A 2.0GB TAPE INT.EXT	749-849
1536 4GB TAPE INT/EXT	899-999
1533 4-8GB TAPE INT/EXT	999-1099
4MM 90MT DAT CART (1/5 PK)	18-86
4MM 120MT DAT CART (1/5PAK)	30-149
3.5"-5.25" CONVERSION KIT	39

SCSI-IDE CABLES

HARD DRIVE EXTERNAL CABLES	
CENTRONICS 50 TO SCSI-II	$50
CENTRONICS 50 TO MAC 25-PIN	25
CENTRONICS 50 TO CENTRONICS 50 6FT	25
CENTRONICS 50 TO CENTRONICS 50 3FT	20
CENTRONICS TO DB-50	50
DB-50 TO SCSI-II	50
DB-50 TO DB-50	50
SCSI-II TO SCSI-II	50
FAST WIDE TO CENTRONICS EXT	99
68 PIN WIDE TO WIDE 3FT EXT	99
HARD DRIVE INTERNAL CABLES	
SCSI 50-PIN RIBBON 2-3-4 DEVICE	$10-15-20
SCSI 50-PIN RIBBON 5-6-7 DEVICE	25-30-35
SCSI FAST 68-PIN WIDE 3 CONN 2 DEVICE	65
SCSI FAST 68-PIN WIDE 5 CONN 4 DEVICE	99
SCSI FAST 68-PIN WIDE 8 CONN 7 DEVICE	139
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VIDEO BOARDS

DIAMOND MULTIMEDIA

SpeedStar Pro 1MB ISA 1MB	$95
Stealth SE 2MB, PCI, VLB	105
SpeedstarStar 64 Graphics 2120, ISA 1MB	149
SpeedstarStar 64 Graphics 2220, ISA, 2MB	175
Stealth 64 Graphics 2120 DRAM, 1MB, PCI, VLB	119
Stealth 64 Graphics 2220 DRAM 2MB, PCI, VLB	175
Stealth 64 Graphics 2120XL 1MB, PCI, VLB	149
Stealth 64 Graphics 2220XL 2MB, PCI, VLB	199
Stealth 64 Video 2120XL VRAM 1MB VLB	169
Stealth 64 Video 2120XL VRAM, 2MB, VLB	229
Stealth 64 Video 3240XL VRAM, 2MB, PCI, VLB	329
Stealth 64 Video 3400XL PCI VRAM, 4MB	469
Viper Pro Video 2200XL PCI 4MB	565

COLORADO MEMORY SYSTEMS

Jumbo 1400 Internal	$229
Trakker 700 parallel port	329
HP Colorado T1000	185
DJ-50T 1360MB Tape Drive	269

CONNER

TapeStor 250MB Parellel Port	$199
TapeStor 420MB Parellel Port	260
TapeStor 850MB Internal	188
TapeStor 850MB Parellel Port	330

EXABYTE

4200C 4GB TAPE INT/EXT	$877-1027
8205XL 3.5-7GB TAPE INT/EXT	1325-1549
8505XL 7-14GB TAPE INT/EXT	2200-2498

MEGA

Bernoulli 230MB Insider SCSI	474
Bernoulli 230MB Transportable SCSI	474
90 MB/150MB/230MB Cartridge	89

MicroSolutions

BACKPACKS

DOUBLE SPD PARALLEL PORT CD ROM DRIVE	$339
QUAD SPD PARALLEL PORT CD ROM DRIVE	399
DISKETTE DRV 1.25-3.5DISKETTE DRV 1.4, 3.5	175
BACKPACK 600MB TAPE DRIVE	249
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Number Nine Computer Corporation

9FX Vision 330 1MB DRAM, PCI, VLB	$139
9FX Vision 330 2MB DRAM, PCI, VLB	179
9FX Motion 531 1MB DRAM, PCI, VLB	195
9FX Motion 531 2MB DRAM, PCI, VLB	225
9FX Motion 771 2MB VRAM, PCI, VLB	295
9FX Motion 771 4MB VRAM, PCI, VLB	445
9GXE Pro 1600 2 MB VRAM, PCI, VLB	549
9GXE Pro 1600 4 MB VRAM, PCI, VLB	719
Imagine 128 4MB VRAM	599
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Graphics Pro Turbo 4MB ISA, VLB, PCI	445

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Voyager 2MB VL-Bus	165

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SVGA 256K ISA	$38
SVGA 512K 1024 X 768 ISA	50
SVGA 1MB 1024 X 768 ISA	88

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SVGA 1024 X 768 1MB ISA VGA card	$88
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MK1924FC	540MB	15MS	SCSI	449
MK1926FC	810MB	13MS	IDE	399
MK2720FC	1.3GB	13MS	IDE	575

IBM

IBMHDN520	520MB	IDE	$399

Seagate

ST9096AG	90MB	16MS	$99
ST9300AG	260MB	16MS	199
ST9385AG	340MB	16MS	249
ST9420AG	420MB	16MS	299
ST9546AG	524MB	16MS	329
ST9816AG	810MB	16MS	479

FLOPPY DRIVES

TEAC

1.44MB, 3.5"	$37
1.2MB, 5.25"	47
DUAL FLOPPY 1.44MB & 1.2MB	99

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270MB INTERNAL SCSI	$375
270MB EXTERNAL SCSI	495
270MB CART SINGLES/5 PACK	73-350
270 PARALLEL PORT	549
270MB INTERNAL IDE	375
CARTS. 44MB/88MB	54-69-75-85
CARTS. 105MB/200MB	64-69-75-85
5200 200MB INT/EXT	399-599

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Half Ht for 3.5"IDE Drives for parallel port	$148
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5.25" Full Ht for (1) FH or (2) HH Devices (2 Bay)	199
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NEC CDR511 Quad Speed SCSI Int	279
NEC CDR512 Six Speed, SCSI-2, Int	329

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DC2300+	Enhanced IDE VLB w-16550 i-o	69
5030	32-Bit PCI BusMaster IDE Caching	159
DC440	BusMaster SCSI-IDE VLB w-10	179
DC540	BusMaster PCI SCSI-WIDE (no cable)	189

FUTURE DOMAIN

TMC1680	SVP 16-Bit 7HD-4FD	139
MCS700	16-Bit Micro Channel SCSI	159

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1505	CD ROM 16-Bit SCSI Kit	$75
1515	16 BitISA-SCSI 2 KIT	99
1520	16 BitISA-SCSI 2 (7 DEVICE CARD)	99
1522	16 Bit 7HD/2FD KIT	139
1522	16 Bit 7HD/2FD Card Only	119
1530PK	16 Bit ISA to FAST SCSI-II Kit	189
1542	Bus MasterCard Only	210
1542CPK	Bus Master Kit	249
1640K	MicroChannel for PS/2, 7HD	299
1670	ISA-SCSI AUDIO KIT	299
2940	32-Bit PCI SCSI-2 Kit	294
2940WK	32-Bit PCI Wide Kit	369
2742T	EISA KIT, 14HDs	369
2742W	FAST WIDE SCSI CARD	399
2825VL	Enhanced SCSI/IDE Kit	179
2842A	VL SCSI 2 VESA	259
1460	Slim SCSI PCMCIA SCCSI Card	289
3940	Dual Channel PCI Controller Kit	469
3940W	32-Bit DUAL CHANNEL KIT	475
3985	Kit PCI RAID controller for netware	839
T160	16-Bit SCSI	85
T348	Parallel Port to SCSI Plus	149
T358	Parallel Port to SCSI Plus Enhanced	199

