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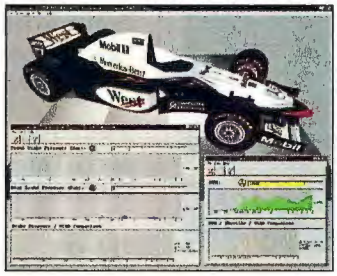

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BYTE
COVER STORY

June 1998, vol. 23, no. 6

Win98 roadmap

By John Montgomery

66

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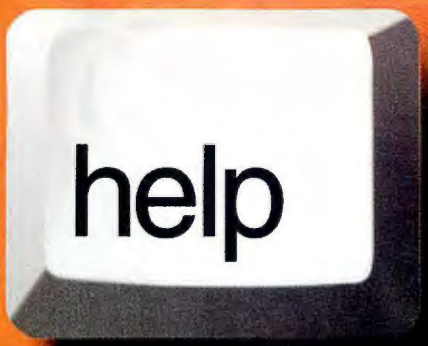

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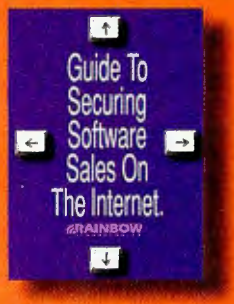

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San Mateo: 1900 O'Farrell St. #200, San Mateo, CA 94403, 650-513-6912.
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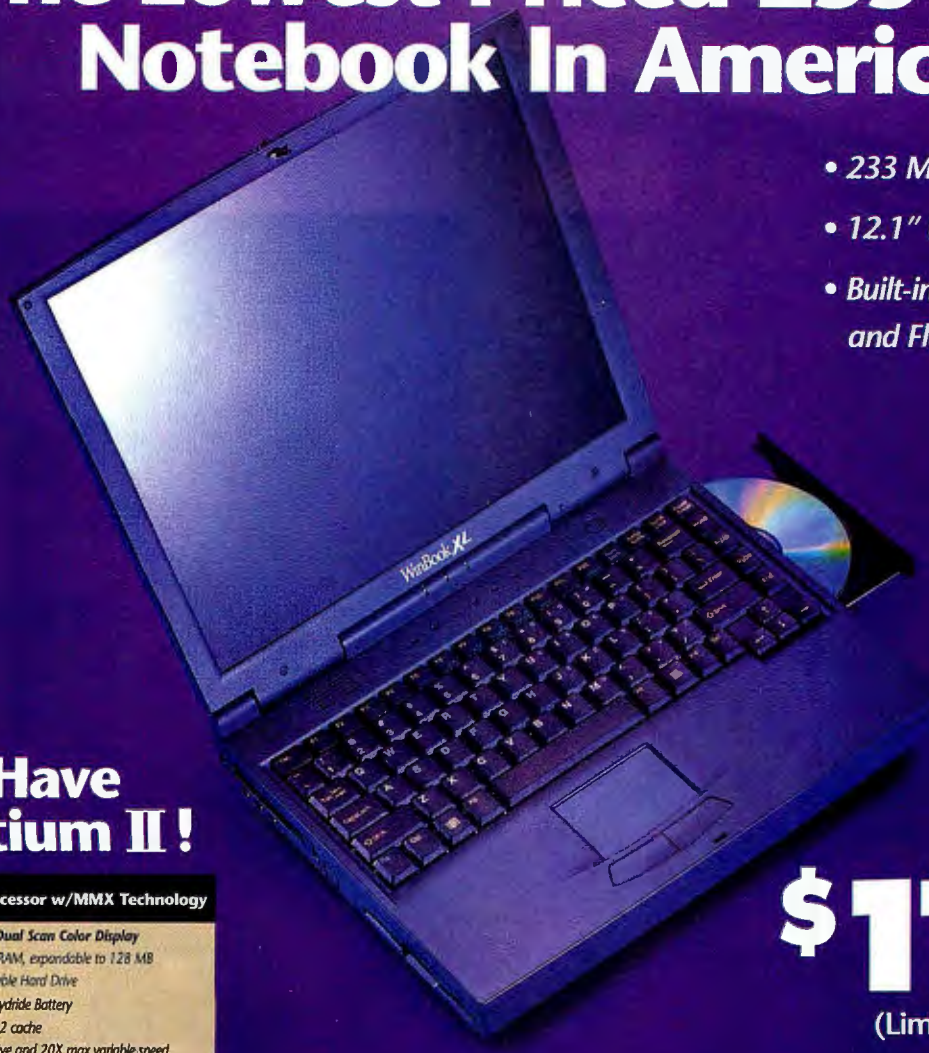

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Gnawing Doubts

Why I'm underwhelmed by a pretty good upgrade.

Windows 98 seems an awful lot *like nouvelle* cuisine to me. Sounds great on the menu, looks good on that big white plate, but after dinner I'm still hungry and feeling vaguely ripped off.

When you get past the squid ink pasta and the Gorgonzola, is Windows 98 just macaroni and cheese?

Actually, Windows 98 breaks new ground when it comes to integrating the desktop and the Internet. That's a permanent and significant shift in computing that we highlighted in our cover story about network user interfaces in the July 1997 issue. So why am I less excited about this NUI than I am about the whole idea of NUIs?

In part, it's because bandwidth and server bottlenecks are still universal problems. But equally it's the sense that Microsoft still believes it can dictate the terms of network computing.

Out of the box, the Win 98 NUI is ActiveX and ActiveServer Pages. These are powerful tools, and they're sometimes dismissed too readily. However, they're not enough in a permanently heterogeneous world. Microsoft missed the chance to use its money and skill to create the world's best universal desktop. Netscape hardly has the resources to do so, and the Suns and Oracles of the world basically just want to replace Microsoft with their own lock-in.

Beyond the standards issue, Win 98's NUI is unimaginative. In this month's Web Project (see page 105), Jon Udell demonstrates that Web technology has the potential to combine connected and disconnected desktop computing in new ways. It's that kind of innovation that I had hoped to see from Win 98 when it was still known as Memphis. But it's not what I'm getting. And my biggest disappointment with Win 98 is its lack of reliability.

This is surprising, since the inclusion of network-update features in Win 98 lays the foundation for the whole concept of subscription computing. Turn on, tune in, and get a computer-health checkup.

But that's probably for the best, anyway. Win 98 is a six-story building sitting on DOS's log-cabin foundation. The Leaning Tower of Redmond can't take much more expansion.

So if Win 98 is not the pièce de résistance, what is? Let me suggest a radical notion: It's time to abandon the idea of one desktop for everyone. Microsoft itself recognizes this and is doing a pretty good job of segmenting its OS line.

Once upon a time, we all wanted just one server OS. We had to give up on that in the early 1990s to gain the efficiency of NetWare for LAN services, NT for smaller application servers, Unix for larger ones, and large host OSes—such as MVS, OS/400, and VMS—when they were appropriate. The world is better for this: It has allowed IT organizations to focus on the right tool for the job.

It's time to abandon the idea of one desktop for everyone.

Now you have at least four different solutions to choose from. Microsoft's Win32 application environment runs nearly everywhere and is quite rich. Java runs in even more places and should get richer. Plain old browsers with scripts are as universal as it gets. And yes, you can even use all of them together—shocking, but true!

Of course, there are many noteworthy proprietary application environments besides Microsoft's, although few have that kind of breadth and depth. But this can be a blessing—as in highly specialized computing, be it real-time, scientific, or other niche scenarios.

A year from now, we'll know a lot more about the future of Windows. For me, NT 5.0 will be a watershed for the user community. If Microsoft can't deliver a fully scalable server platform and a highly manageable and reliable desktop platform, I think people will look elsewhere.

Lord knows the wolf is at the door, but Gates would be foolish to look at the situation just in those terms. Microsoft will have forced the user community to consider alternatives if, after nearly a decade of broad-scale Windows deployment, the platform still hasn't lived up to its full promise. Meanwhile, my stomach's still grumbling.

Mark Schlack

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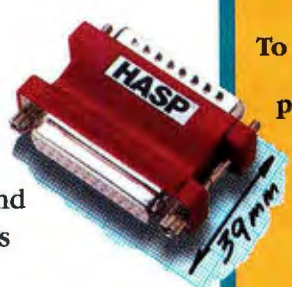

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inbox

Amen!

My hat is off—again—to BYTE, this time for facing quality issues head-on. "Crash-Proof Computing" (April cover story) and "Reliability Counts" (May editorial) express my sentiments exactly. It is painful to find customers already angry at the whole computer industry when I show up for a meeting with them. While they vent their frustrations, I find myself apologizing for sins I didn't commit, before I can even try to help them deal with their disasters. OS weaknesses are the most frustrating. And yes, cheap, poorly made, and virtually unsupported hardware is a big problem, too. Apparently many vendors are forgetting to tell customers that good PCs actually cost less in the long run.

George Rogers Clark
grclark@usaconnect.com

Embedded Risk

"Crash-Proof Computing" is right on target: Reliable software is simply not a high priority for software vendors or for their customers. You also correctly say that embedded systems are generally more reliable than PC software. But embedded systems threaten to become more like PCs, as pressure rises for reduced development costs, shorter time-to-market, and shorter product life cycles. Most disturbing, the exploding complexity of embedded systems is comparable to what happened in the PC industry 10 years ago, and embedded systems developers have started to emulate the PC industry even where this is irresponsible. For example, many developers switch from languages like Ada, Pascal, or Modula-2 to C, rather than to safe languages like Java or Component Pascal.

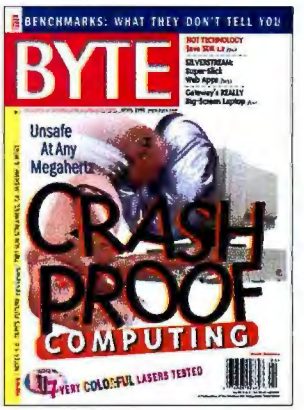
One final note: A single-address-space operating system is not a bad thing per se; it's even necessary for efficient component software. But we need better protection mechanisms, which can either be done in software, by using safe languages, or in hardware, by separating address mapping and memory protection.

Dr. Cuno Pfister
Managing director,
Oberon Microsystems
http://www.oberon.ch/

Blinded by SQL

In "Stored Procedures: Threat or Menace?" (March), authors Joe Celko and Jackie Celko state that E.F. Codd's work indicates that SQL is sufficient for dealing with all database problems, and that nothing more is ever necessary. This is false. It is a theorem that certain kinds of database problems—for example, transitive closure problems—cannot even be stated in SQL. Many IS professionals are blind to the implications of transitive closure problems in the real world.

Carlie J. Coats, Jr.
Chapel Hill, NC



I would refer readers to my book Joe Celko's SQL for Smarties *(Morgan-Kaufmann, 1995) or my columns in the March-June 1996 issues of* DBMS *magazine. I discussed in detail how to manipulate tree structures in SQL by modeling them as nested sets instead of graphs. There is no need to do a procedural traversal in SQL, and I can produce results several orders of magnitude faster than procedural code.*

The better example of procedural programming problems would be those with a combinatorial explosion that has to be pruned, using a criteria that involves the whole set. SQL and set-oriented solutions tend to produce the combinatorial explosion in full before they can prune it. Fortunately, problems of this class do not come up often in commercial applications.
—Joe Celko

Web OS Fallout

In "The Best OS for Web Serving" (March Software Lab Report), you gave Caldera's OpenLinux the lowest rating of the OSes you tested. The version you used is the oldest commercial Linux distribution sold. I'm sure you chose OpenLinux because it comes with FastTrack, but RedHat 5.0 would have been a better choice. It has features like automatic hardware probing and easy graphical system administration tools, and it will also run in 64-bit mode on Alpha processors, which should give it performance comparable to Digital Unix. Don't judge a family of products by its oldest member.

Jason Fillman
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Most BYTE readers today work in, for, or near a corporate IT department, and if

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they have to maintain high-traffic commercial Web servers and sites, they don't normally want to be on the bleeding edge of OS development. They need something that's reasonably advanced but still stable and reliable, and with formal corporate support mechanisms behind it. That's why we finally chose the Caldera OpenLinux 1.1 standard version aimed at Internet/intranet server installations. That it came bundled with Netscape's FastTrack made it a more appealing choice for the corporate reader we had in mind. We know that many versions of Linux support multiple CPUs (even if it may require building a custom kernel) and run on other platforms; the one we tested did not. The features table applied only to OpenLinux 1.1. (We plan to review a group of free Unixes in the near future.)

Now, about our testing: Because these diverse OSes don't run on the same hardware, we opted to go into the field to examine real-life installations, and where we could take advantage of long-running experience. Some readers have objected that Solaris was tested on older Sun hardware. Surprise: Lots of OSes run on older hardware in the real world. Since there was no common platform, and since comparing OSes running on different processors is difficult to impossible, we ignored processor performance considerations and didn't try to generate comparable performance numbers. Based on tracings through portions of the OS, as well as an examination of the TCP/IP driver protocol stack and the disk driver modules, we concluded Digital Unix "is a turbocharged I/O engine" that "served up static Web pages nearly instantaneously." We examined debug traces, memory dumps, and disassembly listings to find out which OS was more efficient and thus "performed" best. We also confirmed our findings by talking to other industry experts.
—Russell Kay, technical editor

"The Best OS for Web Serving" contains factual errors about AIX in the features chart. AIX 4.3 fully supports 64-bit applications, based on industry agreement of the LP64 data model. AIX supports 12 CPUs, not eight; 16 GB of RAM, not 3.75 GB; and its maximum addressable memory range is 16 exabytes, not 4 GB. Maximum shared memory is 16 TB, not 4 GB, and the largest file system size is 1 TB.

I also question the testing methodology. You claim that "each OS was tested on the kind of hardware it's most likely to be used on." The IBM RS/6000 hardware most likely to be used for Web serving is not an R50 but an RS/6000 Model 43P, F50, or SP. The R50 is targeted at the database market. This review did not accurately reflect the proven performance of AIX and the RS/6000.
Miles Barel
Manager of AIX Marketing, IBM Austin, TX

We stand corrected about CPU and memory support under AIX 4.3. IBM documentation for the RS/6000 R50-based system we evaluated indicated the lower figures we published, which reflected hardware limitations particular to that system. Regarding our choice of the R50 system, we selected a real-world Web server installation that we could gain test access to in the time frame of our review. Apparently that IBM customer had not been told it was using an inappropriate system.
—R.K.

Yes, We Need a Vacation

In "Weaving a Better Web" (March cover story) you mention the ISO 8061 standard in connection with formatting dates. ISO 8061 relates to the quality of alpine skis! The correct reference is ISO 8601. I have a Web page with information about ISO 8601 and links to many other sites. I wonder if the author had his mind on his forthcoming holidays, rather than the article he was writing?
Ian Galpin
http://ourworld.compuserve.com/homepages/dstrange/y2k.htm

Taking Exception to Exceptions

I must take exception to "Better Performance with Exceptions in Java" (March Core/Programming). It is not clear from the article that "try/catch statements under Microsoft's virtual machine (VM) exact a substantial overhead," whereas the Sun VM does not (p. 54), since Mr. Orchard used the Sun compiler to run his tests on the Sun VM and the Microsoft compiler to run his tests on the Microsoft VM. Could the overhead be due to the compiler? C++ try/catch blocks exact a substantial overhead, even when exceptions are not thrown. Is it certain that the Sun VM (or compiler) does not add this extra overhead whether or not try/catch blocks are used, and that the Microsoft VM (or compiler) optimizes the case when no try/catch blocks are in use?

I disagree that slightly altering the loop syntax and adding the try/catch block around the loop improves code legibility. An experienced developer could look at the traditional solution and immediately understand it; it requires a doubletake (and some thinking) to understand how "clever" the altered solution is.

Also, I dispute whether exceptions can improve performance at all in real-world code. The altered solution yields better performance only because the body of the FOR loop is trivial. I do not question Mr. Orchard's empirical results, but without more information, they are at best inconclusive.
Roger Tawa
Montreal, Quebec

To reiterate the purpose of my article: The use of exceptions instead of array bounds checking may improve performance for applications, depending on the VM used. I had no intention of saying that a particular Java compiler or VM is faster or slower than another. I specified the performance difference that the technique caused in my environment. Additionally, I did run a test of the Sun JDK-compiled code using the Microsoft VM and the Sun Java VM, with the result that the Microsoft VM was responsible for poorer performance when exception handling was added to the loop. Perhaps in other environments the Microsoft VM will

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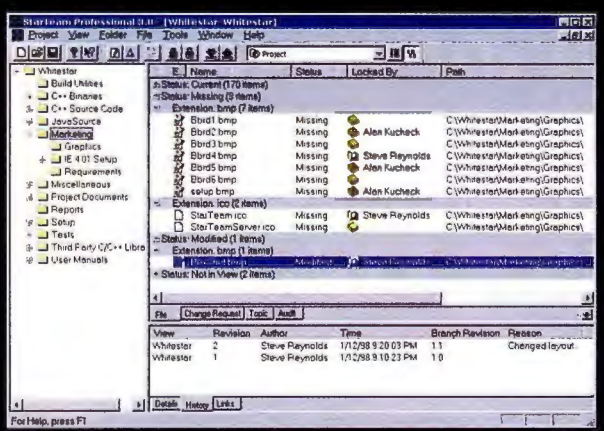

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respond better to the use of exceptions. If so, the technique is even more useful. I encourage readers to test this in their own environments.

You correctly point out that the more complicated the set of instructions within the loop, the less the performance improvement in "real-world" code. I have found many times, especially in image processing algorithms, that loops contain very simple instructions. It is up to readers to see if they have complicated or simple loop contents and then decide whether or not to use the technique.
—David Orchard

FIXES

In "Scriptlets Simplified" (April Core/Programming), the `hideMe` function was left out of the code listing on page 56. Here is the code that should have followed the function `selectMe`:

```
function
public_hideMe() {
  document.all.tags("P
").item(0).style.dis-
play="none";}
```

In the chart "Notebook Performance on Five Photoshop Tests" (May Bits, page 24), the footnote for the Mac G3 PowerBook is incorrect; the system was tested with 64 MB of RAM, not 96 MB.

In the Details section of the May issue's Hardware Lab Report ("333-MHz Pentium IIs: Slow-Bus Swan Song"), we indicated that there was a 64-bit PCI slot in the NEC PowerMate Professional P9000. The slot is a 32-bit slot with a SCSI RAID extension.

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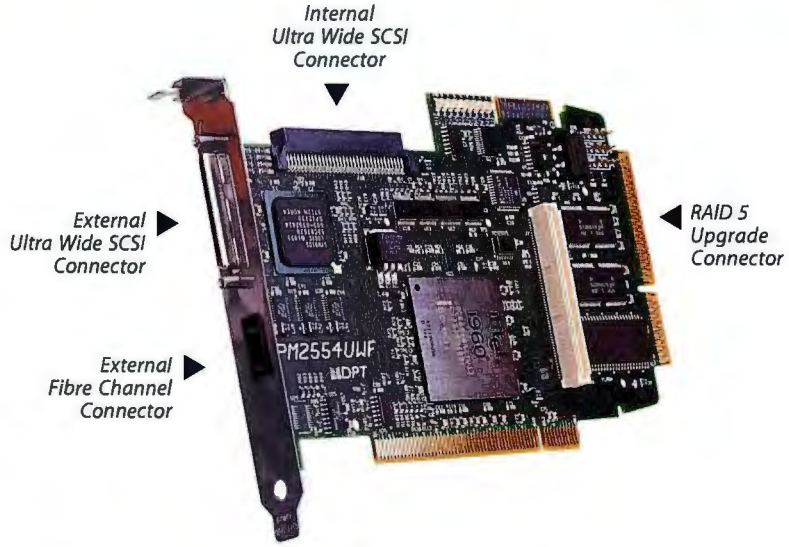

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Intel Launches Hasty Low-Cost Counterattack

Intel's latest foray into low-cost CPUs delivers less-than-stellar performance.

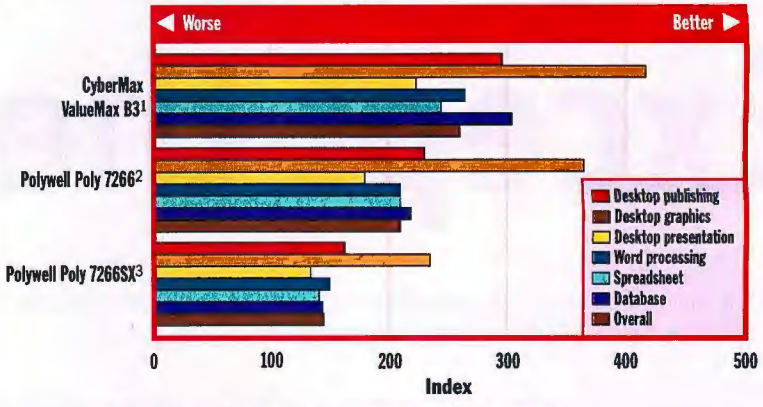
Intel's latest chip, the Celeron, may help the company capture a bigger portion of the low-cost PC market, but its design hobbles both performance and the justification for the proprietary Slot 1. The Celeron, Intel's hastily improvised answer to rapidly plunging PC prices, is a Pentium II chip, minus the secondary (L2) cache and cartridge case.

Intel designed the chip this way to reduce its production costs, so it could better compete in the sub-$1500 and sub-$1000 PC markets. At $155 (in quantity 1000), the Celeron's price is low compared to the prices Intel usually commands (between $300 and $600) for a mainstream processor. But in tests against Intel's own Pentium II, AMD's K6, and Cyrix's 6x86, BYTE found the Celeron lacking in some key respects.

Stripping off the L2-cache static RAM (SRAM) chips doesn't lower the cost much. The only other thing Intel could do was to cheapen the packaging. The most logical way to do this would be to sell the Celeron as an ordinary chip that fits Socket 7. Since the Celeron doesn't have an L2 cache, it doesn't need the back-side bus in Slot 1. But Intel wants to kill Socket 7 and drive the market toward its proprietary slots. So, Intel removed the Single Edge Contact (SEC) cartridge case. The naked circuit board and missing L2 cache blow away the last remaining technical justifications for Intel's proprietary slots and cartridges: easy, safe upgradability and support for a back-side bus.

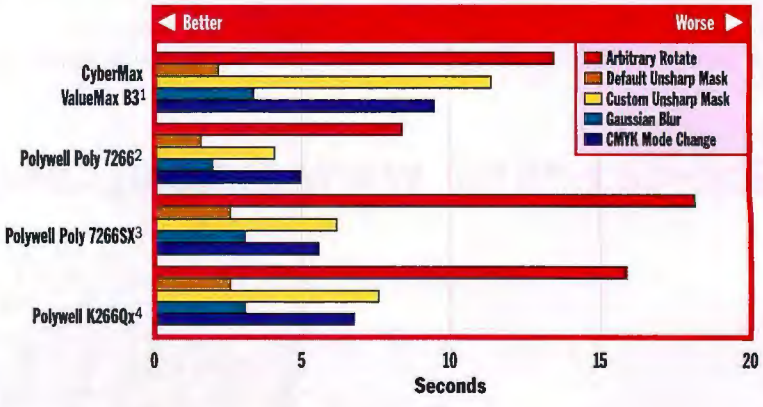
The Celeron is electrically compatible with Slot 1. However, it wiggles around loosely, because there's no cartridge housing to grip the vertical guide rails on both sides of the slot. In fact, Intel had to design new guide rails especially for the Celeron. In effect, it's a new variation on Slot 1.

Sysmark/32 Performance Scores



BYTE was unable to fully run the Sysmark test suite on the AMD-based Polywell K266Qx.[4]

Performance on Five Photoshop Tests



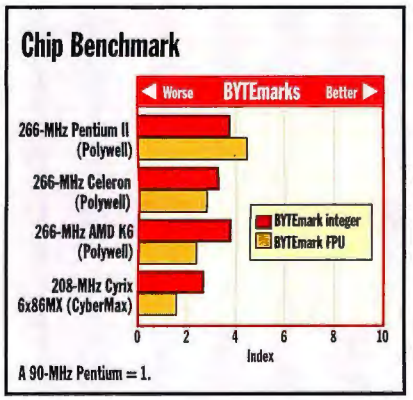
[1]Has 83.3-MHz system bus, Cyrix 6x86MX PR266+ (208 MHz) with 64 MB of SDRAM.
[2]Has 66-MHz system bus, 266-MHz Pentium II with 64 MB of RAM.
[3]Has 66-MHz system bus, 266-MHz Celeron CPU with 64 MB of RAM.
[4]Has 83.3-MHz system bus, 266-MHz AMD K6 w/MMX with 64 MB of RAM.

Intel's Celeron suffers in Photoshop and Sysmark/32 application benchmarks, due to its secondary cacheless design.

The new name is another part of Intel's strategy. Internally, the Celeron is identical to the Pentium II. By renaming it, Intel is doing everything possible to distance the two products from each other.

"We believe Intel is out to devalue the sub-$1000 market with an inferior Slot 1 chip," says Stan Swearingen, senior director of business management and marketing with Cyrix. "Its approach is simply to defeature a Pentium II; there's no innovation there."

BYTE tested the Celeron in a Polywell (800-999-1278, *http://www.polywell.com*) system. We swapped the Celeron out for a Pentium II to obtain comparative scores. We also tested a Polywell K266Qx, based on AMD's 266-MHz K6 processor, and the Cyrix 6x86MX PR266-based ValueMax B3, from CyberMax (800-345-8939, *http://www.cybmax.com*). All four systems retail for less than $1300 (without a monitor) as tested. The Celeron is a relatively strong performer on tests such as BYTEmarks, which measure raw CPU power. But it suffers on some application-based benchmarks such as Photoshop and Sysmark/32, because the Celeron's missing L2 cache creates a bottleneck.



Intel doesn't expect big sales from the Celeron immediately, but it could be a successful stopgap measure, earning Intel a place in the cheap PC market and luring system vendors to the modified Slot 1, and corporate customers to the Intel name. A better solution is slated to arrive later this year, when Intel introduces a chip code-named Mendicino. It integrates a 128- or 256-KB cache on the CPU die, which should improve performance significantly.

Product managers for PC vendors expect relatively low demand for the Celeron initially. "Celeron is for you if you're committed to the Intel architecture and are replacing a 486 or a Windows terminal, and simply need to run something like the Microsoft application suite," says Michael Takemora, a product manager for Compaq. But with the price of Pentium II systems coming down, aggressive announcements from competitors, and low sales expectations, the Celeron almost seems irrelevant as soon as it was launched.

–Jason Krause

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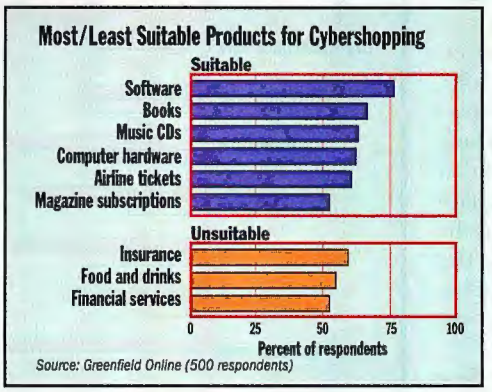


In a survey of 500 on-line users that was conducted by market research company Greenfield Online (Westport, CT), respondents most often chose software as a product that's suitable for cybershopping (see the table). The least suitable service, according to the survey results, was insurance.

Greenfield conducted the survey for BBBOnline (http://www.bbb.org), a wholly owned subsidiary of the Council of Better Business Bureaus.

Unabashed BYTEmarks

Is a Power Mac G3 really twice as fast as a PC using Intel's Pentium II processor? Yes, and no.

Recent Apple Computer "toasted bunny suit" advertisements claim that the processor in a Power Mac performs up to twice as fast as a Pentium II. In one ad, Intel's famous dancing lab technician dressed in a clean-room "bunny suit" gets "toasted" by the PowerPC's speed. Apple points to the high scores that its systems achieve on the BYTEmark integer tests to back up its claims.

We've received numerous queries from readers and the press about the BYTEmark suite, asking if those claims are true. Full details are available at our Web site (*http://www.byte.com*), but the bottom line: The 300-MHz Power Mac 750 processor executes the BYTEmark integer-based tests more than twice as fast as a 300-MHz Pentium II. Further tests show, however, that better integer processor performance doesn't always translate directly into better application performance.

The BYTEmark suite determines how a processor, including its FPU, influences overall system performance. Thus, it can provide an idea of how well a given system will perform. The 10 tests in the BYTEmark suite simulate operations performed by popular business and technical applications. Seven BYTEmark tests measure integer performance. The other three, LU Decomposition, Fourier, and Neural Net, measure floating-point performance.

BYTEmarks do not, however, emphasize the performance of a system's OS,

Contents

hard drive, or video subsystem. Differences in these and other subsystems and components can cause two machines using the same CPU to report very different results in an application-based test. This is why BYTE often uses both application benchmarks and BYTEmarks to test computer systems.

If you examine the table "PowerPC vs. Pentium II (Bitfield Test Enabled)," you'll notice that the PowerPC scores particularly high in the Bitfield test (which simulates what happens inside an OS that uses a bit map in memory to track the allocation of disk blocks). This is because the PowerPC compiler used to build the BYTEmark generates code that's different than the code generated by the x86 compiler we used.

From the beginning (see "BYTE's New Benchmarks," March 1995 BYTE), BYTE has said that compilers play an important role in how well a system scores running BYTEmarks. Compilers generate code based on developers' knowledge of the target processor's architecture, and the PowerPC compiler we use produces machine code that implements the Bitfield algorithm faster than the x86 compiler.

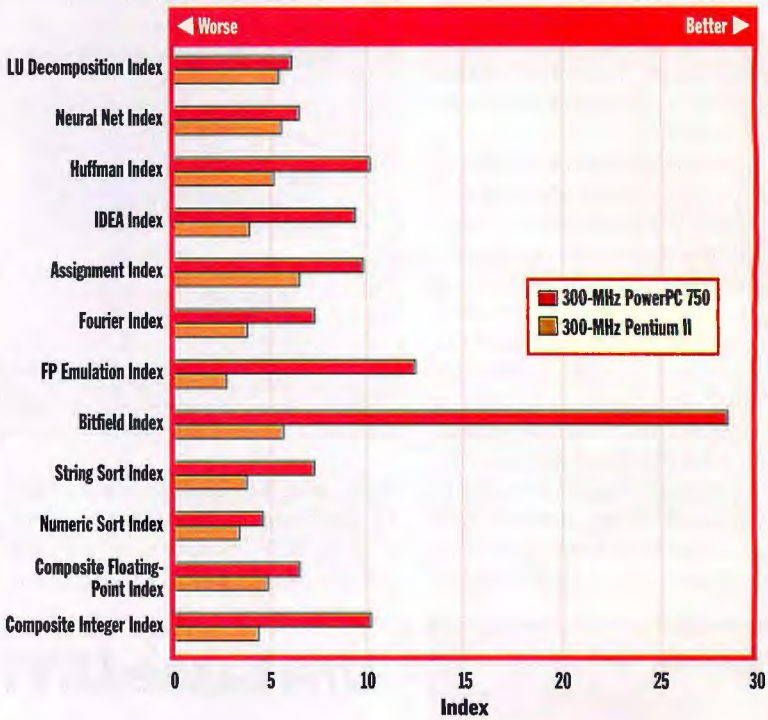
With the Bitfield test enabled, the 300-MHz PowerPC achieves BYTEmark integer scores that are more than twice as fast as a 300-MHz Pentium II. With the Bitfield test disabled (see "PowerPC vs. Pentium II [Bitfield Test Disabled]), the PowerPC's advantage in its BYTEmark score is reduced, but it is still almost twice as fast in BYTEmark integer performance as a Pentium II.

BYTEmarks measure processor subsystem performance only, and a system's overall performance is also determined by many other components, as mentioned above. Performance tests run in Adobe Photoshop have shown that the Pentium II's MMX capabilities can help it equal or surpass the performance of a PowerPC in important operations such as the Unsharp Mask and Gaussian Blur. The Power Mac retains its edge in other operations that do not leverage MMX, such as an arbitrary rotation of a bit map.

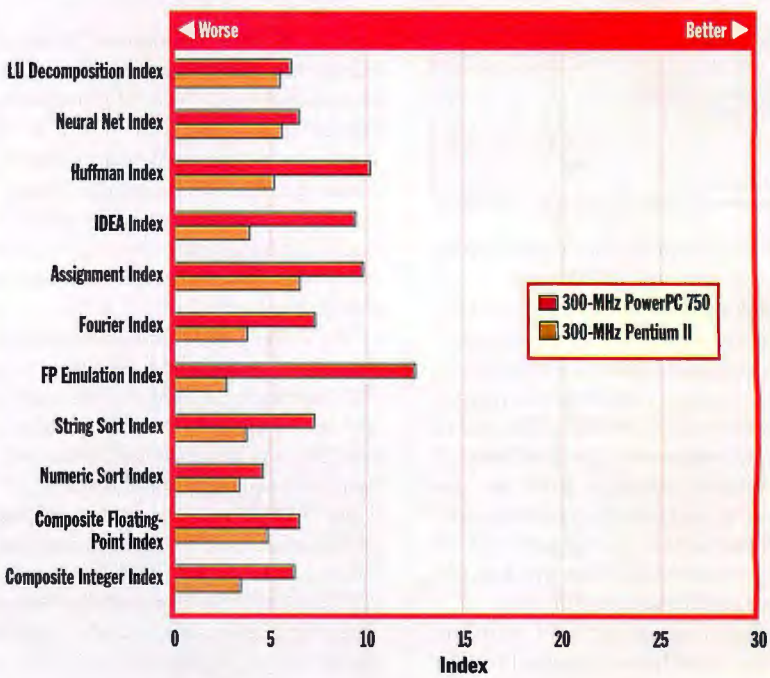
In Photoshop operations that are not MMX-optimized, the PowerPC is still the faster performer. For example, our test 300-MHz Power Mac performed the Arbitrary Rotation test in the BYTE/Van Horn Photoshop test suite almost twice as fast as a 300-MHz Pentium II (3.8 versus 7.5 seconds; lower scores are better).

BYTEmark Showdown: PowerPC vs. Pentium II

PowerPC vs. Pentium II (Bitfield Test Enabled)



PowerPC vs. Pentium II (Bitfield Test Disabled)



Even with the Bitfield test disabled, the PowerPC beats the Pentium II in the BYTEmark tests.

Joe reboots his PC every day.

That's a fact.

Conventional OS Architecture
The monolithic OS on Joe's machine clumps all OS components into a single address space. One subtle programming error in just one driver, and ***whoomp!****, Joe has to reboot – again.*

Dave hasn't since 1994.

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The QNX OS on Dave's machine runs ***every*** *OS component in its own MMU-protected address space. So if a driver – or virtually anything else – fails, the rest of the system stays up.*

Four years ago, Dave Cawlfield at Olin Chemicals replaced expensive PLCs with OMNX Open Control Software and the QNX Realtime OS. "Since then," says Dave, "we've upgraded the control system regularly with new hardware and software – including parts of the OS itself. But not once have we had to reboot."

For a handy 12-point checklist on OS reliability, download Dave's paper, Which OS for PC-based Control?, *at www.omnx.com/productinfo/technical_papers.htm.*

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Apparently there are those who do not subscribe to an all-Microsoft approach.

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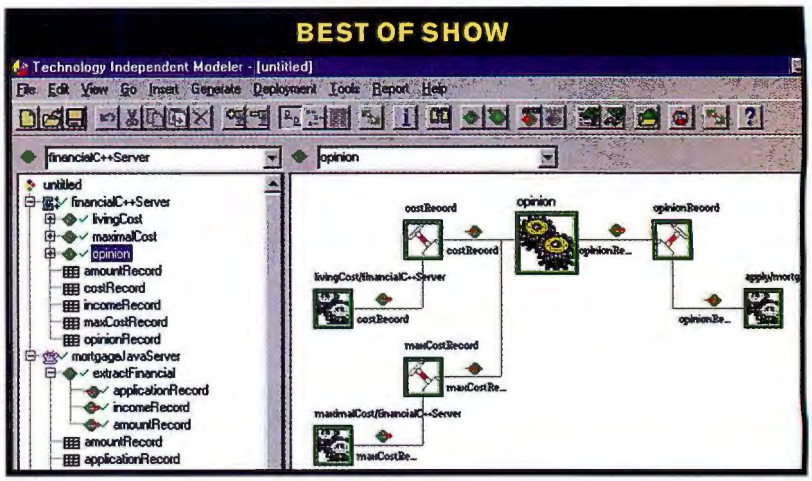
Best of CeBIT

SuperNova's Visual Concepts, a development environment that lets you mix and match ActiveX, Common Object Request Broker Architecture (CORBA), and Java components visually, without having to write new code, won BYTE's Best of Show award at the CeBIT show in Hannover, Germany. Finalists in the category were Software AG's Bolero, an object-oriented development environment, and Langner GmbH's Luca 2.1 communications application framework.

The award for Best System went to Compaq's E2000 Platform Architecture. It clusters Pentium Pro–based Proliant 6500 PC servers and Virtual Interface Architecture–compliant (VIA) hardware and applications for reliable, scalable, and cost-effective enterprise computing. Finalists were Siemens Nixdorf's Multimedia Integration Box, a PC TV, and MD-CO's Windows CE 2.0–based Vehicle Server for mobile users.

Compaq's E2000 Platform features VIA-enabled PC servers.



Visual Concepts' application-modeling environment lets you assemble applications based on a wide variety of components.

Best Technology winner was Swatch Telecom's SwatchTalk (see below). Finalist Ericsson's Intelligent Home Control is a wireless network for controlling devices over IP. The other finalist, Siemens Nixdorf's Fingertip Handy, provides communications security in a button-size pad.

The award for Best Internet Product went to Philips Speech's Access Point. It lets people access the Web by making verbal requests. Zoner Software's Callisto 3, a drawing and multimedia publishing program that supports Dynamic HTML (DHTML), and Intershop Communications' Intershop 3 e-commerce platform, were the two finalists.

Siemens' Scenic Mobile 800, a notebook with a magnesium case, smartcard reader, and removable keyboard, won Best Portable. One finalist was Acer's Pentium II–based TravelMate 7300. The other two finalists were Philips' Nino 300 Personal Companion and Everex's Freestyle. Both keyboard-less pocket PC organizers run Win CE 2.0.

The Best Peripheral, the Siemens Virtual Touchscreen (SIVIT), projects an image onto a wall or other physical object and uses gesture recognition to interpret users' movements. Peripheral finalists were Toshiba's SD-W1101 DVD-RAM drive and Alps' MD-1300 Micro-Dry/photo-quality color printer.

Best Application Software winner was Star Division's StarOne, a full-featured Java component-based office suite. Finalists were Lotus Development's Notes 5.0 client and Dialogika's Multidesk Workflow 3.0, a sophisticated work-flow automation server for Microsoft's DCOM environment.

The winner of Best Communications

Future Watch

Future Swatch Watch

Swatch Telecom is developing a new watch with an integrated cordless phone.

The watch is currently only a technology demonstration and isn't slated to become commercially available for another 12 to 15 months, according to Tomas Vucurevic, international marketing director of Swatch Telecom. The watch will likely be based on the DECT standard.

For further out in the future, Swatch is planning a version of the watch that can tell time and also function as a mobile cellular telephone. "The most obvious cellular technology to do that for at the moment is Global System for Mobile Communications (GSM), which is not, unfortunately, very big in the U.S. and Japan, but is everywhere else in the world," Vucurevic says. However, he says that Swatch will monitor the adoption of other emerging mobile telephony standards, including universal mobile telephony standard (UMPS), which by the time Swatch is ready, may be more popular than GSM.

Swatch's watch/phone.

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Best of Show/CeBIT Product Contact Information

BEST OF SHOW: SuperNova/ Visual Concepts (212-686-2650, http://www.supernova.com).

BEST DEVELOPMENT SOFTWARE: SuperNova/Visual Concepts. *Finalists:* Luca 2.1 (+49 40 271006, http://www.langner.com). Bolero (http://www.softwareag.com).

BEST SYSTEM: E2000 VIA Platform Architecture (281-370-0670, http://www.compaq.com). *Finalists:* Vehicle Server (+32 3 4513060, http://www.md-co.com). MMIB PC TV (+49 180 52 11 100, http://www.sni.com/pc).

BEST TECHNOLOGY: SwatchTalk (+41 32 343 9193, http://www.swatch.com). *Finalists:* Ericsson Intelligent Home Control (+46 8 7190516, http://www.ericsson.se). Siemens Fingertip Handy (Manfred.Bromba@pn.siemens.de, http:// w2.siemens.de/pn).

BEST INTERNET PRODUCT: Access Point (+49 241 8871 101, http://www.speech.be.philips.com). *Finalists:* Intershop 3 (650-373-1530, http://www.intershop.com). Callisto 3 (+420 545214788, http://www.zoner.com).

BEST PORTABLE: Scenic Mobile 800 (+49 821 804 2658, http://www.sni.de/pc). *Finalists:* TravelMate 7300 (800-733-2237, http://www.acer.com). Nino 300 (408-558-2200, http://www.nino.philips.com). Freestyle (510-498-1111, http://www.everex.com).

BEST PERIPHERAL: Siemens Virtual Touchscreen (+49 89 636 42 573, http://www.siemens atd.de/). *Finalists:* SD-W1101 DVD-RAM drive (714-583-3000, http://www.toshiba-teg.com). Alps MD-1300 (+353 29 70677, http://www.alps.ie).

BEST APPLICATION: StarOne (+49 40 23 646 500, http://www.stardivision.com). *Finalists:* Multidesk (+49 6897 9350, http://www.multidesk.com). Lotus Notes 5.0 (617-577-8500, http://www.lotus.com).

BEST COMMUNICATIONS SOFTWARE: MRS 3.1 (Message Routing System), (+49 2404 901 0, http://www.ppcom.com). *Finalists:* EWSD InterNode (+49 89 722 38824, http://www.siemens.de/oen/products/sn.htm). XaCCT 3.0 (+9723 6180040, http://www.xacct.com).

BEST COMMUNICATIONS HARDWARE: MC220 56K Platinum PC Card (+33 557 97 72 72, http://www.com1.fr). *Finalists:* Apollo Pro (+972 3 645 8555, http://www.radlan.co.il). Vanguard 6400 (+49 6151 880720, http://www.mot.com/MIMS/ISG/).

BEST MULTIMEDIA SOFTWARE: Cinema 4D 5.1 (+49 6172 5906 0, http://www.maxon.de). *Finalists:* Voice Xpress German (+32 2 4560500, http://www.lhs.com). Video Clip MPEG-2 (+33 1 46 730606, http://www.vitecmm.com).

BEST MULTIMEDIA HARDWARE: 601 (425-489-5009, http://www.fastmultimedia.com). *Finalists:* mp-man (+822 3468 7296, http://www.mpman.com). Power VR Second Generation (800-338-9549 [NEC] or +44 1923 260511 [VideoLogic], http://www.powervr.com).

BEST SECURITY PRODUCT: First Access Enterprise (+972 4 840 3322, http://www.access-1.com). *Finalists:* clPro-VPN (201-828-9611, http://www.radguard.com). Secure4U (+420 2 5731 3491, http://www.acrmain.com).

BEST OPERATING SYSTEM: UnixWare 7.0 (800-726-8649, http://www.sco.com). *Finalist:* Windows 98 (425-882-8080, http://www.microsoft.com).

Software was PP-COM's Unified Messaging Server MRS (Message Routing System) 3.1. Finalists were XaCCT Technologies' XaCCT 3.0, a reporting and auditing system for TCP/IP networks, and Siemens' EWSD InterNode, which integrates a PBX with the Internet. Best Communications Hardware winner, COM One's MC220 four-in-one 56K Platinum PC Card, supports 56-Kbps modems, ISDN (2B+D), GSM (data, fax, and SMS), and 10-Mbps Ethernet. Finalists were Motorola's Vanguard 6400, a multiservice edge networking device, and Radlan's Apollo Pro, which integrates up to 30 existing routers in a distributed router-switch network.

Maxon's Cinema 4D 5.1, a 3-D modeling, animation, and ray-tracing package, won Best Multimedia Software. Finalist Vitec's Video Clip is a low-cost MPEG-2 nonlinear editor that offers basic copy and paste functions. Lernout & Hauspie's Voice Xpress German was the other finalist.

The award for Best Multimedia Hardware went to Fast Multimedia's 601, a professional MPEG-2-based video-editing solution. Finalists were NEC and VideoLogic's PowerVR Second Generation 3-D Graphics Accelerator Technology, and Saehan's mp-man, a portable digital audio player that plays MPEG-3 files.

Best Security Product winner was First Access Enterprise, a contactless smart-card authentication system. Finalists were Radguard's clPro-VPN and Advanced Computer Research's Secure4U program that protects against hostile code.

Best Operating System went to SCO's UnixWare 7.0. Win 98 was the finalist.

Bug of the Month

Microsoft Application Doubles as Ad

A recently discovered bug in Microsoft's Extensible Markup Language (XML) parser makes it appear that the company is trying a little too hard to promote the Microsoft Java virtual machine (JVM). While experimenting with the parser, a Java application that moves data back and forth between tagged-text format (XML) and an in-memory object representation, BYTE editor Jon Udell got hit with this error message:

IOException: UTF-8 is not supported by your Java virtual machine. Try installing the latest VM from http://www.microsoft.com/java/download.htm

Java does UTF-8, which is one way to encode Unicode characters, so the problem was not with the JVM. Why did the application want us to download a new VM? Jon found the offending bug in this string:

```
String version = System.get
Property("java.version");
jdk11 = version.equals("1.1") ?
true : false;
```

It became apparent, and Microsoft confirmed, that the error is triggered if the variable jdk1.1 is false. This variable is false in our case because Jon was running Java Development Kit (JDK) 1.1.5. Microsoft wrote the program this way since the XML parser uses the JDK 1.1 InputStreamReader to implement XML encoding. This class does not exist in JDK 1.0, so the test was designed to prevent users from using 1.0. But the parser ought to test for a variable greater than 1.0, not merely equal to 1.1.

Microsoft has no immediate plans to fix the problem. It says the only way to fix it is to change the lines to read jdk11 = true; and recompile that class. **–Jason Krause**

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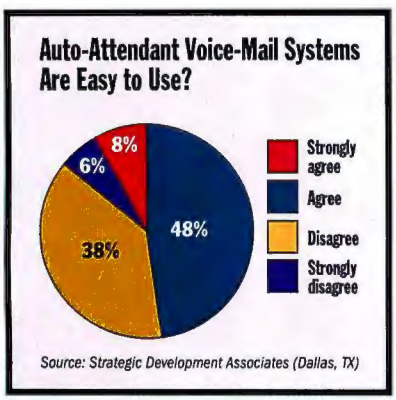
Talk Your Way Out of Voice-Mail Purgatory

Customer-service experts have long advised companies to curtail or abandon the use of automated telephone attendants in favor of human receptionists, who can immediately respond to a customer's needs. But solutions are now available that let customers talk to a computer—instead of a person—to quickly make the right connection.



Several companies now offer solutions that marry traditional corporate phone systems with personal speech-recognition technology. With these systems, instead of having to press a series of numbers on their telephone keypad, customers that call your business can get to the person they want by simply saying "John Smith."

Parlance (Medford, MA, 781-306-2200 or *http://www.parlance-ncs.com*), a developer of solutions that use speech-recognition technology, recently expanded its offering of NameConnector products. EmployeeConnector, PublicConnector, and PagerConnector make phone-system directory resources available to internal staff and external callers, via simple voice commands. Callers are greeted by a synthesized human voice. It invites the caller to say the name of the person they wish to reach. The Parlance system seeks a match in a user-defined registry of names and automatically forwards the call.

Parlance is not the only company in this market. Other products include the

GartnerGroup Report

Firewalls Proliferate

In the last three years, users' questions about firewalls have evolved from "What's a firewall, and why do I need one?" to "Which firewall is right for me?"

The answer is no longer straightforward. The firewall is here to stay, but a process of differentiation and market segmentation is under way. Choosing the right type of firewall is increasingly an issue of how much security you need.

We see three distinct market segments developing for firewalls. The first is the high-security segment, which includes enterprises in the health-care, high-tech, biotech, oil-exploration, and banking/financial industries. Among corporate entities with highly confidential intellectual property to protect, the chief selection criterion is a firewall's ability to resist attacks.

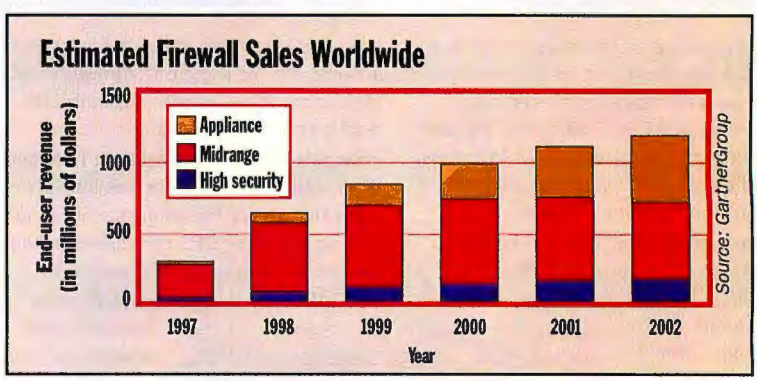
Network security is very important at these enterprises. They typically have a dedicated information-security staff. Ease of use is a secondary consideration. Invariably, products in this category are built on a modified version of Unix, the best of which effectively remove superuser privileges and base their designs on application proxies rather than multilayer packet inspection.

The second market segment, midrange enterprises, consists of traditional manufacturing and service industries that are not at high risk for industrial espionage. The biggest security threat comes from hackers who may be trying to make a statement or who use the enterprise's resources as a launchpad for an attack on a more attractive high-security target.

While recognizing the need to safeguard their Internet access points, these enterprises do not have to build fortress-like network defenses or maintain information technology (IT) security staff. Mirroring these enterprises' client/server network strategies, the firewall products tend to be NT-based. This segment currently represents 80 percent of the total firewall market. Amazingly, we think the market share will shrink to about 40 percent by 2002, due to the exponential growth we are projecting in the third segment, low-end firewall users.

For this fast-growth segment, made up of companies with revenues of $200 million or less, firewall protection often is viewed as a simple filter problem. They look for a simple, cheap, all-in-one firewall appliance that does for Internet access what purification filters do for water—keep the bad stuff out. These firewall appliances must boot in a default safe state and with minimal intervention, while permitting secure access to the Internet. Eventually, these devices will evolve into more than just security devices. Simple e-mail servers and Web servers will be incorporated into the firewall package. This utility mix may reduce the quality of security, but many users will find this trade-off acceptable.

Some analysts have questioned whether firewalls will be around in a few years. We believe firewalls will continue to be used for the foreseeable future (2002). It is true that application-based security offers the most precise and fine-grained access control, and when combined with cryptography, it can provide what appears to be undefeatable security. Unfortunately, the great mass of desktops and current applications are unlikely to disappear in the next five years, and relying on users to secure desktops is a bad security risk. Combine this with the trend of more server-like software appearing on desktop PCs, and we have a demonstrable need for firewall-based solutions.



Michael Zboray, *a vice president and research director at the GartnerGroup, has worked in the networking industry since 1979.*

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A big justification for programs such as these is their ability to improve the cost-effectiveness of your current phone system. "There are people who will use these speech-recognition phone systems that wouldn't otherwise use a system requiring them to spell a name," says Jim Norman, speech-recognition analyst at Wohl Associates. "The greater the number of callers, who may be customers, the greater the return on investment."

Brad Prizer, director of marketing at Voice Control Systems, agrees. He says that a recent survey indicates that just over half of the respondents said automated voice-mail attendants are easy to use (for more information, see the figure on page 34). "We weren't expecting that almost half of those surveyed would find it difficult to use auto-attendants," Prizer says. Mobile users are also using the technology to remotely access phone registries, report generators, and third-party phone systems.