Acculogic

s-IDE-2 PCI 2HD/Enhanced IDE	$399
s-IDE-3 2HD/2FD	49
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21	2HD, 4FD up to 2.88Mb	69
32	8 Multi-port IDE, Flpy, Tape,& I/O Accel	129

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-2 Kit	289
KT747C	32-Bit EISA Fast SCSI-2 Kit	299
BT757S	32-Bit EISA Fast Wide SCS Card	349
KT946C	32-Bit PCI Fast SCSI-2 Kit	290
KT956C	32-Bit PCI Fast Wide SCSI-2 Kit	329

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KT510A	ISA/IDE Cache Controller	95
KT410A	VESA/IDE Cache Controller	125
KT910A	PCI/IDE Cache Controller	185

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500	16550 2HD/2FD 2-16550 2s/1p/1g VLB	99

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CDS545 Quad Speed IDE Internal	$109
CDS545 Quad Speed IDE External	329

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PX-43CS	Internal 4-Speed, 256 Cache	$279
PX-45CS	External 4-Speed, 256 Cache	349
PX-63CS	Int 6-Speed, 256K Cache	355

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CD-55AB	SuperQuad 4X AT Drive	$189
CF-506A	ComboQuad 4X CD w/1.44 Flpy	239
CD-56E	Six Speed Int	210

TOSHIBA

XM5302A Quad Speed IDE Int/Ext	$179-329
XM3701 Six Speed SCSI Int/Ext	305-430

MITSUMI

CRMC-FX400 Quad Speed Int/Ext IDE	$119-269

SCSI-IDE CONTROLLERS

Q-LOGIC

QL-ISA-FL	16-Bit ISA	139
QL-VLB-FL	32-Bit VLB	209
QL-EISA-FL	32-Bit EISA	229
QL-PCMCIA	PCMCIA	249
QL-VLB-FL	32-Bit PCI Basic Entry Level	129
QL-PCI-10	32-Bit IIQ-PCI Wide SCSI-2	299

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2278D+	VESA 4 IDE/EIDE Device, FDD 16550 UART SERIAL, Parallel & Game Ports	$30
2278E	Same as 2278D+ W/ECP/EPP Port	35
2130PCI	PCI IDE/EIDE	30
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2270	PCI SCSI	128
3270VL	VLB SCSI	128

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Accura V.42 FAST 14.4 Internal	$89
Accura V.42 FAST 14.4 External	106
Accura V.34 FAST 28.8 Internal	179
Accura V.34 FAST 28.8 External	192
Optima V.34 w/voice Internal	289
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Optima V.32 FAST 14.4 PCMCIA Card	199
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US Robotics

Sportster 14.4 Internal	$89
Sportster 14.4 External	108
Sportster 28.8/V.34 Internal	192
Sportster 28.8/V.34 External	209
Sportster VI 28.8 V.34 Int	239
Courier V.34 28.8/28.8 Internal	387
Courier V.34 28.8/28.8 External	422
Courier 28.8 PCMCIA V.34	469

intel-PURE DATA

SatisFAXtion 200 Int	$229
SatisFAXtion 400 Int	299
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14.4 Fax/Modem Internal	$75
14.4 Fax/Modem External	100
28.8 V.34 Fax/Modem Internal	199
28.8 V.34 Fax/Modem External	215
14.4 PCMCIA Fax/Modem	165

BOCA

14.4 Internal	$79
28.8 Internal V.34	169
28.8 External V.34	209

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FOCUS 9000 PROGRAMMABLE	65

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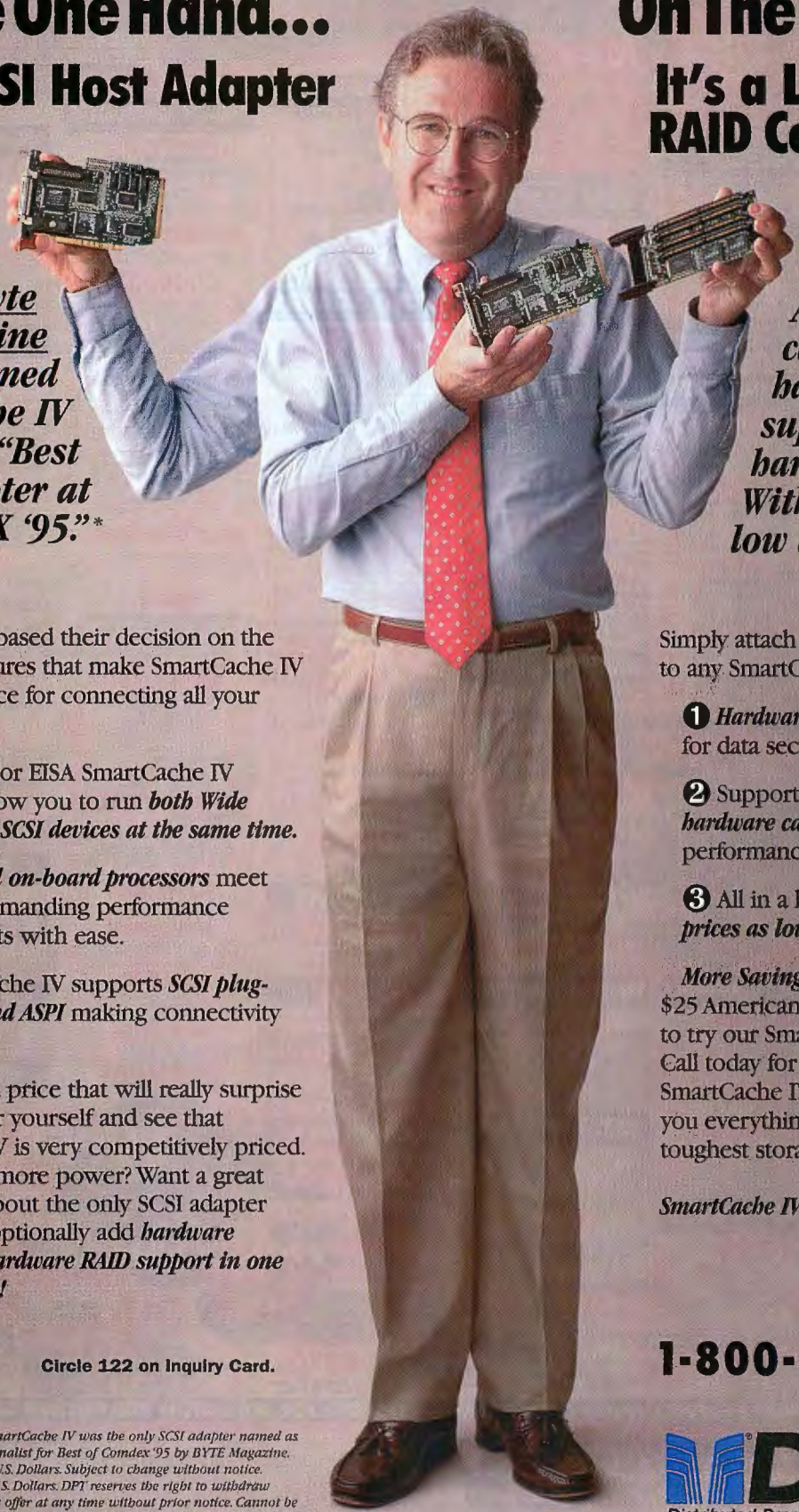