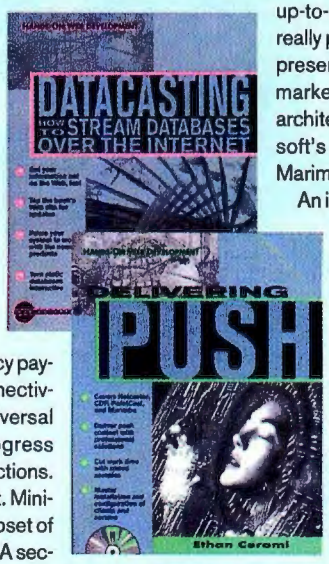
Given the newfound flexibility this technology offers, why hasn't its adoption been more widespread? "The opportunities are tremendous," says Norman. "However, the target market is not necessarily endowed with all the resources to take advantage of them. With all the companies developing in this segment, the one who helps the user best understand and reach this potential will win the day." **–Dan Coyle**

Book Reviews

The Black Art of Data Broadcasting

The excitement of static Web pages has worn off. Now it's time to face more difficult challenges, such as seamlessly extracting live data from corporate databases and automating the delivery of Web content.

Datacasting: How to Stream Databases Over the Internet discusses Web-based access to a wide range of database technologies, from displaying flat files to tapping desktop databases, from exporting data with Java applications to porting legacy COBOL to the Web. The book is chock full of juicy technical information.



Datacasting canvases the tools and strategies recently adopted by the major database vendors to support Internet connectivity. For example, IBM Connectors is a set of gateways for deploying enterprise applications and data over the Internet. IMS Web Studio lets browsers download a set of Message Format Services (MFS) source files, generates C++ and HTML files for transactions, and compiles the C++ code as an executable CGI-BIN program. Sample code shows how to convert a legacy payroll system to a Web-based application. Other connectivity solutions cover Sybase's web.sql, Informix-Universal *Web* Connect, Oracle Designer/2000, and Progress Software's WebSpeed for securing Internet transactions.

Refreshingly, shareware solutions are not left out. MiniSQL, developed by David J. Hughes, supports a subset of SQL, a database engine, and a C programming API. A second shareware component, basically a CGI scripting mechanism, provides the interface between MiniSQL and the Web. WDB, a shareware application written to archive and access observations made with the Hubble space telescope, installs as a CGI script and generates a standard HTML form for accepting database queries.

Three chapters are devoted to database access with Java. Java's portability, security, and object-oriented architecture make it ideal for Web-based development, but these same features cause problems for database access. For instance, security restrictions prevent Java applets from connecting to a server other than the one that downloaded the applet. Databases generally reside on dedicated servers. A three-tier approach employs middleware such as JetExpress or OpenLink to accept the Java query on the Web server and pass it to the database server. *Datacasting* also grapples with client-side implementation issues when deploying proprietary interfaces, ODBC, or JavaSoft's Java Database Connectivity (JDBC) drivers. Other chapters cover specific database optimizations for Web applications, natural-language interfaces, Directory Services, and in-depth case studies.

Delivering Push explores technologies for dynamically sending up-to-date content to Web-enabled desktops (it's not really push; it's automated pull). The first four chapters present an overview of push technology and the push market. The rest of the book covers the major push architectures, including Netscape's Netcaster, Microsoft's Active Channels, the PointCast Network, and Marimba's Castanet.

An inordinate amount of space is devoted to the end-user software (how to subscribe to channels, schedule downloads, work off-line, and so on). But the end-user component in a push architecture is typically easy to use. Because you would normally deploy only one vendor's offering on your desktop, you would be better off with a book (or on-line manual) detailing the features of your chosen interface.

The chapters in *Delivering Push* on developing channels are more compelling than the ones on the end-user component, especially if you intend to broadcast content from your own Web site. Here, you get key information on the development of channels for each major push architecture (you'll need to consider all the major protocols to support your potential clients). These development chapters give you a good idea of the tools and the coding required to build and broadcast your own content channels.

Stanford Diehl *is a frequent contributor to BYTE.*

Datacasting: How to Stream Databases Over the Internet
by Jessica Keyes, McGraw-Hill, ISBN 0-07-034678-X, $39.95

Delivering Push
by Ethan Cerami, McGraw-Hill, ISBN 0-07-913693-1, $49.95

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Blasts from the Past

5 Years ago in BYTE

Five years ago, Microsoft was marketing or planning numerous versions of Windows. In addition to Win 3.1 and Win for Workgroups, Microsoft had Win NT plus a new "32-bit" successor to Win 3.x, code-named Chicago. Modular Windows, for interactive TV and other devices, is defunct. WinPad, a version for hand-held PCs and PDAs, never happened: Microsoft went back to the drawing board and now we have Win CE.

10 Years ago in BYTE

Our product focus looked at modems that "take transmission rates to a blazing 9600 bps and beyond." Also in the news: America's PC industry was starved for memory chips, thanks to a U.S. trade policy that was supposed to stop the "dumping" of low-cost chips in the U.S. However, that policy backfired and instead actually caused the shortage.

15 Years ago in BYTE

An article by Tim Paterson of Seattle Computer Products discussed the pluses and minuses of an OS originally called QDOS (Quick and Dirty Operating System) in August 1980. Microsoft eventually bought all rights to the OS, which became MS-DOS and had reached version 2.0 status at the time of the article.

20 Years ago in BYTE

Shugart's new fixed disk drive cost $2550 (quantity one) for a 14.5-MB version, $2500 for 29 MB.

Software Security Guard

Edward Amoroso, author and chief technical officer of the Information Security Center at AT&T Labs, discusses cracker detection.

BYTE: *Does anyone really know how much network hacking is going on?*
Amoroso: Honestly, it's very difficult to say for sure. We can only know for certain those things that we detect, and we certainly cannot detect everything. Whether we see most, some, or only a tiny bit of the real hacking going on is undetermined. However, statistics from organizations such as Computer Emergency Response Team (CERT), National Fraud Center, and the FBI suggest a huge increase in real security breaches.

BYTE: *Do you need a security expert on your staff to catch a hacker?*
Amoroso: I can see how it might seem that way. Most of the incidents to date that have been reported in the literature and in books have involved experts using their own tools while an incident is occurring. Luckily, automated tools are available that make this sort of thing more feasible for mere mortals like the rest of us.

BYTE: *What kind of hacker-detection tools are being developed?*
Amoroso: Intrusion detection is the term most often used to describe them. Companies such as Network Flight Recorder, Internet Security Systems, ODS Systems, and the WheelGroup make intrusion-detection products that you can purchase for prices that range from $40,000 to $50,000 down to free. Early adopters of this technology are finding it useful in their network security architectures, but it remains to be seen if these tools will ever reach mass markets. The recent purchase of the WheelGroup by Cisco signals that the big boys are paying attention to this technology.

BYTE: *How do these tools work?*
Amoroso: Most of them encode some sort of internal representation of known attacks and search for these representations by either watching live network traffic or parsing through audit-trail data. Some tools include "dirty-word" checkers that will search for suspicious strings such as '/etc/shadow' in a Unix networking environment. In addition, intrusion detection relies on profiles of what is considered normal, so that observed behavior can be compared with expected behavior. Alarms are generated when there is a significant difference.

BYTE: *Some intrusion-detection systems are free but a little limited. But, the alternative seems to be the $20,000 mondo software product. Is there anything in between? Will there be in the future?*
Amoroso: Freeware will always have its place in the network security administrator's toolbox. But as network security becomes more mainstream and important, organizations will demand products that are supported commercially. We now have with intrusion detection what happened in the early days of firewalls—price chaos. But firewalls have settled into a more reasonable pricing strategy, and so will intrusion-detection systems.

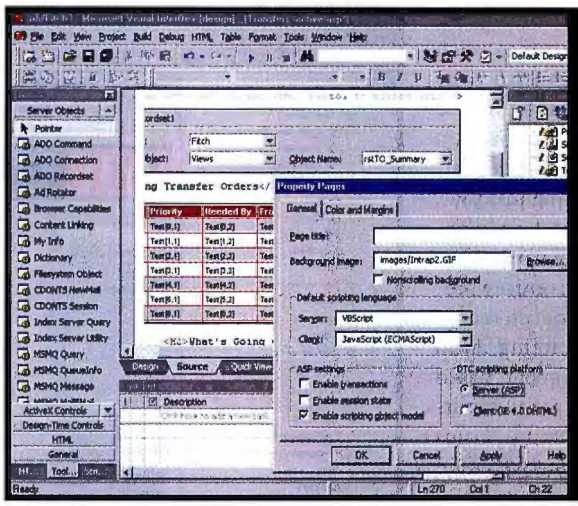
Edward Amoroso's new book, *Intrusion Detection: An Introduction to Internet Surveillance, Processing, Traps, Trace Back, and Response*, will be available later this year from Intrusion.Net books (located at *http://intrusion.net*).

Microsoft's RAD tool for data-enabled Web apps has server-side debugging and a VB-like environment. By Steve Gillmor

Visual InterDev Grows Up Fast

Visual InterDev 6.0 (VI6) follows Visual J++ 6.0 out the door with a prerelease edition that showcases Microsoft's new Visual Studio integrated development environment (IDE). With drag-and-drop data binding, WYSIWYG page editing, Web-enabled remote debugging, and team development tools, VI6 takes giant steps closer to being a truly visual rapid application development (RAD) tool for building Internet applications. It's more feature-rich than its predecessor, VI1.

The program shares many of its Java companion's features, including the three-tabbed Dynamic HTML (DHTML) editor/viewer and a customizable suite of Toolbox, Property, HTML, and Script Outline windows. The new Site Designer lets you rapidly prototype and modify your site's architecture in the FrontPage 98–compatible Site Diagram. A Page Navigation design-time control (DTC) automatically generates HTML navigation bars that update when you change the project hierarchy. You can apply customizable themes and layouts, and use the new cascading style sheets (CSS) editor to preview style changes in an embedded Internet Explorer 4 window.



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Price to be determined

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Enter HotBYTEs No. 1063.

Visual InterDev 6.0 lets you convert server-side design-time controls to Explorer's DHTML for richer intranet functions.

VI6 introduces the Scripting Object Model (SOM) and DTCs that transform HTML scripting into Visual Basic–like, forms-based development. The prerelease version uses JavaScript and scripting libraries to create the SOM's pseudo objects that let data-bound DTCs interact. I used a wizard to set up a target Web server and to program in Master mode. Changes on my workstation were automatically updated on the server.

To wire a local or remote database to your Web site, you drag a RecordSet control onto the Design view of your page and then right-click to edit its tabbed property pages. You can drop data-bound text, list, option, and grid DTCs from the ToolBox, or auto-create them by dragging fields from the Project Explorer.

VI6 is a work in progress. I couldn't find a mention of frames and table wizards in the incomplete on-line documentation. The program showcases but does not fully implement deployment features that automate moving, registering, and installing project components in Microsoft Transaction Server (MTS) packages residing on production servers. And though VI6 and Visual J++ 6.0 share common code, I had frequent crashes until I reinstalled VI6 by itself.

Beta blues aside, VI6 should prove seductive for FrontPage 98 users looking to data-enable their sites. With VI1 and Visual Basic already holding league-leading market shares, the VI upgrade may prove irresistible to NT shops eager to migrate multitier business applications to the economies of the Web. B

RATINGS	
TECHNOLOGY	★ ★ ★ ★
IMPLEMENTATION	★ ★ ★ ★

Steve Gillmor is a consultant for Southern Digital, Inc. (Charleston, SC). You can reach him at **(sgillmor@southerndigital.com)**.

TECH FOCUS

Remote Debugging

Distributed Web applications require debugging across both client and server. With Visual InterDev 6.0, you can set breakpoints in HTML and Active Server Page (ASP) scripts, add "watch" variables, and step through code from workstation to server. This new remote debugging technology employs Distributed COM (DCOM), Internet Information Server (IIS) 4.0, and tight integration with Microsoft Transaction Server (MTS) to run applications out of process in their own memory space.

After selecting Server Script options to enable ASP server- and client-side debugging on launch, you set breakpoints and make this ASP your project's start page.

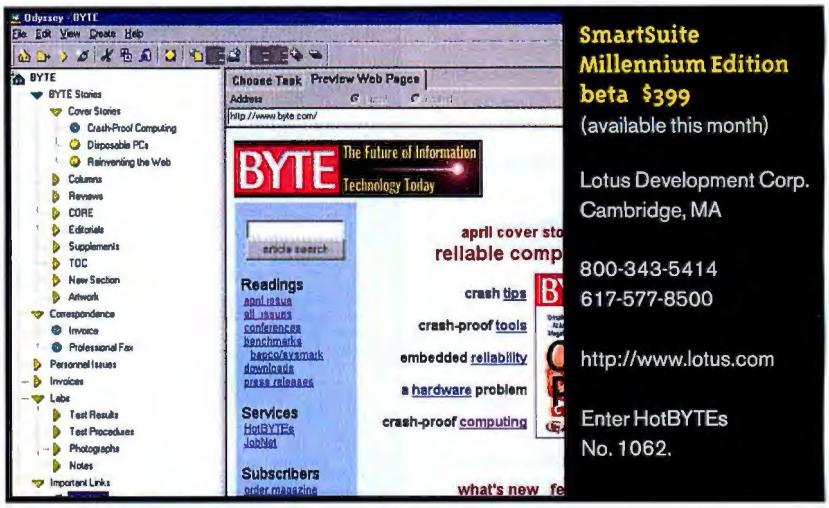
Lotus's newest edition of SmartSuite is Web-smart and Y2K-savvy, but a long way from being an MS Office killer. By Cynthia Morgan

SmartSuite Heads for the Millennium

One thing about being the underdog: You stuff as much new technology into your product as possible, just to stay in the game. Lotus's SmartSuite, a distant also-ran against the Microsoft Office megamonster, is doing just that.

I examined a beta copy of the Millennium edition and found features that Microsoft offers only as promiseware: fully integrated ViaVoice speech recognition, greatly improved scripting, and a Tivoli Management Environment–based software-distribution scheme that puts Office 97 to shame. Most notably, Lotus has added FastSite, a promising Web-integrated work environment.

SmartSuite Millennium introduces a concept Microsoft plans to incorporate in its next Office suite: the use of HTML as a standard file format. SmartSuite applications move in and out of HTML format without fuss, making it relatively easy to modify intranet pages. Lotus also added Extensible Markup Language (XML) and jDoc (a Java publishing format similar to Acrobat), and promises direct, round-trip compatibility with Office and WordPerfect file formats. I had no problem opening documents from Word, Excel, and WordPerfect in SmartSuite, saving and reusing them in their original applications.



SmartSuite's FastSite groups Web links and documents in a single work environment.

SmartSuite's SmartCenter, a document-centric file-drawer menu, is more useful than the Office toolbar I usually discard. The Web-centric, however, will probably turn it off in favor of FastSite.

FastSite lets you build an intranet-style work environment. It stores links to documents locally, on the network, or on the Web, in a frame-like file list. Clicking on a document name brings up a browsable view of the document or, if it's not in jDoc, HTML, or XML format, launches the file's application. FastSite does a fast and remarkably accurate job of converting files to HTML or jDoc format, and it lets you stage and deploy Web pages.

SmartSuite's other applications are uneven competitors. I still prefer Word, quirks and all, to WordPro, although I lean toward Lotus 1-2-3's veteran ease of use over Excel. PowerPoint could learn a lot from Freelance's elegant templates and unobtrusive help. And while I'm a longtime Approach user, I still prefer the power and customizability of Access for database development.

RATINGS	
TECHNOLOGY	★ ★ ★ ★
IMPLEMENTATION	★ ★ ★

Will the new features be enough to make Office 97 sites switch to SmartSuite Millennium? Probably not, particularly for those with a heavy investment in Visual Basic for Applications (VBA) customization and application add-ins. Lotus Notes/Domino administrators, or those deploying IBM's e-suite for network computers and other Java-based clients, will want to evaluate the new suite's high degree of integration with each.

Existing SmartSuite users should almost certainly upgrade. For the rest of us, SmartSuite's mixed bag means we'll pick and choose among both suites. B

*Cynthia Morgan (**cynthia.morgan@byte.com**) is BYTE's editor.*

TECH FOCUS

Entering the 21st Century

Lotus has adopted IBM's "sliding-window" approach to Y2K for SmartSuite Millennium, defining two-digit years according to a 100-year window around the current date that looks 19 years into the future or 80 years into the past. You can change the default, but only within the registry. For example, this year, the date 2/1/19 automatically becomes February 1, 1919, while 2/1/17 is considered to be February 1, 2017. Learn more about IBM's Y2K focus at http://www.ibm.com/IBM/year2000.

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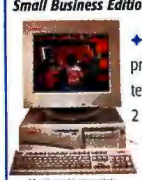

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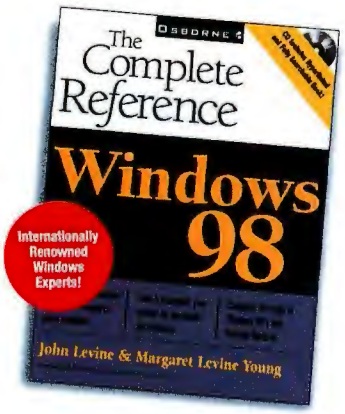

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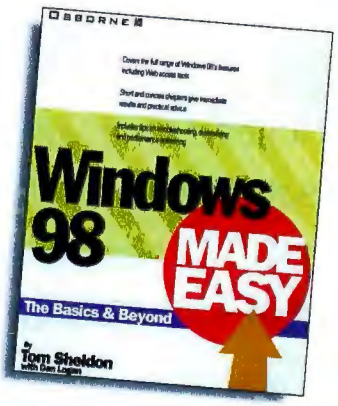

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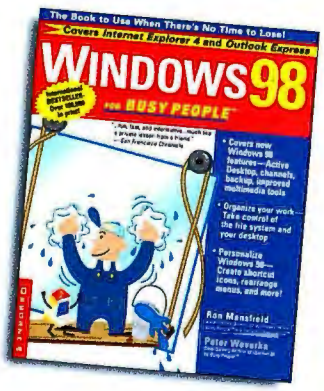

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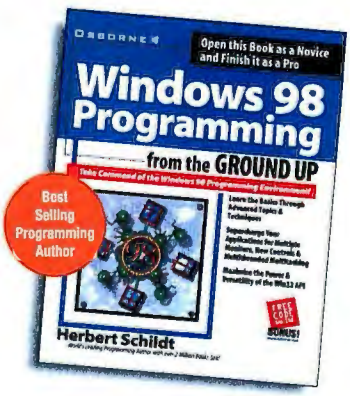

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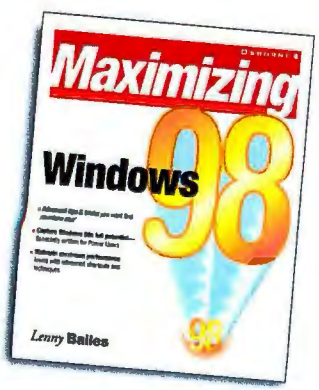

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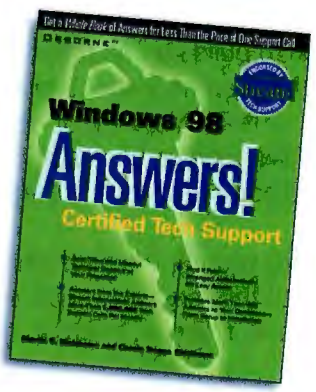

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The Cobalt Qube offers more of what you want in a mini server, and at a micro price. ***By Michael Mathog***

Qube Is Convenience Squared

Microservers are the latest product line born of the Internet craze. A good example is the tiny Cobalt Qube 2700WG. This microserver is fast, offers sophisticated services for up to 50 people, is easy to use, and has a low price.

I tested the $1249 Cobalt Qube, which runs Linux 2.0. It comes with a 2.1-GB hard disk and 16 MB of RAM (and can hold up to 64 MB). The box has only one PCI slot, which does not, as yet, support current expansion cards.

After unpacking the machine, I plugged it into my LAN. Using the buttons on the back of the device, I quickly assigned it the correct IP address, subnet mask, and gateway. I launched a Web browser (Netscape or Internet Explorer 3.0 or greater with frames support is required) and typed in the Qube's IP address. The browser quickly presented a nicely organized HTML-based setup wizard.

Through the Web browser, I configured the Qube with users, added groups, and enabled e-mail, threaded discussion, file sharing, and FTP support. The Qube even supports CGI, Perl 5.0 scripting, and Telnet access, though I didn't try these.

Once setup was completed, each user on my LAN had a personal Web page, e-mail, and up to 5 MB of file storage. The system is accessible through Windows SMB, FTP, AppleTalk, HTTP, and TCP/IP.

My lack of perfect understanding of the domain name services prevented me from quickly configuring e-mail for my users. And unfortunately, it's not well documented in the Qube manual.

Even after configuration was completed, the Qube exhibited some specific file sharing idiosyncrasies with Windows 95 and Windows NT, which luckily the manual addressed. Additionally, it wasn't obvious how to access threaded discussion and FTP services. Sometimes, navigating around the Qube itself was a bit strange. Occasionally the browser's Back button did not return me to the previous Web page.

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TECH FOCUS

Security Through Software

The Cobalt Qube does not have a firewall or contain any manual switches to limit write ability. To secure the Qube, I configured user access rights. Through this process I learned that the Qube's interface is powerful and flexible without sacrificing simplicity. I set up password schemes to grant and limit users' abilities to access home pages, install CGI scripts, and use Telnet. Cobalt says it approached security completely through software and a browser to allow the administrator to make changes remotely.

RATINGS	
TECHNOLOGY	★ ★ ★ ★
IMPLEMENTATION	★ ★ ★ ★
PERFORMANCE	★ ★ ★ ★

These problems are minor considering how easy it is to connect the Qube to the LAN and access highly complex and very useful services. The device performed adequately with FTP, HTTP, SMB, and AppleTalk transfers and moved files at around the same pace as my Pentium 200 PC. Although I wouldn't recommend it for extremely heavy Web serving, database computing, or CGI processing, the Qube is certainly adequate for most small LAN uses. B

Michael Mathog runs a small testing firm in San Francisco. You can reach him by e-mail at **mike@maddogtech.com.**

You can take your office voice and data connection functions home with you. ***By Andrew W. Davis***

A Portable Device for PBX @home

Have you ever wanted to take the office PBX home with you so you can enjoy voice mail, call forwarding, and speed dialing from your bedroom or study? The MCK EXTender 3000, a line of remote PBX extensions, lets you do just that. This hardware/software combo gives off-premises employees the same telephone and data functions they have at corporate headquarters.

This isn't a magical transformation for the average telephone, and at $2400 per remote user, it's not for everyone. The kit includes a PBX handset (phone), MCK's modem-size EXTender hardware for the office and the remote site, and the software to control them. You need a separate ISDN or analog line for each remote user.

The office unit sits between the telephone network and the company PBX, spoofing the PBX into thinking the remote phone is an office extension. Using the PBX digital handset and MCK's remote-voice technology, off-site workers can place and receive calls, use four-digit dialing, speed dial, transfer calls, initiate and participate in conference calls, access voice mail, and use intercoms. The red message light even comes on.

Dial 9 and you get an outside line. You can make (and receive) an interoffice page, which is startling the first time it happens. The EXTender also enables remote use of automated call distribution (ACD) systems and call accounting software. The operation is totally transparent. Your fellow workers don't have a clue that you're not in your office.

RATINGS	
TECHNOLOGY	★ ★ ★ ★
IMPLEMENTATION	★ ★ ★ ★

For busy executives, the EXTender series removes a barrier to successful telecommuting. And for call centers where telephone efficiency is key and floor space precious, it can give at-home workers all the office functions they have in their cubicles. Cost, however, will limit widespread adoption. Until MCK lowers prices, by using central site concentrators and next-generation silicon and software expected in 1999, you're more likely to find this device extending PBX services to a warehouse or a CEO, not to thousands of teleworkers.

But the EXTender also provides important options that allow remote employees to access the corporate data network using existing remote-access solutions. The model 3000S multiplexes voice at 32-Kbps adaptive differential pulse code modulation (ADPCM, a standard technique in the voice coding industry) and data over one ISDN B channel. The second channel is available for analog devices, including fax or modem.

The model 3000E offers dedicated, dial-on-demand voice over one ISDN B channel and 64-Kbps Ethernet data (or analog voice) on the second. When it detects voice or data traffic, the unit can call a voice switch or any remote router that supports bridging. Another model, the EXTender 3000T, provides voice on one B channel and data on the second, using an RS-232 connection to the PC. Most of the product family requires a line dedicated to the PBX; the 3000T's standard dial-in client and terminal adapter also lets the PC dial out to any ISP.

The fly in the ointment is cost. The price may be worth it for full-time remote access, or even part-time executive access. But it's simply too expensive for the occasional night-owl worker. B

Andrew W. Davis (**andrewwd@ultranet.com**) *is a consultant, market researcher, and writer.*

MCK's modem-size EXTender 3000 is available in ISDN and POTS models to deliver your office's PBX functions to remote locations.

PHOTOGRAPH: STEVE GREENBERG © 1998

★★★★★ Outstanding ★★★★ Very Good ★★★ Good ★★ Fair ★ Poor

The RSVP protocol implements data paths with predictable delays over IP-based networks. ***By Dinesh Dutt***

Bringing Quality of Service to IP

With the integration of voice and video with data networking, the nature of intranet traffic is about to change substantially. While bursty, loss-intolerant, but delay-tolerant network traffic was once the norm, soon things will become oriented more toward constant and loss-tolerant traffic that requires predictable delays. The technology that will permit this to happen is the appropriately titled quality of service (QoS).

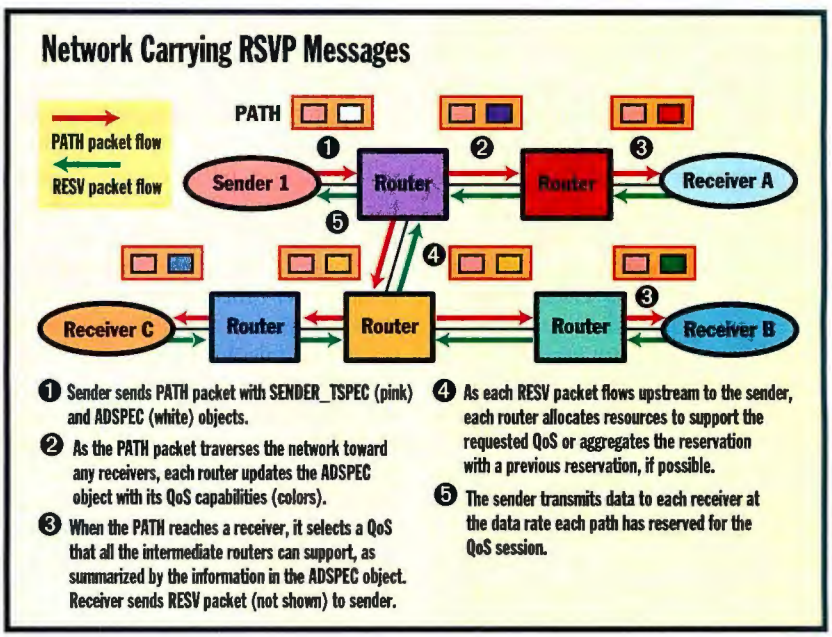
The concept of QoS is not new. It has been available in network technologies, such as asynchronous transfer mode (ATM), for a long time. The growth of the Web requires that QoS be made possible over TCP/IP- and Ethernet-based networks. However, TCP/IP doesn't immediately lend itself to the implementation of such capabilities: It's a best-effort service that doesn't attempt to prioritize packets or provide any guarantees about the time taken to deliver a packet.

Enter RSVP

The Internet Engineering Task Force (IETF) has devised an architecture that enables QoS through TCP/IP. Called the Integrated Services Model (ISM), this architecture retains the Internet's common infrastructure and unified protocol stack while layering QoS functions on top of the current best-effort model. Thus, applications requiring QoS can safely interoperate with existing applications. For more details on ISM, see RFC 1633.

To implement QoS, applications must be able to specify their requirements to the network, which then tries to provide QoS. The IETF has agreed upon a new protocol, which goes by the cute moniker of RSVP (Resource Reservation Protocol), for this purpose. RSVP reserves resources along the application's data path in the intermediate routers.

In RSVP, the reservation setup is receiver initiated, not sender initiated. Why? First, it simplifies multicast sessions, since receivers can come and go at any time without the sender's being aware of it. Second, the receiver experiences the effects of QoS delivery, and different receivers might be connected via differing media. Finally, the receiver is probably paying for the resource.



RSVP allows receivers to establish reserved data flows at rates these paths can sustain.

It's in the Message

RSVP uses control messages to initiate and maintain a QoS session. These messages are simply IP datagrams and are thus compatible with both IPv4 and IPv6. Within these messages are protocol fields, or objects, that describe the application's desired QoS service and convey management information among the network routers. The object's contents are opaque to RSVP: It merely transports them and hands them over to the appropriate software or hardware modules at each intermediate router, which then reserves the necessary resources. The details of these actions are covered in RFC 2210.

It's best to describe how RSVP builds a reserved path by using an example. Consider the figure above, which contains a sender, several receivers, and a medley of routers. The action begins with the senders. A sender (e.g., a videoconference or an audio broadcast) that desires to have its data flows subject to some QoS sends PATH packets downstream toward the receivers. The address embedded in this message is the sender's multicast/unicast address. At each hop, the intermediate router retrieves the previous hop address and overwrites it with its own address before forwarding it.

As a result, when the receiver sends

messages, the upstream neighbor's address is available. Since PATH messages are routed like regular data packets, RSVP functions correctly in the presence of non-RSVP-aware routers. But QoS might not be possible in the presence of such routers in the data path.

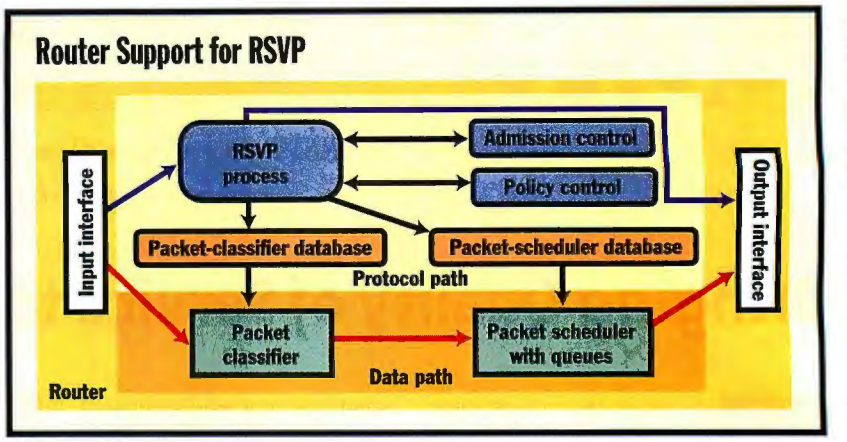
The PATH packet contains various objects, two of which are of interest here. The first is the SENDER_TSPEC, which lists the QoS control services that the sender offers and the bandwidth they require. The intermediate routers record this information and forward the message without modification.

The second object is the ADSPEC. It contains information such as the availability of a particular QoS control service at the router and the actual resources available for each of the control services. Each intermediate router modifies this object to reflect its capabilities; when the PATH message arrives at a receiver, the ADSPEC contains a summary of the data path's available QoS. The receivers use this information to make a QoS reservation that the path can sustain.

Receivers use RESV messages to make a reservation. These packets travel upstream from the receivers to the senders, but only as far as the router at which the receiver's data path joins the multicast distribution tree. In other words, RSVP aggregates the reservations where possible at each intermediate node.

RESV messages also carry various objects. A FLOWSPEC object stores the QoS requirements for the data flow. Another object, the FILTERSPEC, specifies which packets use the reserved resources. RSVP provides mechanisms that allow multiple data flows to share a single reservation or make a reservation private to a single data flow.

The QoS requirement specifies the type of QoS control service that an application desires and its traffic contract, using such parameters as the peak data rate and the maximum packet size. Currently, two kinds of QoS control service are offered: Guaranteed and Controlled-Load. The Guaranteed service (RFC 2211) is for loss-tolerant applications that require a predictable packet delay, such as audio and video applications. The Controlled-Load service (RFC 2212) is for applications, such as adaptive real-time programs, that demand minimal packet loss and a reliable upper bound on the packet delay.



Software and hardware modifications are necessary for a router to effectively support RSVP.

Making Reservations

As RESV packets flow upstream, routers act upon the information contained in the FLOWSPEC and FILTERSPEC objects, as shown in the figure above. The figure gives an overview of a router modified to support QoS. It has two paths: one for the RSVP protocol and another for the data. The RSVP protocol path is typically software that's downloaded to the router. The RSVP process along this path detects RSVP packets and directs them to the proper modules for processing.

Before a QoS reservation can be made, the router must check to see if it has sufficient resources to meet the receiver's QoS requirements. This is handled by the admission-control module. If the resources are available, this module modifies the packet-classifier and packet-scheduler databases. These two databases in turn steer elements in the data path so that the router implements the QoS.

If the requested QoS requirements cannot be met, the admission-control module rejects the reservation request and returns an error message to the receiver. If the module accepts the request, the RSVP process forwards the RESV message to the next upstream router via the previous hop address. A policy-control module also enforces administrative policies, such as denying streaming-video QoS to certain organizations.

QoS's data-path elements are a packet classifier and a packet scheduler. The packet classifier identifies reserved data flows and places their packets into categories, or classes. These classes are defined by the FILTERSPEC. The packet scheduler places the packets in queues by class and then issues them to the appropriate router port at the priority set by the QoS reservation. The packet scheduler also polices the data flow to ensure that the reservations are not being violated.

Routes are subject to change, receivers can abruptly disappear, and many other catastrophes might strike in netland. RSVP dynamically adapts to all such problems by maintaining the reservations as a *soft state*. This means that the receivers and senders periodically send refresh RESV and PATH messages. Reservations are timed out if these refresh messages are not received within a specified time period. Of course, the route change can cause a previously available reservation to fail in the middle of a session. This can't be avoided. Receivers and senders can also request to explicitly terminate existing reservations via RSVP messages.

An Emerging Standard

QoS and RSVP are both fairly elaborate schemes; many issues, such as security, error handling, and traffic contract specifications, are not covered in this article. Routers need to be modified to support admission control, packet scheduling, and RSVP.

Many internetworking devices already make RSVP available on their platforms. Still, the RSVP standard is evolving, and work is ongoing in integrating routing and QoS, determining how switches function in the presence of RSVP, implementing policy control, and more. B

Dinesh Dutt (Santa Clara, CA) is a software engineer at Cisco Systems. He can be reached at **ddutt@cisco.com.**

Turn your Power Mac into a powerful Unix server. By Tony Cox

MkLinux: Linux for the Power Mac

There are many reasons to recommend a Mac. Plug and Play made Mac hardware setup trivial long before it became a hyped technology on other platforms. The computer's built-in networking support ensures that connecting Macs with both AppleTalk and TCP/IP is quick and simple.

However, the ease with which you can construct Mac peer networks creates management problems. Tracking different versions of hundreds of files distributed over many machines is tedious. Maintaining security and performing backups are a real nightmare.

Centralizing the important data on a single server was the logical solution. However, as much as I like the Mac OS, it is not robust enough to provide file-system security or manage quotas and resources such as the Web, e-mail, and name servers.

Organizations that have made an investment in Mac hardware may legitimately wonder what is the best option when they need a server that provides these functions, yet integrates seamlessly into the existing network. Can these services still be provided by a Mac? The answer, as I discovered, is yes.

Linux on the PowerPC

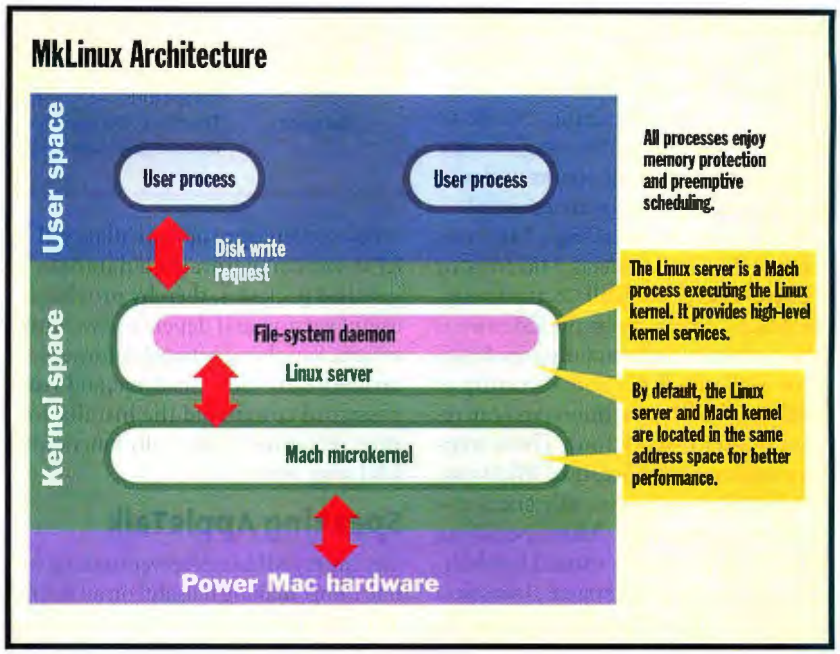
While I was researching these issues for a small Mac network, I came across the MkLinux OS—Linux for the Power Mac. MkLinux began its life in 1995, when Apple began supporting a project by the Open Group's Research Institute to port this freely distributable Unix-like OS to the Power Mac.

Both MkLinux and the BeOS lead the trend to open up the Mac platform to alternative OSes. For a historic and current perspective on OSes that the PowerPC supports, see the text box "Different Times, Different OSes" on page 52.

In a departure from the monolithic kernel design of other Linux distributions, MkLinux runs natively on top of the Open Group Mach (PMK 1.1) microkernel, which itself is derived from Carnegie Mellon University's Mach 3.0 microkernel. The Mach microkernel performs only a small number of functions. Among these functions are low-level hardware I/O, interprocess communications (IPC), memory management, and scheduling.

These services provide an abstract layer onto which you can port other OSes. A server is a Mach process that gives the OS its "personality" and provides higher-level functions such as file-system and network support, as shown in the figure "MkLinux Architecture."

MkLinux thus runs as a Linux server. That is, Linux runs as a Mach process that contains an orthodox Linux kernel, which is modified to use low-level Mach services. To improve performance, the Linux server can reside in the same address space as the Mach kernel.



With its Unix-like OS features, MkLinux enables a Power Mac to be a reliable file and Web server.

Installing MkLinux

MkLinux runs on most Power Macs, including early NuBus-based machines (6100, 8100, and 9100), first- and second-generation PCI models (7100, 7200, 7300, 7500, 7600, 8500, 8600, 9500, and 9600), some PowerBooks (2400, 3400, 5300, and G3), and the latest G3 Power Macs. A multiprocessor kernel is available that supports Apple dual-processor machines and clones, as well as DayStar Digital's two-way 604e CPU upgrade card.

Installing Linux on any platform is not

for a novice. Much of the MkLinux installation is automated, but some knowledge of networking, SCSI, and disk partitioning is required for things to go smoothly. I installed MkLinux on an external 1-GB SCSI hard drive attached to a Power Mac 7600. It takes only two partitions to install MkLinux (one to hold the Linux file system, and the other for swap space), but four or more are commonly used because they provide better flexibility.

Although Apple provides a functional disk-partitioning program, offerings from FWB and LaCie are more sophisticated and let you resize partitions without reformatting. If you are willing to forgo a GUI, MkLinux has a serviceable, if somewhat unfriendly, character-mode disk utility called pdisk. I created a 70-MB "\" (root) partition, a 32-MB partition for \swap, and a 100-MB partition for \home, which leaves the remaining 798 MB to \user. Note that disk-partitioning software offers new and exciting opportunities to junk your data; backups are essential.

Setup begins by installing a MkLinux Control Panel that selects MkLinux or the Mac OS as the default OS at boot-up. The Mach kernel is put in the Extensions folder, and a folder containing the Mach server is placed in the root directory of your bootable Mac partition (you can remove it after installation). These steps were sufficient to bootstrap MkLinux.

Rebooting automatically starts the installation program. After specifying which disk partitions should hold different parts of the file system, I was presented with a list of "packages" to install. Packages are compressed binary archives that contain all the files necessary to implement a particular OS service or user application. You can install packages from a distribution CD, over the Internet from an FTP server, from an NFS mount, or from a local hard drive. Because the *MkLinux* distribution is nearly 300 MB in size, the CD distribution makes sense.

Packages necessary to run a basic MkLinux system (including the X11.6 windowing system) are preselected for you, so accepting the default is a wise move. Installing other packages later is easy. I installed some additional packages, including developer tools (Gnu C, C++, and FORTRAN compilers) and both HTTP and FTP servers.

The excellent RedHat Package Manager (RPM) performs the installation by expanding packages and copying the contents to their appropriate places. The RPM system maintains a database of installed packages, thereby providing a useful version and dependency control system. Supplying network information, a name for my "new" machine, and a root password completed the installation. After rebooting, I had a fully functioning MkLinux server.

Speaking AppleTalk

Getting my MkLinux server running was one thing; making it useful on an AppleTalk network was another. Mac users like to access servers via the Chooser, and this convenience can be provided easily if you install Netatalk.

Netatalk is a kernel-level implementation of the AppleTalk Protocol Suite for Unix systems running over Ethernet. It is available as either source code or the RPM package and is part of the MkLinux distribution. It includes support for routing AppleTalk, serving Unix and AFS file systems over the AFP (AppleShare), serving Unix printers, and accessing AppleTalk printers.

Once installed, Netatalk made the MkLinux server appear like any other Mac on the network. Mac users with an account on a MkLinux server running Netatalk are able to log in and mount their home directories as network drives. Clever file translation ensures that folder attributes, file icons, and their program associations are preserved on the MkLinux file system.

If you need to transfer files between HFS and MkLinux partitions, there are a series of "h" utilities to help you. These mimic their Linux counterparts but operate on a local HFS partition. If you need complementary functions, an excellent shareware utility by Michael Pollet called LinuxDisks allows file transfer to and from MkLinux partitions from within the Mac OS.

MkLinux presents a very attractive way to provide low-cost network services to a Mac network without having to install a new and possibly foreign system. The pre-Developer release 3 version of MkLinux is currently available from the MkLinux Web site. It builds on previous releases by adding the latest Linux kernel (2.0.33). The usual caveats apply when using prerelease software, but over several weeks of testing, my system has remained perfectly stable. B

Dr. Tony Cox works at the Jodrell Laboratory, Royal Botanic Gardens, Kew, U.K. You can contact him at **a.cox@rbgkew.org.uk**.

Different Times, Different OSes

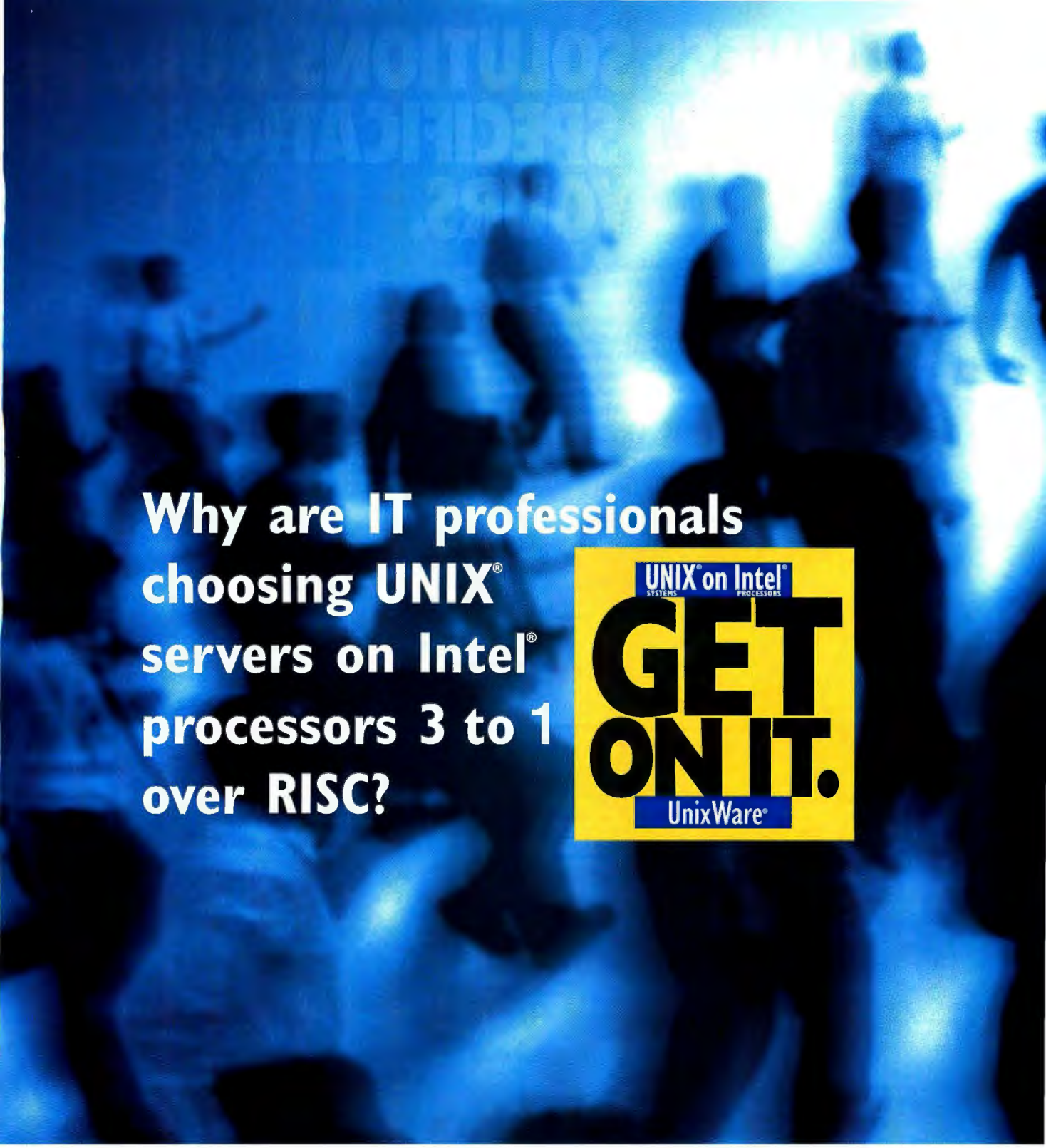
In 1993, the PowerPC processor was expected to host at least six OSes. With five years behind us, the picture has changed. Surprisingly, many of what might have appeared to be major players have dropped out. In fact, native versions of OS/2, Solaris, and Taligent never shipped. Today, out of the original lineup, only the Mac OS and IBM's AIX are still present. Interestingly, several new OSes became available for the Power Mac: Windows NT, the BeOS, and Linux.

However, Windows NT is here with an asterisk. The company dropped support for a PowerPC native version of this OS beyond version 4.0.

1993		1998	
OS	**Description**	**OS**	**Comment**
System 7	Apple's Mac OS	**Mac OS**	System 8.x
AIX	IBM's flavor of Unix for workstations	**AIX**	
OS/2	IBM's multitasking OS with a GUI	**BeOS**	Multithreaded, multitasking OS from Be, Inc.
Solaris	Unix from SunSoft with a GUI	**MkLinux**	Freeware Unix-like OS for the Power Mac
PowerOpen	A variant of AIX with GUI support, Mac OS emulator		
Taligent	The "Pink" OS from Apple, codeveloped with IBM	**Windows NT**	No longer supported

WHERE TO FIND

MkLinux:	**http://www.mklinux.apple.com**
LinuxDisks:	**http://www.pollet.net**
Netatalk:	**http://www.umich.edu/~rsug/netatalk**



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This high-performance processor can readily manage the video, audio, and modem operations of a videophone. ***By Osman Khan***

TriMedia Powers a Videophone

This year, the much-anticipated media processor makes its market debut and enables the deployment of a wide variety of Web-aware multimedia systems such as videophones, digital TVs, and microcomputers. A media processor is a special type of computational engine optimized to handle complex real-time processing tasks such as motion video and streaming audio. Media processors perform these tasks more efficiently than a general-purpose CPU and more flexibly than traditional fixed-function chips.

Media processors such as Philips' TriMedia architecture offer accelerated processing of audio, video, graphics, and communications data on one chip. These capabilities will help it play an important role in the coming convergence of video entertainment, video communications, and computer technology.

TriMedia Architecture

The TM-1000 is fabricated using 0.35-micron, four-metal-layer CMOS. It's a 3.3-V part, packaged in a 240-pin metal quad flat pack (MQUAD). It operates at 100 MHz. To deliver a cost-effective solution, the TM-1000 was built with a diverse array of computational resources integrated on-chip. The chip combines key fixed-function acceleration units—such as an image coprocessor (ICP) and a variable-length decoder—with a programmable 32-bit very long instruction word (VLIW) processor core.

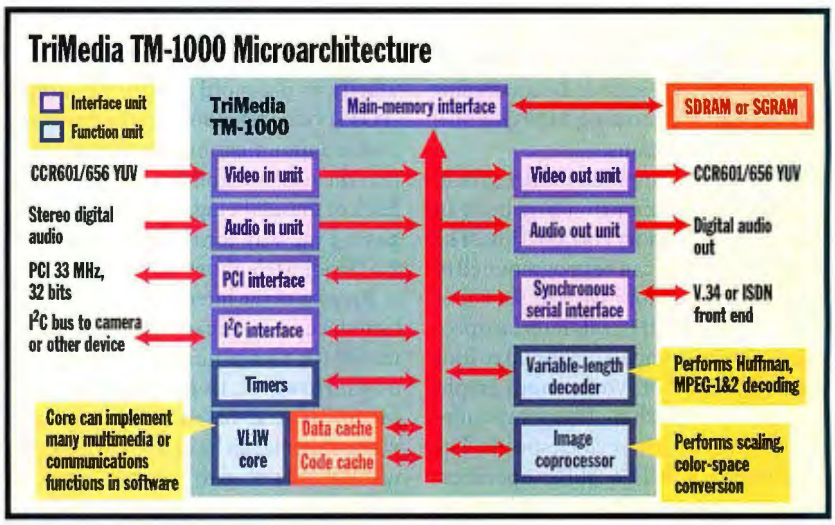
The core orchestrates all on-chip operations and implements portions of complex multimedia algorithms. It's assisted in this latter task by an instruction set that provides common RISC operations, DSP-style (digital signal processor) single instruction/multiple data (SIMD) functions, and IEEE 32-bit floating-point computations. Other function units manage the TM-1000's memory interface, PCI bus, and high-speed serial and video I/O interfaces, as shown in the figure "TriMedia TM-1000 Microarchitecture." These units provide glueless connections to most peripherals.

The TM-1000 has separate eight-way set-associative data and instruction caches to support the VLIW core's high throughput. The data cache is 16 KB in size and dual-ported to minimize contention between the core and main memory. The instruction cache is 32 KB in size. To reduce internal bandwidth demands, the instructions are stored in a compressed format. A decompression unit expands the instructions before the core processes them.

The throughput of these caches obviates the need for any secondary (L2) cache, which can lower a product's cost. In addition, the TM-1000 has a high-speed internal bus with separate 32-bit address and data lines that expedites transfers between external synchronous DRAM (SDRAM) and all the function units.

Complementing the VLIW core are several specialized fixed-function processing units (e.g., the variable-length decoder) that off-load specific media-processing tasks. Collectively, these units are implemented as 27 pipelined function-processing elements. The core uses a five-issue-slot engine to dispatch up to five instructions per clock cycle to these elements. The elements execute them concurrently. This achieves the high degree of parallelism required for the simultaneous processing of multiple types of digital media streams.

The TM-1000 has a bevy of I/O units used to capture, format, and output video, audio, and graphic data. Each unit can act as a bus master or slave on the processor's internal bus and uses DMA transfers to shuttle data around the chip. A digital video input (VI) unit accepts data from any CCIR 601/656–compliant device that outputs 8-bit time-multiplexed 4:2:2 YUV data. The VI unit provides a glueless connection to some digital video



The TM-1000 provides glueless interfaces to video, audio, PCI, and an SDRAM bank.

cameras. If necessary, the VI unit does real-time horizontal subsampling of the data before storing it in memory.

A video output (VO) unit generates an 8-bit multiplexed YUV data stream. Before output, the VO unit performs any specified processing (e.g., graphic overlays and alpha-channel blending) and, if required, upscales the image. The VO unit supports a variety of video formats. The audio in and audio out units connect to most serial A/D converters (ADCs) and D/A converters (DACs). The units handle 8- or 16-bit audio samples arranged in monophonic or stereo formats.

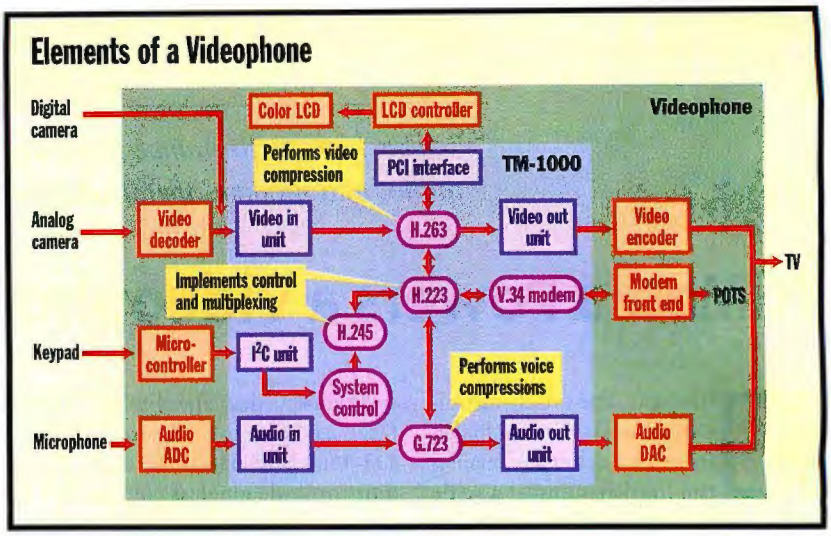
A synchronous serial interface (SSI) can connect to high-speed modems or ISDN front-end devices. An ICP copies images from SDRAM to the host's frame buffer or to memory. The ICP can apply filtering to the image, resize it, and perform YUV-to-RGB color-space conversions. The variable-length decoder directly decodes Huffman-encoded data streams and assists in decoding MPEG-1 and MPEG-2 video streams.

The TM-1000 simplifies the design and cost of products by providing built-in interfaces for memory and a PCI bus. The memory interface can be programmed to operate with memory parts at 66, 80, or 100 MHz. At 100 MHz, this interface provides a glueless connection for up to four external SDRAM or synchronous graphics RAM (SGRAM) chips. It supports more memory chips at lower clock speeds. The PCI interface is PCI Local Bus Specification revision 2.1–compliant, and it operates at 33 MHz.

Finally, because of the VLIW core, the TM-1000 can be programmed to operate as a coprocessor (perhaps augmenting a PC's multimedia capabilities) or as a stand-alone unit (acting as the embedded processor in a consumer device).

Video Telephony Evolves

Of the many examples of media-processing applications, video telephony stands out as requiring a diverse set of demanding media-processing tasks. First, we need an overview of video telephony itself to understand how the TM-1000 suits this application's needs. Until recently, videoconferencing capabilities have been used mainly in business environments, over high-speed ISDN links using the ITU H.320 multimedia communications standard or over LANs using the ITU H.323 standard.



The TM-1000 directly handles audio and video I/O. The VLIW core implements most of the ITU H.324 algorithms in software.

The challenges that hindered the popularity of plain old telephone service (POTS) video telephony in the past were cost, communications latency, quality, and the user's inability to experiment. Each of these is being surmounted today, paving the way for the deployment of POTS video telephony (H.324).

Because of the Internet, real-time multimedia communication is becoming a reality for a large number of individual users. However, its quality tends to be inconsistent. IP-based H.323 audio and video streams can be choppy, with irregular latencies of up to 1 second—making it difficult to carry on a conversation.

By contrast, properly implemented point-to-point H.324 can deliver consistent quality with delays of under one-quarter second—adequate for normal interaction. The interoperability of H.324-based devices lets technically savvy PC users connect to non-PC users through stand-alone videophones.

To provide video and audio communications over a POTS line, a videophone must at a minimum provide a number of functions. It must manage a 33.6-Kbps POTS modem; implement NTSC/PAL video decoding and capture, H.261 or H.263 video compression and decompression, NTSC/PAL video encoding and output scaling, and G.723 voice compression and decompression; and perform digital acoustic echo cancellation.

A typical videophone set-top box includes audio and video codecs, a telephone-line interface, a keypad or keyboard, and memory, as shown in the figure "Elements of a Videophone." Other external devices include a microphone and speaker, a CRT or television screen, and an RJ-11 phone line. A videophone can easily be built with a minimum of parts around a 100-MHz TriMedia TM-1000 operating in stand-alone mode.

For example, the TM-1000's SSI unit would manage the external modem, the VI unit would handle input from a digital camera, and the ICP and VO unit would display transmitted video on a TV or LCD screen. The VLIW core would implement the algorithms for the H.263 and G.723 compressors/decompressors. This H.324 videophone can deliver QCIF resolution (176- by 144-pixel images) at up to 14 frames per second. The user would have the option of dynamically scaling the frame rate upward or downward to favor either interactivity or picture quality.

Video Telephony's Future

Video telephony inspires a vision of the future that lets people keep in touch with friends or work with greater efficiency while out of the office. Low-cost videotelephony products based on the TriMedia processor and other architectures ensure that this future will be a reality soon. Also, the technology will cost much less than the price of a one-way coast-to-coast economy-class airline ticket. B

Osman Khan is a videoconferencing manager at Philips Semiconductor. You can reach him at **khan@ehv.sc.philips.com.**

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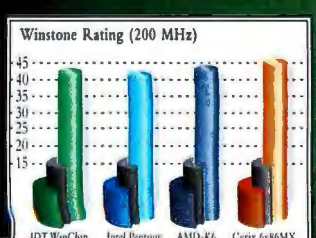

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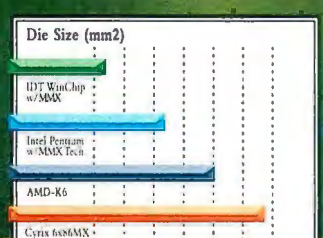

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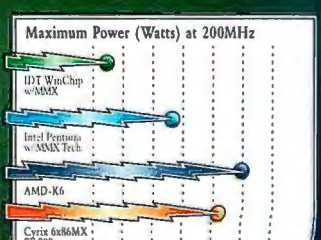

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Java's object-oriented nature makes database programming and maintenance easier. By John Dreystadt

Storing Java in a Relational Database

If Java appears to be occupying many of the minds of the computer industry these days, it's because this language is a powerful blend of object-oriented features and class libraries. In addition, developers are discovering that Java is a good foundation for writing reliable, portable software.

Unlike conventional programming languages, which generate machine code for a target processor, the bytecode produced by Java compilers targets a virtual machine. Interpreters for each target machine translate this bytecode for their own use. Because bytecode is just bytes, programs can be created through the manipulation of these bytes. You can, for example, use a relational database to store bytecode and then retrieve it for later use in an application. I'll do it here with Java Database Connectivity (JDBC).

Viewing Complex Data

Storing bytecode in a database offers several advantages, including easy viewing access to complex data. You could use this technique to retrieve medical records from a massive hospital database, for example. These records could include such diverse items as patient histories, X rays, test results, diagnostics, and even billing information. Many hospitals have satellite clinics that use older platforms and applications, which makes synchronization of such data a problem.

Java's ability to run on multiple platforms makes it a good choice for this type of application. It's possible to build a separate class for each type of medical record—good programming practice—and put the classes into the database. That makes it easy to add new viewers as new kinds of medical records are added later.

Storing classes in the same database as the data viewed by those classes offers another advantage: It becomes easy to locate all the pieces of the application puzzle when the time comes for maintenance and support.

Loading with Class

To begin with my example, it's necessary to determine how to load classes. As an application runs, classes load automatically as they are referenced. Referring to a class by name—known as a *direct class reference*—causes it to be loaded from the standard class path.

In addition, Java supports the indirect reference of classes (i.e., *dynamic classes*), which lets an application identify and load classes automatically. When a class isn't present on the current machine, you use `ClassLoader()`, an abstract class designed for dynamic loading with recursion support. As a class loads, this recursion mechanism can trigger additional class-loading in support of that class.

`ClassLoader` has four methods: `defineClass()`, `findSystemClass()`, `resolveClass()`, and `loadClass()`. Together they enable the recursive loading of classes. The `loadClass()` method lets you extend `ClassLoader` and provide your own way to load the bytecodes.

Resolving the Puzzle

Now to try putting the puzzle together. First, since `ClassLoader` is abstract, I have to create a new class that extends `ClassLoader`. `ClassLoader`'s `defineClass`, `findSystemClass`, and `resolveClass` methods are final and can't be overridden. That leaves `loadClass` to override, since it's the only abstract class. I extend `ClassLoader` by providing a new `loadClass` method, which is known as `loadClass(String)`.

The `loadClass(String)` method must perform five tasks. First, it determines if the class requested was loaded previously. Because `loadClass` can be called recursively by `resolveClass`, this is a vital step. Second, it checks to see if the class requested is along the system path and, if possible, loads it from that path. Third, it retrieves the bytecodes as a byte array. Fourth, it creates a class out of the retrieved bytecodes. Finally, it checks to see if the newly loaded class

A ClassLoader Fragment

```
import java.util.*;
import java.io.*;
import java.sql.*;

class DBLoader extends ClassLoader
{
Connection conn;            // Database connection
byte[] classData;           // Bytecode storage
HashTable cache =
        new HashTable();  // Stores loaded classes
PreparedStatement queryStmt;        // Stores a parameterized SELECT
PreparedStatement rdTextStmt;       // Stores a parameterized READTEXT

public DBLoader(Connection conn)
  {
        this.conn = conn;
  }
```

continued

needs any supporting classes loaded.

Along with a new class that overrides `loadClass`, I must also add new constructor methods. Since I'm trying to read bytecode from a database and therefore need a connection to the database, I'll pass the connection in the constructor.

The box on page 61 shows code that extends `ClassLoader` by defining a new class, `DBLoader`. I start by defining fields for a database connection and a `HashTable` to store classes as I load them; that eliminates unnecessary reloading of classes. Then I use a simple constructor to capture the database connector I'll use.

The `dbReadBytes(String)` method, shown in the box at right, does the actual work of getting the bytecode out of the database and into a byte array. It varies, depending on the type of database you use; the example I'm using here controls a connection to Microsoft SQL Server.

Hello, World, the Hard Way

Now to try using my new class to retrieve bytecode from a database. First, I need an actual class to store in the database, so the example I'll use will print out the industry-standard line "Hello, World."

```
package com.threecities
  .testing;
import java.util.*;
public class PrintHelloWorld
implements SimplePrintable
{
    public void printMessage()
    {
        System.out.println
          ("Hello, World");
    }
```

The new class, `PrintHelloWorld`, has a single method, `printMessage()`. I store this class in a package called `com.threecities.testing`. If necessary, I will create the directory `com\threecities\testing` along my class path.

To test my class, I need some way to call the `printMessage()` method. When the `loadClass` method returns, it simply returns a `Class` object representing the class that the bytecodes created. To actually call the method `printMessage()`, I'll need an object of that class. I do that by calling the `newInstance()` method of the `Class` object. This returns a reference to the newly created object with type `Object` (which is the superclass of all classes in Java).

Next, I cast the reference into some known type with the `printMessage()` method. To do that, I can either define a superclass that `PrintHelloWorld` extends or define an interface that `PrintHelloWorld` implements. I'll opt for the second alternative and name the interface `SimplePrintable`.

Now I store my new `PrintHelloWorld` class in the database, using a table definition that stores bytecode into a database, like so:

```
CREATE TABLE dbo.JavaClasses (
ClassKey int IDENTITY (1, 1)
  NOT NULL,
ClassData image NULL,
ClassName varchar (255) NULL
)
GO
```

Finally, I create a small application to put these pieces together. It will connect to the database, create an instance of `DBLoader`, call the `loadClass(String)` method, create an instance of the returned class, and then call the `printMessage()` method of the new instance. I have room to show only a portion of the `ClassLoader` code here, but you can get the complete code for the `DBLoader` (with the `loadClass` override), the main program, and the interface definitions from The BYTE Site (*http://www.byte.com/art/download/download.htm*).

A ClassLoader Fragment *continued*

```
private int dbReadBytes(String name) throws SQLException, IOException
  {
        String queryClassInfo =
                "SELECT textptr(classData),datalength(ClassData)" +
                "FROM JavaClasses WHERE ClassName = ?";
        String queryClassBytes =
                "READTEXT JavaClasses.ClassData ? 0 ?";
        if (queryStmt == null)
                queryStmt = conn.prepareStatement (queryClassInfo);
        // Submit a query for the class
        queryStmt.setString(1, name);
        ResultSet rs = queryStmt.executeQuery ();
        // Get the information.
        rs.next();
        byte[] textPointer = rs.getBytes(1);
        int dataLength = rs.getInt(2);
        rs.close();
        // Get the data
        if (rdTextStmt == null)
                rdTextStmt =
          conn.prepareStatement(queryClassBytes);
        rdTextStmt.setBytes(1, textPointer);
        rdTextStmt.setInt(2, dataLength);
        rs = rdTextStmt.executeQuery();
        classData = new byte[dataLength];
        // Pull out the data
        InputStream byteCodeStream = rs.getBinaryStream(1);
        byteCodeStream.read(classData);
        rs.close();
        return dataLength;
        }
}
```

Easier in Java

JDBC's ability to provide an object-oriented wrapper around database entities means that database programming and maintenance are much simpler in Java than they might be with more traditional methods. And Java's support for dynamic classes, in combination with a relational database, offers an easy way for applications to modify their behavior at run time.

The important thing to remember is to use dynamic classes. Their ability to keep your program flexible and adjust to changing conditions will make your code more robust and reliable. B

John Dreystadt works at ArborText (Ann Arbor, MI). You can contact him by sending e-mail to **johnd@ic.net**.

How well a database system grows over time will be determined by decisions made in its initial design. ***By Ron Fryer***

Data-Warehouse Scalability

What does scalability mean in data warehousing? In data warehousing, the objective is to build a strategic user tool. To this end, the data warehouse must let any user, in any order, ask any question using any data. Critically, the system must deliver an answer in a realistic amount of time. This might not seem an issue when you build a data warehouse, since you'll start out with surplus capacity. But as the data warehouse expands, those early design decisions that you made can impact how well the data warehouse grows with the work load. Therefore, it is important to design the data warehouse so that it scales up easily.

Dimensions of Scalability

In this environment, scalability can be thought of in four dimensions: data volume, environmental complexity, user concurrency, and support. Data volume is the most basic form and first dimension of scalability. The real issue here isn't how much data you can store, but how much data the user can access. The primary technology enhancement for performance is parallel processing, or parallelism. Not all parallelism is created equal, however.

A product that parallelizes 100 percent of its operations can show linear scalability, while a product that parallelizes only 90 percent of its operations will show only a 45 percent performance improvement when the available processing power doubles. Because you can expect the data volume in a data warehouse to grow sixfold every 18 months, any nonparallel functions in a data warehouse quickly become project stoppers.

The second dimension of scalability is environmental complexity, which stems from the nature of the data warehouse. Giving users insights into the business and their customers' behavior involves very complex relationships requiring complex data models and queries. Therefore, the DBMS must support complex analysis, and do so without human intervention. Specifically, its database optimizer must evaluate various approaches using built-in cost algorithms and choose the best one it can find to answer an unknown, often extremely complex question.

Furthermore, it must do this in a realistic amount of time. In other words, the database optimizer must be robust enough to take any request from any user or tool, no matter how complex or poorly formed it may be, and develop a realistic execution plan without assistance from information technology (IT) professionals.

The third dimension of scalability, user concurrency, refers to the number of users accessing the warehouse at once. Of course, not all users have the same needs or priorities. Some require no more than simple, planned queries; others require full run of the warehouse. You must be able to optimize the warehouse so that all types of users can simultaneously access their data with the performance level they require.

The DBMS must be able to handle hundreds, or even thousands, of users concurrently. It must monitor what the current work load is and combine redundant operations across independent queries to improve overall throughput. The DBMS

Coercing a New Question into a Data Mart

For a DBMS implemented as a data mart, it isn't easy to ask for a new set of results outside the boundaries of the mart's preprogrammed summary data. Here are the steps required to modify a mart to respond to a new type of inquiry:

1. The user requests a new report using an intranet application.
2. The user's request is allocated to the least busy programmer via an automated scheduler.
3. The request goes into the programmer's "to do" list.
4. The programmer examines the request to determine if one of the existing data marts has the data to execute the request. If one does:
   a) If the platform cannot support the request, hardware reallocation begins.
   b) The systems group determines if the current mart hardware can support another application.
   c) The programmer proceeds to step 6.
5. If no data mart exists that can satisfy the request:
   a) The programmer designs a new data mart for this request.
   b) The systems group locates a server that can support the new mart.
   c) The programmer designs and tests a procedure to create the data mart from the centralized data warehouse.
   d) The programmer develops maintenance procedures for the new mart.
   e) The DBA group performance tunes the new mart's maintenance procedure.
6. The programmer designs, codes, and tests the new user request.
7. The DBA group performance tunes the new request.
8. The user examines the results returned from the programmer to see if they match the original request.
9. The user and programmer work together to resolve any outstanding issues.

must be able to assess how critical a request is and compare this with the current system work load to properly schedule execution. Most important, it must be able to change priorities dynamically as the work-load mix changes.

Support, the fourth dimension of scalability, is perhaps the most critical, and certainly the most overlooked, aspect. As data volumes, complexity, and the user community grow, the data-warehouse engine must be able to support the environment. This is perhaps the most critical part of the DBMS selection, because it must be able to automatically do everything. Every time IT professionals must intervene, time is lost and responsiveness is sacrificed. And, the likelihood that the user will simply stop asking new questions increases.

Design Considerations

The initial design of the warehouse will dramatically impact its ultimate scalability. The crucial decision is whether the architecture will be warehouse- or mart-centric. That is, will the users' primary access method be through the detailed data warehouse or through summary data marts? It is difficult to overstate the importance of this central decision. Both approaches will yield benefits, but one choice will dramatically limit the returns you get and your scalability in all dimensions.

Consider our original design goals: Let users ask any question, of any data, from any source, at any time. The goal is to create a model that best represents the business. This means we must create logical groupings of types of data (called entities) and the relationships between them. This process is called normalization, and third-normal form models provide the most detailed business representations.

In a mart-centric approach, data is modeled to allow faster access to known questions, using techniques such as star-schema. Star-schema combine certain entities based on assumptions. This is done because the third-normal form creates complex models that can overwhelm the DBMS's optimizer, while star-schema give the optimizer fewer choices to consider. For example, a star-schema might combine two tables into one, so that an optimizer doesn't have to worry about how to combine them later.

The problem with this approach is that our assumptions are actually biases. Some are accurate, some are not; but none of them are likely to stand up to every question over time. When we build a star-schema model, we ensure that the answers we get will include these biases. Therefore, data-mart users normally have access only to summary data, in a denormalized, application-centric form. Summary data places limits on the level of detailed investigation that can occur, and denormalized models predetermine the relationships that users can explore.

Mart-centric environments are created because the underlying database engine is incapable of supporting a warehouse. What happens when a new question about the data comes in?

The first line of defense will be to attempt to fit the question into a mart-centric structure, as described in the text box "Coercing a New Question into a Data Mart." Clearly, this is a lengthy, slow, and cumbersome process. It dramatically reduces the likelihood of fast response times, limits the number of questions a user can ask, and has significantly higher support costs. Ultimately, this type of environment becomes unsupportable.

With a warehouse-centric design, a user asks a new analysis using a graphical front-end tool. The tool passes the request directly to the DBMS, which automatically optimizes the new request, with no intervention. Finally, the DBMS returns the answer. In this environment, many ad hoc user requests are answered in minutes, most in under one hour, and all by the next morning. The user can ask more requests, test more hypotheses, and better understand the environment. The user can respond quickly to developing trends and issues. There are no practical limits to support scalability.

Of course, the DBMS must have a robust, mature optimizer—and one that was designed for decision support. The optimizer's capabilities directly impact the support dimension. If it isn't very smart, it forces the IT staff to take over, and there is simply no way people can keep up with the complexity and volume of the requests. Anything less than an exceptional optimizer—and one designed for decision-support applications—will cause support issues to increase faster than people can be hired.

Key Decisions

A high percentage of data-warehouse efforts fail. Yours does not have to. Your models and platform choice should give you the maximum in scalability and flexibility. Build your data warehouse to reflect your business, and expect tremendous growth. Any other approach is an unrealistic compromise.

Furthermore, do not overlook support issues, as summarized in the text box "The Do's and Don'ts of Designing a DBMS." The DBMS must be able to automatically partition and place data, tune queries, eliminate redundant processing, and manage its work load for optimal efficiency, no matter how large its storage, environmental complexity, and concurrency grow. If it's implemented properly, your users won't be afraid to ask new questions, perhaps obtaining valuable insights for the company. B

The Do's and Don'ts of Designing a DBMS

DO:

- ✔ Recognize that warehousing is a different game than on-line transaction processing (OLTP), and choose your platform accordingly.
- ✔ Recognize that business responsiveness is the ultimate competitive advantage.
- ✔ Demand technical and business references, and check them thoroughly before you start.
- ✔ Let users complete access to any data and tools they need.
- ✔ Simplify the warehouse as much as possible.

DON'T:

- ✗ Use current in-house standards to select your warehouse platform.
- ✗ Assume most users can rely on summaries.
- ✗ Assume most user access will be through data marts.
- ✗ Believe that DBMSes are a commodity, and that any can handle a warehouse.
- ✗ Let information technology (IT) drive the warehouse effort.

Ron Fryer is the director of the Data Warehouse Marketing Computer Systems Group at NCR Corp. You can contact him at **ron.fryer@denverco.ncr.com.**

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Win98 road map

If you think a migration to Windows 98 is the best thing for you, think again.

By John Montgomery

Three years ago, millions of us confronted a daunting task: upgrade Windows 3.1 to Windows 95. This meant a new user interface, some application incompatibilities, and some hardware that didn't work. But the promise was huge, and most of us upgraded.

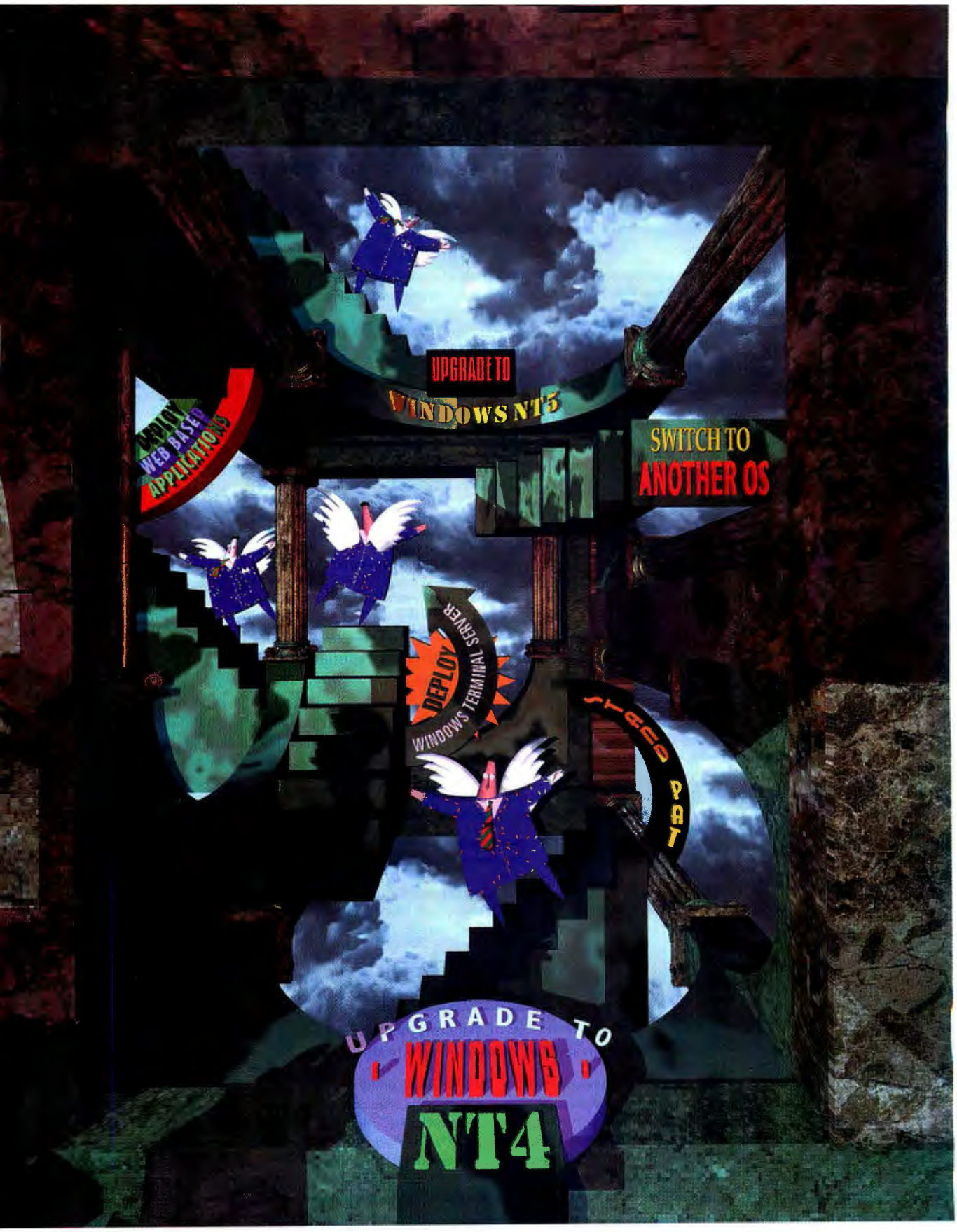
Now, millions of us are faced with a sequel: upgrade to Windows 98. It's the same deal: a new user interface, more application incompatibilities, and more hardware that won't work. But this time there's a difference: Windows 98 is no big deal, at least not for IS departments. For IS, it's basically a bunch of Windows 95 service packs rolled together–a dot release.

What is important, though, is that with Windows 98, we're looking at the end of an era—the end of Microsoft's commitment to 16-bit operating systems. "In terms of [16-bit-based] technology," says Phil Holden, Windows product manager at Microsoft, "Windows 98 is the end of the line."

In fact, Win 95 is really the last one-size-fits-all desktop. Although Win 98 will let the lazy continue that practice, the astute IS department needs to begin tailoring its desktop OS choices better to suit the applications and users. Microsoft is already making strong moves in that direction with its thin-client solution, NT Server 4.0, Terminal Server Edition (formerly Hydra).

That said, Windows 98 isn't the best OS for everyone, though it's not really harmful for anyone. Put bluntly, there's no reason to migrate to Windows 98 unless you need its modest improvement in performance (and probably in stability), or you need support for more modern hardware technologies, such as Universal Serial Bus (USB), Accelerated Graphics Port (AGP), etc. If your burning need is for manageability or security, you're going to be disappointed. And if you're looking for a simpler environment for end users, Windows 98 isn't as good as NT 4.0 Terminal Server Edition.

It's time to stop thinking about mass migrations and time to



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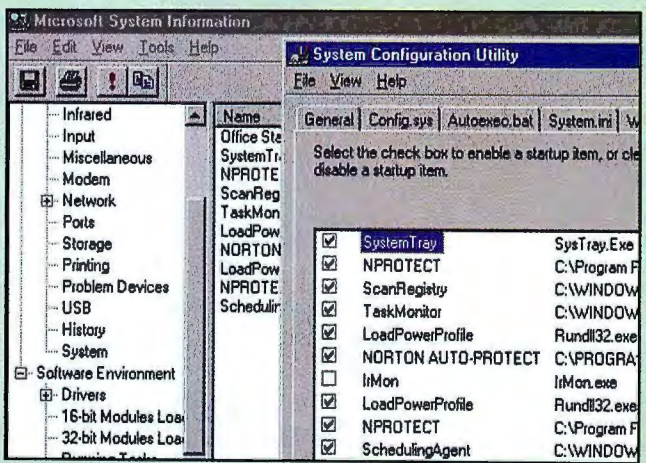
Evaluating Windows 98

For the past few months, your intrepid writer (that's me) has been running various prerelease versions of Windows 98. Right now, I'm up to RC0 (Windows 4.10.1691). Granted that prerelease software isn't always the best way to judge the final product, RC0 can tell us some things we might be on the lookout for.

KERNEL TWEAKS

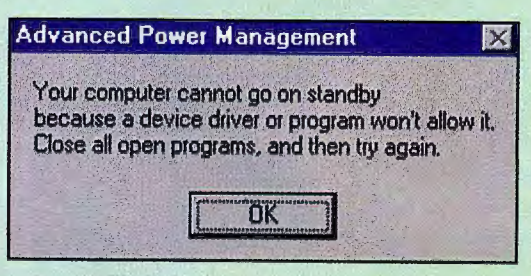
For starters, Windows 98 has a slightly tweaked kernel. The kernel tuning falls into three basic areas: boot and shutdown improvements, better memory management, and faster application launching.

Boot and shutdown. Windows 98 employs several techniques that enable drivers to initialize and load when they're needed, rather than when the system boots. Also, Windows 98 supports FastBoot BIOS (although currently no systems do), which sets a boot flag register that the OS can use to communicate boot options to the system BIOS and add-in cards. Information that goes into that register might include whether to run a system diagnostic or not. Shutdown has been speeded up by skipping the unloading of drivers that Windows 95 does—the OS just cuts power to the system and devices and reinitializes them when power is restored. How much faster will this be? If my two test machines are a good example, you'll notice it, but you won't be bowled over by it.



Windows 98's System Information utility has a configuration application that lets you change start-up features.

Memory management. Three basic things are going on here: preswapping memory to disk, mapping pages out of cache, and realigning applications. Preswapping basically means that, during idle time, the OS tries to deduce which application is going to need to be swapped to disk. Mapping pages out of cache is done by a new utility called MapCache; realigning applications is done by WinAlign. These two utilities work together to modify application executables so that file sections start on 4-KB memory boundaries. When this works, applications from the disk cache can be mapped directly from the cache into memory, eliminating the overhead of copying them to aligned memory. Basically, it prealigns applications. (In case you're wondering, this technique appears to most virus checkers as an application upgrade.) Will you notice? Maybe. I didn't.



Portables with betas of Windows 98 often had problems shutting down or going into standby.

Application launch acceleration. This is a game of watching and modifying binaries. The OS sniffs requests from the binary loader, logs them, and uses this information to determine the order of the disk clusters that the application uses during loading. This gets coupled with Windows 98's new disk defragmentation utility that optimizes the applications into the sweet spots on the disk. It puts the most-used applications near the edge of the disk. You'll notice the performance improvement from this unless your system is already so fast that apps appear to launch in no time.

These technologies work together to create what Microsoft calls the Windows 98 steady state. In an average of four weeks, the combination of disk cleanup, disk defragmentation, and realignment of applications is supposed to put Windows into a state of optimal performance.

EVALUATING THE FEATURES

Windows 98 also includes a host of new features, most of which are useful, though not earth-shattering. A lot of it is stuff that users have been screaming for.

I'll fix that file... First among these is the System File Checker. For me, it found all sorts of system files that needed replacing because their versions were off (most of them were too old). It found them one by one, and asked me if I wanted to replace them one by one. That would have been OK, except it couldn't find any replacement files. Though I had all the Windows cabinet files on my disk, I had to manually extract the files it needed. After about the eighth file, I gave up.

Windows Update. I really like this feature. It can go on the Internet and tell you if your OS has the latest patches installed. Of course, this is something IS departments will want to turn off (using Win 98's System Policies); you can imagine that GM's IS department, for example, probably doesn't want all its Windows 98 users updating their OS themselves.

Defrag on steroids. The built-in Windows disk defragmentation utility now includes Intel's Application Launch Accelerator technology. Basically, the new defrag not only defragments your disk, it moves oft-used applications to the sweet spots on your disk. The decrease in launch time for some applications is not noticeable; for others you'll notice it immediately.

FAT 32. FAT32 first appeared in Windows 95 OSR2 and is now a standard part of the OS. For most systems, FAT 32 is a great idea. Its smaller cluster sizes will make large disks appear larger and improve the performance somewhat. One problem comes on laptops: FAT 32 file systems evidently don't like some computers that hibernate. Fortunately, the FAT 32 converter warns you before you'd be likely to convert your laptop's disk.

System information. The old MSINFO was pretty lame. We all knew it. The new one (MSINFO32) is much better. Not only does it provide a gateway to many of the other system utilities (System File Checker, System Configuration Utility, and Registry Checker), it provides a wealth of information about what's running on your system. Through the System Configuration Utility, you can do things like modify what applications load with Windows, run the Registry Checker, and load the Version Conflict Manager.

Power down? One of the new features in Windows 98 is faster shutdown. I applaud this feature, though it wouldn't have been the first thing I asked for. I can't applaud it, however, when it doesn't work. I tested it on a Dell Dimension XPS 200M and a Toshiba Portege 660CDT laptop. Both systems would shut down sometimes, and wouldn't at other times. And Windows 98 on the Toshiba offered a "Stand By" mode that followed a similar work schedule, sometimes telling me that some application wouldn't let the system go into standby mode when there was nothing running (at least, nothing I could shut down).

New hardware. Sure enough, Windows 98 discovered the IrDA port on the back of my Portege, which Windows 95 never saw. Of course, I couldn't get it to work. Eventually, I will. Perhaps the discovery of the IrDA port is related to the loss of my serial mouse, which stopped functioning after installing Windows 98. Oh, I got it to work again, but only by swapping my Xircom combination 56-Kbps modem and 10/100-Mbps Ethernet card for a different card with no modem. Evidently, the additional modem (the 660CDT has an internal modem) confused Windows 98 and it shut down the COM port.

Things That Didn't Get Fixed

With all these changes, there are still two annoying things that Windows 98 doesn't fix:

1 Why do I still have to reboot after I reconfigure? Why do I have to reboot after installing software? With NetWare, I can strip down the entire OS and bring it back up, adding new applications and features, without rebooting. Ditto for Unix. Windows 95 introduced virtual device drivers (VxDs), which should have made this the standard way to operate. Yet I still have to reboot when I install a network protocol or change my IP address.

2 Why do I have to carry a copy of my installation CD? I insert a new PC Card, and Windows asks for my Windows 98 CD so it can read the drivers. I add a protocol, and ditto. I change my log-in parameters. Ditto. Why? Windows NT 5's installation gives you the option to copy the basic drivers (compressed) onto your hard drive. Why can't Windows 98 do that?

Overall, I found Windows 98 to be an unobtrusive upgrade (provided some of the odd bugs I discovered get left behind before release). There are some annoying shortcomings, like it still doesn't offer the option of copying the installation files (.cab files) onto the hard drive like the Windows NT 5.0 beta I looked at. But overall, it represents many of Microsoft's fixes to Windows 95 wrapped into one CD. For about $100, it's probably a good idea for most of us. **– John Montgomery**

start a more flexible plan. You have seven basic choices: stand pat for now, upgrade to Windows 98, upgrade to Windows NT 4, wait and upgrade to NT 5, deploy Windows NT Terminal Server Edition, deploy Web-based applications, or switch to another OS. Let's look at each of these.

Stand Pat for Now

If it ain't broke, don't fix it. These words have been the guiding principle of IS departments for decades. Even minor application upgrades are greeted with skepticism by some. That explains a possibly frightening statistic: The bulk of desktops in large corporations are still running Windows 3.1. According to Dan Kusnetzky at International Data Corporation, in an NT adoption study conducted in 1997, the desktop in large corporations was most likely running Windows 3.1, followed by a large jump down to Windows 95, then a dumb terminal.

If you're one of the millions of users still running Windows 3.1, it's likely that Windows 98 offers no greater reason to upgrade than Windows 95 did. Windows 95 has been out for two years, and it was Microsoft's designated, no-brainer upgrade from Windows 3.1. Why haven't corporations upgraded from Windows 3.1, which, by all measures, is not nearly as stable, fast, or manageable?

There are lots of reasons. Windows 95 offered no compelling new features for the task-based users running data entry applications. It cost about $100 to upgrade a desktop, not including the time spent to do it or the extra hardware it might have required. Lots of PCs simply couldn't run Windows 95 acceptably. Many applications broke with 95. And many corporations were waiting for some other OS, like Windows NT, to offer everything. But, of course, all the reasons that applied to an upgrade to Win 95 also apply to an upgrade from Windows 3.1 to Windows NT.

Similarly, if you're running Windows 95 and haven't already upgraded to NT, why should you bother with Win 98? There are many service packs and patches that you can download from Microsoft's Web site that will offer some of Windows 98's new features and increase Windows 95's reliability. Windows 98 isn't the huge step forward that Windows 95 was.

And despite any new features or technical advances, Windows 98 is being greeted with some skepticism. "Is Windows 98 worth an upgrade from Windows 95?" asks Michael Gartenberg, research director at GartnerGroup. "Probably not. There aren't enough new features unless you want some hardware-specific feature not supported in Windows 95."

These are all good reasons not to upgrade from Windows 95 to Windows 98. And there are even more reasons you can find not to upgrade to Windows NT. First of all, NT costs more. Second, it doesn't support a lot of the hardware (especially gaming hardware) that Windows 95 does, and it has problems running many 16-bit DOS and Windows applications that access hardware directly. Plus, it's a hardware hog compared to Windows 95.

If you're running NT 3.51 or NT 4 with Service Pack 3, you have a pretty stable, manageable OS. Your most obvious upgrade path is to Windows NT 5—an OS that isn't out now and probably won't be until summer 1999. Randy Kennedy, senior analyst at Giga Group, is blunt: "Expect NT 5 in Q2 1999, plus 12 months to shake it out." That's right: Q2 2000 before you should roll out NT 5.

Reasons to Not Migrate

- Your 16-bit DOS or Windows applications won't run on Windows 98.
- Your hardware isn't powerful enough.
- You use devices for which Windows 98 has no drivers.
- Windows 98 has no compelling new features for you.
- It's not in the budget.
- You are considering a transition to another OS platform.

Upgrade from NT 3.51 to NT 4? At this point, you can come up with many reasons to postpone moving to NT 5. True, NT 4 offers greater performance, improved hardware support, and Service Pack 3 is pretty reliable. But you're probably looking at confronting other issues (like Year 2000 compliance problems), and you should just put off your upgrade plans until you can go directly from 3.51 to NT 5.

Drawbacks. The main problem with standing pat is that you might miss out on something. For example, the Windows 3.x-to-Windows 95 upgrade gave users increased reliability. And new operating systems often incorporate new features—better networking, for example, or better

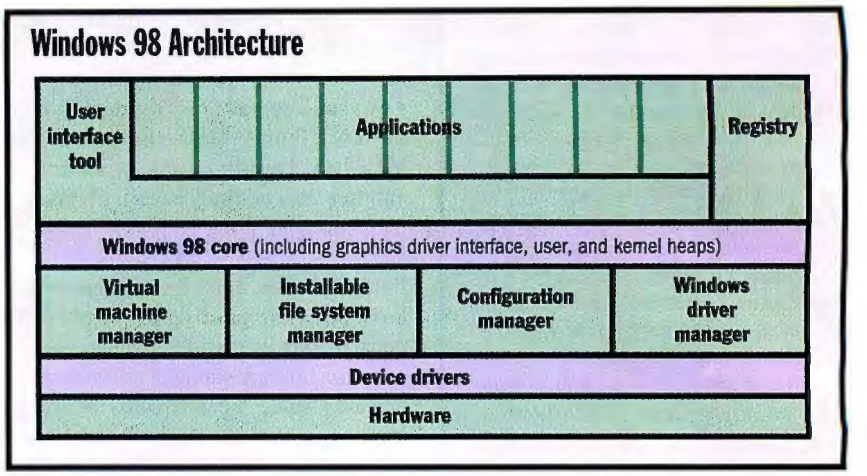
diagnostics. And new OSes also support new applications. But, in all, if what you have works, you can make a strong argument to stand pat until you see something really compelling that makes you need to move up.

Upgrade to Windows 98

Windows 98 is pretty tantalizing. And the same IDC survey that said most users at large corporations are still running Windows 3.1 also said that by the end of 1998, the number one spot will be held by Windows 9x, followed by NT running on x86, followed by Windows 3.1. So these large corporations are upgrading—they're just doing it methodically.

Windows 3.x migration. Users running Windows 3.1 will find lots to like in Windows 98—once they buy their new hardware to run it. It's more stable and lets you run more applications at once. And it supports all sorts of new hardware. Windows 3.1 users will probably be quite taken with hardware autodiscovery and the improved networking that Windows 95 introduced and Windows 98 carries a step further. And Microsoft has made sure the upgrade from Windows 3.x to Windows 98 is smooth.

Worried about application support? Windows 98 should support most of the DOS and 16-bit Windows applications that are running on these legacy systems. Clearly, if it doesn't support some key application, you can't migrate. But remember that 16-bit Windows is going away—Windows 98 is the last release to be built with things like a thunking layer. If you're depending on applications that won't run on Windows 98's Win32 architecture, it's time to think about upgrading or rewriting those applications. Since it'll support many DOS and 16-bit Windows applications, Windows 98 provides a pretty smooth way to keep most of your applications running while you work on porting whatever legacy code you have.



Windows 98's changes include tweaks to the virtual memory manager and a driver manager subsystem that's like Windows NT's.

Windows 95 migration. For Windows 95 users, the prospects of an upgrade are far less daunting—nearly all applications that run on Windows 95 will run on Windows 98 (see "Some Win 98-Hostile Applications," at left).

And though some analysts and even Microsoft product managers label it a maintenance release for business users, it's a good one. "The versions of Windows 98 that we are running have been extremely good in terms of our testing," says Vesa Rasanen, a development manager at American Express. "We have a number of legacy systems [with old 486 processors and 16 MB of RAM] and many of the latest machines. The installations (both clean and upgrade) were near perfect."

John Leopold, director of technical support at Block Trading, concurs: "I'm fairly impressed with Windows 98. The installations I've done have gone fairly smoothly, both as an upgrade to a straight Windows 95 system and a scratch installation. I've found it to be stable, the compatibility with my applications [seems to be good], including some games. It supported the hardware I've exposed it to, or I've been able to use the Windows 95 driver." There's always the possibility, however, that some hardware—particularly custom hardware—won't work under the new OS. "Because of legacy hardware, I prefer to stay on the Windows 95/98 platform," says American Express's Rasanen. "It's not that our applications don't work in NT 4, but I feel more comfortable with 98."

And hardware requirements are also an issue. Windows 98 will run on a 486-class

Some Win 98-Hostile Applications

Although the final software compatibility list for Windows 98 isn't due out until the final release of the OS, there are some applications that are known to behave differently under Windows 98 than they do under Windows 95.

Product	Problem
Agent 95, Agent 97 (Connectix)	Fails.
Ascend 97 Franklin Day Planner (Franklin Quest)	Fails but there's a workaround.
Director 4.04 (Macromedia)	Fails systems with more than 2 GB of free drive space.
Office Standard for Windows 95 v. 7.0 (Microsoft)	Has problems with ODBC.
Office 4.0 (Microsoft)	Fails.
Visual C++ 4.2 (Microsoft)	Conflicts with Active Desktop.
Norton Utilities AntiVirus Navigator for Windows 95 (Symantec)	Disk utilities won't work on FAT32 drives.
PC-cillin version 2.0 (Trend Micro)	Won't uninstall.
Photoshop 4.0 (Adobe)	Crashes sometimes.
Stacker 4.1 (Stac)	Windows 98 won't run on a Stacker-compressed hard drive.

system in 16 MB of RAM. (Not well, but it will run.) Its sweet spot is probably 24 or 32 MB of RAM on a 133-MHz or faster processor. Windows NT 4.0 has a sweet spot starting at 48 MB of RAM running on a 166-MHz Pentium or better. This sweet spot will likely become the minimum for Windows NT 5.0. Most corporate desktops today simply don't have the horsepower to take this radical tack. On top of that, Windows NT 4, though it has improved PC Card support and power management, still isn't as good an OS for portable computers as Windows 9x.

Windows 98 also offers lots of new stuff (see "Win 98's New Features," below). First and foremost is the integrated Web browser, giving users a new, single-click interface through the local file system as well. This isn't the best new feature, however. "Most of the people that I've unofficially polled did not like at first the single-click features or the Active Desktop features," says Rasanen, "but once we pointed out that you can turn them off, they would say 'OK, good.'" And not only did they like the fact that you could turn these features off, "Once they got over that hurdle, I found that they would go back and turn on these features."

System administrators have a different view of Windows 98 relative to Windows 95. The USB and IEEE 1394 support (courtesy of the new Windows Driver Model) are secondary to some new administration tools. According to Rasanen, "Under Windows 95, I might have utilities like CleanSweep or Norton Utilities, but I'm much less dependent on them. In Windows 98, either features from them are in the basic OS shell or I have no need for them."

Both Rasanen and Leopold cite the System Information and System File Checker utilities as particularly useful. More important, Leopold expects these new utilities will cut down on calls to his help desk.

Troy Sandal, software design engineer at Visio, points out that "Windows 98 and NT 5 will have compatible registries... For IT shops, I think Windows 98 has a better step up to NT 5."

GartnerGroup's Gartenberg agrees that Win 98 looks good. "We don't believe there are major discontinuities with Windows 98 to warrant waiting for a service pack. Users can deploy it upon release."

Reasons to Upgrade to Windows 98

- Supports new hardware technologies (Universal Serial Bus, IEEE 1394, Accelerated Graphics Port, etc.).
- Promises increased performance and reliability.
- It's coming on new hardware anyway.
- Has improved system administration features.

Win 98's New Features

Windows 98 rolls together many of the patches and updates to Windows 95, improves some of the built-in utilities, and adds a few new features. Rather like an automaker tweaking a car's look and adding antilock brakes, Microsoft has improved Windows, but Windows 98 is not really new the way Windows 95 was new. Here's a rundown of the features that IS departments will notice (and have to cope with) first.

Integrated browser. This is the new feature grabbing all the headlines: Microsoft has integrated IE 4 into the shell of the OS, giving you the ability to single-click on icons instead of double-click, and run ActiveX controls right in the desktop (among others).

Year 2000-compliant. You'd have to hope it would be.

FAT 32. This file system allows drivers over 2 GB to be formatted as one partition. Also, it updates the older FAT 16 with smaller cluster sizes, so you basically get more space out of your big disk.

ACPI support. The Advanced Configuration and Power Interface, in theory, lets you switch your PC on and off as if it were a TV or a toaster.

Windows Update. Afraid you don't have the latest versions of everything? Windows Update will go to a Microsoft Web site, download a couple of ActiveX controls, scan your system, and tell you what you have that needs to be updated, then install it.

Mail and News Clients. Tired of the Inbox? Microsoft Outlook Express, a POP3 client and NNTP newsreader, is in many ways a step up, and it's now included.

Client VPN support. The Point-to-Point Tunneling Protocol client in Win 98 enables you to establish encrypted connections with PPTP servers (like the one in NT 4), giving you a virtual private network over the Internet.

System Information Utility. Remember how useless SYSINFO was? Well, there's a new SYSINFO in town, and it's pretty slick: It tells you what's running on your machine, how your system is configured, and basically puts to shame its predecessor.

System File Checker. Oops. That last program you installed blew away COMCTRL32.DLL, didn't it? With Win 95, you were hosed. With Win 98, the System File Checker should let you easily restore it, along with many other critical files.

Registry Checker. "You do know," asks Microsoft tech support, "that you should have backed up your registry before you did that, don't you?" They ask that a lot. Now, finally, you can back up your registry. Registry Checker also scans it for problems (like corrupted keys) and can fix some of them.

New Dr. Watson. Most of us don't run Dr. Watson, but when your system crashes, this utility can tell you a little more about why than "a system error occurred."

System Configuration Utility. I hate SYSEDIT. You hate SYSEDIT. It's just Notepad that opens a few specific files. The Windows 98 System Configuration Utility is actually useful: You can not only modify your .ini files intelligently, you can actually tamper (safely) with parts of the registry.

Remote Access Server. Yes, you can finally dial into your Windows desktop system from the road and treat it (more or less) just like you'd treat an NT RAS.

Multiple display support. OK, the Mac and Unix have had this one for years. We know that. It's still kind of neat.

New hardware support. USB, IEEE 1394, AGP, DVD. If these acronyms mean nothing to you, check your brand-new system: It probably has at least one if not two of these thingies. And Windows 95 (even OSR2) doesn't do such a great job supporting them. Included in this list is also integrated IrDA infrared support and improved PC Card support (with 32-bit CardBus).

NDS support. You don't have to install the Novell Directory Services client: Now it comes in the OS.

DCOM support. For those of us wishing to run distributed applications, Win 98 includes support for Distributed Component Object Model (DCOM). Now, all we need are the applications...

Leopold is more cautious. "If you're stable at Win 95, hold still for a while," he advises. "Give it six months. If what we see today holds, you may not even have to give it six months." In the grand scheme of things, six months isn't long to wait. You can let somebody else iron the bugs out. Based on some of the experiences with early release candidates of Windows 98, caution might be the better option.

Oh, and if you're worried about running Windows 95 and Windows 98 side-by-side, don't be. "Running a [mixture of Windows 95 and 98] shouldn't be a major problem," says Randy Kennedy, senior analyst at Giga Group.

Drawbacks. An upgrade to Windows 98 has four big things going against it. First, it's new and it'll probably need some time to get the bugs knocked out. Second, there's still something weird going on between the Justice Department and Microsoft; who really knows what that could mean for you? Third, it's the end of the line. Although Win 98 prolongs the life of the 16-bit-based Windows platform, if you're still wedded to that architecture, you really need to be thinking of other alternatives, like Windows NT or one of the thin-client solutions.

Fourth, and possibly the biggest drawback, is that there really isn't an absolutely compelling feature that Windows 98 offers. If you didn't find a reason to upgrade from Windows 3.x to Windows 95, Windows 98 isn't going to lure you, either. And if you have a stable Windows 95 system, Windows 98 offers little except support for some new hardware that really isn't making a big impact on corporations yet.

Upgrade to Windows NT 4

You read about all the new features and hear the reports of the beta testers and you think, "Windows 98 is great." But it's still not NT. And NT is where many of today's Windows users will wind up—eventually.

Windows NT 4 gets Microsoft's vote as the preferred business desktop environment, too. Of course, Microsoft makes more money off each copy it sells. But Windows NT is unquestionably more stable than Windows 95 (and likely Windows 98, since that's built on Windows 95's kernel). It's also easier to manage, and more secure. It runs virtually all the same Win32 applications and most of the Win16 apps.