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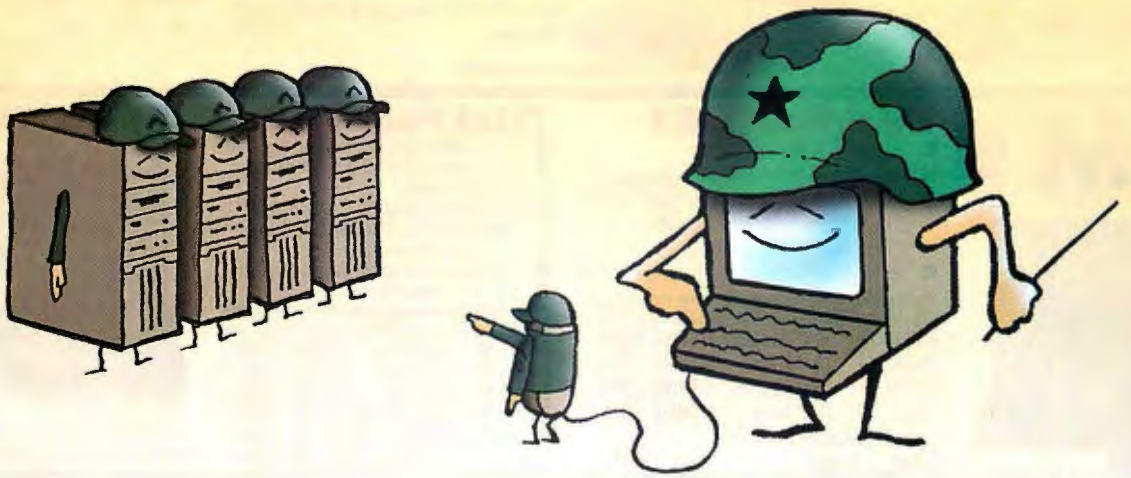

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Tecra 700

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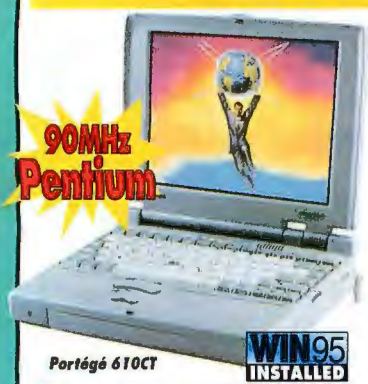
- Multimedia docking station with PCI bus (optional accessory, priced separately)
- Built-in 16-bit sound, microphone, **2 speakers** & MIDI
- **HUGE**, 1.13GB hard drives

WIN95 INSTALLED

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



Portégé 610CT

WIN95 INSTALLED

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

Satellite 2130CS/100CS

Satellite 2130CS/100CS

Processor	Screen	RAM/HD	Price
486DX4/75	10.4" Dual Scan	8/500MB	$1599
Pentium 75	10.4" Dual Scan	8/500MB	1969*

*EDO RAM

Satellite Pro 410

Satellite Pro 410

- Built-in 4X CD-ROM Drive (Swap floppy & CD-ROM) (Active models 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	$3199
Pentium 90	11.3" Active	8/772MB	4399

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- 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*

*Features built-in 2X CD-ROM drive

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 models 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	$4999
Pentium 90	12.1" Active	8/720MB	5499
Pentium 120	12.1" Active	8/720MB	5699
Pentium 120	12.1" Active	8MB/1.08GB	5999
Pentium 90	12.1" Active	8MB/1.2GB	6699*
Pentium 120	12.1" Active	8MB/1.2GB	6899*

ThinkPad® 760

*Features built-in 4X CD-ROM drive
WIN 95 models available. Call for details.

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 resolution)
- 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 Models with 4X CD-ROM

Processor	Screen	RAM/HD	Price
Pentium 75	10.1" Active	8/810MB	$3799+
Pentium 90	10.4" High Res.	8/810MB	4499
Pentium 90	10.1" Active	8/810MB	4499+
Pentium 120	10.4" High Res.	8MB/1GB	4999

+ Features built-in 4X 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

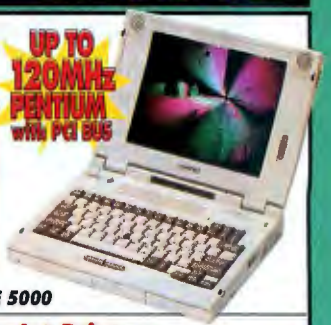
- Up to 120MHz Pentium power w/PCI bus & 256KB cache
- 32-bit PCI Local bus graphics
- 8MB RAM exp. to 72MB
- Built-in 16-bit sound, microphone & **2 speakers**
- MultiBay – holds CD-ROM, 2nd HDD, Floppy, or 2nd battery
- Up to 1.35GB hard drives (2.7GB max. capacity)
- Built-in infrared for wireless communications
- Supports NiMH batteries (up to 8 hrs.)
- Optional MPEG and TV video adapter

WIN95 INSTALLED

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

UP TO 120MHz PENTIUM with PCI BUS



LTE 5000

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2. 60-page sheet feeder
3. Color Kit

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HP LaserJet Printers

HP LaserJet 5P printer (IBM, 6ppm, 600dpi) C3150A	$879.99
HP LaserJet 5L printer (IBM, 4ppm, 600dpi) C3941A	479.00

HP InkJet Printers

HP DeskJet 340 printer (portable) C2655A	$289.99
HP DeskJet 340 CV (bundle) C2664A	329.99
HP DeskJet 600 printer C2184A	289.99
HP DeskJet 600C printer C4547A	299.99*
HP DeskJet 660C printer C2164A	389.99*
HP DeskJet 660Cse printer C4548A	399.99*
HP DeskJet 855C printer C4551A	498.99*
HP DeskJet 1600C printer C3540A	1349.99*

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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 (Active model only)
- 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	$2200
486DX4/75	9.5" Active	8/340MB	2500

HP OmniBook 5500

- 133MHz Pentium with 32-bit PCI local bus
- 12.1" Active Matrix display with 65,000 colors
- Super VGA-800x600 resolution on notebook
- PCI Local Bus Video, 1.5MB video memory
- Instant on capabilities
- Optional internal 4X CD-ROM available

Processor	Screen	RAM/HD	Price
Pentium 133	12.1" Active	8MB/1.35GB	CALL

133MHz Pentium processor

HP OmniBook 5500 Product differs slightly from photo

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UP TO 100MHz PENTIUM with PCI BUS

Ascentia J

NEW!

AST Ascentia J

- Integrated 14.4/14.4 Data/fax modem
- PCI bus architecture with 256KB L2 cache memory (selected models)
- 10.4" SVGA (800x600) resolution Dual Scan and Active Matrix displays

Processor	Screen	RAM/HD	Price
Pentium 75	10.4" Dual Scan	8/500MB	$2450
Pentium 100	10.4" Dual Scan	8/800MB	2840
Pentium 100	10.4" Active Matrix	8/800MB	3120

Ascentia 950N

Processor	Screen	RAM/HD	Price
Pentium 75	10.4" Active	8/800MB	$2560
Pentium 75	10.4" Active	8MB/1.2GB	2880
Pentium 90	10.4" Active (SVGA)	8/800MB	3430
Pentium 90	10.4" Active (SVGA)	8MB/1.2GB	3750
Pentium 120	11.8" Active (SVGA)	8/800MB	4469
Pentium 120	11.8" Active (SVGA)	8MB/1.2GB	4849

Additional 950N models available. Call for details.

TEXAS INSTRUMENTS

75MHz Pentium with PCI BUS

WIN95 INSTALLED

Built-In CD-ROM

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

Processor	Screen	RAM/HD	Price
Pentium 75	10.4" Dual Scan	810MB	$2749
Pentium 75	10.4" Active	1.2GB	3699

Extensa 560 Product differs slightly from photo

TravelMate 5100/5130/5200/5270

NEW MODELS!

Processor	Screen	RAM/HD	Price
Pentium 90	10.4" Active	8MB/1.2GB	$3399
Pentium 90	10.4" Active	8MB/1.2GB	3699*
Pentium 120	10.4" Active	8MB/1.2GB	4649*
Pentium 120	11.3" Active	8MB/1.2GB	5079*

*800 x 600 resolution

BYTE 4/96

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PIPELINE BURST CACHE MODULE
256K–$79 512K–$189

1x32-70 4MEG, 72 PIN–$124

T400, 600
8MEG–$439 16MEG–$879 32MEG–$1759

THINKPAD 755, 750, 360, 355
1.3 GIG HARD DRIVE–$1119

CACHE MEMORY

	12NS	15NS	20NS	25NS
8Kx8	–	6.50	8.00	5.50
32Kx8	14.00	9.00	8.00	7.00
32Kx8 (3.3V)	–	14.00	9.50	–
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
128Kx8	–	29.50	26.00	24.00

CACHE MODULES

256K (160 pin) Pipeline Burst Cache Module $79.00

512K (160 pin) Pipeline Burst Cache Module $189.00

256K (160 pin) Async Cache Module $79.00

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	–	–
256x4(Page Zip)	–	9.25	9.00	8.95	–
256x4(Video Zip)	–	–	12.95	11.95	9.95
256x8(SOJ)	–	19.00	18.00	–	–
256 x1	–	3.25	2.95	2.75	2.25
64x4	–	–	–	3.75	–
64x1	–	–	–	–	2.00
256x16 SOJ	–	–	29.00	–	–
256x16 Video Zip	–	49.00	39.00	–	–

INTEL Math Chips

80287-XL	39.00
80387-16 DX	39.00
80387-20 DX	44.00
80387-DX (Does All)	39.00
80487-SX (Does All)	199.00
Intel SX (Does All)	69.00
Intel SL Mobit	69.00
Intel 16SX	29.00
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SIMM MODULES (Add $5.00 for SIPP)

	40NS	50NS	60NS	70NS	80NS	100NS
256 x 9	–	–	–	10.00	9.00	8.00
1Meg x 9 (3 chip)	–	–	41.00	39.00	36.00	–
1Meg x 9 (9 chip)	–	–	41.00	39.00	28.00	24.00
4Meg x 9	–	–	152.00	149.00	142.00	–
16Meg x 9 (9 chip)	–	–	497.00	497.00	–	–

72 PIN SIMMS (EISA), EDO

	60NS	70NS	80NS
256 x 36 1 mg	–	54.00	49.00
512 x 36 2 mg	89.00	84.00	69.00
1 meg x 36 4 mg	147.00	144.00	139.00
2 x 36 8 mg	309.00	299.00	299.00
4 x 36 16 mg	569.00	549.00	549.00
8 x 36 32 mg	1159.00	1139.00	1139.00
16 x 36 64 mg	2569.00	2549.00	–
1 x 32 4 mg	129.00	124.00	124.00
2 x 32 8 mg	249.00	239.00	239.00
4 x 32 16 mg	499.00	489.00	489.00
8 x 32 32 mg	999.00	979.00	979.00
1 x 32 4 mg EDO	134.00	134.00	–
2 x 32 8 mg EDO	259.00	259.00	–
4 x 32 16 mg EDO	589.00	589.00	–
8 x 32 32 mg EDO	1299.00	1269.00	–

DIMMS (168 pin, 64 bit)

1 x 64	8Meg	269.00
2 x 64	16Meg	499.00
4 x 64	32Meg	989.00
8 x 64	64Meg	2039.00

SO DIMMS (72 pin)

4Meg 164.00
8Meg 319.00
16Meg 619.00

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AST MEMORY

MODEL	AMT. UPGRADED	AST PART #	PRICE
Bravo LC Series, Bravo MT, Bravo MS, MS-L, Advantage Pro DX33, SX25	4Meg	500987-002	129.00
	8Meg	500987-003	258.00
	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. 386/33T, 386 SX16, Prem.II 386SX.20, 386/25	4Meg	500780-004	189.00
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

Ambra Pentium-60	4/8/16 Meg	144/299/599
Ambra NC 425SL	2/4/8 Meg	109/169/319
Ambra N Series	4/8/12/16 Meg	179/319/549/619
Ambra SN Series	4/16 Meg	179/639
Ambra Sprinta SLC II	2/8 Meg	89/319
Ambra N-75, N-100	4/8/16	164/319/619

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286/386SX-16, 386SX-20, 486SX-20 & 386-33 *all are 72PIN SIMM:*
1MEG – 59.00 4MEG – 159.00 8MEG – 319.00 16MEG – 549.00

ZENITH MEMORY MODULES

MODEL	AMT. UPGRADED	MFG. PART #	PRICE
Z386/33, 25, 20, 33E	1Meg	ZA3800ME	59.00
Z386/33, 25, 20, 33E, 466/25E	4Meg	ZA3800MK	149.00

We also sell Memory for: Dell, Gateway, HP, DEC, Sun, Zenith, Acer, NEC and Epson