Reasons to Upgrade to Windows NT 4

- Increased reliability
- Increased security
- Increased manageability
- Improved system administration features

Windows 3.x users have an especially compelling reason to think of NT 4: dumping 16-bit apps. You might think that the straightest path forward for Windows 3.x is to go to Windows 9x, then see what develops. But that may not be the case. "If you're going to a 32-bit OS," says analyst Kennedy, "Windows 9x may not be worth the hassle... You lose manageability and reliability compared to NT... You're going to have to bite the [16-to-32-bit conversion] bullet at some point, so you should only bother with Windows 9x if you have specific applications that require a DOS/Windows 9x infrastructure."

"Windows NT is the future of Microsoft, and organizations should start the migration now," says Kennedy. "If you want to stay in step with Microsoft, plan to be on a client NT platform in the next two years." In other words, as long as you're upgrading your Windows 95 systems, why not upgrade to Windows NT 4?

This is a pretty radical point of view. After all, if you choose to upgrade from Windows 95 to NT 4, you'll be faced with problems, not the least of which is that NT 4's system registry is incompatible with Windows 95's. But compared to Windows 98, users get greater reliability, and administrators get much better security. Windows NT 4 also offers better multithreading and support for multiprocessing hardware. This means that your desktop client machine can run what are traditionally thought of as server applications, like Web servers. And you can run really heavy-duty applications, like LightWave 3D or Photoshop, without batting an eye.

Block Trading's Leopold has some representative experience with NT, and he says, "In any high-end workstation, for anything important, we're running NT. Most of the time, we'll ask that new systems come with NT installed. I don't have as many support problems with NT desktops." That said, Leopold cautions that you may want to stick to equipment on NT's hardware compatibility list.

Drawbacks. NT 4 Workstation is no lightweight. It offers all sorts of administration, networking, and security features, and these features come at a substantial

A Quick Look at Microsoft's OSes

DOS and Windows 3.x. Still popular at large corporations. The simplest path would take users from Windows 3.1 to Windows 95, Windows 98, and eventually to Windows NT Workstation. Nothing's ever simple, though, is it?

Windows 95. Today's OS for millions. It's more reliable than Windows 3.x but not as reliable (or as ready to take over for an OS like Unix) as Windows NT 4.

Windows 98. This is the last of the 16-bit Windows OSes. It boasts an integrated browser and a few other new features, but really isn't much of a step up from Windows 95 for corporations.

Windows NT Workstation 4. The future of Windows on the desktop, if you ask most of Microsoft. Pretty solid and reliable, but a real hardware hog.

Windows CE 2.0. Yes, it's not really a desktop OS. But if you're thinking about thin-client computing, you should realize that your thin client might be running Windows CE and the Windows Terminal Server Edition client.

Windows CE 3.0. As much rumor as reality, CE 3.0 will support more substantial computers (even desktops?) than the current version, which is mainly aimed at hand-held PCs. It will also be a great OS for Windows-based terminals. Rumor has it that CE 3.0 will be ascending later this year, but Microsoft officials wouldn't comment.

Windows NT 5. The super OS that analysts are pegging for release in Q2 1999. It'll include many improved management features, like IntelliMirror.

Windows NT 5 "Lite." Another rumored OS that will strip features out of NT 5 to make it more like Windows 95. But can Microsoft really make an OS smaller?

hardware price: Though NT 4 will run in 16 MB of RAM, any applications you load push over this boundary. Although NT has virtual memory, running it and your applications on anything less than a 48-MB system is asking for a performance slowdown. It also doesn't support nearly all the hardware that Windows 9x supports. Plus, with Windows NT 5 a year away (if Microsoft doesn't let it slip), you'd be faced with two major OS upgrades in pretty short order. The compelling reason to upgrade to NT 4 is that it's more reliable than Windows 9x or Windows 3.x, but if what you have works for you, this reason becomes less compelling.

Upgrade to Windows NT 5

If you've heard anything about NT 5, it probably sounds wonderful. But so does most promiseware, as it's called by cynics. Because Windows NT 5 is about a year away from production release, it's hard to talk about what advantages it offers over the OS you're running today. The work I did with NT 5 beta 1 showed that it was a mostly stable OS. But it couldn't migrate my prerelease Windows 98 registry, and some of the applications I use wouldn't install or run properly.

Until a more complete beta is widely available, let's just focus on some of the features that Microsoft has slated for NT 5.

Within NT 5's 29 million lines of code are some huge steps forward for Microsoft—addressing problems like Windows 9x-to-NT registry migration and all the portable computer issues (although not the issues about hardware requirements). But, more important, it's got a lot of features, like IntelliMirror and support for new hardware (USB, IEEE 1394, multiple displays, and AGP). Of these, IntelliMirror is the most important for corporations.

IntelliMirror is part of the Zero Administration for Windows (ZAW) initiative. It includes three basic parts: "no-touch" application management, policy-based administration, and client-side caching.

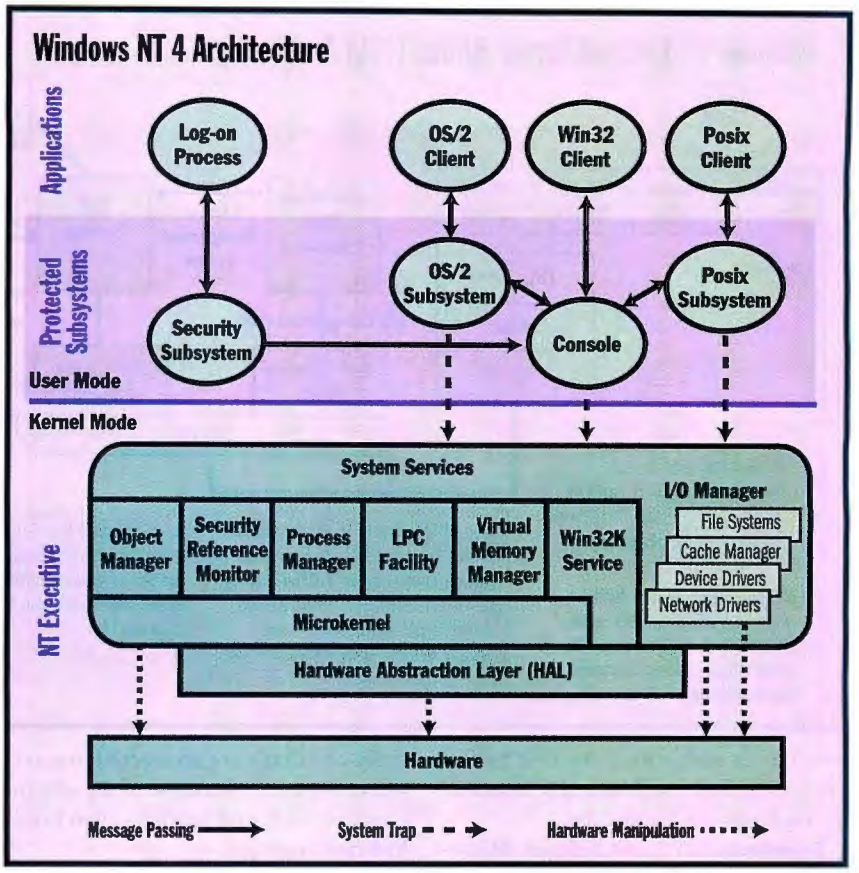
No-touch application management lets administrators assign or publish applications to users over the network. Assigned applications appear as icons on users' desktops, and when a user runs the application for the first time, the application installs itself automatically. Published applications aren't installed automatically, but when the user runs the Add/Remove Software Wizard, they appear as options.

Policies and profiles describe users' desktop configurations and allowable actions. For example, they describe what appears on the Start menu or desktop, and they can disable OS features. Stored on a central server, they ensure that users log on to "their" desktop no matter what system they're using.

Client-side caching is probably the most powerful of these features (though it goes hand-in-hand with policy-based admin). Client-side caching mirrors user preferences, applications, and data on a server. This means that users can log onto any system on a network and get not only their own desktops but also their own applications and data files. And if their system should happen to die, IS can install a new one and walk away; the next time the user logs in, the server automatically repopulates the machine with all the user's applications and data. (According to Microsoft's Russ Madlener, product manager for desktop operating systems, it's unlikely that this feature will make its way into Windows 98.)

If these features sound familiar, it's because they are. Microsoft Systems Management Server (SMS) promised them for previous versions of Windows and, to some extent, delivered them. SMS also adds remote software and hardware inventory and diagnostic tools. It extends application management with richer rules (including rules based on hardware and software inventories), and enables IS to "dry run" a rollout—test an installation without actually installing the software. And SMS provides a rollback: If a rollout should fail, SMS lets IS undo it.

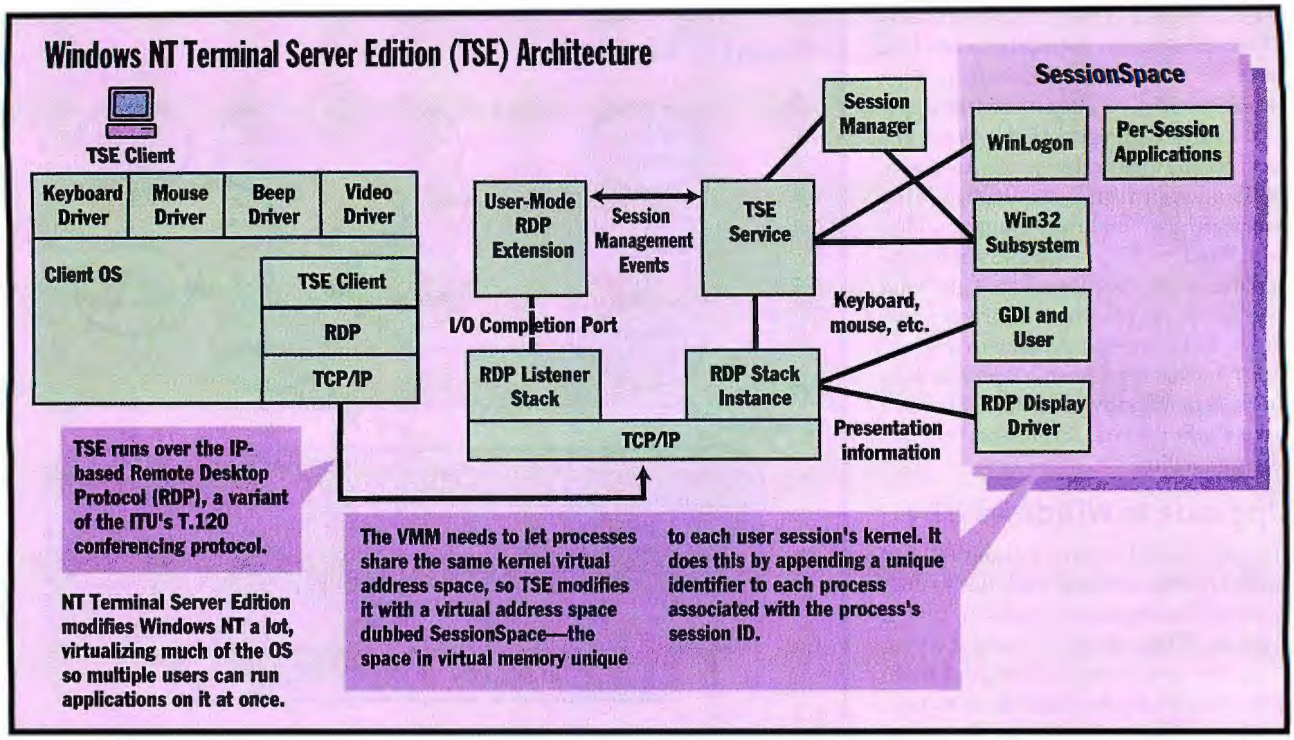
Of course, the big problem with NT 5 is that it's not available today, and it likely



Although it's early to tell, Microsoft sources say that Windows NT 5 architecture will change little from Windows NT 4.

Reasons to Upgrade to Windows NT 5

- Offers increased reliability/security/manageability.
- Improved system administration features.
- Legacy application porting projects will be done by then.
- OS upgrade will be in budget then.



won't be available until the first half of 1999. Even then it will be a year before all the big kinks are worked out.

Drawbacks. NT 5 isn't here yet. Microsoft has historically had problems shipping its operating systems on time, so skeptics are already saying that even the Q2 1999 ship date might slip. How long can you wait for NT?

At the time of this writing, NT 5 was in its first beta. Many of the technologies that Microsoft promised in NT 5, like IntelliMirror, weren't yet in evidence (though BYTE editors have seen them in demos).

Another big problem with NT in general is that it needs a lot of hardware to run. Microsoft knows this, and rumors of an NT "Lite" (sometimes called NT Consumer Edition) have been around for a while. When you ask Microsoft about it, representatives get very cagey. Basically, they'll tell you that it's logical to expect a "lighter" version of NT. A source close to Microsoft (who preferred to be left unnamed) told BYTE that Microsoft is already working on this lightened operating system, and that you should expect it some time after the turn of the century, probably in 2001.

A lighter version of NT would address critics' concerns that Windows NT is a resource hog. To lighten up NT, it's unlikely that Microsoft would write tighter code. It's more likely that Microsoft would strip out features that are less necessary for a single-user workstation, especially one that's not connected to a network. For example, some of the administrative tools and perhaps even IntelliMirror might go.

Keeping in mind that Microsoft is better at writing fatter code than slimmer code, it's also possible that a future version of Windows CE will grow into the midsize OS that Microsoft will need to fill the void after Windows 9x goes away.

Deploy Terminal Server

Windows NT 4.0, Terminal Server Edition (TSE for short, and formerly code-named Hydra), is Microsoft's thin-client solution due out this summer. It's impressive—and possibly the most important technology we're discussing in this article. NT TSE enables most 16-bit Windows, nearly all 32-bit Windows, and even some DOS applications to run on a Windows NT server, yet display their screens on separate, networked clients.

These networked clients can be Windows 3.1, Windows 9x, or Windows NT systems. Or, thanks to Citrix's pICAsso product, they can be Macintoshes or some flavors of Unix. Or, they can be Windows-based terminals—super-thin clients with no local storage and only enough local CPU power to process screen and keyboard I/O. Such devices already exist, from Wyse's $349 monochrome model to terminals from NCD, Tektronix, and others for prices more like $700.

Think thin. Thin clients make a lot of sense for many users. Transactional workers, as IDC's Kusnetzky calls them, stay in one application (like order entry or accounts payable) nearly all the time. Even when they do use other software, they don't stress it. How powerful does a typical desktop system need to be for them? Not very. Yet they're often equipped with Pentium-class systems with lots of RAM.

That wouldn't be so bad—after all, system prices are at an all-time low—but

Reasons to Deploy Windows NT Terminal Server Edition

- Has improved system administration.
- Lowers total cost of ownership (TCO).
- Your applications are low-intensity.

IS departments must shoulder the cost of maintaining these full-fledged networked systems. According to Kusnetzky, hardware and software combined typically aren't more than 15 percent of the cost of a system over its life. The support staff represents 50-60 percent of the cost, and anything that lowers staffing cost goes straight to the bottom line.

Of course, thin-client solutions have their place. "If you're running SAP R/3 or

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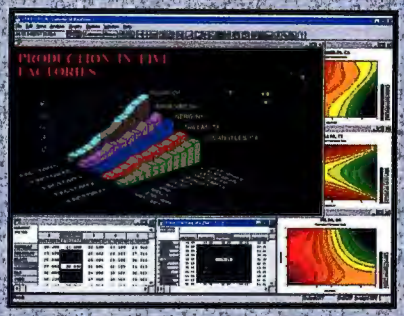

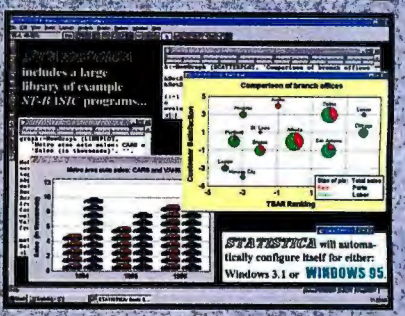

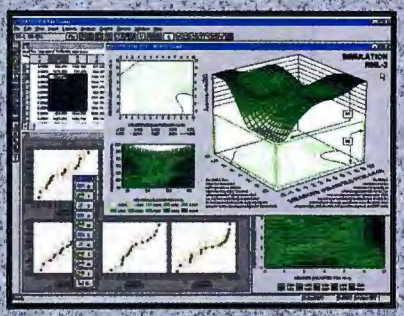

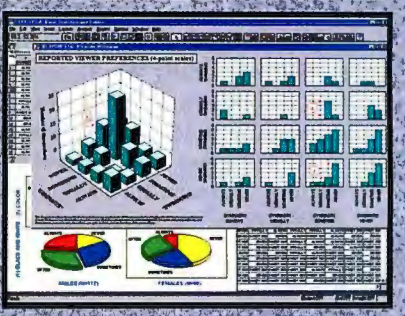

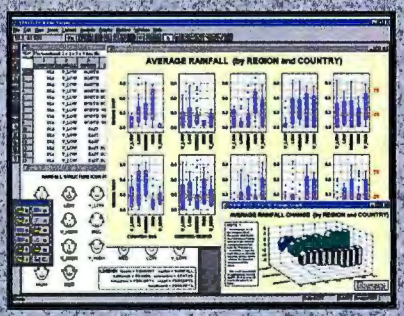

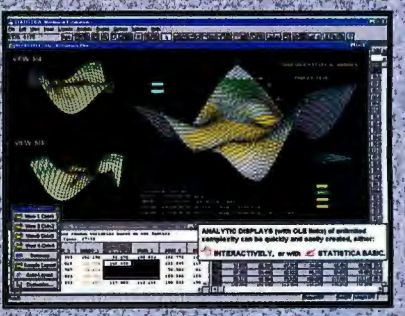

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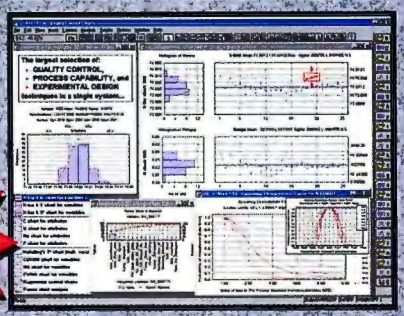

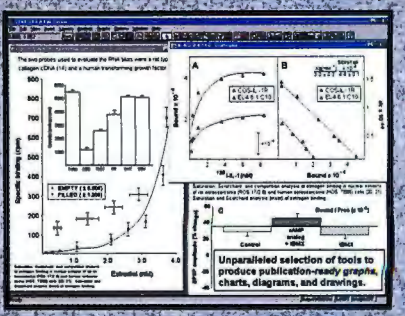

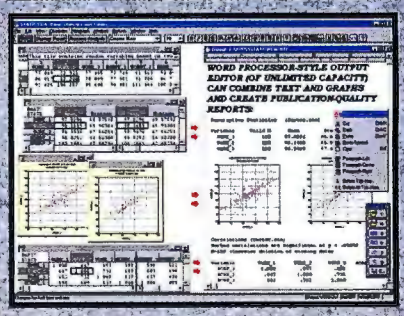

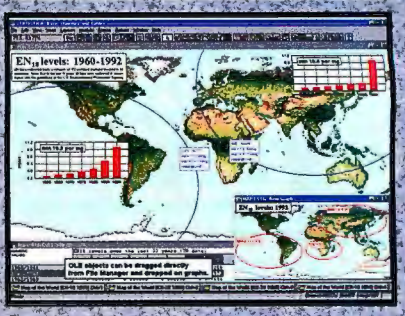

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an order entry system, a thin client is a perfectly valid approach," points out Gartenberg. "If you're running SoftImage or other high-bandwidth apps, you won't be satisfied with performance."

Windows 3.x migration. NT TSE gives Windows 3.x a new lease on life. If the reason you're considering an upgrade from 3.x is that you wanted to run some Win32 application (for example, Office 97), you now have the option of keeping that desktop in place, installing TSE client software, and running the Win32 app on an NT server.

Alternately, you can replace the Windows 3.x system with a near-zero-maintenance Windows-based terminal. If the applications running on that Windows 3.x system will run under Windows NT 4, it's likely they'll run under NT TSE.

Given its ability to turn a Windows 3.x system into a fully Win32-capable system, the obvious use for TSE would be to give new purpose to older systems—turn an old 486 into a Windows-based terminal. But "Fortune 1000 companies just don't have the budget reasons to do that," according to John Frederiksen, group product manager at Microsoft. "Education, government, and the military are more interested" in such reuse.

Windows 9x & NT migration. What about systems that are already Win32-capable? For transactional workers, running TSE still offloads a tremendous administration burden from an IS department. But even for knowledge workers, it offers interesting capabilities. If you need some applications only once in a while, why go through the hassle of running a full install on your system? Why take up the disk space, cram more stuff into your registry, and risk who-knows-what potential DLL conflicts? Instead, if you run the NT TSE client, you can have ad hoc access to applications that run on a server without burdening the client system.

Drawbacks. Windows NT Terminal Server Edition is hardly a slam-dunk choice. For example, if users need to work when disconnected from their servers (e.g., they need a portable computer), TSE's superthin client isn't going to suffice.

Also, the performance may not be all you want. The perennial ding against NT TSE (and its predecessor, Citrix's WinFrame) has been that it's just not as fast as using a stand-alone desktop system, and you can't run as many applications at once. "Users are not going to be running Office all day with four applications open," says Microsoft's Frederiksen. Compared to WinFrame, TSE has some improvements such as better caching on the client and server and better data compression over the wire. But it's still painting screens remotely, and client performance seemed a little sluggish when I saw it.

The next issue after client performance is server load. NT TSE shifts the processing and administration requirements from the client to the server. You will need a dedicated server with lots of RAM and probably multiple processors. Microsoft recommends 32 MB of RAM as a starting point, plus 4 to 8 MB of RAM for each "typical" simultaneous user. Microsoft says that you should be able to get 15 to 25 users per server processor. These numbers are backed up by manufacturers of Windows-based terminals such as Tektronix and NCD. Lee Rainey, director of marketing for the network displays division at Tektronix, says the network load of running TSE is negligible, so at least you won't have to upgrade your network.

Another thing you'll have to worry about is application compatibility. There will be some applications that won't work so well. "Well-behaved 32-bit applications shouldn't be a problem," according to

CE on Your Desktop?

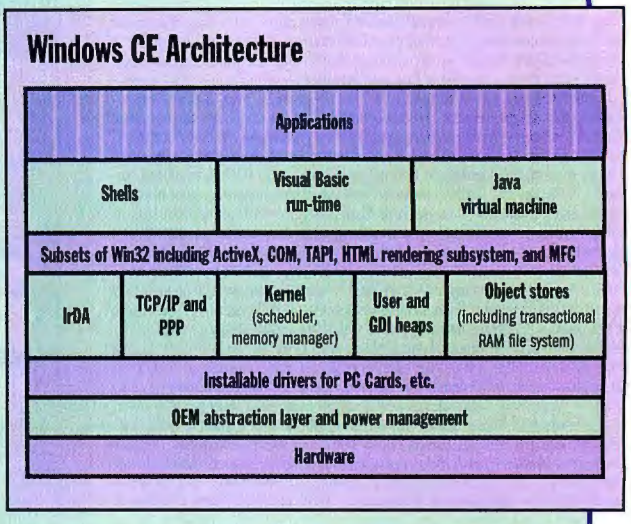
All this talk about thin clients and NT Lite might make you think: Microsoft already has a low-end operating system—Windows CE. Though it currently doesn't have all the features of a Windows 98 or Windows NT, Windows CE points the way forward for a small-footprint version of Windows.

Microsoft has already ported to the Palm PC and Auto PC. But Windows CE can be a lot more than that. Take a look at the Windows terminals built around it by companies like Wyse and NCD.

GartnerGroup research director Michael Gartenberg feels that Windows CE will stay off the desktop, however. "We don't see Microsoft trying to push CE devices with desktop-class applications—that would fragment the ISV market and cause too much confusion."

But, technically speaking, Windows CE could grow up to fill some of the gap that Windows 98 will leave when its life is over. After all, Microsoft has proven itself much better at making software larger, not smaller.

Windows CE 2.1 supports much of the Win32 API set, including COM/ActiveX, Microsoft Foundation Classes (MFC), and MAPI. It includes TCP/IP support, and it supports installable drivers (as for PC Cards). It uses a transactional RAM-based file system. And it includes a Java virtual machine. In short, it's nearly a desktop OS already.



On top of that, it has been ported to many processors, including the Intel x86, several Mips-based chips (NEC's Vr4300, Toshiba's TX 3912, and Philips' Poseidon), and the Motorola MPC821, a PowerPC-based CPU.

That said, it includes none of the desktop administration tools that Microsoft is introducing for Windows 98 and especially for Windows NT 5. And there's a limited subset of hardware that it supports compared to both these operating systems.

In short, Windows CE would have to grow way up to support all the features and applications that we expect from a stand-alone desktop operating system. To some degree, that's starting to happen with the larger-form-factor Windows CE 3.0 devices. According to industry sources, Windows CE 3.0, due out some time this summer or fall, will sport 640x480 screen resolution and support for Universal Serial Bus.

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Craig Cumberland, product manager for Windows NT Server.

Well-behaved? Well-behaved 32-bit applications, according to Microsoft, share some characteristics. For example, they use the HKEY_LOCAL_MACHINE registry key only when they want to modify a global parameter. They separate global and local files instead of just dumping them all into WINNT\SYSTEM. And they minimize the use of splash screens.

There are some very popular applications that might not work well under Hydra. For example, Microsoft recommends against using IE 4.0's Active Desktop when NT Terminal Server Edition is in multiuser mode. Also, modifications that it makes to the Windows NT kernel thread scheduler mean that it's not a good idea to try running other server applications (such as the BackOffice apps) on the NT TSE machine.

Deploy Web-Based Applications

If you're thinking of going to a thin-client architecture, you might also think about what Web-enabled applications can do. Web-enabled applications fall into three broad categories: direct access to specific legacy systems, middleware access to arbitrary existing applications, and Java solutions. Each category has different characteristics.

Right now, this kind of migration is still largely in the "thinking about it" stage, but IDC's Kusnetzky is hearing rumblings that the future may bring these kinds of changes. "People buy applications, not processors or OSes," he says. "Right now the most intriguing apps are on Wintel, but I'm starting to see more environments saying that Wintel may not always be the right community." In particular, the Linux community is growing fast. Kusnetzky estimates that sales of new Linux units on the desktop were $2-6 million in 1997.

Web-enabling the legacy. Research at IBM indicates that more than half the Windows 3.x desktops still in use are dedicated to running a terminal emulator. These terminal emulators hook into text-based applications running on large systems—things like order entry, accounting, and resource planning. Rather than look to a new OS to run the latest version of the emulator, companies can upgrade many of their systems, including CICS and Encina, to immediately Web-enable them.

These solutions, though possibly expensive, give people the same kind of direct access to the legacy systems they've always had, yet they free them from needing a terminal emulator. Users can log in from any Web browser. They don't need any specific OS, just a system that can run a browser—anything from an X terminal to a Windows-based terminal to a full-fledged client running Unix or NT.

In some ways, Web applications offer the advantages of a GUI with the advantages of a text-based application. Like a GUI, Web applications are easier for users to learn than the sometimes arcane text-based interfaces they're confronted with. Users can easily be taught the basics of navigating hypertext (if they don't know already) and can apply it to any application you roll out. But like text-based applications, Web applications don't carry a lot of user interface overhead and usually require no particular software on the client except the browser. This lowers the amount of time it takes to develop and administer the application.

Projecting applications. Or, IS departments can look to applications such as SCO's Tarantella, which can take all kinds of existing applications and transport their screens onto thin clients, much as Terminal Server does for NT. The difference is that Tarantella itself runs on SCO UnixWare, Solaris, HP-UX, and AIX, and can interact with everything from terminal-based applications running on mainframes to Windows applications to Unix applications.

Tarantella is a Web-based program. Users connect to Tarantella through a Web browser. The Web server returns a page containing the Tarantella bootstrap applet. They then log in and receive their "webtop"—a Web page dynamically generated to reflect the users' profiles. The webtop includes Java applets that link to specific Web pages. If the Java applet links to an application, then the webtop downloads the correct display engine, which finds and invokes the associated application.

Tarantella (and similar environments from companies like Attachmate and Wall Data) offers many of the advantages of NT TSE. For example, it can take existing applications and redirect them onto any arbitrary desktop. But it goes beyond the Microsoft TSE solution because it's designed to hook into more existing applications out of the box and it runs on operating systems other than NT.

Rewriting in Java. Another alternative in this vein is to rewrite all or part of your application in Java. Java's platform neutrality opens your upgrade path from the next version of Windows to anything with a Java virtual machine—everything from Windows CE to Unix to a JavaStation.

Also, Java gives you greater freedom to migrate application logic up and down your multitier network. If you have a powerful system on your desktop, a Java application could download and run entirely locally and even save a copy of itself for use later. And, of course, a Java application can be coupled with a product like Tarantella or NT TSE to project its screen image onto the thinnest of clients.

In any of these scenarios, Java offers administrators the capability to upgrade the application or applet whenever the user runs it. This couples centralized application distribution control with platform independence and a real GUI.

Drawbacks. Each of these three solutions has some drawbacks. Possibly the largest, however, is that a lot of users hate the idea of thin clients and will undermine rollouts. For them, thin-client computing isn't a rational argument. It's an emotional argument. They view the thin client as a loss of freedom. Overcoming this obstacle will be as much a fight as overcoming any technical hurdles to thin-client deployment.

Reasons to Deploy Web-Based Applications

- ✔ Creates open client platform.
- ✔ Administration is easier.
- ✔ Lowers total cost of ownership.

Of course, that's not to say that the technical hurdles are small. Rewriting applications in Java could be a major task that provides no major immediate financial gain. And if you're looking for shrink-wrapped applications to run on your JavaStations, you may see some weaknesses. For example, today's Java-based office suites are still slow, first-generation products.

It's going to take time before such full-fledged network-computing-based applications are ready for prime time. "It may take 18 to 20 months to develop and document something, and by that time the media is saying 'It must not have worked,'" says IDC's Kusnetzky. "The reality is that

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the network computing model is just starting to come to fruition."

Switch to Another OS

If you're considering a migration as serious as moving to thin-client computing, it might behoove you to take a second to think outside the box. What if you weren't planning on running a Microsoft OS on the desktop? In particular, with all this hoopla about the world's most-used desktop OS, where do the Macintosh and Unix sit?

Macintosh users will take a look at some of the new features in Windows 98 and ask, "What took so long?" Support for multiple monitors and plug-and-play hardware have been around in one form or another on the Mac for a while.

Most people buy computers for what they can do—usually that means the applications they can run. Applications like Adobe Photoshop and QuarkXpress (mainstays of the publishing industry) will probably continue to run better on the Mac. And people who were trained to use these applications on the Mac will continue to prefer the Mac to run them. Artists who have added multiple SCSI disks to their systems to deal with their plethora of 80-MB Photoshop files really don't want to try the same trick with Windows 9x. It's still not as easy on Windows 9x.

Unix on the desktop these days means mostly either high-end workstations or systems running either Linux or some other free Unix-alike (like FreeBSD). High-end workstation users fit into the same category as Mac users: They have their applications (which often cost more than the workstation they're running on) and have little incentive to switch right now.

At the low end, many users are trying Linux. They're finding what you'd expect: It's extremely flexible, it doesn't crash easily, it isn't a resource hog.

WHERE TO FIND

Attachmate
Bellevue, WA
800-426-6283
425-644-4010
http://www.attachmate.com

IBM
White Plains, NY
800-IBM-7080
416-383-5152
http://www.pc.ibm.com/networkstation

Microsoft
Redmond, WA
425-882-8080
http://www.microsoft.com

The Santa Cruz Operation
Santa Cruz, CA
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http://www.sco.com

Wall Data
Kirkland, WA
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425-814-9255
http://www.walldata.com

And what do you really get from this major migration? Freedom from Wintel. Freedom to run whatever operating system you want. Freedom to run whatever hardware you can afford. You can set up the network using reliable or low-cost OSes like Linux. You can experiment with new embedded OSes like Lucent's Inferno or Sun's JavaOS. This is where philosophy starts to play a role in your IT decisions. If you believe that the Wintel monopoly is a bad idea, then Java is a godsend—it'll run on anything, anywhere.

Drawbacks. Switching horses entirely off Windows isn't something a lot of people are contemplating. Analyst groups like IDC say that the Mac is losing desktop market share, and will continue to lose it. Linux is growing in share, but corporations are still nervous about running what they perceive as unsupported software (though many Linux vendors, as well as the Linux community, offer support).

And Windows NT is gaining in mindshare. Workstations from companies like Intergraph are starting to make a dent in that market, and even SGI has admitted that NT systems might not be such a bad idea.

Finally, Linux won't run Microsoft Office (for better or worse). Remember: It comes back to applications, and Linux desktop applications—even the good ones like StarOffice and ApplixWare—still don't have the familiarity and, more important, the near universality of applications like Microsoft Office. Even though ApplixWare can read most Office file formats, users who have trained on Office will need to be retrained, and IS departments don't want to have to support multiple office suites. Plus, these free Unix-alikes still look like Unix. Even when you load the window manager, you're left with a sometimes confusing new user interface to learn.

In short, the future of Unix and the Macintosh on the desktop is a niche role, performing one or two critical functions. It's not about the quality of the OSes; in many ways, these OSes are better than Windows. It's about perception, it's about availability of applications. And it's about universality—sometimes it's just easier to run the same software as everybody else.

Making Your Choices

Any OS upgrade choice is the result of a push and a pull. Missing features (including hardware support), lack of applications, poor reliability, and high cost of ownership are typical pushes. They all have corresponding pulls. And blockers like legacy applications, old hardware, budgets, and deadlines hamper every OS upgrade.

The question of the day is: "Is an upgrade to Windows 98 a good idea?" The short answer is that if you haven't felt the push so far to either Windows 95 or to Windows NT, Windows 98 is probably not worth an upgrade. That's not to say you can avoid it; it will probably come on all your new systems. Nor is this to say that Windows 98 is a bad idea—it's a fine incremental upgrade from Windows 95. Just remember that it's a stepping stone to Windows NT.

If you are feeling a strong push, you have more options—and more confusion—than ever before. Windows is splintering: With every release, it leaves behind one more legacy platform. Now we have Windows 3.x, Windows 95, Windows NT 3.x, Windows NT 4, and Windows CE. On top of that, Microsoft offers NT Terminal Server Edition, which can supply Windows applications to non-Windows platforms. Windows NT 5, NT 5 "Lite," and Windows CE 3 are all waiting in the wings, promising features that further confuse things.

Reasons to Switch to Another OS

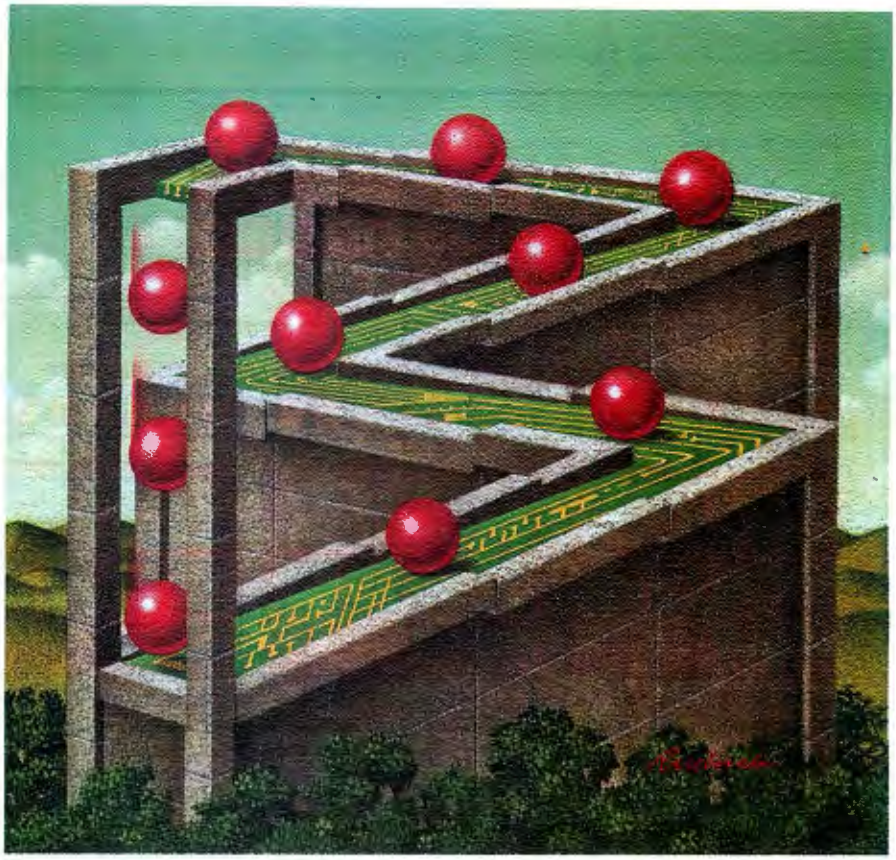
SWITCH TO ANOTHER OS

- ✔ Potentially more stable
- ✔ Potentially easier to use
- ✔ Potentially less expensive to maintain
- ✔ Potentially more secure

And that's just from Microsoft. New thin-client solutions like SCO's Tarantella and Web gateways for many existing applications are offering corporations a way to escape Windows with little or no reworking of their legacy applications. Java offers a thick-or-thin-client solution that will run anywhere. And Linux is gaining ground as a new, non-Windows OS choice.

All these platforms offer strong pulls of their own, but they will all entail some pain. What degree of pain you face on the way will depend on what choices you make. Just remember that a low-pain measure you take today could cost you later. B

John Montgomery is BYTE's West Coast bureau chief. You can reach him at **jmontgomery@byte.com.**



INSIDE IA-64

IA-64 builds on CPU and compiler technologies that have been brewing for at least 20 years.

By Tom R. Halfhill

Contrary to popular myth, the computer industry doesn't always move at lightning speed. Truly fundamental technologies such as the Internet, graphical user interfaces, object-oriented programming, and RISC can take years or even decades to evolve before winning broad commercial success. And the inevitable early failures can fool pundits into dismissing new trends prematurely.

The trick is figuring out which blips on the radar screen are significant and which are meaningless ground clutter. In the case of IA-64—the new 64-bit CPU architecture devised by Intel and Hewlett-Packard—the blip is significant indeed.

One obvious reason is that IA-64 is the heir apparent to Intel's dominant but aging x86 architecture. What's less obvious is that IA-64 is the latest attempt to commercialize some "new" parallel processing and compiler technologies that dozens of companies and universities have been developing for at least 20 years.

To report this story, BYTE talked to CPU architects and engineers at competing companies as well as at Intel and HP. We also interviewed academic researchers and computer scientists who have spent years working on the basic technologies behind IA-64. Conclusion: When Intel and HP say their new architecture goes "beyond RISC," it's not just marketing hype. IA-64's roots are decades deep, and it represents the general forward trend in microprocessor design.

EPIC vs. RISC

The basic techniques behind IA-64 are instruction-level parallelism, long or very long instruction words (LIW/VLIW), and branch predication (not the same thing as branch prediction). Intel and HP refer to this combination as *explicitly parallel instruction computing*, or EPIC. (See "Beyond Pentium II," December 1997 BYTE.)

EPIC is a broad definition, like CISC or RISC. Anybody can design a CPU architecture based on EPIC. IA-64 is the first example: It's a proprietary CPU architecture defined by Intel and HP, just as Intel's x86 is a proprietary architecture based on CISC and HP's PA-RISC is a proprietary architecture based on RISC.

Merced is the code name for the first IA-64 processor that Intel plans to ship in the second half of 1999. More IA-64 chips will follow, all from Intel. (HP is a partner but will not independently design, manufacture, or sell any IA-64 chips.)

"Just as RISC represented a revolution in processor technology over CISC, EPIC represents a revolution in processor technology over RISC," says Carol Thompson, a compiler architect at HP.

It's not an empty claim. EPIC is the result of work that started long before Intel and HP formed their IA-64 partnership in 1994. Two direct ancestors are the highly parallel VLIW machines designed by Multiflow and Cydrome in the 1980s. Although both companies are defunct, a remarkable number of their former employees now work at Intel, HP, and satellite companies.

More distant ancestors of EPIC are parallel-processing systems designed by IBM, Control Data, Digital, Loral, MasPar, Cray Research, Thinking Machines, and others. Additional research at universities has been under way for decades.

This background is important for two reasons. First, it shows that EPIC is part of a slowly cresting wave, not merely a ripple.

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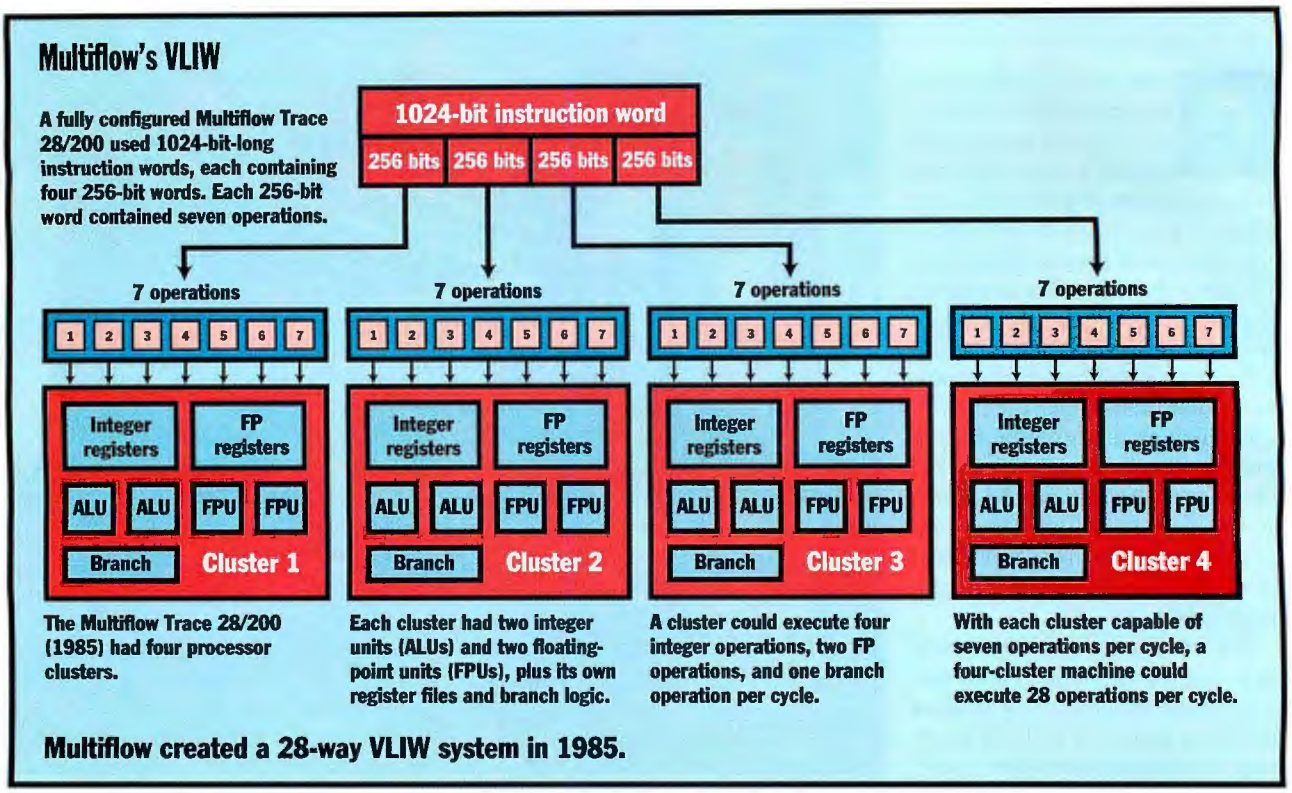


Just as RISC can trace its roots back to the pioneering work of John Cocke at IBM in the 1960s and 1970s, EPIC can trace its heritage back to the 1970s and 1980s. CPU architectures have been moving in this general direction for a long time. EPIC was more or less inevitable, with or without Intel and HP.

Second, the long gestation period means EPIC is not built on experimental, unproven technology. This is especially important for the compiler technology—EPIC relies more heavily on optimized compilers than RISC or CISC does. It will probably take a few years' experience in the field to refine the compilers and processors, but the first examples should give users a glimpse of IA-64's potential.

Limits of RISC

EPIC tries to address the shortcomings of RISC, just as RISC addressed the shortcomings of CISC. Those shortcomings—as perceived by EPIC proponents—are the limits of hidden parallelism and the increasing complexity of dynamic instruction scheduling.

Basically, there are two ways to make a faster CPU. One way is to increase the clock frequency, which increases the number of operations a CPU performs each second. All other things being equal, a 200-MHz processor is twice as fast as a 100-MHz processor. Fortunately, higher clock speeds are a natural byproduct of shrinking circuits.

The other way to make a faster CPU is to increase the number of operations it can perform per clock cycle. Modern RISC and CISC processors do this with two techniques: instruction pipelining and superscalar microarchitectures.

Pipelining works like a factory assembly line. It divides the execution path into stages, so the CPU can work on multiple instructions at a time, with each instruction at a different state of completion. Superscalar processors have two or more of those pipelines, so they can work in parallel on multiple instructions.

If achieving higher performance were as easy as adding more and deeper pipelines, engineers could go home at 5 o'clock. Unfortunately, they soon hit a wall of diminishing returns. The main problem is finding enough work to keep all those pipelines busy.

Program code is rarely suitable for parallel processing because it's riddled with control-flow instructions that change the path of execution. Those pesky instructions include branches (IF-THEN-ELSE), loops (FOR-NEXT, WHILE-DO), jumps to subroutines (calls to functions, procedures, and methods), and error handlers (TRY-CATCH, ONERROR). Of course, those are the same instructions that make software useful. Some scientific programs have long sequences of calculations that are easy to execute in parallel, but most code has a branch every five or six instructions.

Because the CPU doesn't know for sure which way a branch will fork—it often depends on user input—the CPU must resolve the branch before executing any instructions beyond it. So there's little point in having 10 pipelines if the CPU can't execute more than five or six instructions in parallel before hitting a branch barrier.

To get around that problem, modern RISC and CISC processors resort to a variety of techniques: branch prediction, speculative execution, and out-of-order execution. The first two allow a CPU to make a good guess about which way a branch will jump so the CPU can begin executing instructions along the predicted path. That way, the CPU can fill more instruction slots in its pipelines before resolving the branches.

The third technique, out-of-order execution, tries to keep the pipelines busy by rearranging a program's instructions at run time. If an integer instruction is immediately followed by a floating-point instruction, but all the integer units are busy, the CPU might begin executing the FP instruction first and come back to the integer instruction later. A conventional

in-order CPU would stall until an integer unit becomes available.

But these three solutions create new problems. If the CPU mispredicts a branch, it must flush its pipelines of the partially completed instructions to make way for the correct instructions. The more pipelines, and the deeper the pipelines, the bigger the penalty in lost clock cycles. A processor with four seven-stage pipelines might lose 28 cycles (4 × 7), not counting the additional cycles it may require to reload the cache. A processor that's twice as wide and twice as deep could lose 112 cycles (8 × 14). The penalty becomes so enormous that it wipes out the gains of parallelism.

Out-of-order execution has a price, too. The CPU needs complex interlock circuitry and a large register file to juggle the instructions. It has to work fast, because it's rescheduling the instructions while the program is running. It can't see more than a small piece of the program at any one instant. And out-of-order CPUs are much more difficult to verify.

Digital's 21264, the first fully out-of-order Alpha processor, was delayed for months while engineers labored to verify its complex design. The first out-of-order CPUs from Intel (Pentium Pro) and Mips (R10000) were difficult to verify as well. Some companies, such as Sun, are avoiding out-of-order execution altogether.

CPU architects are eager to solve those problems because new fabrication technology will soon make it possible to build chips with hundreds of millions of transistors. If there's nothing to gain by adding more functional units, they'll have to dump those transistors into bigger on-chip caches. Although bigger caches improve performance to a degree, architects would rather spend their growing transistor budgets on parallel logic that does more useful work.

The EPIC Solution

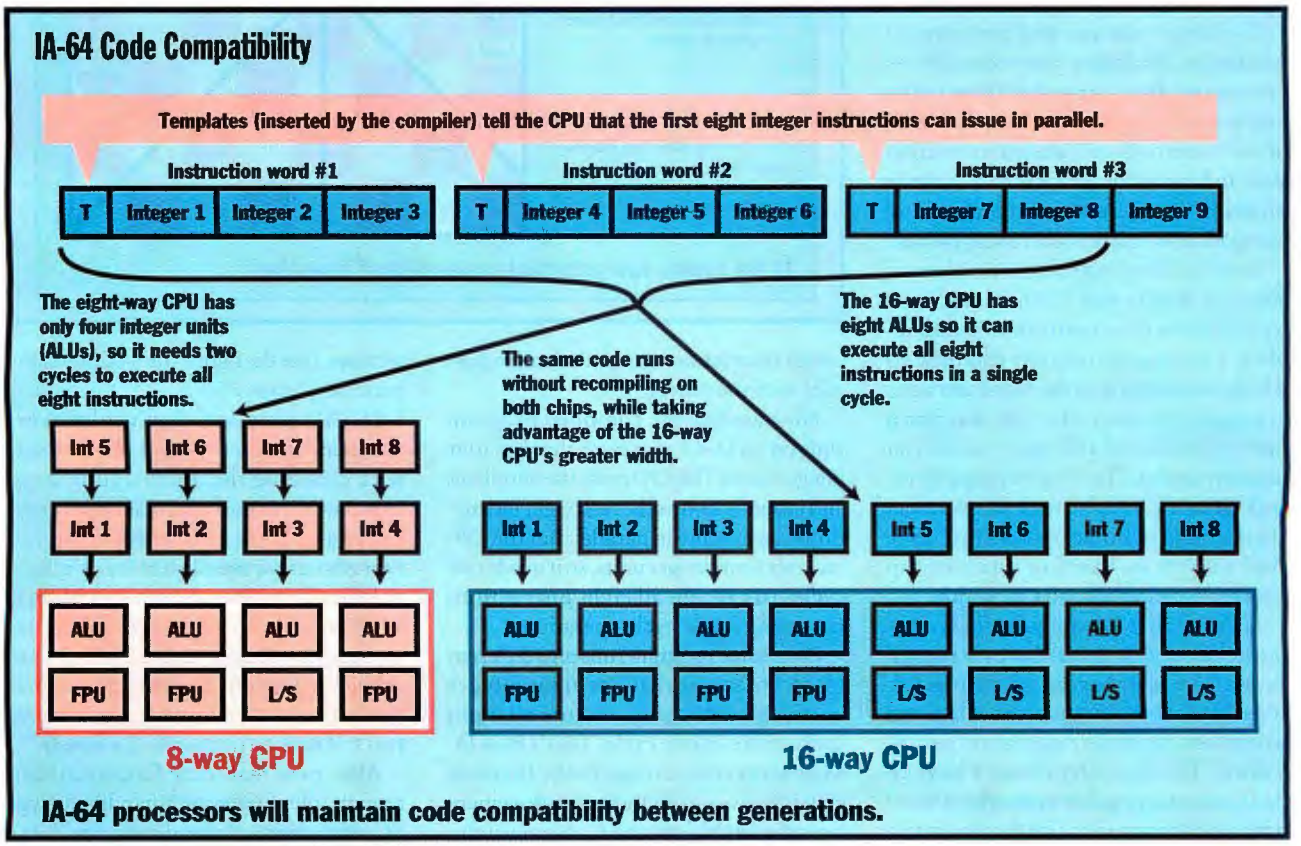
EPIC tries to address the limitations of today's architectures by encoding parallelism at the instruction level and by using branch predication. Instruction-level parallelism (ILP) requires a compiler to statically schedule the instructions at compile time, instead of waiting for the CPU to schedule them dynamically at run time. Compilers already do this to some extent. But a regular compiler has no way to explicitly tell a CPU which instructions it can issue in parallel. At run time, the CPU must scan the instruction stream to find the parallelism. An out-of-order CPU goes even further by reordering the instructions again, seeking "hidden" parallelism the compiler missed.