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IBM PART NO.	WORKS WITH MODEL NO.	PRICE
30F5348 (512K)	30-286	37.00
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
6451060 (4Meg)	80-A21, A-61, 80-A31, 80-111, 80-311	189.00
6450604/92G7196 (2Meg)	70-061, E61, 121, 50Z, 55SX, 65SX, P-70, 55LS, 65LS, X-Station 120 & 130, 35SX, 35LS, 40SX	99.00
[illegible]	70-A21, A-61, B-21, B-61, 35SX, 35LS, 40SX, Val Pt. 325T	80.00
[illegible]	25	86.00
[illegible]	35SX, 40SX, 55SX, 65SX, 55LS, 65LS	154.00
[illegible]	56SX, 55LS, 65SX, 40SX, 35SX, 35LS	154.00
[illegible]	P/S1-286	49.00
[illegible]	P/S1 & P/S1/386SX-2121	109.00
[illegible]	P/S1 & P/S1/386SX, Model-2121	189.00
[illegible]	PSI Expert, Consultant, Willow	154.00
[illegible]	Value Point Performance, PC Server 4/66	154.00
[illegible]	Aptiva 310, 330, 350, 510, 530, 710, 730	129.00
[illegible]	Aptiva 310, 330, 350, 510, 530, 710, 730	239.00
[illegible]	Aptiva 310, 330, 350, 510, 530, 710, 730	489.00
[illegible]	Aptiva 310, 330, 350, 510, 530, 710, 730	972.00
[illegible]	Value Point Performance, PC Server 4/66	299.00
[illegible]	Value Point Performance, PC Server 4/66	559.00
[illegible]	Value Point Performance, PC Server 4/66	1239.00
[illegible]	56, 57, 57SX,90, 95, P-75, 57SLC Value Point 77 486DX2, 486SX, SVR 85	90.00
6450128/92G7200 (4Meg)	57SX, 90, 95, P-75, 57SLC, 56, 56SLC, P/S1, 386SX, Mod-2123, 2133, 2155, Val Pt 77, 486CS2, 486SX, SVR85 Value Point 77 486DX2, 486SX, SVR 85	139.00
6450129/92G7428 (8Meg)	35SX, 40SX	319.00
6450130/92G7202 (8Meg)	56, 57, 57SX, 90, 95, P-75, 57SLC Value Point 77 486DX2, 486SX, SVR 85	319.00
6451158/92G7208 (4Meg ecc)	486; 95XP; 95A (install in pairs)	199.00
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IBM NOTEBOOK & LAPTOP MEMORY

07G1415/07G1420 (4Meg)	Thinkpad 750, C, 700, C, 720, C, CL57SX	175.00
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66G0095 (16Meg, 32Meg)	Thinkpad 750, C	629/1268
66G0094 (4Meg)	Thinkpad 755, 360, 355, 340, 450	164.00
66G0094 (8Meg)	Thinkpad 755, 360, 355, 340, 450	319.00
66G0094 (16Meg, 32Meg)	Thinkpad 755, 360, 355, 340, 450	609/1220
8189098 (4Meg)	Thinkpad 500, 510CS (3.3 volt)	164.00
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
79F1001 (8Meg)	LX40, N33SX, PS Note	319.00
Hard Drive (524Meg, 710 Meg, 1.3 Gig)	Thinkpad 750, 755, 360, 355	769/949/1119
(4Meg/16Meg)	Thinkpad 755 Dimm Modules	169/619
(4Meg/16 Meg w/Adap	Thinkpad 755	228/678
60G0378 (8Meg)	Thinkpad 350, 350c, PS Note 425	319.00
60G0379 (16Meg)	Thinkpad 350, 350c, PS Note 425	569.00
92F8804 (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	199/339/629
(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

COMPAQ MEMORY MODULES

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	[illegible]	149/249
Deskpro 386 25E/20E	[illegible]	79/169
	[illegible]	149/249
Deskpro 386/25, 20	[illegible]	79/169
Deskpro System Pro 386/33, 486/25, 486/50L	[illegible]	99/299/1399
Deskpro 4/66I, 4/33I, 4/25IS, 37331, 3/25I	[illegible]	89/154/319
Deskpro "M" Series	Expansion Board [illegible]	119
Deskpro 450, 466, 4100, 575, 590, 5120, 5133	[illegible]	159, 319, 619, 1149
Deskpro XE 433S, 450, 466	[illegible]	89/154/319
Deskpro XE 560	[illegible]	356/616/1276/2476/Call
Deskpro XL450, 466, XL560, xl566, XL575, 5100 xl590	[illegible]	178/308/638/1238/2378
Presario 433, CDS520, CDJV520, CDL524, CDS526, CDTV528 660, CDS660, CDS720, CDS724, CDS744, CDS860 CDS920, CDTV920, 924, CDS924, CDS954	[illegible]	139/279/549/1049
Presario 400 Series, 600 Series, 800 Series	2/4/8/16/32Meg	89/154/319/649/1189
Presario CDS774, CDS972, CDS982, CDTV978, CDS974 (in pairs) CDS992, 7152, 7170, 7160, 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	59/154/319/649/1189
Prolinea 450, 466, 4100, 575, 590, 5120, 575, 590, 5120 575 mini, 5100 mini, 5133 mini	4/8/16/32Meg	154/319/649/1189
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	129769-002	209.00
LTE LITE/20, 25, 25C	8Meg Module	129769-003	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
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T2100, 2105, 2150, 2155, 2110, 2115	4Meg/8Meg/16Meg/24 Meg		164/319/609/899
T4400SX, SXC T6400, T6600	4Meg	PC-PA2004U	189.00
T4400SX, SXC T6400, T6600	8Meg	PC-PA2005U	379.00
T4400SX, SXC T6400, T6600	16Meg	PC-PA2010U	689.00
T4500, C, T4600, T4700, T1900, C, 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

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[illegible]	[illegible]	501255-001, -002 500814-003 501166-001, -003 501318-001, 002	[illegible]
[illegible] (Call for other Globalyst)	[illegible]		[illegible]
[illegible]	[illegible]	PEC 37651	[illegible]
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[illegible]	[illegible]	PC4 [illegible]	[illegible]
[illegible]	[illegible]	286, 386SX	[illegible]
[illegible]	[illegible]	CF-BA165	[illegible]
[illegible]	[illegible]	MBC-NBMEM2	[illegible]
[illegible]	[illegible]	2568034-0001 2566996-1	[illegible]
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Canon LBP 430	–	–	69	–	–	–	129	–	–	–	–	–
Canon LBP 860	–	–	–	99	–	–	179	–	–	349	669	1249
Canon LBP4, 4Lite, 4plus	–	–	129	179	–	–	–	–	–	–	–	–
Epson 6000, Action Laser	–	–	–	129	–	–	229	–	–	–	–	–
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Epson Action Laser II	–	–	89	–	208	–	–	327	–	–	–	–
Epson 8000, 1800, 4000, 4100, 4300	–	–	89	–	208	–	–	327	–	Call	Call	Call
Epson 1000, 1500, 5000, 5200	–	–	–	*109*	–	–	*218*	–	–	–	–	–
HP 2, 2D-	–	–	–	89	–	–	179	–	–	–	–	–
HP 3, 3D, 3P, 2P 2P+	–	–	–	89	–	–	149	–	–	–	–	–
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HP 4P, 4PLUS, 4MPm 1600, 1600CM	–	–	–	–	–	–	129	–	–	239	–	–
HP 4L	–	–	59	–	–	–	–	–	–	–	–	–
HP 3SI	–	–	69	–	–	–	169	–	–	299	–	–
HP 4SI	–	–	–	89	–	–	149	–	–	299	–	–
HP 5L	–	–	69	129	–	–	219	–	–	399	–	–
HP 5P	–	–	–	89	–	–	149	–	–	299	489	–
HP Design Jet 600, 650, 200	–	–	–	89	–	–	149	–	–	299	–	–
HP Deskjet 500, 500C, 510, 550,560	–	49	–	–	–	–	–	–	–	–	–	–
HP Deskjet 1200C, 1200C/P	–	–	–	89	–	–	149	–	–	299	–	–
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IBM Laser 4029, 4037	–	–	–	–	–	–	169	–	–	–	–	–
IBM Laser 4039, 4079	–	–	–	99	–	–	169	–	–	350	–	–
Konica LP-3110	–	–	119	189	239	–	–	–	–	–	–	–
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Lexmark Winwriter 200, 400, 600	–	–	59	89	–	–	149	–	–	–	–	–
NEC 90, 290	–	–	–	119	–	–	–	–	–	–	–	–
NEC 95, 97	–	–	–	99	–	–	–	–	–	–	–	–
Oki 400	–	–	–	104	169	–	219	–	–	–	–	–
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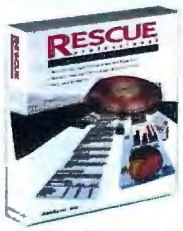