An EPIC compiler schedules the instructions at compile time and exposes the code's parallelism to the CPU. IA-64 defines a template field that encodes this information within a few bits. The CPU reads the template at run time and knows immediately which instructions it can dispatch in parallel to the functional units.

Because an EPIC processor doesn't have to schedule dynamically, it doesn't need as much complex interlock circuitry as an out-of-order RISC or CISC processor. Theoretically, it can be smaller and cheaper.

Another advantage of static scheduling is that a compiler can spend a relatively luxurious amount of time doing global optimizations. At run time, a CPU has only a few nanoseconds to do its job and sees only a tiny fragment of a large program at any moment. A compiler has much more time to analyze the code and sees the whole program (except for any dynamically loaded pieces, such as DLLs or late-loaded class files).

The counterargument is that CPUs know more about a program's actual behavior at run time. "It's a question of how much you can do in hardware versus



how much you can do in software," says Mike Splain, chief technology officer at Sun Microelectronics.

Although recent RISC and CISC processors have been doing more dynamic scheduling in hardware, proponents of ILP are betting on the compilers. "At run time, the CPU knows almost everything, but it knows everything almost too late to do anything about it," says Gerrit A. Slavenburg, chief architect of the Philips TriMedia processor, a VLIW design.

Parallel Encoding

IA-64's templates are a relatively new innovation. Earlier attempts by Multiflow and Cydrome to build highly parallel systems were hampered by designs that bound the compilers too tightly to the microarchitectures. (The microarchitecture is the specific design of a chip, as distinct from the overall defining architecture.)

For example, Multiflow's Trace 28/200 matched 256-bit instruction words to specific processor clusters. Each 256-bit word contained seven operations, and each processor cluster could execute seven operations per cycle. If the type of operations didn't exactly match the type of functional units available, the compiler had to pad the instruction word with NOPs—null operations.

To reduce code size and conserve I/O bandwidth, Multiflow compressed NOPs in memory, then expanded them in the instruction cache after fetching. But Multiflow's approach still wasted instruction slots and forced developers to recompile programs if the system's microarchitecture changed. IA-64 takes a different approach.

IA-64 has long instruction words, too, although they're only 128 bits long. Each word contains three instructions and a template. The template not only tells the CPU which instructions in the word can issue in parallel with each other, but also which *instructions* in the following words can issue in parallel. This requires some interlock circuitry, but it's much simpler than the interlocks in an out-of-order RISC chip. And there's no binding relationship between word width and CPU width.

Let's say an IA-64 compiler finds eight integer instructions that have no mutual dependencies, so they can issue in parallel. It packages those instructions into three words—two complete words and part of a third. The compiler doesn't have to pad the remaining slot in the third word with a NOP; instead, it fills the slot with a useful instruction that can't issue in parallel with the others.

Now assume the compiled program runs on an IA-64 processor that has four integer units. The CPU reads the templates and instantly knows the next eight instructions can execute in parallel. But the CPU has only four integer units, so it needs two cycles to execute all eight instructions (assuming single-cycle operations).

If the same program runs on a different IA-64 processor that has eight integer units, the CPU could execute all eight instructions in one cycle. That's how IA-64 ensures code compatibility between generations—a significant improvement over the Multiflow and Cydrome architectures. (See the figure "IA-64 Code Compatibility," page 83.)

IA-64's templates don't solve every problem, however. "There are two issues with changing the microarchitecture: compatibility and performance," says Richard Lethin, a former Multiflow engineer who is now president of Equator Technologies Consulting, which specializes in VLIW compilers, dynamic compilers, and emulators. "You can change the microarchitecture without breaking compatibility, but if you want maximum performance, you still have to recompile. Definitely."

Also, note that some functional units remain idle if they can't handle the type of instructions chained together. (FPUs

The Eight Queens Problem

Intel and HP illustrate the advantages of EPIC with a benchmark conceived at Stanford University: the Eight Queens Problem. The goal is to arrange eight queens on a chessboard so that no queen threatens any other queen.

There are 92 possible solutions. The primary line of C source code that computes the problem translates into machine code that includes three load instructions and three branches. The algorithm would require 13 clock cycles to execute on a traditional CPU.

IA-64's speculative loading replaces two of the load instructions (see "Beyond Pentium II," December 1997 BYTE). Predication effectively removes two of the three branches. Together, these techniques reduce the algorithm to seven cycles. However, the most important difference is that predication eliminates the possibility of two mispredicted branches—potentially saving dozens of cycles, depending on the depth and width of the CPU.

Critics claim it's not a good example. "Our customers don't run the Eight Queens Problem very often," says Marc Tremblay, chief CPU architect at Sun Microelectronics. But independent research at universities does indicate that fully predicated instruction sets can eliminate about half of all branches in common code.

A Royal Solution

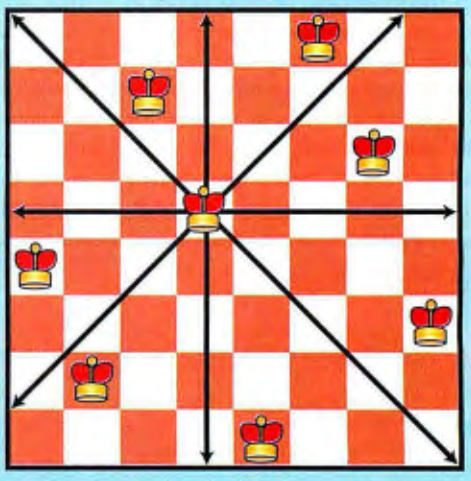
Challenge: Arrange eight queens on a chessboard in such a way that no queen threatens any other queen.

```
if ((b[j] == true) && (a[i+j] == true) && (c[i-j+7] == true))
```

BEFORE
- 3 load instructions
- 3 potential mispredicted branches
- 13 cycles to execute

AFTER
- 2 speculative loads
- 1 nonspeculative load
- 1 potential mispredicted branch
- 7 cycles to execute

(For other solutions, run the Java applet at: http://www-cs-students.stanford.edu/~sab/queens.html.)



IA-64 avoids two potential mispredicted branches.

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cannot execute integer operations, or vice versa.) But it's still better than padding with NOPs.

Branch Predication

A good EPIC compiler must know enough about a processor's microarchitecture to balance the trade-offs between branch prediction and branch predication. One goal of predication is to dodge the penalty of mispredicted branches—a penalty that gets much worse as CPUs get wider and deeper. Merely increasing the accuracy of branch prediction isn't enough.

Even static branch prediction is about 87 percent accurate, notes Stan Head, technical marketing manager at Mips. Intel's Pentium Pro and Pentium II use dynamic prediction to achieve better than 90 percent accuracy, and for good reason: With three 15-stage pipelines, it costs them as many as 45 clocks to flush their pipes after a bad guess. Future processors with dozens of pipelines would pay outrageous penalties.

Predication effectively eliminates some branches from compiled code by using conditional execution. In IA-64, if the compiler decides to predicate a branch, it assigns all instructions along one path to a unique predicate register, and all instructions along the alternate path to a complementary predicate register. At run time, the CPU begins executing instructions from both paths in parallel. When the CPU resolves the branch condition, it writes TRUE in one of the predicate registers and FALSE in the other. Instructions finish executing only if they find TRUE in their matching predicate register.

Since there's no longer a branch, there's nothing to predict, so there's no chance of guessing wrong. Yes, the CPU wastes some cycles executing instructions that never complete. But it's cheaper than the huge penalty of misprediction. And eliminating branches makes it easier for the CPU to schedule the larger, unbroken blocks of code in parallel.

Predication doesn't stop an EPIC compiler from predicting some branches. Jumps to error-handling routines are rare, so a smart compiler would predict the program won't take that branch. Likewise, a FOR loop with 1000 iterations will predictably jump backward to the top of the loop 1000 times, so it's a safer bet than predication. The compiler needs to know enough about the CPU's misprediction penalty to make those decisions. That's why developers will have to recompile their IA-64 software for each generation if they want the best performance—but today's architectures demand that, too.

Predication, to various degrees, is found in architectures as diverse as the Advanced RISC Machines ARM, the Philips TriMedia, the Mips Rx000, the Sun SPARC, the Digital Alpha, the Texas Instruments TMS320C6xx DSP, and even the ancient x86.

In its simplest form, predication appears in an instruction called a conditional move (CMOV). It's easier to attach conditional execution to a single type of instruction than to a whole instruction set. It's also possible to retrofit an old instruction set with CMOVs. Intel added CMOVs to the P6 generation (Pentium Pro and Pentium II) in 1995. They've been in the Rx000 since 1995, the Alpha since 1992, and SPARC since 1991.

CMOVs execute only if a condition code is TRUE. Usually there isn't a special predicate register. Predicating only one type of instruction on a single condition may seem insignificant, but it makes a dif-

ference. According to Stan Head at Mips, about 60 percent of all IF-THEN-ELSE blocks consist entirely of move instructions, so CMOVs can eliminate enough branches to be worthwhile.

Although CMOVs are useful, Digital decided against making every instruction conditional, as in IA-64. The additional gain wouldn't pay off, claims Aaron Bauch, technical marketing manager for the Alpha. Naturally, Intel disagrees: "A more generalized predication model allows the processor to execute longer streams of instructions in parallel," says Carole DuLong, IA-64 principal engineer.

ARM has more experience with predication than practically anyone. All ARM instructions can predicate on 16 possible conditions—a remarkably advanced feature of the architecture since its inception in 1983, says Dave Jaggar, director of ARM's Austin Design Center in Texas. However, ARM processors can predicate through only one branch. That's still a big win because branches occur only about once every eight or nine instructions in ARM code, notes Jaggar. But IA-64 provides 64 predicate registers, so theoretically it could predicate through 32 nested branches.

TI's DSP and Philips' TriMedia are more modern and specialized architectures. Both have fully predicated instruction sets, like IA-64. But TI uses general-purpose registers (GPRs) for predicate registers and devotes only five to that purpose. That's enough for the highly parallel code typically encountered by DSPs, says Henry Wiechman, DSP product marketing manager. "DSP algorithms are more deterministic than general PC applications like Microsoft Word."

Likewise, the TriMedia TM1000 uses GPRs instead of special predicate registers. Multimedia processors frequently execute highly parallel code in audio/video streams, so they don't need to predicate as many branches as regular CPUs.

The point is that predication is not a black art. Allowing a CPU to start executing both forks of a branch before the user chooses "OK" or "Cancel" might seem a little spooky, but it's just another long-used technique that blooms anew in IA-64.

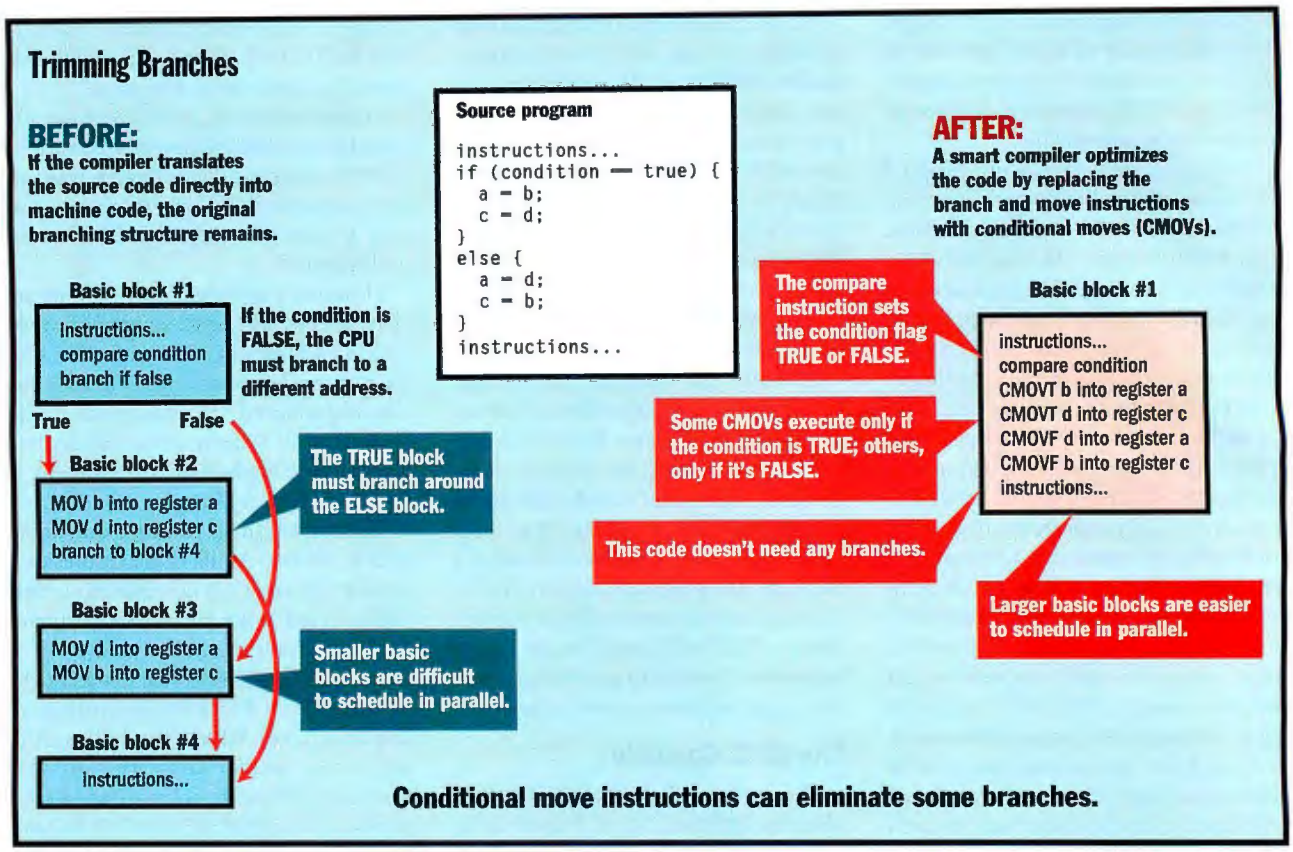
The EPIC Gamble

Intel and HP aren't alone in their enthusiasm for EPIC and VLIW. "VLIW is the next revolution in microprocessors," declares Nat Seshan, applications manager for TI's DSPs. "It will definitely bring more high performance to users."

Gerrit Slavenburg, the TriMedia architect, agrees: "Philips has invested a lot in VLIW because we determined it was the best way to get high performance at a low cost. It is the best architecture I know of at this point."

However, that doesn't necessarily mean that Merced will be the world's fastest microprocessor out of the gate. RISC still has plenty of headroom, and EPIC will take time to gain speed. "I have a suspicion that a good out-of-order machine can do better with most applications than Merced," says Stan Head at Mips.

The current speed champ is the Alpha 21264, the first Alpha that executes out of order. It's twice as fast as the in-order Alpha 21164 at the same clock frequency. Digital says the 21264 will run at 1 GHz (1000 MHz) in the year 2000, shortly after Merced arrives. According to Digital's Aaron Bauch, the 1-GHz chip will score better than 100 on the SPECint95 integer benchmark and higher than 150 on the SPECfp95 FP benchmark. That's about twice the rumored



integer performance of Merced and about three times its rumored FP performance. Moreover, Digital expects the 21264's die to be about half the size of Merced's on the same 0.18-micron CMOS process—despite the extra interlock circuitry Alpha needs to manage out-of-order execution.

How fast can Intel ramp up IA-64's performance? Intel plans to introduce a second IA-64 chip in 2001 that's about twice as fast as Merced. But it probably won't be until 2004, when a true second-generation IA-64 chip will likely appear, that we'll get a clearer picture of IA-64's genuine potential.

By then, CPUs could have 200 million transistors—enough, perhaps, to settle the debate about which architecture makes the best use of those resources. If RISC suffers diminishing returns from dynamic scheduling while EPIC's performance scales on a more linear trajectory, the handwriting will be on the wall.

But don't forget the other key variable: compilers. "My biggest fear about IA-64 is that bad compilers may ruin its reputation," says David August, a researcher at the University of Illinois (Urbana-Champaign). His masters and doctoral theses explore ILP and compiler predication, and he belongs to the Illinois Microarchitecture Project utilizing Advanced Compiler Technology (IMPACT), a research team that has spent years working on next-generation compilers.

"Retargeting an existing compiler is simply not going to work," warns August. "IA-64 compilers need a new infrastructure to do predication, speculation, and static scheduling/optimization correctly. The IMPACT group knows this as fact, and some companies, including Intel, are learning this from us or are using our technology. However, I know some companies don't know not to take the retarget approach. It has always worked in the past for them. This time it is going to be very, very different."

The VLIW veterans at Philips and TI agree. They've labored as long as 10 years on their highly tuned compilers. "Compiler design in some ways is even more complicated than machine design," notes Slavenburg.

It's a tough call. The technology behind EPIC wins accolades from experts, but it's not certain that Intel and HP can break it out of the labs and into the mainstream. History shows that stellar technology does not always mean commercial success. B

WHERE TO FIND

Advanced RISC Machines
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http://www.arm.com/

Digital Semiconductor
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http://www.ti.com/sc/docs/dsps/dsphome.htm

Tom R. Halfhill is a BYTE senior editor based in San Mateo, California. You can reach him at **tom.halfhill@byte.com**.

GET a GRIP on SCRIPTS

Choose scripting languages for dynamic and maintainable Web apps.

By Cameron Laird and Kathryn Soraiz

There are scripts in your future. And we don't mean Hollywood. As companies move to extend their presence on the Web, they are turning increasingly to scripting languages. They are a fast, inexpensive way to create dynamic Web applications that do everything from accepting input from a form to executing queries against a database to attaching to legacy Common Object Request Broker Architecture (CORBA) applications.

For Web applications, scripting languages offer a host of advantages over traditional third-generation languages (3GLs) such as C. They are easy to learn, discourage errors, are widely supported, and are safe. In this context, safe means reliable, inexpensive (if not free), maintainable, and viable.

Viable? We write that to emphasize the management-oriented concept that Rexx, Perl, Tcl (for Tool Command Language), Python, and the other technologies mentioned here are not dead ends. If you have an application written in one of these languages, it's certain you can hire programmers who are savvy in it, train your organization in its use, and find colleagues nearby who will talk shop about it.

In this article, we explain why you should be looking at scripting languages. We also examine several of the main ones so you know what your options are.

More Than Perl

For years, every major Web server has offered CGI capabilities. Over time, CGI has become virtually synonymous with Perl, the Practical Extraction Report Language of Larry Wall. Plenty of people believe that you must use Perl for CGI, though that's not true.

Many famous Internet sites such as Yahoo and Excite use Perl. It also keeps the current flowing at Wisconsin Electric Power, where information consultant Jim Esten says, "We've got a huge Perl-based project that controls the nuclear-fuel management process. The project consists of about 25 legacy FORTRAN codes glued together by Perl, and several stand-alone Perl CGI applications that handle fuel forecasting, financials, government-accountability reporting, and power-generation reporting—both in-house and for the Nuclear Regulatory Commission. The project has been successful enough to market to other utilities."

But other scripting languages, including Tcl, Python, and Rexx, are around and offer some advantages over Perl. Prominent Tcl-powered sites include Travelocity, c|net, and MilliCent. For most sites, "Tcl is the glue between the Web and databases on the back end," explains Brent Welch, senior Web engineer at Scriptics. More than any other scripting language, Python is suitable for coding large, complex applications that are conventionally the province of C++ or Java. Sophisticated sites such as Four11, InfoSeek, and Musi-Cal are examples of Python's use. The IBM server for the Olympics relied on Rexx under AIX.

What Is Scripting?

The core notion of scripting is a simple one. Welch explains that scripting is all about "gluing": It's a way to "assemble a lot

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of diverse components into a whole." The idea is that a job actually gets done by something outside the script. The script directs the action.

Scripts are generally concise. Scripting languages get to the point of a problem more concisely than do C or Java. Programmers can create solutions quickly and succinctly. The computer does more low-level work, and the developer concentrates on the business problem.

This is no surprise. Most scripting languages originated to solve particular problems more rapidly and safely than would have been possible with traditional development in C or other languages. For example, Wall wrote Perl to automate the production of reports on a conferencing system.

Among the responsibilities scripting languages often shoulder is memory management. This is one bane of C development. C programmers who understand how to allocate and use memory correctly are rare. Most scripting languages eliminate entire classes of errors by automating memory management and related functions.

With more work done by the language and less by the programmer, scripting languages also typically hit performance boundaries before C-coded programs do. Does this disqualify them from serious use?

Not at all. It's true that equivalent programs might run twice as fast in C as they do in Perl. On the other hand, developing an equivalent correct program in a scripting language takes only a fraction of the time that it does in C.

There are technical solutions for most performance challenges. If CGI limits the speed of your operations, for example, you can move to a more sophisticated Web server. Mike Cowlishaw, the IBM Fellow who invented Rexx, describes the IBM GoServe server: "The Rexx interpreter is called directly on the same thread as the incoming TCP/IP request, giving significant (seven to 10 times) performance improvements over CGI." This is typical. Each scripting language is available in one or more high-performance Web servers.

The interpreter/compiler debate has merits on both sides. Interpreted scripting languages can run unchanged on any platform with an interpreter. Compiled languages must be compiled on each platform, and the compiled form of the script runs on only that platform. On the other hand, compiled scripts run far faster than interpreted scripts. If you're scripting for mass distribution, you probably want to stick with interpreted scripting languages. If you're writing for a single platform, it makes sense to compile the script and use that.

For applications that need to get up and running quickly, will change often, or need to glue together many existing components, scripting languages make a lot of sense. But for performance-intensive applications, they probably don't.

Structured HTML

Fortunately, on the Web, most applications you're likely to point a scripting language at aren't horribly performance-intensive. One common requirement for growing Web sites is to structure their HTML pages. It's a great advantage to be able to structure your HTML source to factor out common elements such as references to corporate logos, standard page layouts, and textual styles. This improves the consistency of your presentation, reduces errors during development, and slashes the cost of maintenance.

However, the means for such structuring are poorly standardized. By 1994, server-side includes (SSIs) had become popular. They generally look like this:

```
<HTML>
... [Content]
<!—#include file
"standard_logo_and_contact_info
.html" —>
</HTML>
```

SSIs might still be the technique in

Which Scripting Language?

More important than deciding which scripting language is simply choosing one. Any one. It costs only a small amount of time to download, install, and exercise a scripting language. Learning any scripting language has only a fraction of the overhead of working with C, C++, or Java.

Most scripting languages have roughly the same features, so "social" factors, such as colleague support, are paramount.

After those broad guidelines, the choices get more subtle. If your shop is painted blue, select Rexx, available for all of IBM's commercial OSes. Rexx has even kept up with IBM's strategic move toward Java. Many developers find it easier to work with Java objects through Rexx than through Java itself.

If you want the market leader, choose Perl. Perl dominates CGI programming and seems the choice for most Unix system administration tasks.

If you want a language that can also handle your cross-platform GUI-development and network management needs—and more—try Tcl. It is easier for beginners than Perl, due to its interpretation and compilation models, its installation, and so on. Tcl is a favorite for international work, because it conforms to Unicode standards. Moreover, you might already be using Tcl. Many vendors, from router manufacturers to Standard Generalized Markup Language (SGML) vendor DynaBook, expose Tcl as a programmable interface to their products.

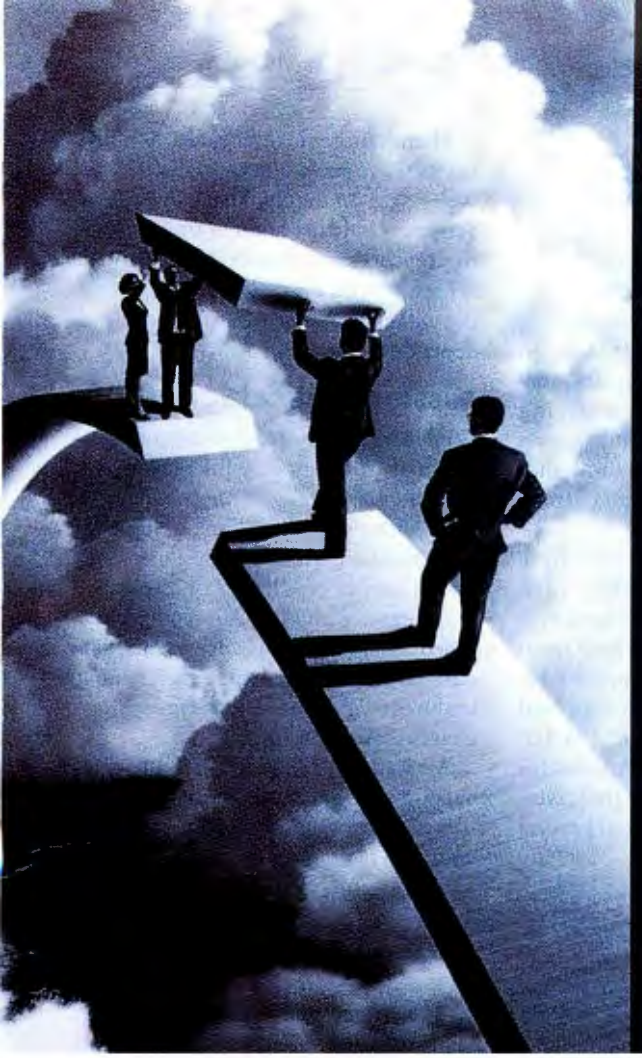
Planning for the long term? Try Python. Its inventor, Guido van Rossum, tells us the single best recommendation he hears is that, "Programmers who try Python end up being happiest with it." Python is clean, portable, ideal for team projects, as fast as Perl, as easy to learn as Tcl, and as capable for big projects as Java or C++.

Want to involve your graphics specialists in scripting? Look at MetaCard, which brings the easy-to-understand HyperCard model to Unix and Windows. (Tcl is also comprehensible to non-programmer graphics types.)

Do you script client-side operations for a Web application? JavaScript is the safest choice here: It's most likely to be available in the browsers of your end users. But if you choose JavaScript, learn at least one other scripting language, too. As of this writing, JavaScript is available only for Web applications, and its portability on the server side is only partial.

Other languages—PHP, Forth, Guile, Frontier, and more—share characteristics with those mentioned. We recommend them only for special purposes. None has the market presence, portability, and functionality to make it a safe choice for now.

Among the technical aspects of the languages, perhaps the one that differentiates them most is the set of available extensions. Sriram Srinivasan, author of *Advanced Perl Programming*, has written, "Languages such as Perl have been highly successful because of the wide availability of third-party modules (libraries). When comparing languages, I consider the availability of libraries to be more important than pure language features."



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widest use. But now, it's easy to configure a Web application for a scripting language, any of which are more powerful than SSIs.

Welch has reengineered the Scriptics Web pages to exploit what he calls "inside-out scripting." In "hot spots," he exploits the power of a scripting language. The employees' HTML page includes templates for information about individuals:

```
[PersonP "John Ousterhout, CEO"
people/john.ousterhout]
John Ousterhout created Tcl
```

PersonP is a procedure in Tcl:

```
# PersonP - Person Paragraph
# name - Their name
# url - Optional, home page link
proc PersonP {name {url {}}} {
  set html "<p><b>"
  if {[string length $url]} {
    append html "<a
href=\"$url\">$name</a>"
  } else {
    append html "$name"
  }
  append html </b><br>
  return $html
}
```

Technical writers and graphics designers reuse commands such as PersonP to code sophisticated, consistent, and correct HTML pages, without worrying about the details of end tags and quoting conventions. Welch says, "I think that HTML/Tcl templates can replace most CGI applications."

Scriptics happens to serve up these pages from a SparcStation running a Tcl-coded HTTP server. But the same server runs under the Mac OS, Windows, OpenVMS, and more. The same Tcl procedures will also run with any other standard HTTP server, through either CGI or Tcl-savvy extensions (for Apache, Microsoft's Internet Information Server [IIS], Netscape's Enterprise Server, and several more specialized ones).

There's more flexibility, too. Scriptics has its HTTP server interpret the Tcl in its Web pages on the fly. That can be slow. Scriptics could use another simple script to preprocess the source into expanded HTML stored on disk instead. In our consultancy, the approach we recommend depends on the circumstances.

Mission-Critical Scripts?

While scripting languages have the reputation of "toys" in some circles, working with them is at least as appropriate for professionals as reliance on leading software vendors. Most scripting languages have a history of a decade of responsive maintenance and development. Their speed, size, and incidence of faults compare favorably to systems programming languages. Expertise in scripting languages is available for hire.

All scripting languages include ways to connect to databases, file systems, Java libraries, network protocols, and other common technologies. All are quick to

Other Web Technologies

Tracking all the ways to make a Web site dynamic and well structured is a full-time job in itself. Here are a few alternatives to standard scripting languages:

Dynamic HTML (DHTML)

Hasn't stabilized yet. No guarantee that a browser will support it. Netscape and Microsoft are feuding about how it should work.

Proprietary Web Development Applications

Some are great. Macromedia's Dreamweaver is a powerful, polished tool for professionals. Silverstream Software's Web Applications Platform management tool can yield large gains for you. Gains come with risk. The time to determine whether the vendor's model of operations fits your organization may well outweigh the license fee. With proprietary applications, you have little recourse if you hit a dead end in portability or features. Scripting solutions are mostly portable across OSes, platforms, and two- or three-level architectures.

Scriptlets

This Microsoft technology works only with Internet Explorer 4, although Microsoft announced a server-side beta release earlier this year.

Servlets

Pluses of these server-side Java codings include support by a growing number of servers. Servlets will play a large part in the Web of the future. For now, we find the scripting languages more mature and easier to teach to beginners.

Server APIs

Netscape and Microsoft offer C bindings called Netscape Server API (NSAPI) and Internet Server API (ISAPI) for their respective Web servers. We've abandoned coding directly in C for them. There are interfaces between these APIs and scripting languages. Scripted solutions are so much more maintainable in a production environment that there is no reason to work in C.

Server Configurations

High-end commercial work involves credit-card processing, currency conversions, hardware coordination, and transaction security. Rather than program these facilities (again) ourselves, we are happy to buy them in commercial HTTP servers such as Microsoft Site Server, Netscape Enterprise Server, and WebSite Professional. But the most efficient way to customize their operation is with well-chosen scripting. Perl interfaces are available. Most support programming in JavaScript, Python, and Tcl. Sites such as InterShop, Amazon, Yahoo, Internet Movie Data Base, and even Microsoft rely on this kind of scripting.

SSIs

Server-side includes never standardized well, and it's cumbersome to interact with them. We've stopped recommending SSIs. Everything they do, scripting (or proprietary site development tools, or sometimes both) can do better.

Extensible Markup Language (XML)

Not yet ready for prime time. Still no ratified XML standard (as of this spring). Will be a big winner eventually, but any use now is experimental. Scripting languages may be the best way to use it. Perl plans an XML extension. Tcl seems to be in good shape, with Unicode built in. Steve Ball, author of *Web Tcl Complete*, has released a TclXML package that gives Tcl applications the ability to parse XML documents.

Scripting languages are more mature—and more proven—than the alternatives. When DHTML and the others become ready, scripting languages will be more teammates than competitors. Traditionally, each new release of a scripting language accommodates important new technologies such as XML or servlets.

Another benefit of scripting languages is their flexibility. You can use them in all sorts of architectures. You can use and reuse the code you write. Java is just approaching this mobility, and JavaScript and VBScript simply don't have it. With scripting languages, we can have it all.

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**Volume 133, Number 2, 2/5/96*

install and learn. In fact, it will take most readers about the same time to download a scripting-language processor, install it, and learn enough to write a first small program, as it does to read this article.

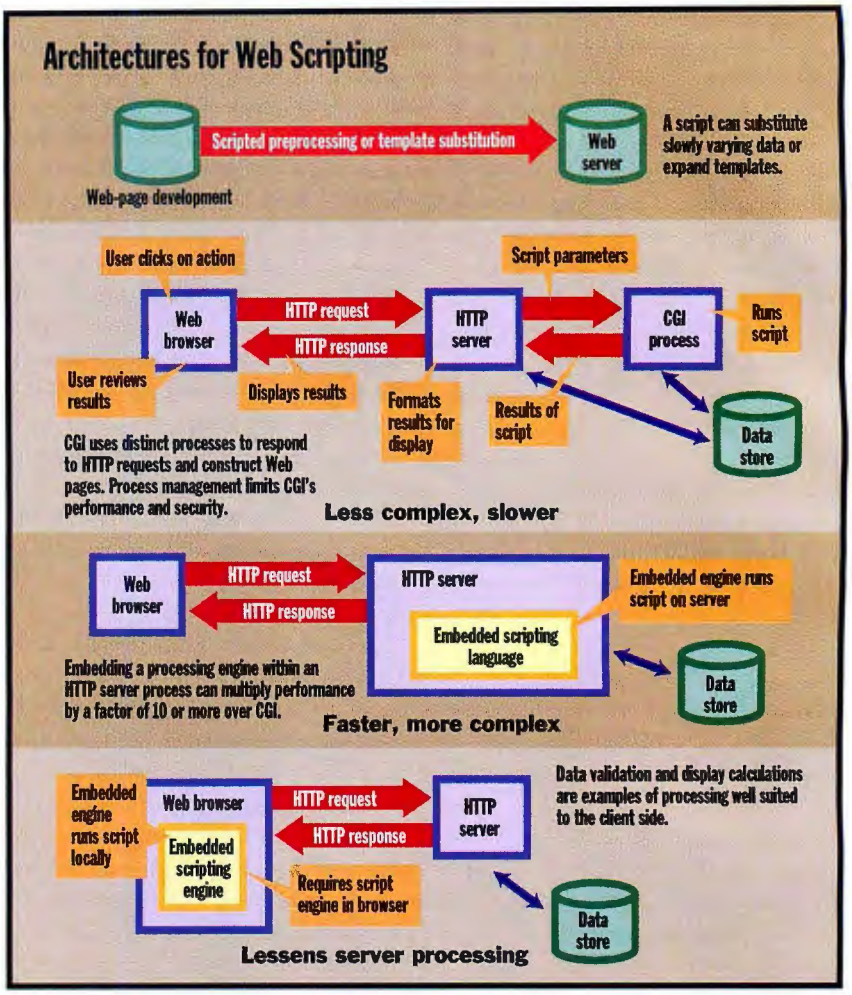
The biggest adjustment to using a scripting language might be on the business end. Bundling of scripting-language products and services differs from conventional software. There are fewer shrink-wrapped packages. The usual path is to download—for free—a processor for a particular platform, and contract for support and training from the independent suppliers for each language. There are variations on this theme:

- MetaCard licenses its scripting language of the same name on the model of Visual Basic or Delphi.
- Several vendors sell Rexx versions (IBM's is Object Rexx) for a variety of platforms, including mainframes.
- Perl programmers and documentation are so widely available that companies see no need to contract Perl support.

Shooting from the Script

The most crucial choice is the first one: to use some scripting language. Their different technical capabilities are almost secondary to their compatibility with the local computing culture. Choose at least one that's accepted institutionally.

Tcl is an interpreted scripting language that was developed by John Ousterhout at UC-Berkeley. (Ousterhout later worked for Sun, and Sun created its SunScript division to market Tcl-based products.) Developers use Tcl to develop graphical interfaces. It's also popular for writing CGI scripts. Originating in the Unix world, Tcl is available for many other



In the Script

Language	Advantages	Disadvantages	Source for information
JavaScript	Standard in modern browsers	Does not work outside Web applications	http://developer.netscape.com/one/javascript
MetaCard	Easy for nonprogrammers to learn	Very small customer base	http://www.metacard.com
Perl	Widely used and dominant in CGI; specialized extensions are available	GUI, Windows, Mac OS maintenance given less attention	http://www.perl.org
Python	A clean, portable, maintainable language	Base of Python expertise still small	http://www.python.org
Rexx	Available for and well integrated with all IBM OSes, including mainframes	Impoverished library of facilities compared to Perl, Python, and Tcl	http://www.rexxla.org
Tcl	Simple syntax, easily learned, extensible	Clumsy for simple arithmetic and some other common operations	http://www.tclconsortium.org
VBScript	Resembles Visual Basic	Single source; useful only with Microsoft Web products	http://www.microsoft.com/scripting/vbscript/default.htm

Note: Be careful with the .com sites. We found some to be error-ridden, at least in comparison to the volunteer work at .org sites.

platforms, including Macs and PCs.

You can use Tcl with ordinary languages such as C and C++. You compile the application with Tcl functions and the Tcl interpreter. The result can then talk to both Tcl scripts and the executable program. Thus, Tcl is one language that can glue pieces of programs together. Tcl acts as the interface between the various components.

Tcl is extensible: You can write commands. Tk is a valuable extension that greatly simplifies constructing GUIs.

One drawback of standard Tcl has been that it lacks code module structures—except procedures. This can make maintaining large scripts more laborious.

Thousands of users download free Tcl from SunScript each week. Sun also sells SpecTCL, for creating GUIs to Java and Tcl applications. (When visiting Tcl sites on the Web, don't be surprised to see feather symbols. Tcl is pronounced "tickle.")

Perl is also an extensible language, but many judge it more difficult than Tcl (if you like `awk` and `sed`, you'll love Perl). However, that hasn't stopped freeware Perl from becoming the lingua franca of CGI scripts. Perl 5 includes object-oriented support and references (for making aliases for variables and constants, and simplifying the creation of arrays).

Perl is popular for handling system administrator tasks. Developers often tap its Unix legacy of string functions (e.g., filtering, sorting, and matching) for string-related tasks on Web servers (this is ironic; Perl started in 1987, well before the Web). A pointer to PerlInterpreter lets you execute embedded Perl scripts from C. You can also extend Perl with C code.

Being free does wonders to increase the number of language users. Perl benefits from this with many free tools and archives full of usable code. Check Comprehensive Perl Archiving Network (CPAN) Web sites (starting from *http://www.perl.com*, a useful Perl directory).

Python is another freeware scripting language. (Yes, its creator, Guido van Rossum, did name it after *Monty Python*.) Interpreter platforms include the Mac OS, OS/2, Windows, and various Unix types. One peculiarity is that statement indentation creates blocks: A block starts where a new level of indentation starts and ends where previous indentation resumes. It does use if, while, and for structures.

Python is adept at manipulating strings and has special list-handling functions. Developers find Python useful for string handling, administration, GUIs, and other general purposes. Free utilities are available on the Web, such as debuggers and profilers. Object-oriented Python is probably more suitable for larger projects than, say, Tcl. It's easier to read and understand than Perl. You can extend Python, as with other languages.

Scripts in Action

Scripting languages have many appealing features. We particularly like that they encourage "incrementalism." You can achieve positive results with even small amounts of effort. This encourages developers to learn more, accomplish more, and so on. You can start the same process yourself: Pick a scripting language, install it, and see how easily you can create reliable, maintainable Web solutions. B

*Cameron Laird (**claird@NeoSoft.com**) and Kathryn Soraiz manage Network Engineered Solutions, a software consultancy near Houston. For updates and amplifications to scripting languages, visit* **http://starbase.neosoft.com/~claird/comp.lang.misc/web_scripting.html.**

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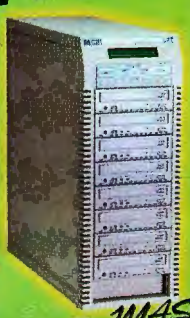

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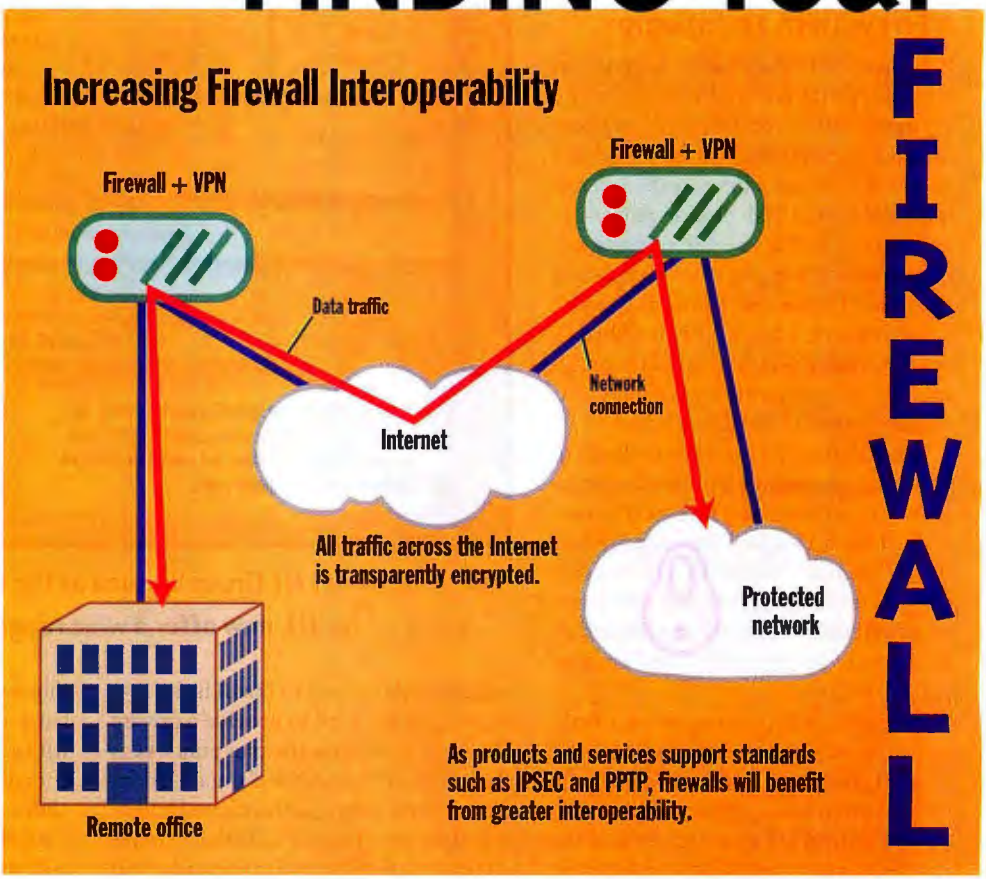


Security appliances and ISPs are currently redefining the art of perimeter defense.
By Marcus Ranum and Scott Mace

Despite the more than 200 different firewall products on the market today, most of us can name maybe a handful. The majority of these products do it all: proxies, filtering, logging, and authentication.

But the days of the one-size-fits-all firewall are waning. In recognition of the fact that the threat from internal sources is growing faster than that from external sources, the firewall's perimeter is increasingly becoming a departmental boundary, not one of the entire enterprise. Thus, corporations need more firewalls, which need to be less expensive and easier to manage.

All of this poses a challenge to makers of traditional firewalls, whose software-based solutions are expensive and hard to manage. They're highly susceptible to misconfiguration, primarily from nonhardened OSes (e.g., Windows NT). And there's a chronic shortage of experienced security administrators. What's the solution?

Judging from the current crop of new firewall ideas, it appears that the leading edge means innovation in four important areas:

- Firewalling on non-Unix platforms, such as NT and security appliances.
- Management of multiple firewalls.
- Outsourcing of firewall management.
- Integration of perimeter defenses with the best features of virtual private networks (VPNs), including the maturing Secure IP (IPSEC) and PPTP standards.

These features all illustrate the fact that vendors realize managing security is difficult and needs to be made easier.

NT Rules

Most firewalls used to run on Unix, except for the few sites that used MULTICS. Most firewalls sold today run on NT. Firewall vendors who used to claim NT wasn't secure enough are now promoting it as the platform of choice. What's the reality? It turns out that most of the current crop of firewalls have moved down the protocol stack so far that the OS doesn't have to do much more than act as a bootstrap loader, file system, and GUI.

The new NT firewall code pushes the firewalling layer right down to the network interface card (NIC) level, bypassing Microsoft's IP stack—usually by pushing a new Network Driver Interface Specification (NDIS) driver above the hardware. The NDIS driver filters, or vectors, traffic to a proxy and never permits potentially hostile traffic to make its way up the protocol stack to applications running on the system. All those denial-of-service attacks that "blue-screen" NT won't work as long as the filtering layer keeps the evil packets away from the NT IP stack. This is a big win.

In addition, since the OS hardly gets involved, the firewall can be pretty fast; there are no context switches or multiple processes. For example, CyberGuard, whose original claim to fame was that it ran on a B2 version of Unix, now comes in an NT offering. This version uses a wrapper methodology that ensures incoming packets are vectored only to the firewall program and nothing else.

NT definitely looks like the wave of the future for firewalls. Among other things, it frees vendors from having to hassle with Unix device-driver compatibility and permits customers to size, choose, and purchase their own system. Making the platform selection and installation concerns of the customer is a huge boon

for firewall vendors. Meanwhile, Unix firewalls will still be used at the high end, but the writing's on the wall.

A Firewall in an Inferno

Bucking the NT trend, Lucent has released a product that moves firewalls to the status of security appliances. The Lucent Managed Firewall (known as "the brick") runs the company's Inferno OS. Inferno is loaded from a flash disk on power-up, and the firewall has no file systems, administrator log-ins, or even a keyboard or mouse. Unlike many firewalls, which act as routers, Lucent's firewall bricks act like bridges: You don't need to configure subnets or partition your networks in order to install them.

Lucent's intent is for these firewalls to be scattered within corporate intranets as well as extranets and Internet connections. This is a big step forward for firewalls, because this architecture treats them as invisible but manageable infrastructure components that can be centrally controlled using a GUI-based Unix or NT workstation.

Probably the biggest step forward taken by this architecture is that it's the first firewall product to be designed from the ground up to be an infrastructure component instead of just a black box on the border of a network. The management system allows you to define access controls in terms of zones, which can have separate policies and be under separate management. This setup fits nicely into a large corporate network, which might have lots of business-partner connections and suborganizations that have different security needs.

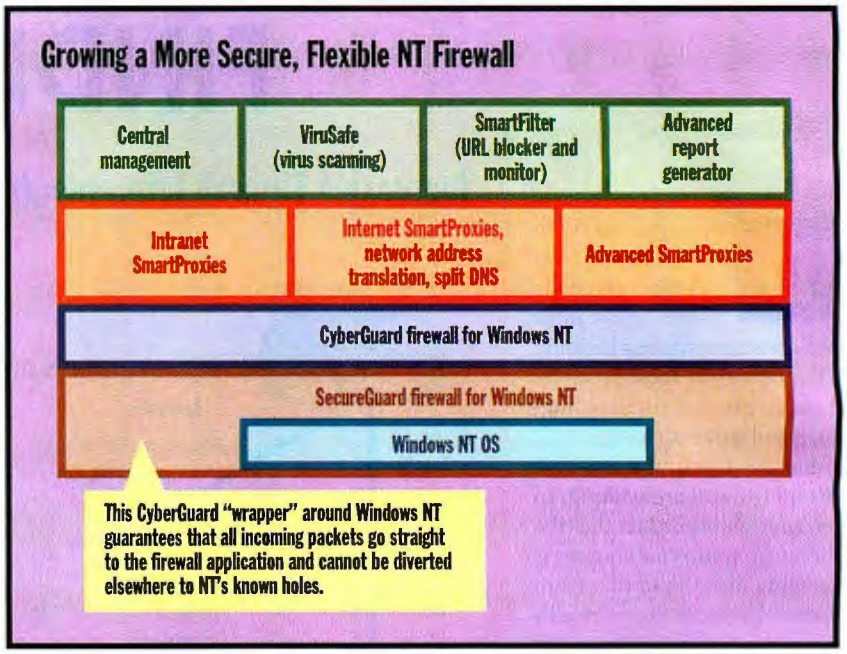
Large-Scale Deployments

Lucent's Managed Firewall wasn't the first so-called firewall appliance to appear on the market. One of the first, the Firebox firewall/VPN combination appliance, was introduced by WatchGuard Technologies in 1996. The product's stripped-down Linux-based OS and software, which came on a single 1.44-inch floppy disk, were praised for their simplicity.

Just last month, WatchGuard introduced its second-generation firewall appliance, Firebox II. ISPs and distant IS administrators can remotely configure Firebox II via an out-of-band dial-up telephone call and securely load the initial IP address and security policies.

Leveraging the growth of public-certificate authorities, Firebox II is the first firewall of any kind to provide a private key hidden in hardware, plus public keys that are held by an ISP or IS organization. This permits secure, authenticated updating of Firebox IIs on a scale that's unimaginable with present-day firewalls. And if thieves were to abscond with one Firebox II, all they would have is a single private key; administrators would be quick to detect such a theft and deny future use of that key.

"With existing products, ISPs can't really make money by remotely managing a firewall," says David Bonn, WatchGuard's chief technical officer. "The biggest reason is that you need physical access to the machine. We're trying to turn that model around with an approach that works." An advanced Firebox II model will support security-policy templates and configure and manage Fireboxes as a single object. WatchGuard's future work includes providing software to aggregate Firebox logs so that they don't become unreadable as the appliances proliferate.



Windows NT firewalls, such as the CyberGuard Firewall for NT, now offer a wide range of extensions.

A Firewall in a Switch

Another appliance-type firewall comes from Optical Data Systems. ODS is pushing security into the performance zone by building it into its switches. For intranet use, performance concerns are often paramount, and networks are increasingly cutting over to switched infrastructures. It's hard to firewall a 100-Mbps connection with a 300-MHz machine; there just aren't enough CPU cycles to do a lot of thinking about each packet as it screams through.

ODS puts an add-in card in its switch and off-loads decision processes to it. The card is usually an Intel-processor-based board running a small OS. ISS's RealSecure intrusion-detection engine, for example, can run on a card within the switch, looking at packets that are forwarded to it over the switch's internal backplane.

Since nobody's network is getting any slower, integrating security into high-performance devices is going to be inevitable. When you look at the number of manufacturers of routers and switches that have made investments in security technologies, it's clear that security switches and routers are the wave of the future.

Outsourcing Clues: Managed Firewalls

Not everyone wants to deal with security. In fact, most people don't. Many organizations have firewalls that they install and simply forget about. The logs accumulate, and nobody reads them. New versions of the firewall software are released, but nobody upgrades them.

Some organizations have chosen to completely outsource their firewall and its management to services such as GTE

Internetworking's Site Patrol. For the organization that wants 24-hour-a-day, seven-day-a-week monitoring but doesn't want to build the required infrastructure, services such as Site Patrol fit the bill. Site Patrol costs less annually than providing salary and benefits to a senior network-security analyst. However, the package probably doesn't pose any threat to security analysts seeking jobs; if managed services didn't exist, a lot of organizations would simply run their networks with weaker security.

Managing your network's security is the ultimate act of placing trust in an outsourcer. As networks get more complicated and the security landscape continues to change, there's a growing niche for specialized services that provide security management. For years, armies of consultants have provided security outsourcing in an ad hoc manner. As part of the across-the-board trend toward better and more centralized management, you can expect to see the latest tools being rolled out through cutting-edge outsourcers.

VPNs: Slow Takeoff

VPNs are a hot technology that suffered early on from interoperation and ease-of-use problems. The latest generation of VPN technologies are much less painful to set up and manage than their early counterparts, but they still tend to be incompatible across vendors. Thus, if you're thinking about deploying a VPN, you're pretty much guaranteed to have to use a single-vendor solution. In addition, if you want to use a desktop-to-firewall VPN, you're going to find that most vendors are putting all their efforts into Windows 95 and NT; Macintosh and Unix users are simply out of luck.

Just about every firewall product out there has some kind of firewall-to-firewall VPN capability. Many routers also support VPNs, although so far, unfortunately, firewall-to-router VPN hasn't been very compatible. With Cisco's involvement in IPSEC and the ISAKMP/Oakley key-exchange-protocol effort, there is hope that within a year or two we'll start to see better interoperability.