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	01222-763773	01222-763774	Sweden	(0) 300-19530	(0) 300-70910
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MEMORY-HARD DRIVE SUPERSOURCE
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HARD DRVIES

Quantum

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31080FBS	1.2GB	12MS	FSCSI-2	275-400
CAPELLA SERIES-5 YEAR WAR.				**INT-EXT**
VP32210S	2.2GB	8.5MS	SCSI	669-794
TRAIL BLAZER SERIES-3 YEAR WAR.				**INT-EXT**
30850TRA	850MB	12MS	IDE	193-343
30850TRS	850MB	12MS	FSCSI-2	197-223
ATLAS SCSI 2 SERIES-5 YEAR WAR.				**INT-EXT**
XP32150S	2.1GB	8MS	7200RPM	819-950
XP34300S	4.2GB	8MS	7200RPM	1029-1160
GRAND PRIX SCSI 2 SERIES-5 YEAR WAR.				**INT-EXT**
GP3401	4.3GB	8.6MS	7200RPM	972-1097
EMPIRE-II SERIES-3 YEAR WAR.				**INT-EXT**
EMP32181S	2.1GB	8.9MS	3.5"X1"	SCALL
EMP34360S	4.4GB	8.9MS	3.5"X1"	CALL
EMP39100S	9.1GB	8.9MS	3.5"	CALL

HEWLETT PACKARD

FACTORY NEW-5 YEAR WARRANTY				INT-EXT
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digital

FACTORY NEW-2 YEAR WARRANTY				INT-EXT
DSP3210	2GB	9.5MS	SCSI	$799-949

MICROPOLIS

FACTORY NEW-5 YEAR WARRANTY				INT-EXT
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MC4110	1.05GB	9MS	SCSI-2	650-775
MC4221	2.05GB	8.5MS	SCSI-2	589-714
MC1936	3.0GB	11MS	SCSI-2	850-999
MC3243	4.3GB	8MS	SCSI-2	969-1094
MC1991	9.0GB	11MS	SCSI-2	1989-2244
MC2217AV	1.75GB	10MS	SCSI-AV	875-1823
MC4221AV	2.05GB	8.5MS	SCSI-AV	699-824
MC3243AV	4.3GB	8.5MS	SCSI-AV	1059-1200
MC1991AV	9.1GB	10MS	SCSI-AV	2119-2264

CONNER

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CFS1081A	1.1MB	14MS	IDE	220-370
CFS1275A	1.3GB	14MS	IDE	249-399
CFS1621A	1.6MB	14MS	IDE	289-339
CFP1080S	1.05GB	11MS	SCSI-2	255-380
CFP2105S	2.1GB	9MS	SCSI-2	609-734
CFP2107S	2.1GB	9MS	SCSI-2	639-764
CFP4207S	4.2GB	9MS	SCSI-2	939-1064

FUJITSU

FACTORY NEW-5 YEAR WARRANTY				INT-EXT
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M1606T	1.1GB	9.5MS	IDE	235-385
M1606S	1.1GB	13MS	SCSI	235-360
M2915S	2.1GB	9.5MS	SCSI	642-767
M2932S	2.1GB	10MS	SCSI	579-704
M2934S	4.3GB	10MS	SCSI	809-1024

Maxtor

FACTORY NEW-2 YEAR WARRANTY				INT-EXT
M7850AV	853MB	12MS	IDE	$195-345
M71260AV	1.2GB	12MS	IDE	249-399
M71626AP	1.6GB	12MS	IDE	285-413
MXT540S	540MB	8.5MS	SCSI	199-224

NEC

FACTORY NEW-3 YEAR WARRANTY				INT-EXT
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D3747	1.6GB	11MS	IDE	259-409
D3827	1.1GB	11MS	SCSI	225-350
D3847	1.6GB	11MS	SCSI	279-404

Seagate

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ST5850A	850MB	11MS	IDE	195-345
ST51080A	1.05GB	10.5MS	IDE	219-369
ST31640A	1.6GB	10.5MS	IDE	359-484
ST32140A	2.2GB	10MS	IDE	385-510
ST31231N	1.0GB	10MS	SCSI-2	339-464
ST51080N	1.05GB	10.5MS	SCSI-2	219-334
ST12400N	2.1GB	9MS	SCSI-2	650-775
ST32430N	2.1GB	10MS	SCSI-2	619-744
ST43400N	3.5GB	11MS	SCSI-2	650-775
ST15230N	4.2GB	9MS	SCSI-2	915-1040
ST410800N	9.0GB	11MS	SCSI-2	2069-2269
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ST15150N	4.2GB	8MS	SCSI-2	1149-1274

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CONNER

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21075W	2.1GB	8.5MS	5400RPM	739
2107W	2.1GB	8.5MS	7200RPM	776
4207W	4.2GB	9MS	7200RPM	1189

Seagate

FACTORY NEW-5 YEAR WARRANTY				
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ST32430W	2.1GB	9MS	3.5X1"	792
ST32550W	2.1GB	8MS	3.5X1"	899
ST15230W	4.3GB	9MS	3.5X1"	1042
ST15150W	4.3GB	8MS	3.5"	1346
ST410800W	9.0GB	11MS	5.25"	2279

Quantum

FACTORY NEW-5 YEAR WARRANTY				
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VP32210W	2.2GB	8.5MS	3.5X1"	726
GP3430W	4.3GB	8.6MS	3.5"	1079
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MICROPOLIS

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MC3243W	4.30GB	8.5MS	3.5	1069
MC1991W	9.10GB	10MS	FH	2099
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MC3243WAV	4.30GB	8.5MS	3.5	1139
MC1991WAV	9.10GB	10MS	FH	2199