For instance, WatchGuard's Firebox and Firebox II support IPSEC out of the box. A recent IPSEC "bake-off" in North Carolina yielded IPSEC interoperability among 15 vendors' implementations, according to Robert Ma, director of product marketing at Checkpoint Software Technologies.

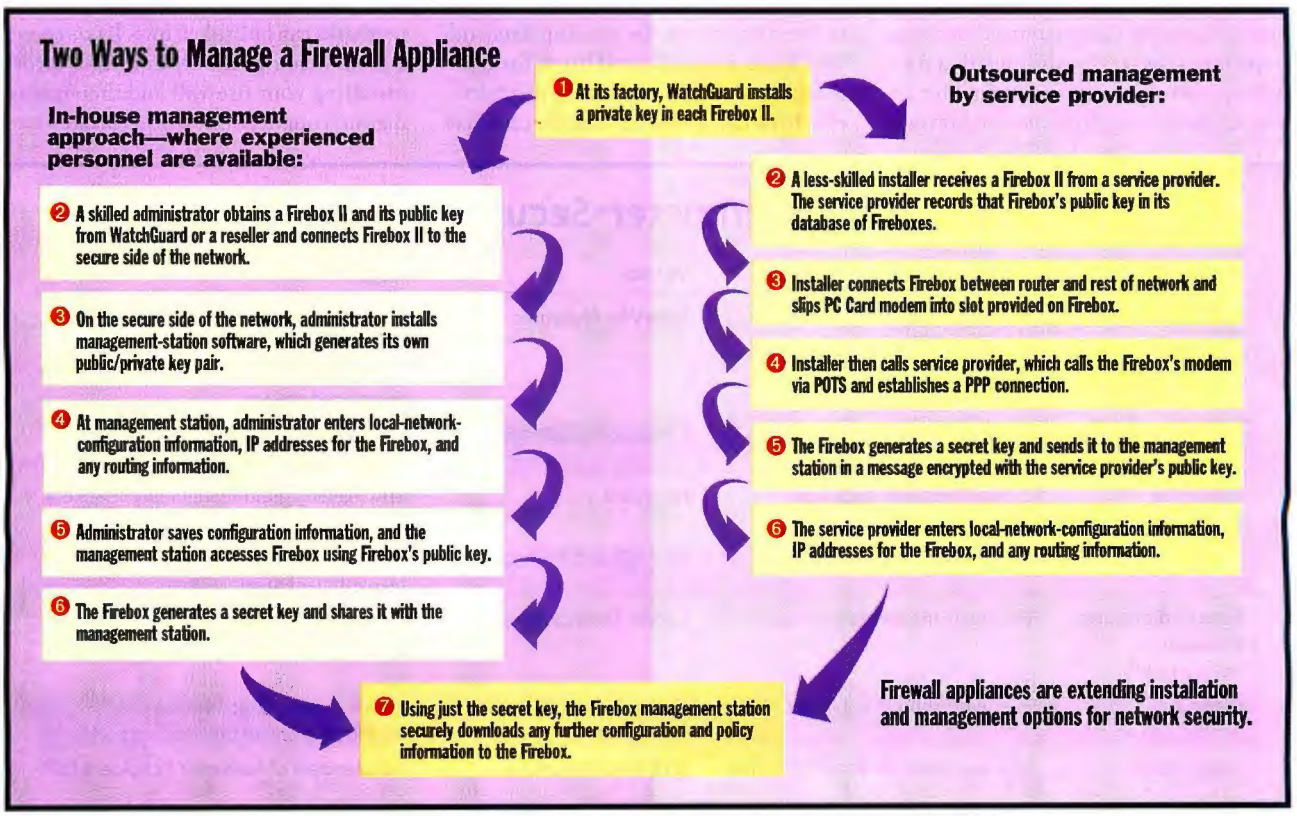
Once network managers start doing the math and realizing the kinds of cost savings that VPNs can provide, we'll see more VPNs deployed in place of leased lines. The big managed service providers and ISPs are going to lead the push toward VPNs as they attempt to convince their big corporate accounts to use a VPN package over their backbone, essentially outsourcing IP dial-tone enterprise-wide to service providers.

Virus Scanning, Intrusion Detection, and Curb Feelers

With regard to software-based solutions running on high-volume servers, firewalls are becoming a place to add everything but the kitchen sink. Because all security technologies assume they're running on a secured system, the firewall becomes a natural place to add features and integrate third-party packages.

URL blocking and e-mail/Web virus scanners are currently proliferating, with Checkpoint Software's Firewall-1 being a popular platform for add-ons because of its content-vectoring capability. With *content vectoring*, a firewall tosses traffic to an external processor for analysis and forwards it along if it passes with a clean bill of health. Many external processing systems run on a dedicated NT system.

Unfortunately, there are no published figures about how much these solutions affect performance on the firewall or



throughput during the retrieval of Web documents. Undoubtedly, they slow things down in comparison to a normal firewalled connection, but by how much?

Firewall and security-appliance vendors will improve the integration between their products and those of plug-in vendors. Performance trade-offs will never go away, but it would be valuable to be able to quickly add new capabilities or upgrade existing ones. Checkpoint's approach is a good start, but within a few years you will be able to get Photoshop-like plug-ins for various kinds of processing in your firewall. Want an intrusion detection plug-in? And a URL blocker? Click here to install....

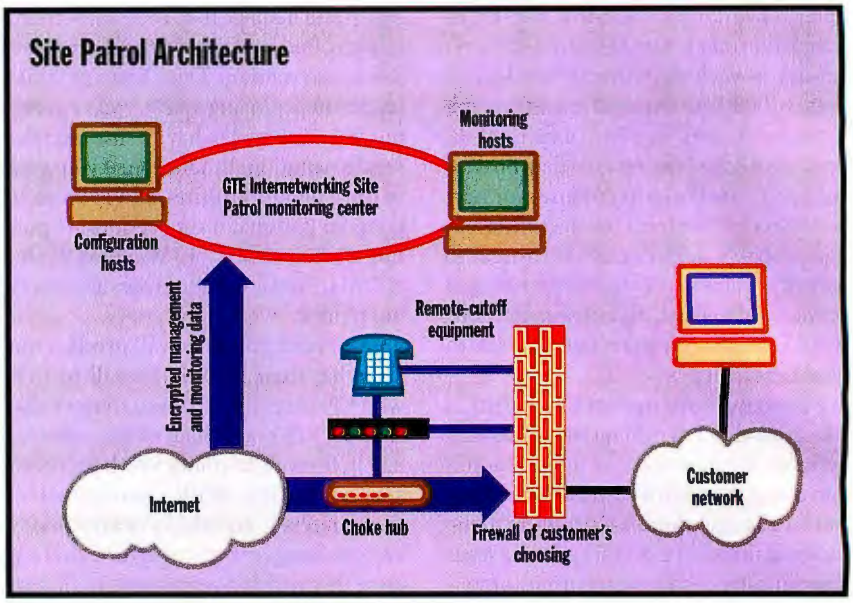
Where Firewalls Fail: Five Things to Watch Out For

Firewalls, unfortunately, aren't a perfect technology: Since they are end-user-installable, a vendor can't accurately predict all the possible problems that might occur after they've been set up. What are the usual ways in which firewalls can fail? Here are five.

1 Misconfiguration. Almost every firewall can be configured to be someplace between "wide open" and "completely closed"; the end user gets to decide where each individual firewall falls along that spectrum. Many firewalls that are broken into are compromised because someone allows traffic through that they subsequently learn was a channel for an attack. This is a tough problem to prevent, since few network managers have enough time to carefully research every new service that their users want to run through the firewall.

2 Apathy. How many firewall administrators watch a firewall carefully? Once one is installed, it's often ignored or forgotten. But security is something you must maintain. Administrators need to keep an eye on the mailing lists and Web bulletin boards and listen for late-breaking news that might affect their security. To be fair, it's usually not the case that firewall administrators don't care about maintaining their security—it's most often the case that they simply don't have the time needed to do it. Security is usually just one of the many tasks that a network manager has to juggle.

3 Dial-in. While it's not a problem directly related to firewalls, dial-in modem pools are one of the ways in which networks can be broken into. If you spend a great deal of money, time, and effort installing your firewall and then ignore dial-in, your network will get broken into



GTE Internetworking evolved its turnkey firewall solution into Site Patrol, a monitoring service that works with most firewalls.

A Sampler of Perimeter-Security Options

Product	Type of solution	Vendor	Key feature
SecureIT Firewall	Software firewall for Windows NT or Unix	MilkyWay Networks	"False positives" deceive hackers into thinking they've broken in; they haven't, but details about the effort are logged anyway.
Firewall-1	Software firewall for Windows NT or Unix	Checkpoint Software	Content-vectoring-analysis packets on external processor.
Guardian	Software firewall appliance for Windows NT	Netguard	MAC-layer stateful inspection of packets.
Firebox II	Hardware firewall appliance	WatchGuard Technologies	Secure, remote configuration and management of appliances.
Lucent Managed Firewall ("the brick")	Hardware firewall appliance	Lucent Technologies	Based on small Inferno OS.
Avertis	Hardware firewall appliance	Galea Network Security	Handles simultaneous streams of 10-Mbps Ethernet traffic on six ports.
Site Patrol	Managed Internet-security service	GTE Internetworking	Independent of customer's choice of ISP.

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anyhow. If you cannot answer the question "How many desktops in my organization have modems?," then you have a potential problem.

4 Incoming traffic. Firewalls are great at providing access control against unwanted connections. But when you allow outsiders to connect to internal services, you need to worry about vulnerabilities in the internal services. For example, if you let e-mail into your corporate mail hub, you need to worry about whether there are security holes in the mail software on the hub. Application gateways and proxy firewalls reduce the level of risk but don't eliminate it entirely.

Incoming traffic is especially a problem with Web servers, where CGI script flaws are a possible point of attack. If you have public-access servers, put them outside your firewall if possible. Also, carefully audit the applications that you allow in through the firewall, as well as the machines that you allow them into.

5 Upgrades. Using an automated scanning tool, Dan Farmer (*http://www.trouble.org*) conducted a survey of several thousand Web sites. He found that over 50 percent of these sites were trivially hackable, and another 10 percent could probably be hacked if a minimum of effort was expended. Mostly, the problems he detected were known bugs in old versions of software. These Web sites had been set up, and then nobody had ever bothered to check to see whether the software needed upgrading.

What do these issues imply for the future? You can bet that vendors will be attempting to develop ways of addressing these five risks in their product offerings. We'll see firewalls that are increasingly aggressive about telling you when they need attention or upgrades—or perhaps firewalls that silently upgrade themselves.

To address the incoming-traffic problem, look for firewalls that have the ability to learn things about the application mix running on the network behind them and block service to any client applications behind them that contain known holes. Tools such as network-security scanners and intrusion-detection engines contain valuable information about network vulnerabilities. That information is something that firewalls need to learn to take advantage of. B

Places to Go on the Web for Information on Firewalls and Security

http://www.cs.purdue.edu/coast The COAST archive at Purdue is probably the most complete archive of security-related links on the Internet. If it has to do with security, it's probably in the COAST archive.

http://www.clark.net/pub/mjr/pubs/fwfaq The official file of frequently asked questions about Internet firewalls.

http://www.ntbugtraq.com/ The NT bug-tracking-list home page. NT Bugtraq is the most popular NT-specific security list on the Internet. This includes the useful "What MUST I fix?" page, which lists the top security holes for NT and steps to take to patch them.

http://www.w3.org/Security/Faq/www-security-faq.html The Web-security list of frequently asked questions. The FAQ includes lots of practical information about how to set up a Web server safely.

Firewalls@greatcircle.com The Internet-firewalls mailing list. This is a high-volume open list, with a lot of off-topic discussion, spam, and the occasional flame war. Subscribe to it by sending mail to **majordomo@greatcircle.com**.

Firewall-wizards@nfr.net The Internet-firewall-wizards mailing list. This is a moderated mailing list devoted to advanced computer-security topics. It's a low-volume list, with a strict no-spam, no-flame, no-advertisement policy.

ftp://info.cert.org/pub/cert_advisories/ The Computer Emergency Response Team (CERT) security advisories page. The main CERT pages are at **http://www.cert.org**.

http://www.gocsi.com The Computer Security Institute publishes a newsletter and has several good publications about the scope and costs of computer crime, as well as a firewall-product-reference matrix.

http://www.clark.net/pub/mjr/pubs Marcus Ranum's security page, which includes vendor-neutral editorials and presentations about firewalls and security.

http://www.rstcorp.com/java-security.html This Java-security and active-content page contains useful information about hostile applets.

http://www.microsoft.com/security/ The site for Microsoft's security pages. **http://www.microsoft.com/ie/security/** contains security information specific to Internet Explorer.

http://www.cs.auckland.ac.nz/~pgut001/links.html Peter Guttman's page of cryptography and security-related links. It also has interesting and useful links to computer- and network-privacy information.

http://www.csd.uu.se/~d95mno/PGP.html A non-U.S. site where you can download the Pretty Good Privacy (PGP) encryption system.

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http://www.checkpoint.com

CyberGuard Corp.
Fort Lauderdale, FL
954-958-3900
800-666-4273
http://www.cyberguard.com

Galea Network Security
Greenfield Park, Quebec, Canada
888-464-2532
514-923-0555
http://www.galea.com

GTE Internetworking
Cambridge, MA
800-472-4565
617-873-2905
http://www.bbn.com

Lucent Technologies
Middletown, NJ
732-615-5173
http://www.lucent.com/security

MilkyWay Networks
Ottawa, Ontario, Canada
613-596-5549
http://www.milkyway.com

Netguard
Fairfax, VA
703-359-8150
http://www.netguard.com

Optical Data Systems
Richardson, TX
972-234-6400
http://www.ods.com

WatchGuard Technologies
Seattle, WA
206-521-8340
http://www.watchguard.com

Marcus Ranum (Woodbine, MD) is CEO of Network Flight Recorder, Inc. He has specialized in Internet security since he built the first commercial firewall product in 1989. He frequently lectures about Internet-security issues and is coauthor of the Web Site Security Sourcebook *(John Wiley & Sons, 1997). Scott Mace is a BYTE senior editor based in San Mateo, California. You can reach them at* **mjr@nfr.net** *and* **scott.mace@byte.com**, *respectively.*

June 98

E-Business TECHNOLOGY

Tailoring your site to each customer's preferences will pay off.

THE WEB GETS PERSONAL

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GSM'S SHORT MESSAGE SERVICE

Telecom Finland uses SMS to give its customers bank account information, stock prices, and more.

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WIRELESS ELECTRONIC FUNDS TRANSFER

Businesses establish new mobile-based retail distribution channels.

PAGE 96E

SMARTCARDS ENHANCE MOBILE E-COMMERCE

Turn your GSM phone into a network computer.

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From the Editors of BYTE

e-business

HOW TO KEEP A SECRET.

In transforming your business into an e-business, the single most important issue you have to wrestle with is the issue of security.

Without flexible control over who sees what information, all the benefits of putting your key business processes online (which is, after all, the definition of an e-business) are a moot point. And when you connect your critical systems to the Web to help you improve customer service or increase the efficiency of your organization – security is a white-knuckle issue for the people charged with keeping your systems running and your data protected.

It's not just a matter of whom you let in and whom you keep out (although that is obviously important). When you're using the Web (or an intranet) to do things like let your employees change the asset allocation of their 401(k) accounts or let your customers see what their credit balance is, you need the ability to determine who sees what and who can make changes to what they see.

IBM e-business solutions can help you manage access to the really important information you make available online. We've spent over three decades protecting the integrity of corporate information systems. We've pioneered things like Realtime Intrusion Detection, Anti Virus Labs, and Emergency Response Services. And we've made security an integral part of IBM e-business technology – so you can build Web sites that know how to keep a secret.

To keep up with the latest IBM security solutions for e-business, bookmark www.ibm.com/e-business. Or call us at 1 800 426 7080, extension NC31.

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A new breed of Global System for Mobile Communications (GSM) Subscriber Identity Module (SIM) smartcards can run software independently and use a mobile telephone's user interface and communications resources. The result: Your mobile phone essentially becomes a network computer.

A number of trials are already under way to test services based on the integration of GSM and smartcards. For example, the Moments project, funded by the European Union and directed by Nokia, is delivering content from Reuters and other providers. The project involves 100 users from three major mobile-phone-network operators—E-Plus (Germany), Omnitel Pronto (Italy), and Orange (U.K.).

Key issues in this trial involve data compression, optimization of TCP/IP for the inherently narrow cellular user channels, presentation of content, and electronic-payment techniques. The project, which uses a multiapplication smartcard from Gemplus that runs the SIM and electronic-cash applications, will also look at how mobile electronic commerce can benefit from the higher mobile-transmission rates for the third-generation mobile systems known as Universal Mobile Telecommunications Systems (UMTSes).

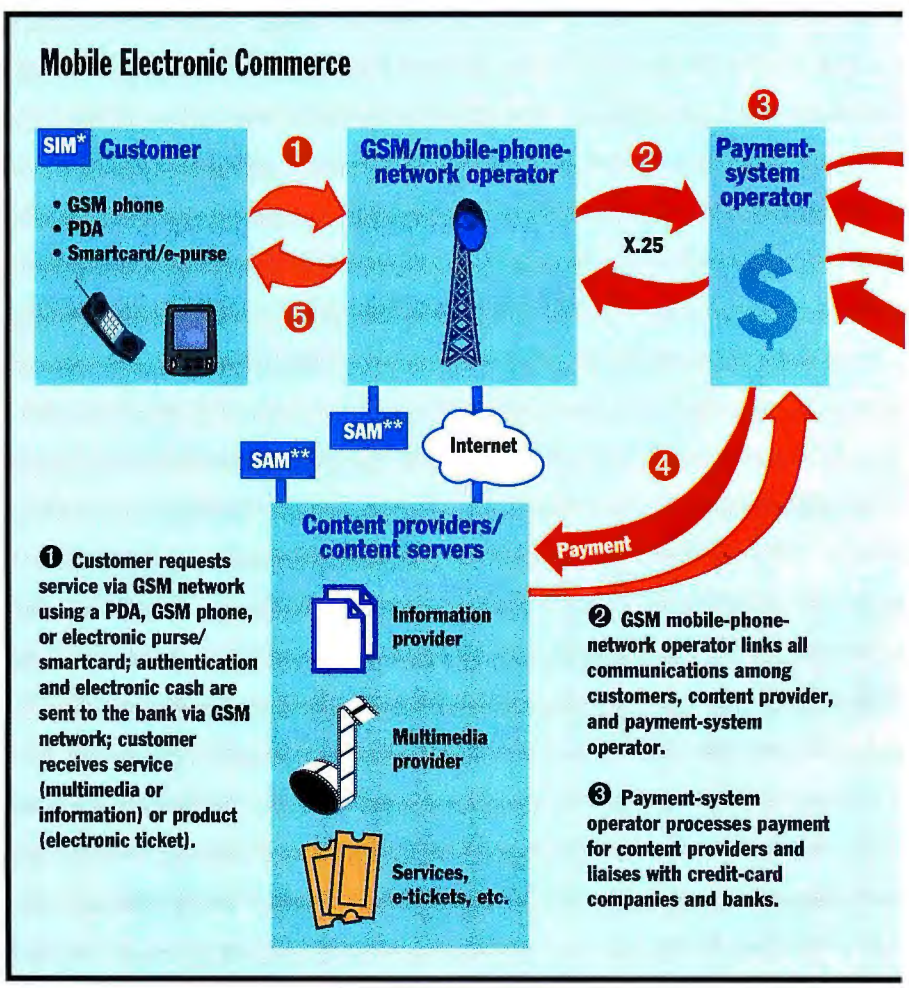
Similarly, a project being run by CyberMark, Florida State University, Gemplus, Motorola, and Powertel (West Point, GA) lets 50 students at Florida State University's Tallahassee campus use Motorola's StarTAC digital mobile phone for a whole range of cashless services. These students can also use their cards to make purchases at vending machines and to operate washers, dryers, copiers, and fax machines. "The smartcard inside the phone is actually the student's identification card, which also acts as a stored-value card that contains cash as a substitute for real currency," explains Jennifer Friedland, marketing director at Powertel.

More applications are on the way. Recently introduced 16K smartcards, such as Schlumberger's Activa card,

New Smartcards Enhance Mobile

SHOP ANYWHERE, BANK ANYWHERE

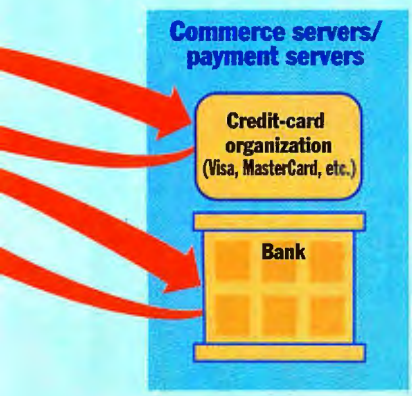
Combine a smartcard with the power of the Internet, the connectivity of a mobile GSM phone, and the flexibility of a Windows CE–based PDA, and you have all the necessary ingredients for the successful implementation of mobile electronic commerce. The integration of GSM and smartcards makes it possible to deliver e-commerce capabilities directly into the hands of customers—anywhere, anytime—via wireless technology. Mobile-phone subscribers can receive content anywhere in the GSM coverage area and pay for it using electronic cash loaded onto a smartcard in their GSM handset. Fascinating new applications are just starting to appear.



offer more memory, which opens the door to having a basic GSM ID application and two or three additional programs on one card. Future applications will be developed in Java, which offers the security and on-line orientation needed to efficiently use the smartcards' limited computing resources.

With over 150 million mobile phone users anticipated around the world by the year 2000, mobile telephony is expected to offer a strong foundation for the further development of mobile e-commerce applications. In a recent report, the U.S. Commerce Department said that the worldwide e-commerce market should reach $300 billion by 2002. **–Peter Hofland**

E-Commerce



❹ Content provider checks with payment-system operator for authorization to transfer service (multimedia or information) or product (electronic ticket).

❺ Transmission from GSM mobile phone to base-station subsystem and mobile switching center occurs; GSM operators allow transmission via GSM network.

*** Subscriber Identity Module**
**** Secure Application Module**

Source: Logica/Nokia/Gemplus/Momenti Trial

Wireless Electronic Funds Transfer

With the growing number of credit-card users around the world, the use of Electronic Funds Transfer at Point of Sale (EFTPoS) systems, which allow retailers to guarantee the clearing of funds from a customer's account into a merchant's account, has exploded.

Traditionally, EFTPoS terminals have relied on a connection to a fixed telephone line, which disqualifies them for use by taxi drivers, pizza deliverers, couriers, and others who rely on their mobility to do business. To solve this problem, Akyman Financial Services (Brighton, Australia) has developed its M-PoS solution, which mixes traditional EFTPoS functionality with GSM connectivity. The AFS-800 hand-held terminal for wireless PoS applications offers an on-line credit/debit card, as well as payment-authorization functions, invoice printing, and mobile paging for person-to-person or smartcard-to-computer links.

The smartcard inside the terminal holds the user's GSM information, plus security codes required for the unlocking and processing of card payments. The AFS-800 can be upgraded with new security keys using Over the Air Programming, which turns it into a flexible billing system.

Akyman's M-PoS solution and other, similar products, such as Schlumberger's Electronic Commerce Unit, are expected to play a major role in the uptake of mobile electronic commerce. "The M-PoS solution establishes relationships among businesses, financial institutions, and GSM network operators, with obvious benefits to all parties involved," says Michale Branagh, director at London-based Digital Commerce International, the distributor of M-PoS in Europe. "It allows businesses to establish new mobile-based retail-distribution channels, helps banks capture merchants' banking business—generating income from transaction-processing fees, card commissions, and money markets—and helps a GSM or mobile-telephone-network operator grow their business. That's a lot of whizbang technology to use to pay for your pizza." **–P. H.**

The AFS-800 wireless terminal.

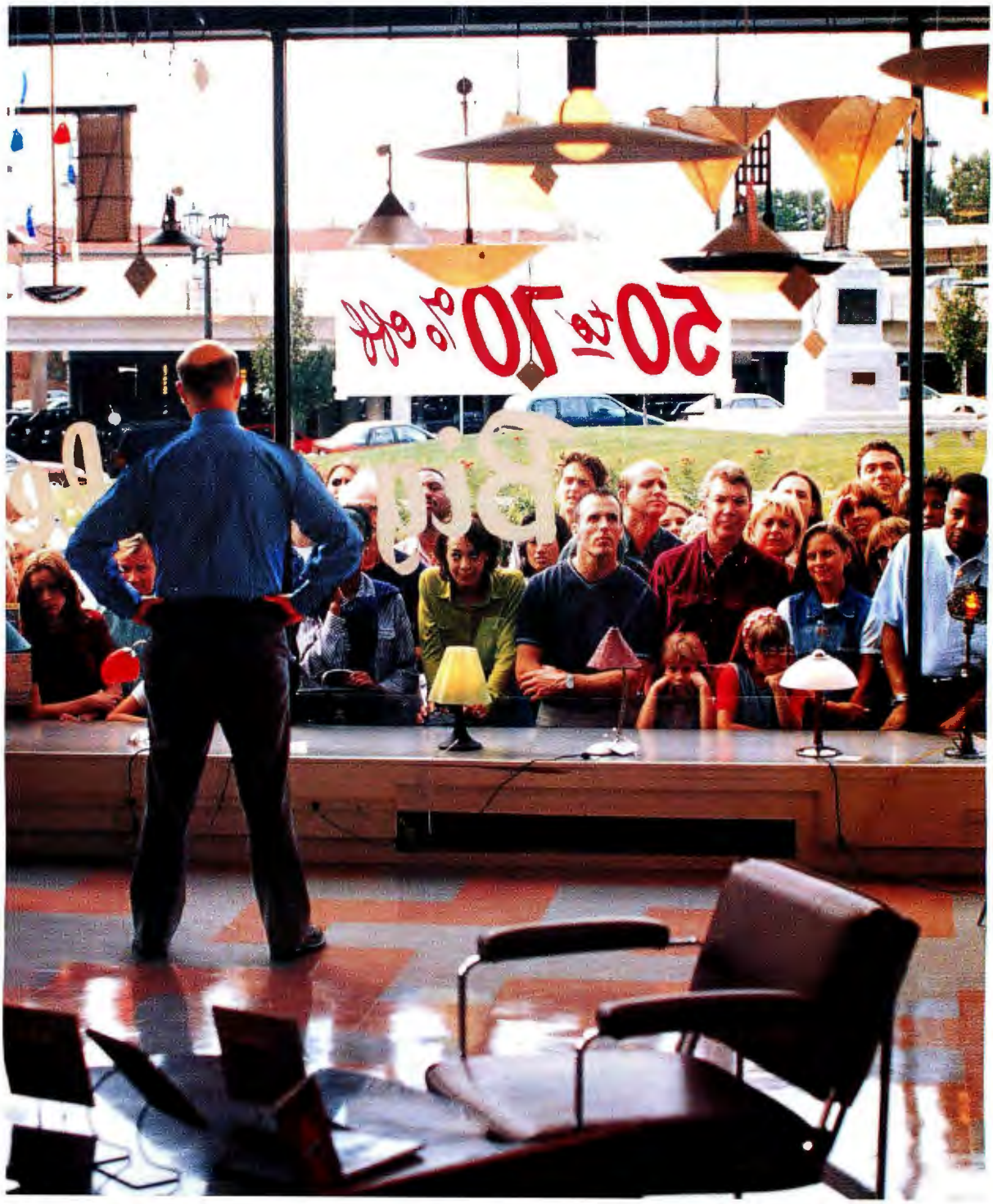
Get the Message

Many Swedish Postgirot Bank customers use their GSM handset to access their bank account. Now users of Telecom Finland Mobile's cellular service can even purchase goods via a wireless on-line service and be charged on their monthly telephone bill.

The key to both of these services is SMS, the GSM network's Short Message Service. "[Using] SMS and the appropriate SIM card allows our customers to do business wherever they are," says Robert Leonardi, Postgirot Bank's business-development manager.

With the Telecom Finland SMS service, a customer calls a special phone number to obtain specific information, such as his or her latest bank-account data, stock prices, or the balance of a loyalty-point scheme. The customer then receives an SMS message containing the desired information. When a user wants to make a purchase, he or she receives confirmation via SMS and is billed later. **–P. H.**

e-business



HOW TO HANDLE FIFTY MILLION UNEXPECTED GUESTS.

The only thing faster than word-of-mouth advertising is word–of–e-mail advertising. A positive reputation in cyberspace can bring you millions of new customers; a bad rap spreads ill will at the speed of light.

When you start sending millions of customers at a time to your Web site to do more than browse, you have to be concerned about the quality of their experience. Too much demand, and the performance of your Web site can slow to an annoying crawl (this is bad). Way too much demand, and users won't be able to connect at all (this is terrible). e-business, after all, is about interactivity – buying, selling, customer service, etc. – and if customers can't get through, they can't interact.

This is why scalability is a major issue for any business thinking seriously about becoming an e-business. Scalability is simply the ability to easily increase the capacity of your Web site – to handle more visitors or unexpected spikes in volume.

IBM designs scalability into all our Web technology – hardware and software. So if your site gets 100 million hits when you expected only 50 million, you can adapt quickly. As we've done with some of history's most heavily trafficked Web sites: the 1996 Atlanta Olympic Games (189 million hits/17 days); the U.S. Open Tennis Championships (70 million hits/14 days) and Deep Blue™ (74 million hits/9 days).

Scalability is just one e-business problem we can help you solve. We've helped thousands of businesses move their core processes to the Web to lower costs, improve customer service and actually sell things. To keep up with the latest IBM solutions, bookmark www.ibm.com/e-business. Or call us at 1 800 IBM 7080, ext. NC33.

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THE WEB GETS PERSONAL

Knowing who your Internet customer is, and what his or her preferences are, pays big dividends.
By Mike Hurwicz

Companies using the Internet to conduct business are reducing costs, increasing efficiency, shortening production cycles, and raising direct-to-consumer sales. At the same time, the Internet is frequently inefficient, as users search and browse to find what they want, often wandering into byways and dead ends along the way. Even when they get to the site they're looking for, potential customers may encounter a sea of information that drowns out what they had hoped to find.

Although companies may brag about the number of hits their sites get, they can't take those hits to the bank. Amazon.com, the pioneer on-line bookseller widely used as the poster child for e-commerce, lost $27.6 million in 1997 (even while reporting nearly $148 million in gross revenues for fiscal 1997, an 838 percent increase over fiscal 1996).

Of course, most new companies lose money for a number of years because of the costs of starting and growing a business. And most Web-based ventures are very new.

Lost in Cyberspace

But many Web sites are counterproductive: A rich, complex, full-featured site that's selling a variety of products often overwhelms and confuses the potential buyer who is interested in just one product—the one that will address his or her particular current need.

PHOTO ILLUSTRATIONS: BILL WESTHEIMER © 1998

Today's e-commerce sites often resemble malls where all the stores are open but there are no sales people and no information desks, just maps, brochures, and long aisles of products. This is often not an efficient way for people to find the products, services, or information they need.

It's probably not an accident that one of the most successful high-tech vendors on the Web, Cisco Systems (doing 50 percent of its business over the Web—$10 million a day, the company says), has implemented automated sales agents that help customers configure network equipment. For Cisco, personalization may have meant the difference between success and great success. For other companies, it may mean the difference between success and failure.

Getting to Know You

Today, the basis of most personalization is the customer profile. An application, such as an e-commerce server, profiles each user and then, when a particular user logs in or attempts to perform some action, reacts differently based on the profile.

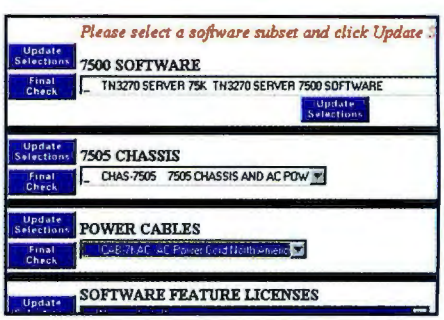
Applications can profile users in any number of ways. Some of the most common ones are:

- The user explicitly provides information by filling out a registration form or survey, or by making a menu choice. This is the usual way of getting basic information such as name and geographic location. Generally, it has to be used sparingly. Most people have a low tolerance for filling out forms.
- The application records the user's actions and builds a profile based on this history. At the simplest level, a site that sells both CDs and books may note that a particular user never goes into the book section, only the CD section. That person gets profiled as a music lover, as opposed to a book lover. To get further information about the person's interests, the application may monitor the site's search engine, record the search criteria, and note which of the results the user pursued.
- The system makes inferences based on time of day or day of the week. Someone who uses the site only on weekends is more likely to be logging on from home than from work.
- The site visitor's domain name tells the application who the user works for, that the person is associated with a university or government agency, or that the user is likely to be a business or professional user. For instance, johndoe@syr.edu is associated with Syracuse University in New York state.
- The application employs third-party data about the user. For instance, a national white pages listing provides the user's address and phone number, based on the user's name and city.
- The application uses statistical means to draw inferences about the user. For example, an on-line bookstore knows from previous buying patterns that readers who buy author A are also likely to buy author B. The application defines a community of customers who buy either author A or author B (or both) and makes membership in that community part of a user's profile.

A profile may be a record in a database. In addition, the application may implement context-based personalization, based on the user's current activity. For instance, it may treat you differently if you're browsing a history of past support incidents than if you're registering a new support incident.

Using the profile, the application may:

- Simply play back some data that the user entered, such as his first name ("Welcome, Frank!").
- Use the information to calculate discounts or trigger special offers.
- Make a suggestion. For instance, it may attempt to up-sell ("Perhaps you'd rather buy this?") or cross-sell ("Maybe you'd like to buy this, too?").
- Ask a question. (After the user purchases an automobile: "Do you already have automobile insurance?")
- Give the user relevant information. ("The equipment you are asking about is not compatible with the equipment you bought three months ago.")
- Display an appropriate ad (e.g., for a weekend trip to Florida if it is winter and the customer lives in a state with a cold climate).
- Implement collaborative filtering, an automatic mechanism for creating communities of people who prefer similar content. For instance, using Catalog Navigator personalization software from Firefly Network, bookseller Barnes & Noble is implementing collaborative filtering on its Web site, building communities of people who are interested in the same types of books.
- Put the user in touch with a customer service representative or salesperson. A smooth transition from automated to personal interaction can be made using products like Interact Express and Interact Service, from Business Evolution (Princeton, NJ). These products offer real-time communication in pop-up windows, so the user doesn't have to make a phone call (without Interact, someone who has only one phone line would have to log off the Web to place an order).



Cisco's site allows the user to create a valid configuration for a router.

Key Technologies

Database technology is basic to many personalization strategies. Not only profiles, but also content, such as Web pages and graphics, can be stored as database records. Thus, relational database technology can provide a standard means of relating profile characteristics to content.

Object technology offers a paradigm based on classes of objects. An e-commerce system might define objects such as customers, communities of customers, Web pages, and products. Each object is

associated with both attributes and actions. A customer object could have attributes such as name, e-mail address, and various preferences. Actions could include logging on to a site, making a purchase, making an inquiry, viewing a Web page, or receiving an offer. Support for actions often makes personalization more straightforward. With a database-oriented approach, if all responses must be triggered by changes in the database, you might need to create a "logged in" field, which the Web server would change when a customer logs in, so that an action could be triggered at log-in time. With object technology, the Web server can trigger the action directly by interfacing with the object, without going through the unnecessary step of changing the database to reflect the login.

Dynamic Web pages are created on the fly in response to user actions and choices, taking into account the user's profile (as opposed to static Web pages, created once and never changed).

Business rules describe the way a business works. In the context of automated personalization, business rules typically describe how an employee would behave if the employee were performing the automated function. ("If the customer is associated with an educational institution, offer a 30 percent discount.")

An *inference engine,* or rules engine, is a software module whose purpose is to solve problems using facts ("A university professor is an educator") and rules ("Offer educators a 30 percent discount"). Facts and rules are contained in a knowledge base or rules base. Inference engines and knowledge bases were first created for expert systems, also called artificial intelligence systems. They are typically designed to seek out and acquire knowledge. Inference engines can work with information that is incomplete or appears incomplete. This is not usually the case with conventional transaction processing or database systems.

A *cookie* is a small piece of data used to identify a particular user, either during a single session or across multiple sessions.

Push technologies send the user information that the user has not specifically requested. E-mail is the most popular push technology.

Let's Get Personal

A wide variety of tools are available to personalize a Web site. Web servers or commerce servers may include features that can be used to implement personalization. For instance, the "personalization and membership" features in Microsoft's Site Server include:

The *Membership Directory*, which can contain both persistent profile information and dynamic information pertaining only to the current session.

The *Rule Manager*, which is used to create and manage rules to personalize Web pages and e-mail messages. Simple rules, such as greeting a user by name when he logs on, can be implemented by modifying a template (in this case, adding the "user name" attribute). Web authors can also create sets of condition tests, content retrieval parameters, and output specifications.

Thanks to the Rule Manager, the Web server can do things like present a special offer only to "premier" members within the U.S., a different offer to "premier" members outside the U.S., and still another offer to nonpremier members. Personalization can also vary with date or time, and rules for a given section of the site can be combined into rule sets and organized by priority.

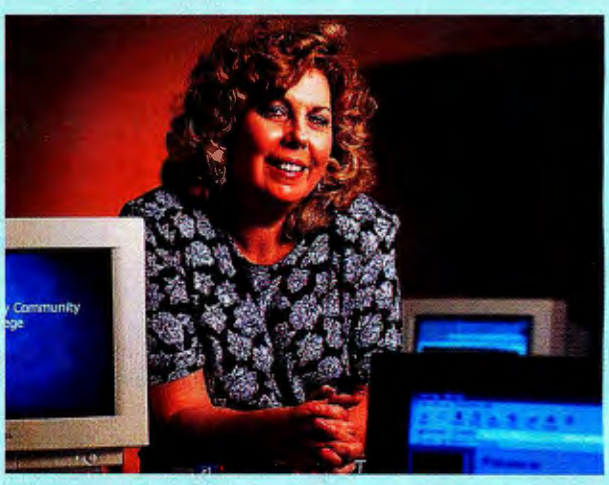
NEURON DATA GOES TO COLLEGE

Oklahoma City Community College is implementing an integrated system to handle student, human resources, and financial information. Administrators, faculty, staff, and students will use the Web to access the functions they need from anywhere in the world.

The rules capability of the system, called ZeoLogix (which uses Neuron Data's Elements Advisor as a back-end rules engine), will allow it to fulfill some of the functions of an academic or financial advisor for students. For example, the system will help each student develop a personalized learning plan, based on the job they're seeking or the college they want to transfer to. The student can plan a semester at a time or make a two-year plan. The system helps students fill out schedules, taking into account personal information such as the student's work hours. Integrating financial aid information into the system will allow it to determine if a particular course will be paid for by financial assistance.

The college spent much of 1997 reengineering its processes to use the new system more efficiently. For instance, many of the mundane administrative tasks that previously took up a faculty member's, advisor's, or financial counselor's time will now be performed by computer.

"The system will allow advisors to spend more quality time with students," says Barbara Vrana, chief information officer for the college. "Rather than spending their time determining whether a particular course transfers to such and such university, they can spend it talking through job possibilities and making recommendations for elective courses."



Barbara Vrana, CIO of Oklahoma City Community College

PHOTOGRAPH: DAN BRYANT © 1998

The *Direct Mailer*, which sends personalized e-mail based on the user's online behavior and profile.

The *Push Server* gathers content from sources such as file directories, commerce databases, "knowledge briefs" created by the Knowledge Manager (see below), the Index Server catalog, and the Search Server catalog. The Push Server places this content into a "channel," which is then routed to users who have requested that channel.

The *Knowledge Manager* leverages the infrastructure provided by the Search, Personalization and Membership, and Push servers. It can search, browse by category, and subscribe to topics of interest from the Push Server. (These features are all new in Site Server 3.0, which went into beta in January and was scheduled for release in the first half of 1998. Pricing was not available at press time.)

PublishingXpert, part of Netscape's CommerceXpert family of products, is designed for selling information on the Internet. It is being used by the *New York Times* and the GartnerGroup. During the registration procedures, customers supply PublishingXpert with demographic information, typically consisting of a list of their preferences. The result is a user profile and a list of preferences and interests. With version 2.0, this information can be used to target e-mail to the customer or to dynamically create a home page that contains choices representing the customer's interests.

PublishingXpert 2.2 will bundle a one-to-one marketing module and an ad server. This brings, first, a sophisticated advertising function, including scheduling, billing, and targeting ads to particular users, and second, the ability for both ads and content to present related material to the user. Version 2.2 supports upselling, cross-selling, or simply presenting related topics that the user did not explicitly mention. More sophisticated business rules can be integrated into the system using JavaScript.

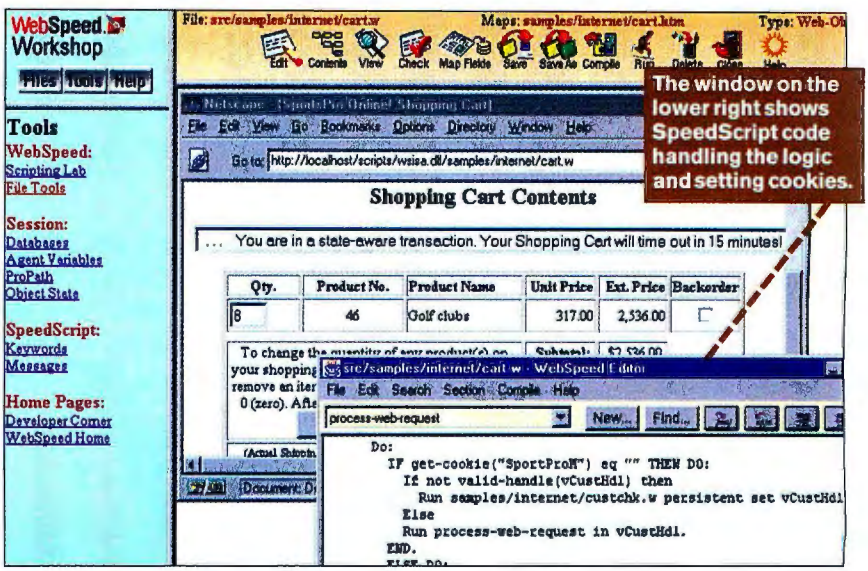
IBM's Net.Commerce software does not currently contain any personalization features, but it does contain a Product Advisor module with sophisticated search functions that can help a user find desired content quickly. For example, you can do a parametric search, which allows you to hunt for a product based on certain features. A site developer using Net.Commerce can set things up so that the user is able to get side-by-side comparisons of products, or create a "tree" of questions that leads to particular products based on the user's answers.

More personalization is coming for Product Advisor. It will be able to support "sales agent" functions such as up-selling and cross-selling, says Darko Hrelic, program director of electronic commerce architecture. IBM is also considering rules-based functionality. No time frame has been announced for these capabilities, but they will probably be available before the end of the year.

Generally, prioritized rule sets like Site Server's are most appropriate to fairly simple, straightforward types of inferencing and personalization. The most manageable rule sets are small, perhaps four or five rules. Beyond that, it can get difficult to test all the possible outcomes, given various user profiles (or different date or time characteristics, if those are used).

Progress with WebSpeed

Atypica (Bedford, MA), a software developer specializing in database-oriented Web applications, used Progress Software's WebSpeed (a Web-oriented rapid application development tool) to build its Qforms application. Atypica's program makes it easy for organizations to develop complex forms-based applications for the Web. Qforms, which can run on Microsoft's Internet Information Server (IIS), Netscape's Enterprise Server, or O'Reilly's Web Server, includes a number of personalization features:



This "shopping cart" application is being developed with Progress Software's WebSpeed Workshop tool.

Multiple levels of cookies. You could set up a system whereby a user who registers at cookie level 1, which just requires typing in a name and password, could participate in discussion groups. A user at cookie level 2, which requires credit card information, could make purchases. And a user at cookie level 3, which requires membership in a professional organization, gets special discounts.

Weighted responses on forms. If several questions on one or more forms relate to credit-worthiness, for example, the application can add up the weights of those questions to determine an overall credit-worthiness score for the user. This could become part of the user's profile in the database.

Prioritized sets of rules can be employed to redirect a user to another Web page. For instance, if 1) the user accesses a technical support page, and 2) the database does not show a currently open technical support incident for the user, and 3)

e-business

WHAT'S THE DIFFERENCE BETWEEN A LITTLE KID WITH A WEB SITE AND A MAJOR CORPORATION WITH ONE? NOTHING. THAT'S THE PROBLEM.

Building a publishing-only Web site is the first step to becoming an e-business. A step that most businesses (and a lot of little kids) have already taken. That's fine as far as it goes – it's a very cost-efficient way to distribute basic information.

But the real payoff (for businesses, at least) comes with steps two and three. Step two is moving to "self-service" Web sites – where customers can do things like check the status of an account or trace a package online.

Step three is moving to transaction-based Web sites – not just buying and selling, but all processes that require a dynamic and interactive flow of information.

IBM has already helped thousands of companies use the Web to make the leap from being a business with a Web site to being an e-business – putting their core processes online to improve service, cut costs or to actually sell things.

For example, we helped Charles Schwab Web-enable their brokerage systems for online trading and customer service. Since opening, Schwab's Web service has generated over one million online accounts totaling over $68 billion in assets.

e-business economics are compelling. According to a recent Booz-Allen & Hamilton study, a traditional bank transaction costs $1.07; the same transaction over the Web costs about 1¢. A traditional airline ticket costs $8 to process; an e-ticket costs just $1. Customers love the convenience; management loves the lower costs.

IBM solutions have already helped thousands of businesses become e-businesses. To find out how IBM can help you do the same, bookmark www.ibm.com/e-business or call us today at 1 800 IBM 7080, extension NC32.

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the user is from XYZ Corporation, then display the Web page for opening a new incident for XYZ Corporation. Knowing the user and the company, the form can be simplified, or defaults can be provided in some fields, such as "company name," to save the user time.

A Sophisticated Advisor

What if you wanted more sophisticated inferencing and business rules capabilities in a WebSpeed application such as Qforms, or for a Site Server-based application? One way of going about it would be to use Neuron Data's Elements Advisor, a business rules platform that operates as an independent component in an enterprise application architecture. Elements Advisor includes a visual rules development environment, a rules engine (which can be deployed as a server, as a client, or with an Internet application such as an HTML page), and a rules base. Neuron Data is a well-established AI vendor bringing its technology to bear on applications such as customer service, electronic commerce, financial services, and intranet applications (including benefits selection, purchase requisitioning, vendor management, and contract management).

Elements Advisor, including the rules engine, is written entirely in Java. Elements Advisor 2.0, released in February, includes enhanced capabilities for integrating objects, including Distributed Component Object Model (DCOM), ActiveX, Java, and CORBA objects, as well as objects that conform to Neuron Data's proprietary object model. This allows programmers to hook their applications up to messaging middleware and distributed application services based on these object models. To take advantage of Elements Advisor, you have to be working in a Java development environment, such as Microsoft's Visual J++, Symantec's Café, or IBM's Visual Age for Java. Pricing starts at $9995 per user for the development environment and $15,000 for a server deployment configuration.

Though the rules base is designed to be maintained by a nonprogrammer, Elements Advisor is a high-end tool for professional Java developers. While its Java orientation is probably a long-term strength, it might be a short-term liability, says Steve McClure, an analyst with International Data Corporation (IDC, Framingham, MA). "Java products are not mature or robust. It's too soon to have enterprise class products in the Java space. It won't be that much longer. Another year and they'll be there."

Meanwhile, Neuron Data announced in February that it will partner with Microsoft to integrate Elements Advisor and other Neuron Data products into Microsoft's Visual Studio and Microsoft's Express Platform. This will allow developers to use Visual Basic, VBscript, and Visual Studio to incorporate Elements Advisor into their programs.

The Old Soft(ware) Sell

Brightware's ART*Enterprise is an application development tool for putting rules-based inferencing behind enterprise applications such as e-mail. ART*Enterprise Web does the same for Web sites. ART*Enterprise assumes a C++ programming environment. The Brightware in-bound marketing agent, on the other hand, is off-the-shelf software that can be installed, configured, and managed entirely by nonprogrammers.

The Brightware Inbound Marketing Agent's most visible strength is its natural language interface. However, behind the scenes, it has a sophisticated inference engine, comparable to Neuron Data's. Combining its natural language and inferencing skills, Brightware engages the Web user in an interactive dialog that simultaneously answers questions and qualifies the user as a potential customer.

Today, with Brightware 1.0, the dialog takes place via e-mail, which means there is a lag while the messages traverse the Internet. With Brightware 2.0 (for which no release date has been announced), the dialog will be interactive in real time.

Brightware is a high-end application, targeted at the Fortune 1000. CountryWide, the nation's largest mortgage banker, generating $6.9 billion in new loans each month, is using Brightware on its e-commerce site. Through the site, the company will make around $33 million worth of loans per month in its first year, according to Cameron King, executive vice president for electronic commerce. Brightware will help customers determine what kind of loan they need and qualify for—a complex and highly personalized process that varies both with changes in the loan market and with the credit-worthiness and needs of the customer. The application was scheduled to go live in April, after about three and a half months of installation and configuration work, mainly devoted to building the knowledge base.

Early experience suggests that Brightware will improve the efficiency of account execs 25 to 30 percent, says King, because they don't have to answer as many questions and they'll be working with better-qualified leads. Brightware 1.0 starts at about $190,000, or $250,000 with the vendor's consulting integration services. That price does not include the e-mail system or the commerce server with which Brightware interacts.

BroadVision's One-to-One

Although Brightware intends to create other agents in the future, for now its software is limited to sales applications.

MINING WEB DATA

The next big step in selling more products over the Web and finding new Internet customers is data mining. Data mining lets you draw conclusions about your products, services, and customers after reviewing large collections of information over an extended period of time. It's a great idea, but we're not aware of anyone who's doing it. It's possible that some companies are doing it and not talking about it, of course.

"Data mining is a deep dark secret weapon used for competitive advantage," says Mike Blundin, director of product marketing for Datasage (Redding, MA), a small developer specializing in scalable enterprise data mining solutions. However, Blundin also says that, while organizations are coming to his company for help in applying data mining to e-commerce and other Web-based applications, no customers have gone on-line yet. Most organizations have got their hands full just trying to mine more traditional data sources within the corporation, without turning their attention to the new flood of intelligence coming into corporate Web sites.

BroadVision's One-to-One, on the other hand, supports three areas of application: commerce (i.e., sales), finance (banking, mortgage loans, mutual funds, insurance policies), and knowledge management (publishing complex information on-line). BroadVision is based not on an inference engine but on "intelligent matching agents," designed to match users with content based on profiles. One-to-One performs various types of personalization, including:

Rules-based matching, based on user profiles or communities ("If the user is a *Wall Street Journal* reader, then display the Baron's ad");

Context-based matching ("If the user is on the sports page, display the sports equipment ad");

Category-based matching, in which content producers classify their content based on certain attributes, users rate their preferences in terms of the same attributes, and a BroadVision agent steers users to appropriate content;

Feedback and learning, in which the application updates the user's profile based on the user's actions, either in real time or as a result of off-line feedback or data mining;

Community rating, in which users are surveyed and the results used to recommend popular content.

U.S. West Communications used One-to-One to create its Interconnect Application System, which allows other telecommunications companies to purchase U.S. West local exchange services at wholesale prices, directly over the Web, in order to resell those services to their own customers. The application, which runs on a Sun server along with an Oracle database, ties together 30 mainframe databases and serves thousands of resellers. Both the tariffs and the regulations governing the sale and resale of local exchange services are extremely complex, hence the need for such high-end technology.

The base BroadVision product starts at $60,000. Each specific application costs an additional $30,000. A typical configuration might cost $200,000. Some high-end installations have gone into the millions of dollars for a full turnkey application, including commerce and database services (but not e-mail).