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IBM

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8X36-32MB-60NS LOGIC	850
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Premmia GX (all models)

8MB	501565-001	$219	16MB	501566-001	$525
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32MB	500987-005	$959	64MB	501569-001	$2,359

COMPAQ

Presario 720, 724, 744, 774, 920, 924, 860, 992, 982, 972, 978, 954, 526, 524, 528, 520, 510

4MB	147522-001	$125	8MB	147523-001	$219
16MB	147524-001	$459	32MB	147525-001	$959

Presario 650, 660, 663, 433, 425, 866, 850, 833, 866

4MB	141684-001	$133	8MB	141685-001	$262
16MB	149320-001	$525	32MB	149147-001	$959

ProLinea 575MX, 590MX, 5133, 5100, 575, 590, 4100, 466, 450

4MB	172712-001	$125	8MB	172713-001	$219
16MB	172714-001	$459	32MB	172715-001	$959

ProLinea Enhanced (all models), 466, 433, 450, CDS, 425S, 433S

4MB	141864-001				$133
8MB	141685-001				$262
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DeskPro 590MX, 575MX, 575, 590, 5100

4MB	172712-001	$162	8MB	172713-001	$299
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4MB	148187-001	$133	8MB	148188-001	$339
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Dimension P75, P90

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16MB	n/a	$459	32MB	n/a	$959

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8MB	n/a	$219	8MB	(EDO) n/a	$262
16MB	n/a	$459	16MB	(EDO) n/a	$699
32MB	n/a	$959	32MB	(EDO) n/a	$1,299

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NEC

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Ready 425, 433

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16MB	n/a	$459	32MB	n/a	$959

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16MB	n/a	$459	32MB	n/a	$959

PC 300 Series (all models) Aptiva (all models)

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Aptiva 300, 500 and 700 series

4MB	n/a	$125	16MB	n/a	$459

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4MB	74G1299				$174

Eduquest 30 , 40 and 50 models

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2MB	92F9935	$79	4MB	92F9694	$149

Valuepoint Performance models

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PS/2 70-A21; A61; B21; B61, PS/Valuepoint Cxx models

PS/1 Consultant, Essential, Expert models

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	8MB	144790-002	$269
	16MB	144790-003	$599
LTE Elite 4/40, 4/50, 4/75	4MB	199013-001	$149
	8MB	199015-001	$309
	16MB	199017-001	$595
Contura 400, 410, 420, 430	4MB	147653-001	$159
	8MB	147655-001	$289
	16MB	147657-001	$649
Elite 5000	8MB	213515-001	$319
	16MB	213515-002	$599
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	64MB	213515-004	$2,199

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	8MB	501488-002	$279
	16MB	501488-003	$629
Ascentia 900N, 910N	4MB	501392-001	$159
	8MB	501392-002	$329
	16MB	501392-003	$649
Ascentia 950N	8MB	501728-002	$299
	16MB	501728-003	$629

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Model	MB	Part No.	Price
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	8MB	B4G5692	$269
	16MB	B4G5995	$599
ThinkPad 365, 365CD	4MB	92G7287	$159
	16MB	92G7293	$629
ThinkPad 701	4MB	04H6193	$159
	8MB	04H6194	$319
	16MB	04H6195	$629
ThinkPad 700, 720	4MB	07G1419	$170
	8MB	07G1420	$299
	16MB	07G1421	$589
ThinkPad 760, 760CD	8MB	92G7316	$339
	16MB	92G7316	$629

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Model	MB	Part No.	Price
Versa S, Versa 2000	4MB	OP-410-1201	$149
	8MB	OP-410-1202	$309
	16MB	OP-410-1203	$629
Versa V, M, P, 4000, 4050, 4080	4MB	OP-410-4001	$169
	8MB	OP-410-4002	$299
	16MB	OP-410-4003	$599
	32MB	OP-410-4004	$1,199

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Model	MB	Part No.	Price
Latitude XPi, P75, P90	8MB	310-3435	$269
	16MB	310-3436	$549

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Model	MB	Part No.	Price
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	8MB	FR-PCP7M-AB	$279
	16MB	FR-PCP7M-AC	$599
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	8MB	FR-PCP8M-AB	$279
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Extensa 550, 550CD, 560, 560CD	8MB	9809810-0001	$299
	16MB	9804841-0001	$629
	32MB	9809811-0001	$1,199
TM5000, 5010, 5030, 5100, 5200	8MB	9798816-0001	$319
	16MB	9798816-0002	$749
TM 4000M	4MB	9793357	$179
	16MB	9793358	$799

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Model	MB	Part No.	Price
T2100, T2105, T2110, T2115, T2130, T2135, T2150, T2155	4MB	NW2026U	$169
	8MB	NW2027U	$299
	16MB	NW2028U	$599
	24MB	NW2029U	$899
T1900, T4600, T4700, T4800, T4850, T4900	4MB	PC-PA2012U	$143
	8MB	PC-PA2013U	$259
	16MB	PC-PA2014U	$628
T3400, T3600	32MB	PC-PA2015U	$1,199
	4MB	PC-PA2019U	$149
	8MB	PC-PA2020U	$279
	16MB	PC-PA2023U	$559
T400, T405, T410, T415, T610 Portege, T100, T105	8MB	NW2031U	$399
	16MB	NW2032U	$749
Tecra 700	32MB	NW2034U	$1,399
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2MB	C3131A	$95	4MB	C3132A	$170

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256K	22707B				$40

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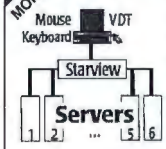

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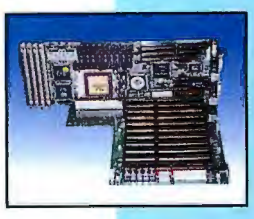

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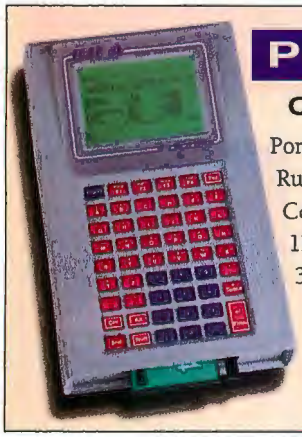

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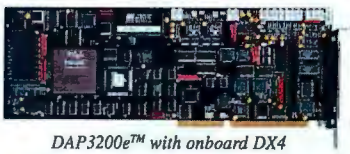

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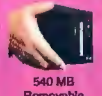

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3 ☐ Reseller/distributor/OEM/integrator/consultant
4 ☐ Other (please describe): _____

B. My job function is best described as: (check one)
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6 ☐ IS/MIS/IT Management
7 ☐ Systems Engineering/Integration
8 ☐ Departmental Management (non-IS/MIS)
9 ☐ Technical Services Support
10 ☐ Other (please describe): _____

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13 ☐ Mac/OS
14 ☐ UNIX (any, including Solaris)
15 ☐ Windows
16 ☐ Windows/NT
17 ☐ NetWare
18 ☐ Other (please describe): _____

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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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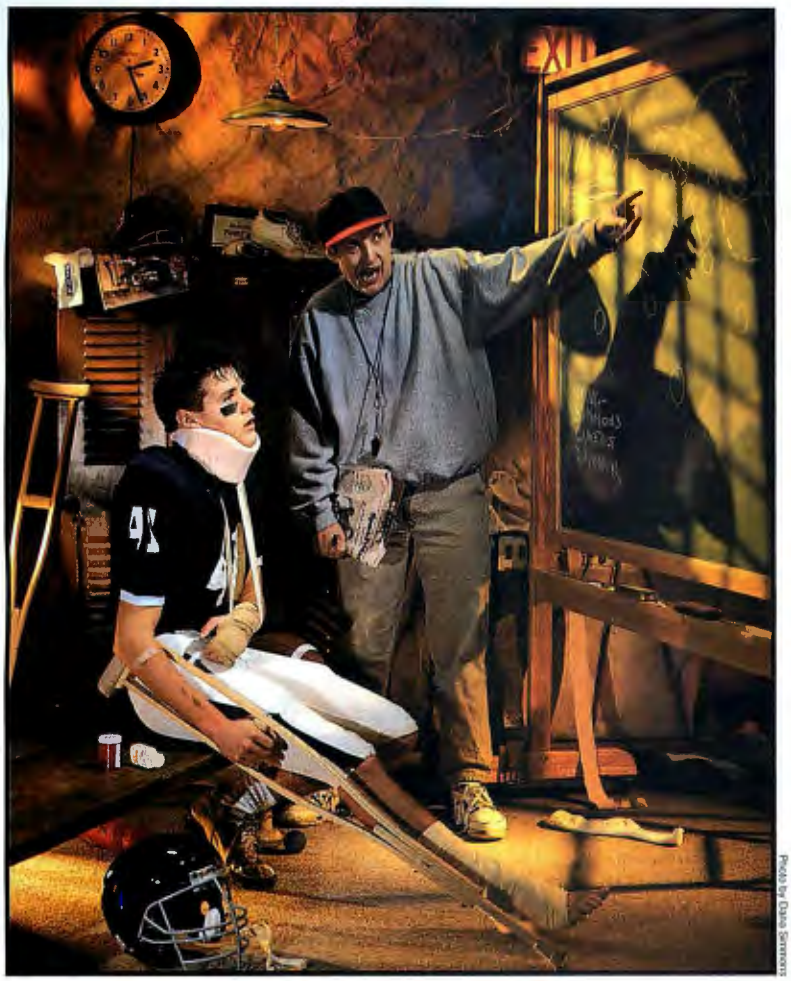

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A Word Is Worth a Thousand Pictures

For some people, text is the only access to the Web

STEVE SIMON © 1996

The author uses Braille 'n Speak, a PDA with a speech synthesizer that works with screen-reading software on his PC.

New technologies are changing the World Wide Web. Snazzy 3-D graphics. Animation. Audio. It's turning into CyberVegas. I hope this drive toward a multimedia Web doesn't leave plain old text in the dust. You see, some of us—blind people, in particular—rely on a text interface to find information on the Web. These new technologies and extensions to the Hypertext Markup Language (HTML) are not compatible with text-based browsers such as Lynx.

It is tempting to Web-page authors to use these tools to animate their sites and build 3-D virtual-reality attractions. Thus, I'm afraid that pure-text access could disappear. If this happens, the blind computer user would be shut out. DOS is still the most popular platform for the blind user because many screen-reading systems are developed for it. I can read almost any text information on my computer using a screen-reading system. The system is made up of a text-to-speech synthesizer and a TSR screen review and navigation program. Basic HTML works, without modification, with almost all existing access devices for blind users.

DOS isn't glitzy, but at least most DOS users can still get a dial-up account of some sort, with access to the Web through Lynx. The E-mail and news readers on these accounts are also accessible, even if they are not very convenient. All the software that works on a VT100 dial-up terminal will also work with DOS speech programs. A Unix shell account is accessible because most of the software (e.g., Lynx, Pine, and Tin) is text-based.

There are Windows screen readers now, but developers are still learning how to make them work effectively. Just when Windows 3.1 versions were showing promise, along came Windows 95. Screen readers for Win 95 will not be fully functional till later this year, despite Microsoft's assurance that it wants to make it the most accessible operating system ever. As things are now, blind users have to spend lots of money for Windows access software.

Unfortunately, most of the fancy Internet tools are written for Windows. The really cool new Internet applications, such as Internet phones and RealAudio, require Windows and a SLIP or PPP connection.

The Internet is a great place for blind users because so much of it is text. There is so much reading material that was not available to me before. I can read up-to-date information on all kinds of interesting subjects. I no longer have to wait for recorded talking books on tape or braille material that is out of date by the time it is produced.

Webmasters want to make their sites visually appealing, so they use new tools to make their pages pretty with graphics. Some Web-page designers are also trying to keep their sites accessible to everyone. I have asked site managers for text-only pages and have gotten them most of the time. Microsoft, for example, has been sensitive to this issue in the on-line world. The Web pages for the Microsoft Network were not accessible at the launch, but MSN now has a text-only page.

Webmasters who want their sites open to all platforms provide a great benefit to blind users of the Internet. If you want your Web site, or your product, to reach the broadest community of users, build in accessibility from the ground up. Remember that one person's enabling technology is another person's disabling technology. ■

Here are some tips for keeping a Web site accessible to blind people:

1. **Use alternate viewers such as Lynx to check the formatting of your Web pages. Lynx is a good choice because it is usable by blind people.**
2. **Be sure that all tags and anchors have a short text description.**
3. **Provide alternatives for tables and forms.**
4. **Use Alt-text tags.**
5. **Provide an alternative text page if your pages require a browser that can display cookies and tables, Java, or the Virtual Reality Markup Language (VRML).**
6. **In text-only pages, avoid complicated layouts such as multiple columns.**
7. **Be sure to provide text descriptions for each locator (URL) in an image map—those regions users can click on to reference different pages—especially if a text-only page is not available.**
8. **Consult the simple guidelines from the Trace Center's gopher site in Wisconsin (trace.wisc.edu/) or the Web site (http://www.trace.wisc.edu).**

Bob Logue lives in Edmonton, Alberta, Canada. You can reach him via E-mail at boblogue@freenet.edmonton.ab.ca.

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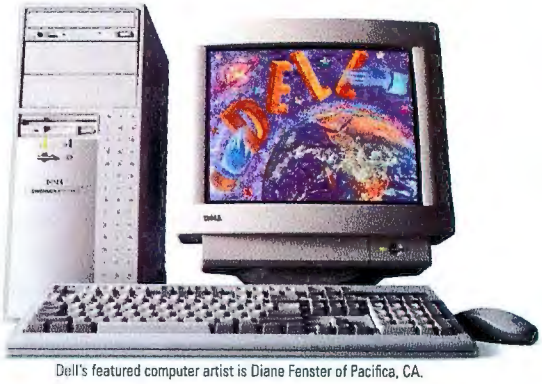

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PC WEEK 1/8/96

Dell's featured computer artist is Steven Lyons

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