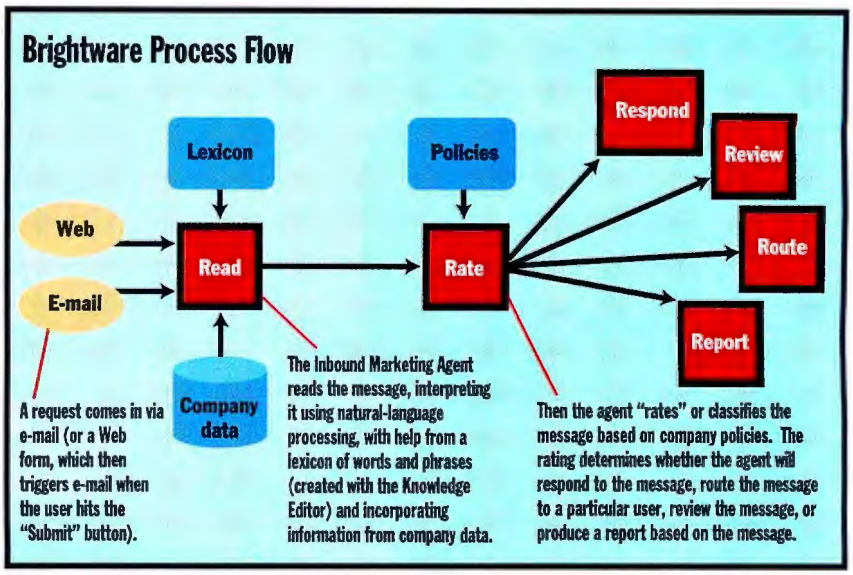
Internationalization

Customization to accommodate users in different countries has not progressed quickly, largely because the U.S. dominates so heavily in the e-commerce arena. Europe, for instance, is 18 to 24 months behind the U.S. in e-commerce implementations, says Patrick King, Neuron Data's sales and operations director for northern Europe. The U.S. accounted for 75 percent of the worldwide commerce server market as of Q3 1997, according to a report from Ovum, a London-based consulting and market research firm.

One obvious opportunity for international customization is displaying text in the user's language, or providing on-demand translation. In France, for instance, availability of French translations is mandated for all advertisements by the 1994 Tourbon law.

Currency conversion is a much more straightforward, but nevertheless extremely useful, function. Even sites that provide currency conversion do so in a limited and nondynamic way today. That is, they include only a couple of currencies, and numbers are not automatically updated as rates of exchange move.

Time zone conversion would be another useful function, particularly for travel and reservations. Local taxes are another area where an e-commerce site could apply knowledge about the user's location. In some cases, the buyer needs to know about taxes at the seller's location. In other cases, it may be the seller's responsibility to impose taxes applicable at the buyer's location.



A customer's question is classified electronically, then answered or routed according to company policy.

One of the problems with personalization is that there is no one product or company that can handle all forms of personalization. "Customers want it all in one solution," says BroadVision's Berry. He sees some consolidation coming in the personalization market, through mergers and acquisitions.

Personalization works best when you already have a good knowledge of your user base. In general, the richer your customer profiles, the better the inferences you can make. For instance, TheProShop.com, an on-line golf store created with WebSpeed, has been running for more than two years. However, the company has only recently built up the customer base, and knowledge about that customer base. Now the e-store can do things like recommend a golf club based on the customer's brand preferences, height, and weight. B

Mike Hurwicz, a freelance writer, is a frequent contributor to BYTE. He can be reached at **mhurwicz@attmail.com.**

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Enterprise Databases

BATTLE ON

PART I

Enterprise databases have a daunting to-do list. How will they cope with new demands?

By Karen Watterson

Winning isn't everything. Fifteen years ago, the emerging relational database management systems (RDBMSes) were fighting to establish themselves as legitimate alternatives to entrenched database products, such as IBM's IMS and Cullinet's IDMS, which were based on the then-popular hierarchical and network/CODASYL (Conference on Data Systems Languages) data models. Enterprise RDBMS vendors, including IBM (with DB2), Informix, Oracle, and Sybase, ultimately won the battle for the on-line transaction processing (OLTP) systems market. But now they face new challenges that are no less daunting: Avoiding being relegated to low-margin "commodity" status by Wall Street and delivering ever-increasing functionality and ease of use to end users.

Consider the diverse list of features that customers expect enterprise RDBMSes to offer:

- Their original OLTP mission—providing the high availability and fault tolerance that enterprises need for their mission-critical 24x7 OLTP systems, such as order entry and supply-chain management.
- Advanced hardware and more parallelization.
- Thin-client support.
- Data delivery to Web application servers (supporting potentially tens of thousands of concurrent connections) and Web-site content management.
- A variety of replication architectures.
- Ease of installation and management.
- Robust participation in electronic commerce.
- Data warehouses, very large databases (VLDBs), and data-mining operations.
- Enterprise performance on Windows NT.
- On-line analytical processing (OLAP) or its relational counterpart, ROLAP.
- Object-oriented functionality as "universal" servers.
- Support for special extended data types.
- More openness in general—interoperation with major systems; network, transaction, and component management software; ODBC/JDBC drivers; repositories; distributed object models, such as the Distributed Component Object Model (DCOM) and Common Object Request Broker Architecture (CORBA); and server-side Java.

As if that weren't enough, users expect enterprise-database vendors to participate in various standards efforts; develop training materials and certification procedures; work with partners, developers, and the distribution channel; provide on-site consultants to important customers and independent software vendors (ISVs); offer migration services from competitors' RDBMSes; maintain a special TPC (Transaction Processing Performance Council, San Jose, CA) benchmark team to crank out some good numbers to post at *http://www.tpc.org*; and sponsor at least one major users-group conference annually.

Is it realistic to expect any one product to do it all well? Has the market for RDBMSes actually become saturated? The answer to both questions is the same: Probably not.

First of all, there's a basic difference between the needs of OLTP and those of OLAP or other decision support. You typically optimize OLTP systems to handle many concurrent data-entry connections, where short transac-

Enterprise Database Wish List

	Oracle	IBM	Sybase	Informix	Microsoft
RDBMS	Oracle8	DB2 UDB	Adaptive Server Enterprise	Informix Universal Server	SQL Server 7.0 (Q398)
Multiplatform	Yes	Yes	Yes	Yes	Intel and Alpha only
Parallel edition	Oracle Parallel Server	DB2 UDB Enterprise Edition Extended	Sybase MPP	Extended Parallel option	
Object support	Cartridges	Extenders	Specialty data stores	Universal Data option	Access via OLE DB
Lean version for mobile computing	Oracle Lite		Adaptive Server Anywhere		
Data-warehousing support	Oracle8	IBM Visual Warehouse	Adaptive Server IQ and QuickStart DataMart	Advanced Decision-Support option	SQL Server 7.0 and its Data Transformation Services
OLAP	Oracle Express	DB2 OLAP Server		MetaCube ROLAP option	Unnamed at press time
Data-mining support		Intelligent Miner, IBM Decision Edge, IBM Business Discovery Series			
Text-mining support	Oracle ConText	Intelligent Miner for Text	Verity search engine (included with Adaptive Server Enterprise)	Text DataBlades (available from Excalibur and Verity)	Microsoft Index Server
Replication	Built-in	Built-in	Replication Server	Built-in	Built-in
TP monitor		TX Series			Microsoft Transaction Server
Message queuing		IBM MQSeries	dbQ		Microsoft Message Queue Server (included with Windows NT 4.0 Server)
Component broker	Object Transaction Server (beta Q398)	IBM Component Broker	Jaguar CTS		DCOM and Microsoft repository
E-commerce	Oracle Internet Commerce Server	IBM net.commerce	Build using PowerSite or PowerDynamo	Build using Web Internet option	Microsoft Site Server
Developer tools	Developer/2000 and Designer/2000	VisualAge family	PowerBuilder, PowerDesigner, and PowerStudio	Informix Data Director	Visual Studio family
Java	SQLJ	VisualAge for Java	PowerJ Enterprise, jConnect for JDBC	Informix Data Director for Java	Visual J++
Other	Oracle Applications product line (accounting)	Small army of IBM Global Services personnel	Only ISO 9001–compliant vendor		1 million+ Access owners can upgrade to Win 9x version of SQL Server 7.0

tions corresponding to database inserts are the norm. High-end OLTP systems run telecommunications and banking systems, stock markets, and airline reservation systems—systems where high availability is a must. IBM's mainframe-based hierarchical IMS is still a leader in this market.

On the other hand, OLAP systems must be optimized for the ad hoc queries associated with decision-support systems (DSSes). About the only predictable things about DSS queries is that they typically require complex joins and can take minutes or hours rather than fractions of seconds to complete. NCR's high-end Teradata systems, which are optimized for decision support, run many of the world's largest data warehouses.

IBM

RDBMS vendors are now recognizing that they can't do everything, and they're beginning to concentrate on areas that leverage their strengths. IBM seems to be staking out the e-business and business intelligence (BI) markets for its DB2 Universal Database (UDB) database servers, which run on anything from NT servers to massively parallel processing (MPP) SP2s. (You can also run UDB stand-alone under Windows 95, but there has been no announcement from IBM about a "lean" version to support mobile computing.)

Given IBM's reputation and strong presence in international IT consulting—its 110,000-person IBM Global Services unit alone generated 1997 revenues of approximately $26 billion—it's not surprising that Oracle CEO Larry Ellison said in an interview (*Upside*, November 1997) that "we really don't have any strong competition from a technology standpoint other than [from] IBM."

IBM, like Oracle and Sybase, has moved aggressively into the Java arena, and observers widely perceive it as offering the most comprehensive support for "extended" object/relational data types (see the text box "Third-Party Help" on page 99). Similarly, IBM has established an early lead in the nascent data-mining portion of the exploding BI market.

Oracle

Like IBM, Oracle derives a substantial portion of its revenues from consulting and services, but, unlike IBM, it's primarily a software company. Although it started as a "pure" database company (Oracle first shipped in 1979), its offerings now include e-business products; "packaged" applications that compete with SAP, Baan, and PeopleSoft; developer tools; and many industry-specific vertical applications. Oracle generated $6 billion in revenue in 1997.

Along with its focus on applications built on Oracle's database servers, the company has a stated mission in the network-computer, or lean-client, market. Its new line of small-footprint Oracle Lite products for PDAs (about 150 KB of RAM) and Windows CE platforms (250 to 700 KB of RAM) debuts this summer. Although Oracle Lite is new, rather than a subset of the current data server, the $195 product will share data with server-based Oracle databases, including those that are extended with data cartridges. Never known

for making its products easy to manage, Oracle has made great strides in "humanizing" Oracle Enterprise Manager.

Sybase

Sybase CEO Mitch Kertzman says that his company is focusing on mobile computing, Internet applications, and data warehousing. Sybase has three main product groups: the Adaptive Server family, Powersoft-division tools, and data-access and movement tools. Sybase's 1997 revenue was $900 million.

Sybase led early on in the mobile-computing race with its Adaptive Server Anywhere (originally known as Watcom SQL). Adaptive Server Anywhere currently offers complete compatibility with the more scalable Adaptive Server Enterprise (formerly known as Sybase SQL Server, first shipped in 1987), but it's slimming down to run on Windows CE.

Adaptive Server IQ rounds out Sybase's database family and is the foundation of the company's data-warehouse strategy. Sybase's Powersoft division, which originally consisted of the popular PowerBuilder client/server application-development tool, has become decidedly more Java- and Internet-focused with PowerSite, jConnect for JDBC, and Jaguar CTS (Component Transaction Server). Sybase, unlike IBM, Oracle, and Informix, lacks an OLAP product.

Informix

Earlier this year, Sybase's Kertzman observed that Informix was effectively "the only company left that's a database company," the rest being more diversified. That's changing, however, as Informix is capitalizing on object technology (acquired from Illustra) and beginning to compete aggressively in the Web-content-management arena (with Visual Basic–oriented Informix Data Director, from CenterView, in Java and Web versions).

Informix's chairman, Robert Finocchio, has stated that the company will focus on the high end in three key areas: high-performance OLTP, Web-content management, and data warehousing. Although Informix, like all the vendors mentioned here, has an NT version of Informix Universal Server, the company doesn't seem that interested in the low end. This makes sense, since Microsoft seems destined to dominate that market.

Microsoft

When Microsoft ships SQL Server 7.0 this summer, the database market is going to explode, especially the low end. Not only will SQL Server finally be available on Windows 9x platforms—which will entice many Microsoft Access users to upgrade—it will also offer what promises to be a powerful, easy-to-use, NT-based OLAP server. (But, as the table on page 98 shows, SQL Server lacks high-end parallel server support.)

Everyone expects SQL Server 7.0 to slowly move up the database food chain into the enterprise, despite its lack of a Unix version. Nevertheless, it has come a long way since its origin as a PC version of Sybase SQL Server. Expect to see it deployed across the board in OLTP, data-warehousing, OLAP, and e-commerce applications. Where it seems weak is in the object/relational market, in its use of "extended" data from OLE DB, and in its confusing array of data-access APIs.

Other Options

Although the vendors mentioned here dominate the market, there are many other significant players, including Progress Software and object-database vendors.

If someone were to hand out report cards regarding the aforementioned list of features that users are demanding from enterprise databases, no company would get all *A*'s. Microsoft, for example, is particularly weak at supporting hot boxes, such as MPP systems. This is the downside to having a product so tightly integrated into the OS (NT and Win32). Because data mining makes such heavy demands on host systems, it's not surprising to see IBM staking out that turf.

No major market player is likely to entirely ignore customer demands. What will distinguish these players is not just how well the pieces of their products work together but how well they scale. "Reliability, scalability, and availability" used to be the mantra for enterprise OLTP DBMSes. Today, users are likely to adapt that mantra to reflect their own needs.

Wall Street is probably right: You are most likely already running major applications on Oracle, DB2, Sybase, or Informix. However, that doesn't mean you won't be purchasing another vendor's products.

Today's economy is data-driven and populated by knowledge workers. That's good for database vendors. In addition to the obvious arenas for databases, IT should consider harnessing database technology to serve knowledge management and avoid data-related lawsuits. B

Karen Watterson is a San Diego–based writer and consultant specializing in database design and data warehousing. You can reach her at **karen_watterson@msn.com.**

Third-Party Help

In addition to IBM's own DB2 UDB extenders for text, audio, video, and images, third-party extenders include:

- Optical storage management (Consistency Point Technologies)
- Add-on SQL functions (The Fillmore Group)
- Complex data RAD environment (Formida Software)
- Multimedia application authoring (Innovus)
- Advanced data extraction (IsoQuest)
- Name and address (OG Software)
- DES encryption (Prime Factors)
- Field-level security (Protegrity)
- Time-series analysis (EcoWin)
- Currency (i.e., money) (OANDA)
- Spatial extenders: MapInfo; ESRI's SDE spatial tool; and ESRI and IBM's joint work on a spatial extender, which IBM will probably offer.

WHERE TO FIND

IBM Corp.
Armonk, NY
800-426-3333
914-765-1900
http://www.ibm.com

Informix Software, Inc.
Menlo Park, CA
800-331-1763
650-926-6300
http://www.informix.com

Microsoft Corp.
Redmond, WA
800-426-9400
425-882-8080
http://www.microsoft.com

Oracle Corp.
Redwood Shores, CA
800-633-0596
650-506-7000
http://www.oracle.com

Progress Software Corp.
Bedford, MA
800-477-6473
781-280-4000
http://www.progress.com

Sybase, Inc.
Emeryville, CA
800-879-2273
510-922-3500
http://www.sybase.com

Enterprise Databases: PART II

Relations with Your Data

We wring out four enterprise-level RDBMSes, and the results bear out the marketplace trend.
By Barry Nance

Relational databases—they're powerful, versatile, and reliable, and most automated business applications depend on them. But RDBMSes can also be inconsistent, cranky, demanding, irritating, inscrutable, and downright painful. RDBMSes—you can't live with them, and you can't live without them. If you're happy with yours right now, thank your lucky stars. If not, and you're thinking of making a switch, maybe this Lab Report can help you.

For this review, BYTE asked five major RDBMS vendors to supply their flagship product. Four chose to participate, though some with surprising restrictions. (See the text box "Don't Ask, Don't Tell" on page 104.) We report fully on IBM's DB2 Universal Database 5.0 Enterprise Edition and Sybase's Adaptive Server Enterprise (ASE) 11.5. We also evaluate Microsoft's SQL Server Enterprise 6.5 and Oracle7 Server Database 7.3 (in this case, the company failed to send us the latest release, 8.0), but we're prohibited from publishing a performance evaluation of them. Informix first agreed to participate and then changed its mind.

We tested each of the four RDBMSes on a fast Ethernet LAN consisting of two Windows NT Server 4.0 machines and 25 clients. The servers were a Gateway 2000 NS-8000 with two 333-MHz Pentium II processors, 512 MB of RAM, and three 9-GB RAID level 5 drives; and a Gateway 2000 NS-7000 333-MHz single-processor machine. The clients were a mixture of OS/2 Warp, Windows 95, Macintosh, and Windows NT Workstation PCs. During the tests, we turned off all NT's nonessential services on each database server.

Our database criteria were simple yet comprehensive. In our tests, we looked for scalability across a range of platforms, support for a variety of clients, reliability, capacity, speed, programmability, ease of administration, and security. We also examined the tools that each vendor ships with its database, including those for replication, schema manipulation, and temporarily off-line remote clients.

Using any of these vendors' supplied query tools to issue SQL statements was a poorly documented, painful experience. Oracle's tool, SQLPlus, offered to let us use a semicolon, slash, or period to delimit commands and statements. However, it demanded one delimiter for a block of SQL statements and a different delimiter for a PL/SQL stored procedure. The parser within SQLPlus also revealed its shortcomings by requiring a blank line between a comment line and a SQL statement. The fundamentally similar query tools from Sybase and Microsoft were easier to work with, but IBM's tool, Script Center, was much more limiting and difficult.

Within the limits of our test-lab capabilities—which provide a good simulation of a departmental installation, but not an enterprise situation—one clear winner emerged: Oracle7 7.3.

BYTE BEST
RDBMSES

Oracle7 7.3
This package scores with a robust, quick database engine, good scalability across many platforms, and good management tools.

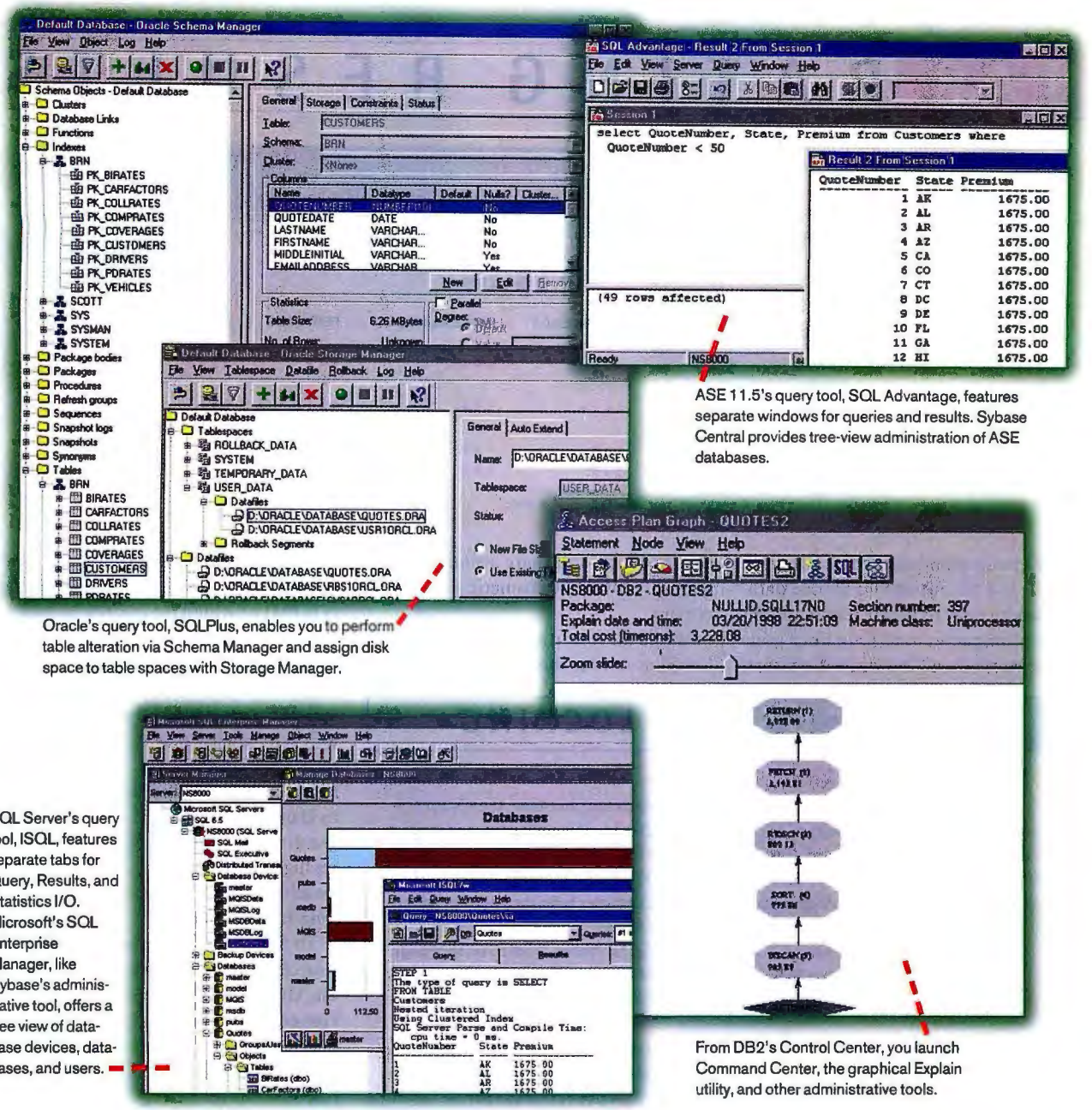
Oracle7 Server Database 7.3

Oracle scales well across more server platforms—92—than any other RDBMS. It handles sizable work loads, offers good security, has excellent third-party support, and connects with a variety of clients via ODBC, Java Database Connectivity (JDBC), or Oracle's own SQLNet protocol layer. Oracle wasn't the fastest database we tested, but it performed with alacrity. Oracle's tools proved useful, but they were not quite in the same league as Sybase's.

Oracle's strength is its pervasive platform support, which makes choosing an appropriate amount of database horsepower an easy job. In addition, because many transaction-processing (TP) monitor middleware products (e.g., BEA Systems' Tuxedo, IBM TXSeries, and Sybase Jaguar CTS) work well with Oracle, a growing application can scale up through the simple addition of more database and application servers. Oracle detects, and can take advantage of, multiple-CPU environments.

Like DB2, Oracle locked individual rows of our database rather than whole pages (i.e., collections of rows). The finer degree of concurrency control at the row level is especially helpful in high-volume situations in which page locking would tend to block database access for users merely wanting access to an adjacent entry (see the Tech Focus box "It's My Data; No, It's Mine" on page 102).

In an effort to improve the processing



ASE 11.5's query tool, SQL Advantage, features separate windows for queries and results. Sybase Central provides tree-view administration of ASE databases.

Oracle's query tool, SQLPlus, enables you to perform table alteration via Schema Manager and assign disk space to table spaces with Storage Manager.

SQL Server's query tool, ISQL, features separate tabs for Query, Results, and Statistics I/O. Microsoft's SQL Enterprise Manager, like Sybase's administrative tool, offers a tree view of database devices, databases, and users.

From DB2's Control Center, you launch Command Center, the graphical Explain utility, and other administrative tools.

All four of these enterprise RDBMSes provide extensive support for queries and administration, but each takes a slightly different tack.

of SQL statements, Oracle uses an optimizer to predigest SQL. As long as statistics exist in the database's data dictionary for at least one of the tables referenced by a SQL statement, the optimizer employs cost-based algorithms to consider the available access paths and then determines the most efficient execution plan for that access.

Oracle offers support for dynamic SQL and, for embedded SQL, a form of static SQL. However, unlike with DB2, there's no separate "bind" step for the programmer to perform during development.

Oracle supports replication onto other Oracle databases and DB2/MVS mainframe databases. Across multiple Oracle servers, we had several options for data replication. Oracle provided "strict" data replication through two-phase commit (or unsynchronized table snapshots) as well as loose, time-delayed replication from a primary database site. We could also specify optimistic replication, which allowed any one database site to update without waiting for other sites to catch up.

Adaptive Server Enterprise 11.5

ASE 11.5, from Sybase, is a multiplatform database manager that is more versatile and manageable than the other products we reviewed. The company ships three flavors: ASE, for mixed on-line TP/decision-support-system (OLTP/DSS) work-load environments; AS IQ, for data warehousing; and AS Anywhere, for workgroup, mobile, and embedded environments. We focused on ASE for mixed work loads.

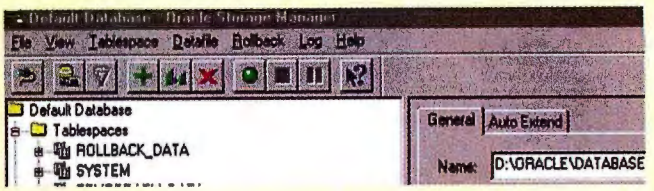
continued

LAB RATING RESULTS

BEST OVERALL

Oracle7 7.3

A robust database engine and good management tools show why this package is still the market leader.



	PRICE PER SERVER	PRICE PER FIVE USERS	TECHNOLOGY	IMPLEMENTATION	FEATURES	PERFORMANCE	OVERALL
Oracle7 7.3	**Contact vendor**	**$1475**	★★★	★★★★	★★★	★★★★	★★★★
Adaptive Server 11.5	$995	$3595 (eight users)	★★★★	★★★	★★★	★★★	★★★
DB2 Universal DB 5.0	$999	$995	★★★	★★★	★★★★	★★★	★★★
SQL Server 6.5	$849	$1399	★★★	★★★	★★	★★★★	★★★

★★★★★ Outstanding ★★★★ Very Good ★★★ Good ★★ Fair ★ Poor

In the past, up through Sybase SQL Server 4.9.2, the Microsoft and Sybase database products were nearly identical. But the two companies have long since gone their separate ways, and while their database products still share a similar architecture, only a few cosmetic similarities remain.

While all four database products allowed us to tune their behavior and performance, ASE's Logical Memory Manager (LMM) and Logical Process Manager (LPM) provided the greatest latitude in configuring the database engine. We used the LMM to explicitly name and allocate segments of memory to database objects, and then we adjusted the I/O block sizes for each named cache with values from 2 to 16 KB. Using the LPM, we assigned CPU resources to individual database users and to groups. This detailed control over the granting of database-resource usage let us set higher priorities for OLTP tasks while we allotted fewer resources to reports and long-running queries.

To further prevent low-priority, resource-hogging queries from hindering our OLTP tasks, we used ASE's Resource Governor. It monitored long-running queries and, using resource limits that we specified, throttled the database engine's response rate for those queries. At the same time, ASE's asynchronous prefetch kept those queries from starving by issuing multiple asynchronous concurrent physical reads, each having a memory buffer of 16 KB in which to work. Query performance thus improved because query tasks had to wait less time for read operations to complete.

Not all users have permanent connections to the database. The SQL Remote component of ASE 11.5, intended typically for salespeople on the road, replicates a portion of the database onto a notebook computer at the start of the workday and then reverses direction late in the day to replicate database updates from the notebook back to the central database. During the day, while off-line, people up-

TECH FOCUS: LOCKING

It's My Data; No, It's Mine

When two users try to update the same record in a database at the same time, there's a potential problem. Each user gets a copy of the record and makes his or her changes, and the last person to write the updated record wins—that is, the first update is overwritten and lost. To prevent this, when a user asks to update a record, the RDBMS locks up part of the database, preventing anyone else from having write access until the first user is finished and the update is written. But how much or how little can the RDBMS lock up?

A page-level lock ties up one page of a table, which affects all rows residing on that page. Row locks, in contrast, affect only individual rows. RDBMSes with large page sizes, tables with a few small columns, or a combination of both conditions makes page-level locking especially restrictive.

Oracle7 and DB2 allow row-level locking. SQL Server and Adaptive Server do not, although SQL Server supports row-level locking just for insert operations. One way to reduce the effect of page-level locking is to distribute the database content randomly throughout the tables, a feature that Ingres (not reviewed here) supports but that SQL Server and Adaptive Server lack. Clustering data to avoid contention requires a deep, detailed understanding of the database's contents.

The way in which an application handles transaction isolation with a page-oriented database is important, too. ANSI defines four levels of isolation. "Read uncommitted" allows the *reading* of rows with pending changes. "Read committed" prevents such reads. "Repeatable reads" supplies the same values for a row to an application no matter how many times the application accesses the row, but it prevents others from updating that row until the first application finishes its transaction. "Serializable" allows database modification by multiple applications only if the result is the same as if the applications executed serially.

If the number of page-level locks increases beyond a certain threshold in SQL Server, the database software escalates the lock to the table level, thus temporarily giving ownership of the entire table to a single user. Designing applications to keep the duration of transactions extremely short and closing any open cursors before displaying the contents of the database for update purposes are two measures that help reduce page-locking problems considerably. An application that opens a cursor, fetches only the first few rows for presentation, and leaves the cursor open for later fetching of other rows can cause considerable problems in the typical page-locked environment.

date their private copy of the database. In contrast to Oracle's Mobile Agents, SQL Remote includes a conflict-resolution feature to help you deal with the situations that can arise when the application of deferred transactions would cause database anomalies.

Sybase also includes sophisticated tools with its database. PowerDynamo enabled us to quickly and easily create dynamic Web page content from the database, while SQL Modeler gave us a graphical database-design workshop. SQL Modeler is an offshoot of the Sybase PowerDesigner product, which was called S-Designor before Sybase acquired it. We used SQL Modeler to reverse-engineer the database, make some changes, generate scripts to implement those changes, and then document the database.

DB2 Universal Database 5.0 Enterprise Edition

We found that IBM's DB2 scales well, runs quickly, is easy to administer, and adapts painlessly to Web-site use. For 24-hour, seven-day uptime, the DB2 database engine is high quality and reliable. While Command Center (DB2's graphical query tool) and other utilities gave us some trouble, the engine itself performed admirably.

Because it runs on AIX, HP-UX, NT, OS/400, OS/2, and Solaris, DB2 scales across quite a range; as with Adaptive Server, you can run DB2 on a variety of computers, from notebooks through clustered environments and massively parallel processors. However, Oracle scales that same range even more finely.

A central toolbox, called the Control Center, holds DB2's graphical database-management aids for administering, configuring, and tuning DB2. From the Control Center, you can manage and run scripts, monitor for database alerts, and make database changes, such as resizing a table space. Control Center and the other graphical tools are an order of magnitude better than the old command-line interface (which is still available for those who want to use it), but these new graphical tools too often show their lack of maturity. They failed for us several times by executing illegal instructions or accessing unowned memory.

Command Center, the graphical query tool for running scripts interactively or from a file you've prepared, choked on the 180-KB SQL script file for constructing our benchmark database. It then informed us that "the maximum number of 30,000 bytes has been reached." In addition, DB2 accepts only up to eight characters for user ID and up to 18 characters for table names and other identifiers. The "administrator" user couldn't log on to DB2, and the foreign key-constraint name "FK_COVERAGE_REF_CUSTOMER" was illegal.

On the other hand, IBM's wizardlike graphical SmartGuides were a pleasure to use. We used the Performance Configuration SmartGuide, for example, to dis-

RDBMSES FEATURES

	Adaptive Server 11.5	DB2 Universal DB 5.0	Oracle7 7.3	SQL Server 6.5
Price per user	$450	$199	$295 B	$280
PLATFORMS				
Windows NT	✔	✔	✔	✔
OS/2		✔	✔	
Solaris	✔	✔	✔	
AIX	✔	✔	✔	
DEC Unix	✔		✔	
HP-UX	✔	✔	✔	
NetWare			✔	
CLIENTS				
Windows 95	✔	✔	✔	✔
OS/2	✔	✔	✔	
Windows NT	✔	✔	✔	✔
Macintosh	✔	✔	✔	
Solaris	✔	✔	✔	
AIX	✔	✔	✔	
HP-UX	✔	✔	✔	
GENERAL				
Memory (MB)	16	16	16	16
SMP support	✔	✔	✔	✔
Row locking		✔	✔	
Graphical modeling tool	✔			
Mobile user support	✔			
Java in stored procedures		✔		
Maximum ODBC threads	30	Configurable	30	48
Static SQL		✔	✔	
Transactions per second (untuned)	8	10	*	*

B = BYTE Best ✔=yes *Microsoft's and Oracle's license agreements prohibit our disclosing these results.

The Next Sequel to SQL Server

We looked at the beta 2 version of SQL Server 7.0 to determine whether upgrading from version 6.5 is likely to be worthwhile. Our answer: a qualified yes, although we'll revisit this question in late 1998 or early 1999, when version 7.0 is closer to its production release.

This beta has a number of improvements that look promising. SQL Server won't require manual intervention to resize databases; instead, it will grow the databases automatically in 64-KB chunks. The internal page size is larger, increasing the maximum size of a field or row to 8 KB from its former 2 KB. SQL Enterprise Manager will become a Microsoft Management Console (MMC) plug-in, usable either directly on the database server or remotely via a Web browser. Version 7.0 also sports much-needed row-level locking.

Unfortunately, you'll pay a price for these big changes—the complete conversion of your databases—because version 7.0 won't work with or administer version 6.5 databases. A Version Update Wizard will help you make the switch. Microsoft estimates that a disk-to-disk conversion of 50 GB of data will take about 12 hours. A tape-based conversion will take considerably longer, and the Update Wizard will be useful only if you can afford to have your database off-line during the conversion. Organizations needing 24-hour, seven-day database availability will have to plan and execute their conversions carefully indeed.

cover the extent to which we could tune and configure DB2's behavior. Through experimentation, we found that DB2 is a chameleon; in one configuration, it performed like a data warehouse, yet in another it responded like a dedicated OLTP environment. The SmartGuide let us review a summary of proposed changes and then either execute the changes or save them to a script for later processing.

DB2's SQL compiler is highly tunable. Administrators and developers can choose from nine levels of optimization, resulting in performance that's specially tailored to the SQL emitted by a query tool or the SQL produced by an application program. This version of DB2 continues to distinguish between static and dynamic SQL, and clients can connect via a native calling interface, ODBC, or JDBC. DB2 even allows the coding of stored procedures in Java, a feature that Oracle7 7.3 needs desperately.

SQL Server Enterprise 6.5

This review comes at an awkward time for Microsoft. A new SQL Server version, 7.0, is in the works (although there's no target date for its release), which means the remaining lifetime of the 6.5 version we reviewed might be as short as a year. (See the text box "The Next Sequel to SQL Server" on page 103 for our evaluation of a beta version of SQL Server 7.0.)

SQL Server runs only on NT, of course. It's quick (although we're not allowed to tell you how quick), and it offers comprehensive administration via graphical tools. Its performance is likely related to its thirst for memory, which it consumes as it deems necessary. In one of our longer-running tests, SQL Server and NT fought over the last dregs of memory. However, neither one emerged the winner, as NT died and required a restart.

SQL Enterprise Manager (SEM), Performance Manager, and Security Manager are useful administrative tools surpassed in features only by Adaptive Server's utilities. Performance Manager displays a real-time graph showing SQL Server's resource consumption, by resource. Details such as cache-hit ratio, transactions per second, page reads per second, and single page writes per second are available for graphical display. Security Manager allowed us to choose between setting up separate SQL Server log-ons and instructing SQL Server to rely on NT Server's built-in security.

Through SEM, we created tables, users, and views, and we resized database devices. We also used SEM to set up replication between databases. SQL Server replication, via publish-and-subscribe, distributes content by subject onto subscribing remote database servers. A publication database server defines source tables, and a subscription database server subscribes to those published items.

SEM's interface makes configuring replication a particularly easy and painless process. However, changes made on a remote SQL Server by means of a remote procedure cannot be rolled back (i.e., undone), and replication of SQL Server databases is particularly memory-intensive.

SQL Server uses a cost-based optimizer to examine and reformat SQL statements, but its optimizer isn't as advanced as DB2's. As with the other products we tested, NT schedules individual threads on different CPUs if your database server is a symmetric multiprocessing (SMP) machine, but it doesn't execute queries in parallel.

Answering Your Query

Despite some awkward syntax problems with the SQLPlus query tool, the need to download working ODBC drivers from Oracle's Web site, and a counterintuitive installation process, the Oracle package emerged from our testing as the best all-around RDBMS. The core database engine is robust and quick (again, Oracle won't let us tell you *how* quick), the database scales well across a wide variety of platforms, and the package comes with a useful set of administrative tools.

Finishing a close second behind Oracle7 7.3, Sybase's Adaptive Server Enterprise deserves special mention for its tools, ease of administration, and scalability that's nearly as good as Oracle's.

Still, every one of these products gave us a significant amount of trouble. All leave considerable room for improvement. B

Barry Nance, a computer analyst and consultant for 25 years, is a BYTE consulting editor and the author of Introduction to Networking, *4th Edition (Que, 1997), and* Client/Server LAN Programming *(Que, 1994). You can reach him at* **barryn@erols.com.**

Don't Ask, Don't Tell

The relationship between the RDBMS vendor and the licensed customer can be rather strange at times. For this report, BYTE contacted five major RDBMS vendors, and their varied responses surprised us: Two of them accepted, two were skittish, and one left us standing by the curbside. For the record, the willing participants were IBM and Sybase.

Upon hearing that we planned to do performance testing (benchmarking), both Oracle and Microsoft suddenly expressed a reluctance to participate. Because we already had licensed copies of SQL Server Enterprise 6.5 and Oracle7 Server Database 7.3, we elected to test them rather than simply leave two major players out of this Lab Report entirely. The license agreements for all the tested products except DB2 forbid us from disclosing benchmark results. After listening to a description of our test plan, Sybase gave us permission to publish our benchmark results.

Oracle and Microsoft, however, sternly reminded us of their licenses' prohibitions against any user publishing benchmark results. In BYTE's opinion, this is a truly astonishing restriction, a remarkable example of vendor arrogance and disregard for the user. We're evidently supposed to take their word that theirs is the best product? Right!

PRODUCT INFORMATION

Adaptive Server Enterprise 11.5
$3595 for eight concurrent users
Sybase, Inc.
Emeryville, CA
510-922-3500
fax: 510-922-3210
dbtalk@sybase.com
http://www.sybase.com/
Enter HotBYTEs No. 1044.

DB2 Universal Database 5.0 Enterprise Edition
$999 per server plus $199 per user
IBM Corp.
Armonk, NY
800-342-6672
914-765-1900
fax: 313-225-4020
http://www.ibm.com/

Oracle7 Server Database 7.3
$1475 for five users
Oracle Corp.
Redwood Shores, CA
415-506-7000
fax: 415-506-7200
http://www.oracle.com/
Enter HotBYTEs No. 1046.

SQL Server Enterprise 6.5
$1399 for five users
Microsoft Corp.
Redmond, WA
800-426-9400
425-882-8080
fax: 425-936-7329
http://www.microsoft.com/
Enter HotBYTEs No. 1047.

Enter HotBYTEs No. at http://www.byte.com/hotbytes/

Jon Udell

Web Project

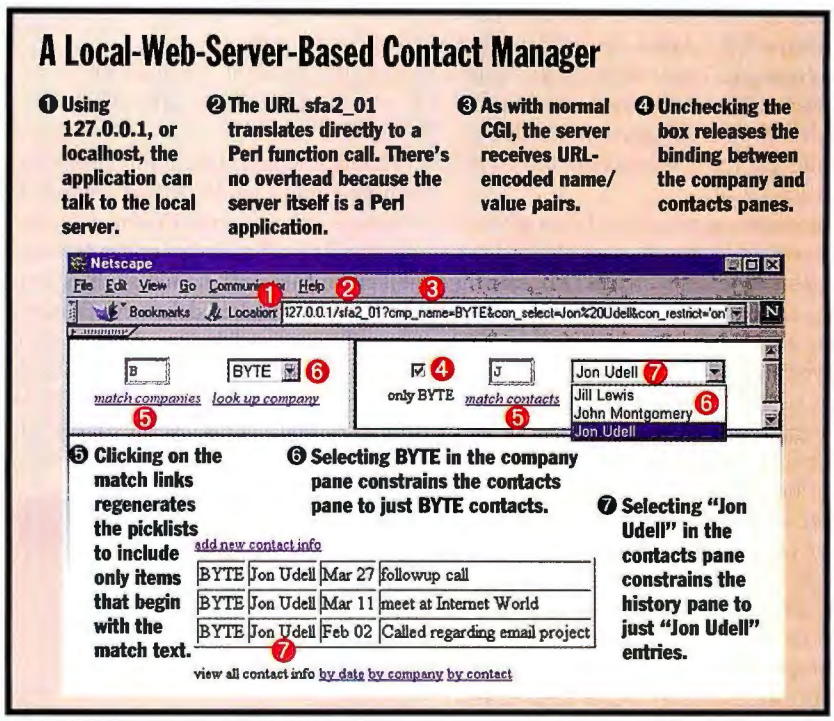
Local Web Servers

Java and Perl can create tiny Web servers that, deployed locally, support off-line browsers. Next step: The peer-to-peer Web!

"It's a nice idea," said editor in chief Mark Schlack of ByteCal, my servlet-based calendar program, "but I can't use it." Why? Like all Web-based software, ByteCal presumes that its display—a browser—connects through the Internet to an HTTP server. So, until the airlines offer Internet dial tone, our peripatetic editor in chief is out of luck.

How hard could it be, I wondered, to run the servlet locally on a disconnected client? Not hard at all, I found. That discovery prompted me to prototype a contact manager based on a tiny Web server written in Perl. These two very different applications share some interesting properties, which are outlined below.

- Small footprint. Both weigh in at under a megabyte, so they can be delivered on a single floppy or by way of a reasonable download. That megabyte includes the local Web server, the application logic, and the data.
- Good performance. Both run acceptably under Windows 95 on my aging 16-MB 486/50 Toshiba notebook.
- Simple configuration. You can install both by just unzipping the contents of a floppy, or an equivalent download, into a single directory. One requires a single environment variable, the other a single registry entry. That's it.
- Simple removal. In both cases, just nuke the directory. Remember when that used to work? It still can.
- Local/remote transparency. Both run identically when connected to the Internet and talking to a remote HTTP server, or when disconnected and talking to the local server.
- Browser orientation. Both exploit the fundamental tenet of Web-based software, which is that the universal HTML/JavaScript client that's already on your machine can act as a front end for a vast number of useful applications, most of which are as yet unwritten.



This little demo will hardly displace Ecco or Access, but it should make you stop and think about the power of local Web servers.

The principle at work here, which is best articulated in the writings of Bob Orfali, Dan Harkey, and Jeri Edwards, is that the client/server architecture of today's Web will inevitably evolve into a peer-to-peer architecture. Many of the nodes of the intergalactic network they envision will be able to function as both client and server.

I've always bought into this vision, but until recently I couldn't see a practical way to apply it. The answer, I think, is that servers needn't be the complex beasts we usually make them out to be. They can in fact be much simpler than the behemoth client applications we routinely inflict on ourselves. And in that simplicity lies amazing power.

Off-Line ByteCal

ByteCal, which is a Java servlet, runs inside a Java-based Web server—either JavaSoft's commercial Java Web Server (JWS) or Jef Poskanzer's free Acme.Serve. Because JWS is bigger and more complex than Acme.Serve, I immediately zeroed

in on the latter. Acme.Serve delivers servlet hosting in just 1500 lines of Java. It's perfect for a lightweight deployment.

How much of Java do you need to support Acme.Serve, which in turn supports ByteCal? I started with the current Java Development Kit (JDK), version 1.2 beta 2. It's approximately 15 MB of stuff, mostly Java classes not needed by Acme.Serve or ByteCal. To find out what classes I actually needed, I ran ByteCal like this:

```
java -v Acme.Serve.Serve
```

In this verbose mode, the Java interpreter emits the path name of each class that it loads. First I captured the list. Then I unzipped the JDK's classes.zip file to the root of my machine. Then I fed the `java -v` output to JHLZip (mentioned last month), which built an uncompressed Zip file containing just the classes needed by Acme.Serve/ByteCal.

The resulting streamlined class archive, plus java.exe, jvm.dll, java.dll, and net.dll, plus ByteCal's own HTML, config files, and object database, added up to just about a megabyte. I copied this stuff to c:\bytecal on a virgin machine, set PATH and CLASSPATH to c:\bytecal, issued the command `java Acme.Serve.Serve`, and pointed a browser at port 9090. It worked.

Unfortunately, you can't create and distribute a customized Java subset. Although Java is free, JavaSoft's license requires developers to ship the complete Java Runtime Environment (JRE). Alternatively, you can ask users to download the Java Activator, which, though primarily intended as a browser-neutral applet engine, also contains everything needed to run a Java console application, such as Acme.Serve. So, although technically you can deliver a full ByteCal installation on a floppy, in practice there's more overhead.

Another option is to distribute a natively compiled application. I built Acme.Serve/ByteCal with SuperCede 2.0 and found that its minimal footprint is under 3 MB (including ByteCal.exe, its config and data files, and SuperCede's run-time DLLs). That's a smaller package than any legally redistributable JRE, and it's way faster, too. Note that the single EXE file, because it contains the servlet engine, can contain a suite of servlets as easily as a single one.

While I was at it, I converted our online staff calendar from JDK to SuperCede. Interestingly, the performance benefit of SuperCede is largely masked by Web latency—except in the case of searches, which are dramatically faster. For local deployment to Win95 targets, however, SuperCede would be a clear performance win across the board.

Partitioning the ByteCal Database

The released version of ByteCal, 1.1, stores each user's calendar in a hash table and stores the collection of these calendars in a master hash table. When you update a calendar, the servlet serializes the entire structure to the file ByteCal.obj by passing the master hash table to the following chunk of code:

```
ObjectOutputStream o =
  new ObjectOutputStream(f);
o.writeObject(hash table);
```

Minimal support for off-line calendars required only a modest effort. I wrote a one-time-only export method to enumerate all individual calendars and save these objects to files with names such as Jon Udell.obj. Then I altered the servlet's start-up method to read this set of files. I also added a method to update an individual in-memory calendar from disk, which sounds difficult but is just the inverse of the three-line chunk shown above. Finally, I tweaked the update method so that it passes a per-user hash table rather than the whole structure.

The result was a naive implementation of off-line ByteCal. I can copy the file Jon Udell.obj from the server to my notebook PC, transact against the data store locally even while off-line, copy the file back to the server, and resynchronize using a ByteCal URL that reads the changed Jon Udell.obj and overwrites the live version of my calendar. It's fascinating to see how the simple object-database capabilities that flow from Java serialization can support data partitioning and replication.

Client-Side Java Unleashed

A real solution will have to manage the uploading and downloading of calendars, authenticate users who ask to check out calendars, lock on-line calendars that are checked out, and perhaps lock off-line calendars not owned by off-line users. I have not solved these problems yet. The point of this experiment was to test the feasibility of a client-side Java Web server. But given that substrate, I know I can complete the solution. Why? Because this configuration unleashes the full power of Java.

Contrast two possible implementations of calendar downloading/uploading. Although there are many options, I'll use the HTTP protocol in both cases. In case 1, a user downloads a calendar file using HTTP GET, and uploads using HTTP file upload. On download, the user has to deal with the Save As dialog box, and on upload with File Open. The developer would rather eliminate these inconvenient and error-prone user interactions, but the browser's security model requires them.

In case 2, the local servlet speaks the HTTP download and upload protocols directly to the remote servlet. Java inside the browser can't do these things, but Java outside the browser can.

The local servlet engine needn't be simply a mirror of the remote. It can implement whatever intelligence should appropriately reside in the client. Suppose I run local ByteCal from multiple off-line clients. Each, when connected, would like to receive the minimal refresh needed to synchronize with the public server. Each could do just that if empowered to act autonomously. As the client/server Web turns into a peer-to-peer Web, the door opens to a whole new dimension of application architectures. Crucially, these architectures can still rely on good old HTTP, which brows-

TOOLWATCH

LANdecoder32 2.0
$1995
Triticom
http://www.triticom.com/

The latest version of this Win32-based network monitor and protocol analyzer continues to deliver outstanding utility at an affordable price.

BOOKNOTE

Thinking in Java
$39.95
by Bruce Eckel
Prentice Hall
http://www.phptr.com/
ISBN 0-13-659723-8

This Java tutorial will be especially helpful to C++ programmers trying to sort out the ways in which Java is both similar to and different from C++.

ers and Web servers understand and firewalls will transmit.

A Perl-Based Local Web Server

Could local-Web-server technology help solve the application-development challenges associated with a typical contact manager? On a hunch that it might, I dusted off tinyhttpd.pl, Olaf Titz's classic Perl gem that implements a simple Web server in approximately 100 lines of code. I threw away the file-serving and CGI-execution portions, leaving just a simple socket server that can accept calls on port 80 and extract data sent using either the POST or GET method.

In normal Perl CGI, a URL such as `/sfa_01?who=jon&when=today` causes the Web server to launch the Perl interpreter against the script named sfa_01, which in turn receives the URL-encoded data `who=jon&when=today` by one of several means. High-performance variants, such as ISAPI Perl and mod_perl, keep the Perl interpreter in memory.

The same high performance results when Perl itself implements the Web server. This model doesn't make sense for heavily trafficked public sites. But it makes a great deal of sense for a local Web server (or a lightly loaded intranet server).

Capabilities and Features

What are these Perl functions in a position to do? Here are the key things.

- Dynamically generate HTML pages and forms.
- Interpolate values into those generated pages and forms.
- Communicate with ODBC, by way of Perl's Win32::ODBC module.
- Issue HTTP redirections.

These Perl capabilities, combined with some homegrown conventions for using HTML and JavaScript, yielded the application that's shown in the figure "A Local-Web-Server-Based Contact Manager" on page 105 and that is downloadable from *http://www.byte.com/art/download/sfa.zip*. Now, I don't pretend you'll want to dump Ecco or Act to use this prototype. It's just a sketch of a contact manager, but it exhibits some interesting features, including the following.

- *Namespace completion.* Last month I talked about generating HTML SELECT widgets (picklists) based on database lookups. This application does that. Type *M* in the "match companies" field, and you'll regenerate that pane with a list containing just the companies whose names begin with *M*.
- *Event propagation.* When you look up a company, the contacts picklist adjusts dynamically to display contacts at the selected company only. Then the contact-info pane adjusts dynamically to display records for the first name in the contacts picklist.
- *Flexible bindings.* By default, the contacts pane binds to what's selected in the company pane, and it displays an appropriately labeled checkbox. But if you uncheck that box and then type a *J* in the "match contacts" field and click on that link, you'll generate a list of all the *J* contacts at all companies.
- *Context-sensitive forms.* When you select a company for the contacts that exist, the contacts pane lists them. If none exist, the contacts pane invites you to enter a contact. Likewise, when you click on "match companies" and your input selects one or more companies, the company pane lists them. If none match, the company pane invites you to enter a new company. And it prefills the name field with your attempted match.

Parts List for the Contact Manager

The installation footprint is under 0.5 MB. Most of that is Perl itself, plus the module that connects Perl to ODBC data sources. You could add lots of new server capabilities, application logic, and HTML/JavaScript templates with very little size impact.

Name	Size (bytes)
System	
Perl.exe	87,040
Perl300.dll	564,224
Odbc.pll	177,152
Odbc.pm	23,318
carp.pm	2688
config.pm	6393
dynaloader.pm	20,053
exporter.pm	12,457
Data	
mdb.mdb	280,576
Application	
sfa2.pl	11,308
sfa2_02.htm	1895
sfa2_04.htm	2510
sfa2_08.htm	885
sfa2_10.htm	1163
sfa2_12.htm	1270
Installation	
readme.txt	337
sfa.reg	179

Toward a Peer-to-Peer Web

We expect these kinds of search, navigation, and data-entry idioms from applications written in FoxPro or Access. We don't expect them from Web-style applications that play to pure Web clients. Should we? Does it make any sense at all to position the combination of an HTML/JavaScript browser, ODBC/JET, and a local-Web-server-cum-script-engine as an application platform?

A number of factors weigh in favor of this approach. Perl is vastly more capable than the FoxPro, Access, or Notes dialects typically used to script this kind of application. The resulting application is small and fast. It relies on an existing and familiar client: the browser. It exhibits complete local/remote transparency.

There are also big drawbacks. Browsers don't support such data-entry idioms as accelerator keys and custom field-tabbing. JavaScript is flaky. The methodology, an intricate tapestry of signals, substitutions, and redirections involving Perl, SQL, JavaScript, and HTML is idiosyncratic. Data synchronization remains unsolved.

Although I prefer to write about deployed solutions, in this case I have yet to field a local-Web-server-based application. Nor can I guarantee that I will. But my instincts tell me to continue exploring this approach.

The Web client/server paradigm is stunningly productive because, above all, it radically simplifies the rules for developing distributed software. Web servers began as file servers, but they soon became method dispatchers transacting against structured and semistructured data. Those methods, written in rapid-development scripting languages, accomplish most of the useful work that the Web does.

Locating some of these methods and some of their data on clients just might be simpler and more productive than you would guess. If I'm right, the payoff could be huge. B

Jon Udell is BYTE's executive editor for new media. You can reach him by sending e-mail to **jon.udell@byte.com.**

Cosmo
Code 2.5

It's a third generation Java tool. But you've never seen anything like it.

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Javatalk

Rapid Java Development

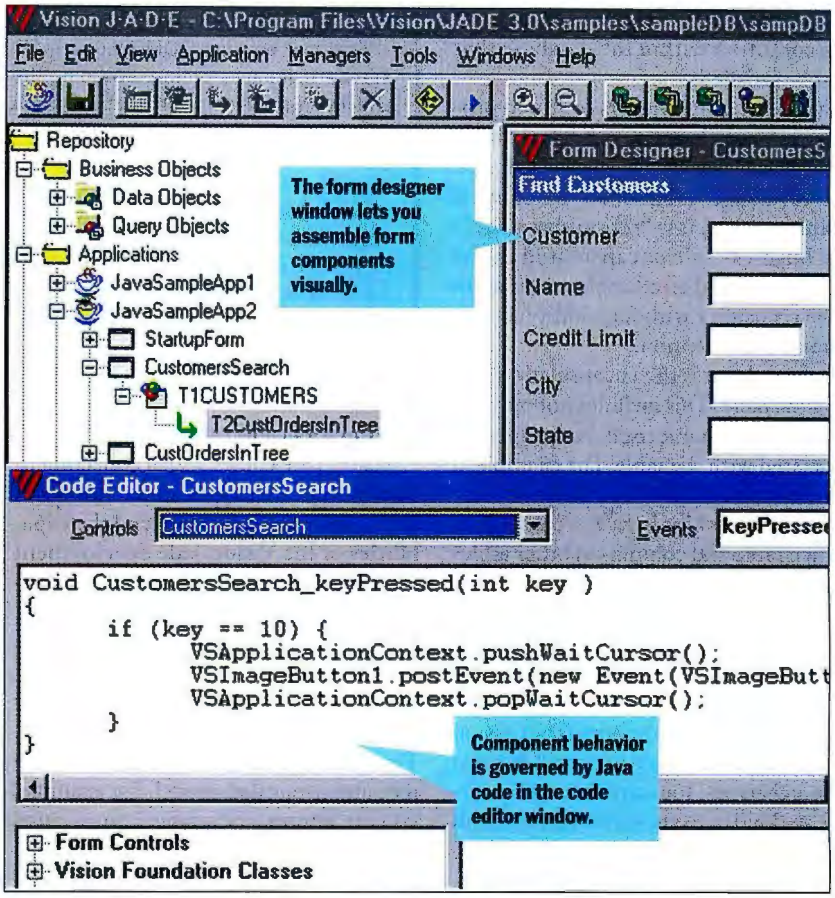
Vision Jade provides enterprise-level database application development.

Although the term *RAD tool* (rapid application development) is overused, Vision Jade deserves it as much as any product I've seen. Vision Jade, for developing complex, enterprise-wide database applications, is technically a Java product, but you will likely find yourself writing little Java code. In Vision Jade's automated visual-programming environment, most of the actual Java code operates behind the scenes.

Vision Jade uses a repository to store all elements of an application. Think of a repository as being a structured collection of objects. Parts of the repository serve as storage for data objects, query objects, and the other "raw components" that a developer knits together to build a Vision Jade application. The repository also stores the data model that defines the structure of the underlying database, as well as the applications themselves.

At its highest level of abstraction, a Vision Jade application is a collection of forms and transitions. A form is a window or a dialog box that displays data from a RecordSource, which is really nothing more than a data object or query object. The former encapsulates—and provides access to—a database table; the latter encapsulates a SQL query. Both can feed data to a form.

When you open Vision Jade, a multipane window appears. The leftmost pane is the explorer, which holds a familiar-looking, expanding-outline data structure for browsing the current repository as well as system archetypes. If you click open the repository in the explorer, the outline expands to let you browse the repository's contents, such as the applications, forms, and transitions. A transition is an event triggered by user activity



Building a form with Vision Jade involves a combination of visual and procedural programming.

(e.g., clicking on a button or selecting an item from a picklist) that causes the application to transfer control from one form to another.

When you open an application, the application designer pane at the right of the explorer pane fills with a tree diagram of the application. Forms are shown as rectangles connected by directed lines. The lines represent transitions.

Clicking on a form's rectangle causes the form designer window to open, filled with an editable image of the form itself. For example, to see the Java code that would be executed when a particular button is pushed on the form, simply right-click on the button, select "events" from the pop-up menu, and you are taken to the code editor. From within the code editor, you can select (from a picklist) the

Abstract Window Toolkit (AWT) events that the button can respond to and view (and edit) the source code of the Java method triggered by that event.

I noticed a great deal of similarity between the design environments of Vision Jade and Visual Basic. If you're a Visual Basic programmer who is familiar with form design and Visual Basic's approach of associating executable code with on-form objects, you should be comfortable working in Vision Jade.

In typical database applications, business rules are implemented by triggers or stored procedures. A business rule is an action that must be performed in response to a specific event. A business rule can also be a condition within the database that must be satisfied.

Instead of using triggers or stored procedures, Vision Jade lets you define a business rule at a high level as a business object. The advantage is that once you define a business object, it is "repository-wide": The business rule encapsulated in the object is imposed on all applications within the repository without additional programmer intervention.

A data object is the encapsulation of a database table. This includes not only the data within the table itself, but properties associated with the table. For example, a data object contains information pertaining to relationships between columns in its own table and columns in other tables (e.g., foreign key relationships). Meanwhile, a query object is the encapsulation of a SQL query. Because a query is manifested as an object, it can serve as a RecordSource for a form (as mentioned earlier).

In Vision Jade, you construct visual components (e.g., buttons and menus) from archetypes. You can think of an archetype as a kind of recipe—it consists of both properties and code (written in a macro language)—that the Vision Jade environment consults when creating a visual object at design time. At run time, the behavior of the object is determined by the Vision Foundation Classes (Java bytecode), which define the execution characteristics of all entities in a Vision Jade application. The Vision Foundation Classes are linked into the application at compile time.

Vision Jade comes with a collection of a dozen or so archetypes for the most common controls. You can extend the capabilities of the Vision Jade development environment by defining your own archetypes. Once you define an archetype, it becomes available to all applications in the repository.

Vision Jade is accompanied by other tools that aid in application development. The Reengineering Manager lets you update an existing data model. For example, you can import a new table into an existing data model. The Repository Exchange Manager lets you exchange objects between two existing repositories. The Query Object Editor lets you edit (and test) the SQL text that forms the functioning heart of a query object.

If you have already constructed a data model in, say, Microsoft Access, you can import that data model into Vision Jade and begin constructing applications to run against that model. The Data Model Validation Utility reads the data model and verifies its suitability for import into Vision Jade. (For example, even though some databases allow embedded spaces in table column names, Vision Jade does not. The Data Model Validation Utility identifies such trouble spots.)

Vision Jade includes support for complementary products. For example, you can use Rational Software's Rational Rose or Logic Works' ERWin to manage the data-modeling portion of application development and then feed the resulting models into Vision Jade. Similarly, you can do Java development in Visual J++ and transfer the code into your Vision Jade applications. In fact, Vision Jade uses the J++ compiler as its Java compiler.

Vision Jade was hitting general availability at the time I was writing this article (March). A trial version is available at Vision Software's Web site. The Vision Jade development system requires Windows NT or 95. Documentation states that applet deployment requires a Java virtual machine (JVM) compatible with either Java Development Kit (JDK) 1.0.x or JDK 1.1.x. Pricing for the Vision Jade developer studio starts at $2995. Costs for the deployment system are higher—contact the company for details. B

WHERE TO FIND

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A Standard for Portable Database Apps

In some of the product reviews I've done in the past few Javatalk columns, I've mentioned the ODMG object-database standard. Here's a brief explanation of what that standard covers. You'll find a more complete explanation in *The Object Database Standard: ODMG 2.0* (Morgan Kaufmann, 1997).

ODMG stands for Object Database Management Group. The ODMG 2.0 standard is an API standard that specifies the necessary bindings (function or method calls) for a particular language, so that applications written in that language can manipulate persistent objects. (ODMG 2.0 describes bindings for C++, Smalltalk, and Java.)

Note that, because ODMG 2.0 is an *API* standard, it says nothing regarding the underlying implementation. That is, ODMG 2.0 doesn't specify what the database holding the persistent objects looks like, nor does it specify the mechanics of how the objects are stored and retrieved. Consequently, an ODMG 2.0–compliant implementation can be erected on top of a relational database (which would then likely be called an object/relational database) or on top of a pure object database.

A key ingredient to the ODMG 2.0 standard is "transparency." This characteristic simply means that an application manipulates persistent objects using the same syntax that would be used to manipulate transient (nonpersistent) objects. For example, setting a pixel object's color attribute to "blue" would look like this:

```
pixel.color="blue";
```

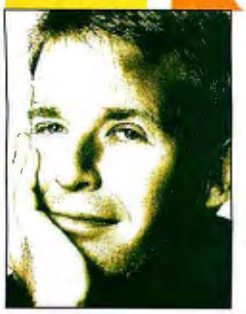
whether the pixel object was persistent or transient. This eases a programmer's learning burden.

Other portions of the ODMG standard describe the Object Definition Language, Object Interchange Format, and Object Query Language (OQL). The latter is a functional querying language based on SQL 92 that provides access to an ODBMS. A number of object-database organizations have products that are ODMG-compliant (I've mentioned several in past articles). These include Object Design, Poet, and Objectivity. JavaSoft itself has adopted the ODMG standard for its Java Blend object/relational database product.

Rick Grehan (Hancock, NH) works for Metrowerks' Discover Products division. You can reach him at **rgrehan@austin.metrowerks.com.**

Udo Flohr

FutureVision



Quantum Leaps

Someday PCs might be augmented by QCs—quantum coprocessors that do massive calculations instantaneously.

An internal directive for BYTE authors jokingly suggests that *Star Trek* references may be used only once every five years. Finally I've found a link between *Starship Enterprise* (as the series is known here in Europe) and the future of computing, so this is my chance. In December 1997, a team of scientists from the University of Innsbruck in Austria, led by Anton Zeilinger, reported they had achieved "quantum teleportation" in the laboratory. Another group in Rome, led by Francesco De Martini, has completed a similar experiment. Sit tight; you're about to be beamed up into the counterintuitive world of quantum mechanics.

The promise of the quantum computer, first envisioned in the early 1980s by Richard Feynman, is that we can exploit the fact that matter on the scale of electrons and nuclear particles also behaves as a wave function composed of multiple, superposed quantum states. One thing we can be certain of is that we must be clever in manipulating quantum particles, since their wave function collapses, or decoheres, when we attempt to measure them, according to Heisenberg's Uncertainty Principle. Quantum-computing research is largely a giant workaround for the Uncertainty Principle.

The power of a quantum bit—known as a qubit—is that it's not limited to a value of 0 or 1. Rather, it would be in a dynamic superposition of both. Thus, a register of three qubits, for example, would hold eight classical bits of information. Each qubit could do two calculations at once. Two qubits could do four, three could do eight, and so on.

Researchers are generally not trying to produce full-fledged, general-purpose quantum coprocessors (QCs). Rather, they are seeking to make coprocessors that are targeted at complex calculations, cryptography, or other special purposes. For example, a massively parallel quantum computer would be exponentially faster than a conventional computer at factoring large numbers into their prime-number components.

A QC could do that almost instantaneously, so it would have a fighting chance at breaking cryptographic codes made up of very large factors. Other examples of operations that QCs would be able to do quickly are the simulation of quantum systems themselves or the weather.

But researchers must overcome three challenges associated with working at the quantum-mechanical level: 1) Reliably inciting and controlling the desired quantum states; 2) Keeping these states stable long enough to do something useful with them until the results are ready to be read out; and 3) Reading out the results through quantum measurements.

Quantum teleportation will play a role in solving the last challenge. According to Zeilinger, if you want to have a distributed quantum-computing network, teleportation is the only known way to do it. If you encode information in an atom or some other particle and you want to transfer that information to another QC device, then this technique allows you to make an exact replica that preserves the particle's superposition information without measuring it. That's precisely the kind of trick needed to work around the Uncertainty Principle, which dictates that certain measurements are possible only to a limited degree of accuracy and will disrupt quantum states.

Keying In on Crypto

Quantum computers, which have the ability to break formerly unbreakable codes in a matter of seconds, also offer a nice solution for the new field of quantum cryptography: quantum key distribution (QKD).

Because measuring a quantum system leads to its unavoidable disturbance, eavesdropping on a quantum communication channel alerts its legitimate users. A random secret key can therefore be communicated between two parties, and the communication is secure even against an eavesdropper with unlimited computing power.

Sound like cold fusion? A team at the Los Alamos lab has implemented a QKD system that uses optical fiber and works over a distance of 48 km (see http://p23.lanl.gov/Quantum/crexper.html for more information). Because the technology will be important for transmissions involving low-earth-orbit satellites—where the use of fibers is impractical—the team is experimenting with "free-space" communication. Low-error transmissions over about 200 meters were achieved in the lab; transmissions over several kilometers will follow.

Spin Doctors

So how does Zeilinger's beamer work? Similar to the transporter on the cult TV series, quantum teleportation transmits information instantaneously. But in this case, it's between a pair of particles that might be a great distance from each other—one could actually be at the other end of the galaxy. The two particles are linked in a state called *entanglement*.

Entanglement is created by a process such as splitting an ultraviolet photon and

Blindly Programming Quantum Computers

Quantum computers might be wacky in some respects, but they're built from logic gates, just as their classical brethren are. These gates can invert a qubit or transform it into a superposition of several states through the application of energy, such as laser or RF beams.

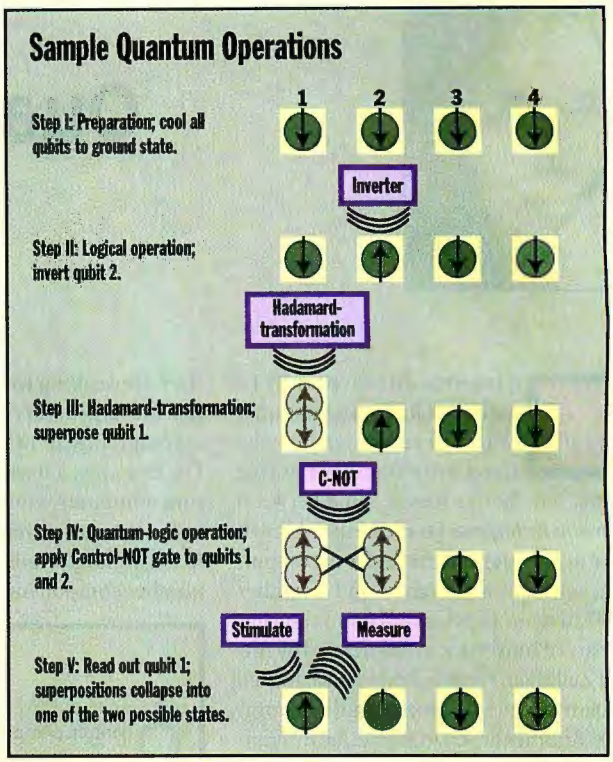
In the model shown in the figure at right, Step I is similar to a classical cold reset. In order for something useful to be done, steps II, III, and IV would be repeated many times and would involve more qubits. Step IV entangles qubits 1 and 2. Step V is the readout. Note that in this example, qubits 1 and 2 could collapse into the other possible state (one down, two up) with the same probability.

A reliable Controlled-NOT gate (step IV), which—similar to a classical XOR—negates the second input only if the first is true, is the next holy grail that experimental researchers hope to attain by year's end. Its appeal lies in its being useful for all kinds of algorithms while requiring only two inputs; quantum-engineering difficulty increases as more I/O channels are added.

The fact that the lid on a quantum calculation, as with that of a pressure cooker, can be opened only after the completion of an operation makes for some interesting programming paradigms. One person who can attest to this is Thomas Beth, who teaches algorithms at the University of Karlsruhe in Germany. His team is currently working on a quantum-logic compiler.

"With no tests or shortcuts, QCs have to use FOR loops instead of WHILE loops," Beth explains. "Representation theory will help us redesign conditional code to the restricted branching scope." Even assignments of the type X: = Y are irreversible and are thus verboten.

Quantum operations must be reversible. Otherwise, they dissipate heat, allowing observations, which would collapse the wave function.



then passing it through a crystal—a process called *parametric down-conversion*. The Zeilinger experiment creates a split beam of two photons traveling in different directions. The entanglement between them is such that one will always have a spin, or angular momentum, opposite to the other's. Which of them has which spin (up or down) is not known, and the Uncertainty Principle dictates that measuring the spin will break the entanglement.

Instead, Zeilinger hits one of the particles (the sender) with another photon (the message), which has a known downward spin. The collision causes the sender to switch to an upward spin. It also destroys both colliding photons. But before that, the receiver particle, which will always have the opposite spin of the sender's, instantaneously acquires the message's spin down. Information has now been beamed instantaneously.

Spooky stuff? That's what Mr. $E = mc^2$ himself called the whole idea of particles interacting at a distance. However, the experiment shows that the idea of entanglement that Einstein, Podolsky, and Rosen first proposed in 1935 at Princeton is indeed correct.

Coffee-Cup Computers

Other researchers are trying to move the technology out of the requirement to isolate particles at a very low temperature. Recently, Neil Gershenfeld of MIT and Isaac Chuang of Los Alamos National Laboratory suggested that bulk quantum computing would make it possible to do such work at room temperature, actually in something resembling a cup of coffee.

This approach overcomes the limitations of working with a few tiny particles by using billions of them. Radio waves incite spin in the molecules' nuclei, which can then be read using nuclear magnetic resonance (NMR) spectroscopy. The caffeine molecule is a good candidate because of its complexity—it has more nuclei to paly with. Only a subset of the particles in the cup are marshaled to follow the spin order, but sophisticated NMR technology allows all others to be considered background noise.

In a similar approach, researchers at IBM's Almaden Lab hope to use a scanning tunneling microscope (STM; see last month's column) to simultaneously set the spin of atomic nuclei inside small magnetic dots caught in ion microtraps, hundreds of which could be printed on a silicon wafer.

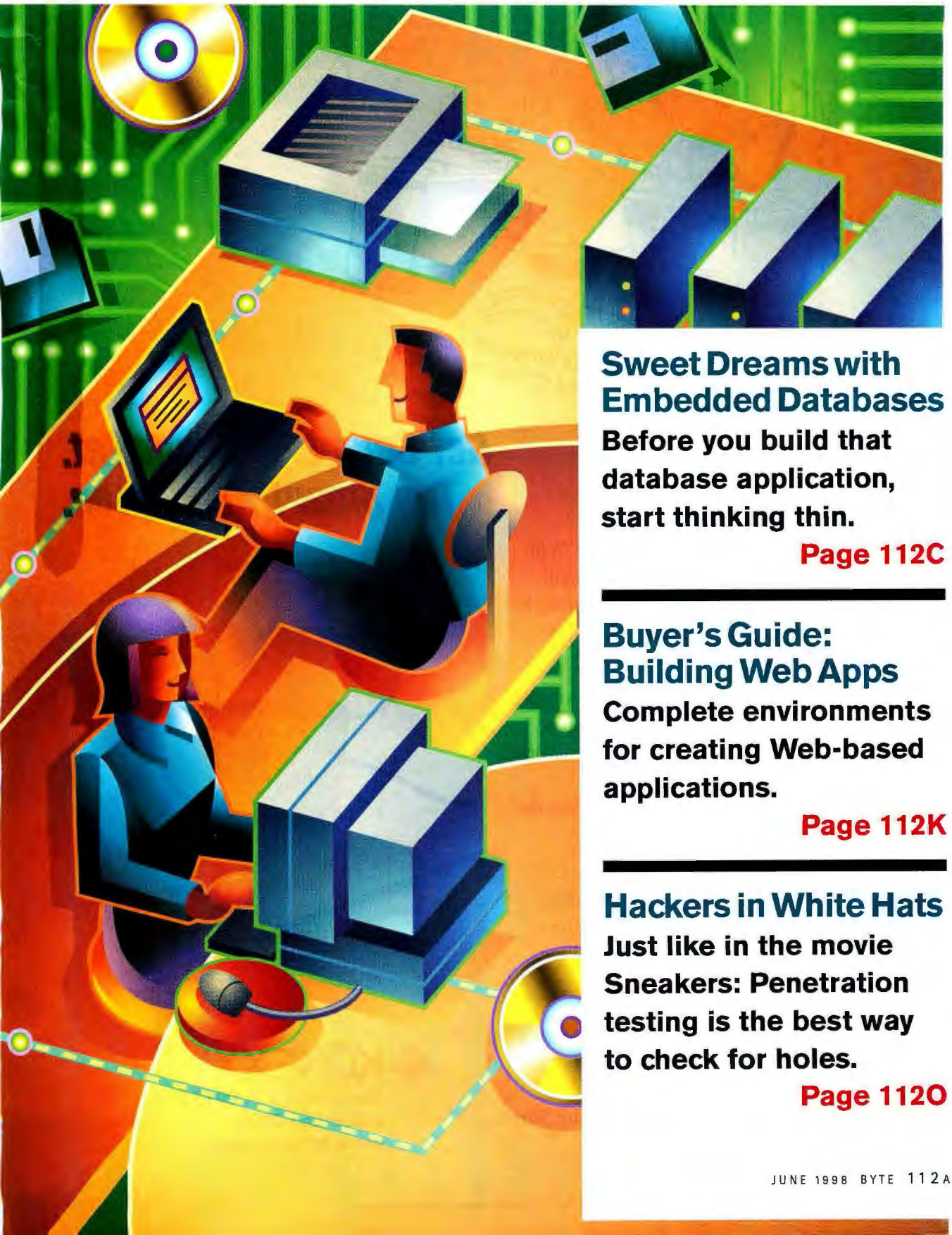
Nuclear spin, according to Gershenfeld and Chuang, is an ideal property for a QC because, due to the nuclei's natural isolation from the external world, the spin has long coherence times, lasting for thousands of seconds.

The concept of bulk NMR quantum computing is also at the heart of a new project at Stanford University, sponsored by DARPA (the U.S. Defense Advanced Research Projects Agency). The project will cascade quantum gates to experimentally demonstrate superfast quantum algorithms, devise workable quantum error-correction code (ECC) technology, and implement a QC compiler.

According to their mission statement, the team reckons it will be "straightforward to reach about 10 qubits" and says "the required instrumentation even promises to scale down to the desktop, so everyone could have a QC." B

Udo Flohr is a BYTE contributing editor who writes about advanced technologies. He is based in Hannover, Germany. You can reach him by sending e-mail to **flohr@dfn.de**.

BYTE Reseller



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Before you build that database application, start thinking thin.

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Buyer's Guide: Building Web Apps

Complete environments for creating Web-based applications.

Page 112K

Hackers in White Hats

Just like in the movie Sneakers: Penetration testing is the best way to check for holes.

Page 112O

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Small, fast, and easy databases are built into applications and hardware everywhere. ***By Edmund X. DeJesus***

Sweet Dreams with Embedded Databases

You've probably used one during the past week without even knowing about it. And you may well decide as you're laying out the specifications of your next software project that you'll be using one quite deliberately.

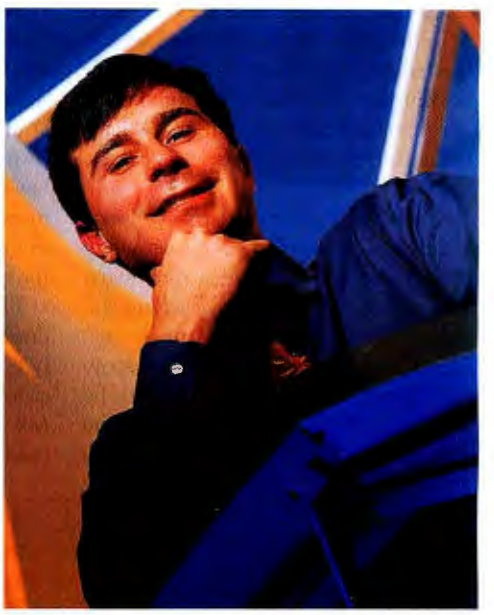
Embedded databases (EDBs) are the unseen workhorses of the computer world. Whether planted in a software application or in a piece of hardware, EDBs handle behind-the-scenes data storage and retrieval. Avoiding the size, cost, and complexity of the usual mongo heavyweights, they are small, easily integrated with applications, and inexpensive to buy and run. They operate without outside help, in small memory footprints, and on a variety of platforms.

No Bells, No Whistles?

Compare an enterprise database with an EDB: Volvo station wagon vs. hot rod. Enterprise databases demand significant IT support, a database administrator, and expensive system resources (see the table "Embedded Databases from 10,000 Feet," page 112H). EDBs don't. Or compare a personal database application with an EDB. Personal databases don't scale to multiple users, handle heavy transaction volume, or support sophisticated data integrity and recovery. EDBs do.

Enterprise databases usually have more bells and whistles than a one-man band. For example, enterprise databases usually offer built-in reports on The Usual Database Stuff that they can generate for you automatically. EDBs generally stick to the basics of storing and fetching data. Enterprise databases often provide extra capabilities, like mirroring of data, to ensure that if something happens to that database, a backup in the wings is ready to take over. EDBs don't bother: It's an unnecessary complication for the roles they fill. Similarly, enterprise databases provide for a graceful emergency fallback to another server if conditions go south. EDB vendors send their products off into the world with the understanding that they're on their own. EDBs have the toughness of simplicity—and the built-in smarts—to handle what their intended world throws at them.

Enterprise databases achieve their goals at considerable cost: in money, in resources, and in complexity. EDBs forego all that



PHOTOGRAPH: GARY LAUFMAN © 1998

"The biggest requirement was multiplatform support. We were primarily a Mac company, but we wanted to have this product on Windows as well."

—Jim Gochee, Connectix

and pass the resultant savings on to you.

This is not to say that EDBs are flat gray dullards without any sparkle. To be sure, one way to distinguish products in the EDB market is by the little extras each can provide (see "The Invisible Database" below).

Other features that might surprise you in an EDB include rollup of older data, data compression, record encryption, and variable-size data formats. (Encryption and compression are necessary for typical EDB jobs—like smartcards—that hold sensitive data but lack elbowroom.) Variable-size data formats are very helpful in dealing with applications whose data length you can't predict. For example, Empress Software's relational database management system (RDBMS) handles multimedia and binary large objects (BLOBs).

Probably the most attractive bell—or whistle?—is relational behavior. Many EDBs do have an orientation toward transaction processing, offering the usual rollback and commit operations. Therefore, one might imagine that, striving for simplicity, EDBs would mostly be flat-file databases. The opposite is the case: Nearly all EDBs are either fully relational databases or have a relational version as an option. (Pervasive.SQL offers simultaneous transactional and relational access to the same data.) Naturally, this simplifies constructing applications that require relational features.

Tiny Footprints

One of the most attractive features of embedded databases is their small memory footprint. Submegabyte sizes are common, and some EDBs need only about 100 KB.

In fact, it's possible to have even smaller EDBs. Some running environments—such as the Java virtual machine—provide processing services that further reduce the requirements on the EDB itself. Some of the latest products, including Java-based or object-oriented programs, have sets of functions in different components. Depending on which functions you can do without, your database's footprint can be positively miniscule.

This gentleness with your resources doesn't stop with memory. EDBs typically take up little disk space, too. Client sizes of 2 MB and server sizes of only 11 MB are not unusual. These little databases also stay in bounds with the databases they control. For example, many EDBs support databases of up to 64 GB in size. They manage this even if the underlying system does not support such large file sizes. They simply use files as big as possible and combine them logically into a single large virtual file.

Unlike certain enterprise databases that will remain nameless, EDBs do not demand the usual multimegabyte operating system or the horsepower of the latest high-end multiprocessor server. (Indeed it's good that they don't, since many EDB applications, such as smartcards, don't include an extension cord.) Many EDBs are happy to run on the 386 or 486 that's on the factory floor. In fact, many of them will run under antediluvian operating systems like DOS. As Bob Krause, president and founder of NeoLogic, puts it, EDBs are designed for a "low water mark." Such modest requirements mean real savings in hardware and upgrades.

Jumbo Savings

Saving money is one of the major reasons that program developers and independent software vendors embrace embedded databases. Vendors cite comparisons

The Invisible Database

Almost amusing paradox: Embedded databases are everywhere, yet they are invisible to users. EDBs are so useful they turn up in all sorts of in-house, proprietary, or shrink-wrapped applications. Operating systems, browsers, system management tools—all contain EDBs.

If your paycheck is processed by payroll giant ADP, it's probably going through an embedded database. Netscape Communicator's e-mail and newsreading facilities are built on an embedded database. Even UPS's package-tracking software is built on an embedded database. And (here we go again) the database is totally hidden from the application user. But not from the developer, who will notice the easy addition of encryption, compression, replication, and other features that could have taken weeks to build in. Here are a few of the many applications that contain an embedded database.

Company	Application	Embedded Database
ADP	Payroll software	Centura/Gupta's SQLBase
America Online	Web browser	NeoLogic's NeoAccess
Bay Networks	NetReporter tool in Optivity	Informix
Cheyenne Software	ArcServe for NT (network backup management)	Raima's Velocis
DeutscheBank	Remote banking services	Centura/Gupta
Federal Express	PowerShip customer system	FairCom
Hewlett-Packard	OpenView Network Node Manage	Not specified
Intermec (formerly Norand)	Hand-held route-accounting solutions	Raima's Database Manager++
Marimba	Castanet (Web push technology)	Cloudscape's JBMS
Microsoft	Windows NT	Not specified
Motorola	Iridium (satellite telecommunications project)	Objectivity's Objectivity/DB
Netscape	Communicator	NeoLogic's NeoAccess
net.Genesis	net.Analysis Pro (Web site analysis tool)	Informix
Sattel Technologies	WorldNet (telephony and data network)	Raima's Database Manager++
UPS	Tracking software	Centura/Gupta's SQLBase

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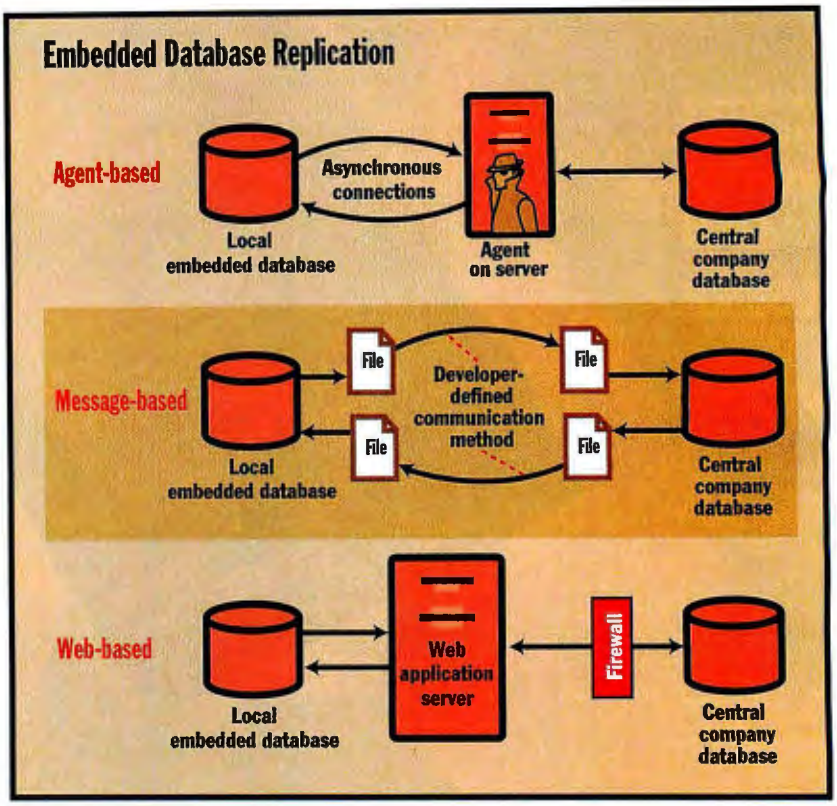
of total cost of ownership (TCO) as frequently as other, more technological, features of the EDB. There are several sources of savings.

One of the most important of these is the autonomous nature of an EDB. It is a set-it-and-forget-it piece of software. Many EDBs are self-tuning and do not require monitoring to optimize their performance. In fact, they can often perform more complex cost-based optimization on their own. They handle file management and dynamic caching by themselves. They create their indexes of data without any hand-holding.

Naturally, this is what you would expect from a database that's embedded within an application: You don't want users seeing the database at all, so it needs to be able to take care of itself. Reliability is one feature to count on in an EDB. Can you imagine if the database embedded in your PDA required a full-time database administrator? Making EDBs reliable takes a big whack out of TCO.

Another source of savings is the licensing structure of EDBs. In contrast to a full-fledged enterprise database or a personal database, where the cost is often determined by the number of concurrent users, embedded databases often cost a flat licensing fee for development use. Surprisingly, no matter how many users, the run-time license is free. When you're developing a new software product, that's music to your ears. Your earnest intention is that your product is going to be the next 1-2-3: The last thing you want is to pay per-copy royalties on the (invisible-to-the-user) embedded database you decided on. It takes a lot of bells and whistles to lure an ISV away from a flat-fee plan.



Embedded databases in mobile applications can replicate to and from a central company database in different ways.

Other developers choose an EDB that has a per-copy fee. If you're going this route, make sure that you're getting something more than software for your money. The vendor should be providing special and ongoing support for your development project. This could include training, seminars, and special technical assistance. Your fees may well be gaining you a partner, not just a software vendor.

One money-saving feature that's popular with resellers is simplicity of installation. EDB vendors typically strive to ensure that installing their database is as speedy a part of the application installation as possible: Get in, install, get out. Resellers like this because the sooner they're done with an installation, the better. Spending a week performing an installation with a recalcitrant database is not cost-effective.

Most companies fall into the SMB range: small-to-midsize businesses. They're probably not dealing with thousands—or even hundreds—of users. Thus, an embedded database, which typically handles one to about a hundred users, may be the perfect solution for their application development needs. Especially at a fraction of the cost of a burly enterprise database. That's why vendors design EDBs to scale up with a company's needs. The same database that runs on a hand-held device or a thin client can handle a hundred users.

Finally, there is an inexpensive way to get started with an EDB. Many vendors permit downloading the product, or a

Choosing the Right Side of the Embed

In the "real" world of software development, multiplatform support is extremely important. Connectix (known for RAM Doubler and Speed Doubler) offers its SurfExpress Web accelerator as a way to speed up seeing previously viewed Web pages. SurfExpress caches Web page data and header information in an EDB (NeoLogic's NeoAccess). It is available for Windows 95, NT, and Power Macintosh platforms.

Since Surf Express is an object-oriented application, the next requirement was a database that fit into that architecture. Also, the database had to support a multithreading model. Written in C++, SurfExpress accesses the database by linking directly with the database source code.

A small memory footprint and fast speed were also critical. Lead engineer Jim Gochee explains, "We are a client-based application, so memory size is extremely important."

Finally, the pricing structure (one-time fee—or yearly subscription for updates—with no run-time fees) was just what Connectix was looking for. "This made perfect sense for us because we didn't want to pay royalties," Gochee says, "and we knew our product would be a high-volume seller."

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Easy (Development) Street

As Charles Dickerson, director of product marketing for Pervasive, points out, probably the first thing to realize about developing applications using embedded databases is that the development model is exactly opposite that of other databases. With the usual database, the database dog wags the application tail. When you have a substantial investment in one of the big-name databases, you look only for applications for that database. The database dictates the applications.

With embedded databases, it's precisely the reverse. The application dog wags the database tail. You begin by designing your application. At some point you realize that an embedded database would make your development life a whole lot easier. You then look around for an embedded database that will fit into the space demarcated by required features, resources, costs, platforms, and other constraints. Those considerations then determine the EDB you choose. Therefore, building applications with an EDB had better be easy.

For example, if you're developing an application in the first place, you probably want it to be able to run on almost any platform. Note that this platform might be anything with a chip in it: a hand-held computer, smartcard, printer, microwave oven, anything. For this reason, EDBs also must run on a variety of platforms. Jim Gochee, lead engineer with Connectix (San Mateo, CA), is clear about the proper considerations in choosing an embedded database for the company's SurfExpress Web accelerator. "The biggest requirement was multiplatform support," says Gochee. "We were primarily a Mac company, but we wanted to have this product on Windows as well." (See "Choosing the Right Side of the Embed," page 112F.) You can usually take Mac OS and Windows as a given, but don't be surprised if supported platforms include OS/2, DOS, VMS, multiple flavors of Unix, BeOS, and real-time operating systems like LynxOS, QNX, or VxWorks.

One hot platform for embedded systems is Windows CE. This operating system is rapidly becoming a standard for hand-held PCs and other mobile devices. Given the limited resources of such a platform, svelte EDBs are a natural for their applications.

A related consideration, especially for client/server applications, is the network operating system you choose. Novell NetWare is the traditional favorite for many businesses, with Windows NT gaining popularity. You need to follow your customer's lead on this, and make sure you choose an EDB that supports several network OSes. According to Darren Laybourn, general manager of global development for Great Plains Software (Fargo, ND), the tie with Novell NetWare was a prime reason for choosing Pervasive's embedded database to hold the hundreds of tables in Great Plains' accounting software.

Most embedded databases support the most popular development tools, such as Delphi or one of Microsoft's programming tools. Some EDBs also come with their own development environment and tools. Simple Software Solutions' e_DB has utilities that automatically generate source code to jump-start development. Common EDB languages include C, C++, SQL, and Java. Greystone Software Technology's GT.M is accessible using M (formerly MUMPS).

Object-oriented development is alive and well in the EDB world. For example, Object Design's PSE Pro and Objectivity's Objectivity/DB are object databases. Oracle's Oracle Lite is also an object-relational database (and it doesn't hurt to have Oracle as an older sibling if your deployment plans point that way).

The scalability of EDBs simplifies development activities. The very same database that runs on a hand-held or a standalone can scale up to a client/server setting without changing a line of application code.

To further accommodate developers, vendors usually offer extensive APIs for their EDBs. This lets developers essentially ignore the inner workings of the EDB and concentrate solely on accessing the services that the database offers.

There are actually two schools of thought about this. One school says that the innards of the EDB don't matter to the developer: All the developer wants is the services of the EDB and the (possibly proprietary) API to use those services. This school would tend not to provide the source code of the EDB.

The other school contends that APIs are not enough. It's vital for programmers to have access to the source code of the EDB. One reason is high performance: If developers want all the performance possible from an EDB, they might want to strip it bare of all extraneous processing. Another reason is limited resources: When you're trying to shoehorn an EDB into an application, you don't want to bother with massive DLLs. Finally, there is platform independence. One sure way to achieve this is by compiling your application directly on the platforms you're writing for—but you can't do this without the source code of the database.

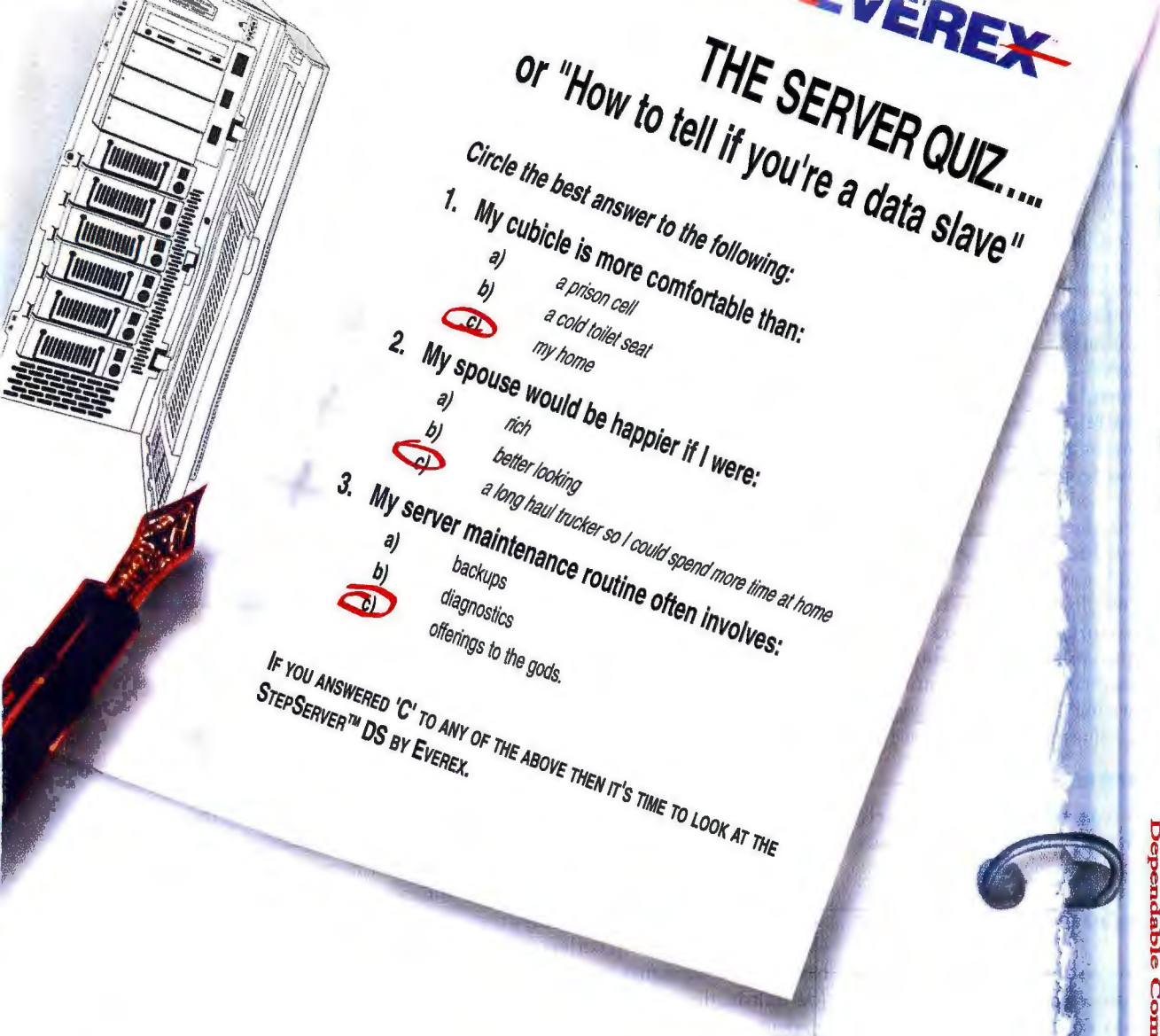
Access to source code can help when tweaking your application for performance. Some EDBs (like Raima's Velocis) offer a low-level C library for controlling the database.

Another option is to use standard nonproprietary database APIs. For example, you can access most embedded databases with ordinary SQL statements. Most also understand Open Database Connectivity (ODBC) calls.

With Java all the rage these days, Java Database Connectivity (JDBC) is becoming more important in the embedded database area. This is especially true for Web-based applications. Of course, Java

Embedded Databases from 10,000 Feet

Enterprise Database	Embedded Database	Personal Database
Large footprint	Small footprint	Medium footprint
Expensive	Somewhat inexpensive	Inexpensive
Leading-edge functionality	Trimmed functionality	Trimmed functionality
Requires database administrator	Self-administrating	Requires some administration
Forces database "lock-in"	Application needs drive database decision	Application needs can drive database decision



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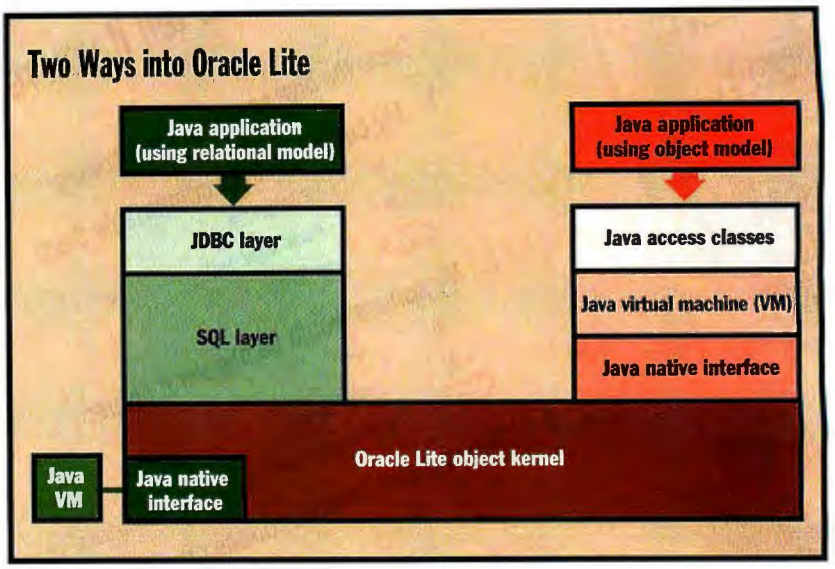
capability is not the sole reason to select an EDB (unless your only interest is in network computers). Features matter.

There are several ways to provide access using Java. One way is to build the database entirely with Java. Cloudscape's JBMS is the first such Java object-relational EDB. Patrick O'Brien, director of Java product development at Object Design, says that Java is an enabler. Pure Java products, including Object Design's ObjectStore PSE Pro, ease portability considerations for developers who may not be database developers.

Another method is to use Java Database Connectivity. JDBC consists of a set of Java classes for interfacing with a SQL database. Yet another way is to use a JDBC-ODBC "bridge." This translates Java access into ODBC access and vice versa. Java purists sneer at this method, which does have the disadvantage of putting two middleware obstacles in the way: Processing takes a performance hit.



A developer can access Oracle Lite using Java as either a relational DBMS or an object DBMS.

No Worries

Embedded databases are gratifyingly independent themselves. We've already alluded to the nonnecessity of database administrators. EDBs are very capable of managing data and queries in a hands-off manner.

They are also fast. Stripped of nonessential processing, they roar through basic database operations, even on modest platforms. You can't amputate an enterprise database, or feed steroids to a personal database, and achieve the same kind of performance. This makes EDBs ideal for real-time or near-real-time tasks, including data acquisition, manufacturing process controls, point-of-sale terminals, and telecommunications. This was important for Bergen Computer (Mahwah, NJ), which offers a line of EDI-based warehouse management software. Joe Walton, director of product development at Bergen, zeroes in on the high transaction speed of Pervasive's Pervasive.SQL as a major reason for using it in Bergen's real-time Simple EDI Paramount product.

Many hardware platforms use applications with embedded databases. Thin clients or network computers are obvious examples, especially for Java-enabled EDBs. But hand-helds and PDAs, telephones and vending machines, hubs and routers—and a hundred other devices—all employ embedded applications with databases.

In terms of the future, Raima president Steven Graves notes a trend of embedding the database within the application rather than making the application access an external database. Centura/Gupta CEO Scott Broomfield even sees EDBs moving into on-line analytical processing (OLAP) and data mining.

Embedded databases are growing in popularity as developers and ISVs realize their usefulness in powering applications and simplifying development. Pervasive claims to be gaining 100,000 new users every month. Sybase professes 3 million users of Adaptive Server Anywhere (formerly SQL Anywhere). NeoLogic claims 100 million users of its EDB; having Netscape as a customer helps. The next time you're looking at a nightmare project, an embedded database may be the database of your dreams. B

Edmund X. DeJesus is a senior technical editor at BYTE. You can reach him at **ed.dejesus@byte.com.**

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When developing Web-based applications, you have a variety of solid tools to choose from.

Buyer's Guide:
Development Tools for Web Applications

The Internet might look like totally uncharted territory, but there is a road map of sorts for developers working with Web-based application-development tools. Before the Web, there was the client/server model. As with client/server systems, tools for building Web applications began life as plodding, complicated development platforms, only to become slick packages requiring less technical prowess as the technology improved over several generations.

Start-ups such as NetDynamics and Haht Software, as well as old standbys such as Borland, IBM, Microsoft, and Sun, are releasing tool sets that offer a rich environment for Web development (see the table on page 112L). Developers can also use these tools for everything networked, from LAN deployments to centralized administration to file backup.

"We're looking for tools that can deliver robust applications with a minimal learning curve," says Jim Ingle, senior executive vice president of custom business solutions at the Revere Group (Deerfield, IL), a systems integrator. "The same reasons why client/server-based tools evolve will advance Web tools, which are becoming more 4GL-like [fourth-generation language], so you don't necessarily need to know Java or CORBA [Common Object Request Broker Architecture] or other technologies. You still need expertise in those architectures but don't have to learn as much about [underlying technology]."

Analysts who are following the area tend to agree with Ingle. They point to sheer demand as the reason for the technical strength that's found in the latest tools. "What was hard to do a few years ago is now center of the road," says Jim Balderston, who is an analyst with Zona Research (Redwood City, CA), an industry consultancy. Balderston praises the latest development software for its increased ease of use. Still, not all tools are the same.

Great variation exists in database integration, use of Java, and automation capabilities. But despite the need to carefully evaluate options, the news for developers is good: Web-based application development is coming into its own.

Says Balderston: "Web developers are building the most interesting applications dealing with interactive content."

–Ilan Greenberg

ILLUSTRATION: BILL FRAMPTON © 1998

Web-Based Application-Development Tools

	Platforms	Purpose	Differentiating factor	Price
Cold Fusion 3.1 Allaire, 888-939-2545, http://www.allaire.com	Windows NT, Windows 95, Solaris	Rapid application development (RAD) system for the Web	Emphasizes speed of implementation	$995 for application server, $495 for workgroup addition
Delphi 3 Borland, 800-932-9994, http://www.borland.com	Windows 95, Windows NT	Building enterprise applications	Powerful debugger, fast compiler	$799 for single-user license
Dresco 3.0 Infoscape, 415-442-5050, http://www.infoscape.com	Windows NT, Solaris	Java development and deployment software for intranet database applications	Developers do not need to know Java	$5000 for two developer seats
Hahtsite 3.1 Haht Software, 919-786-5100, http://www.haht.com	Windows 95, Windows NT, Solaris, Unix	Building Web-based business applications	Emphasizes global scale, inexpensive to deploy	$1995 per seat for developer kit
Java Development Kit 1.2 Sun Microsystems, 650-960-1300, http://www.sun.com	Windows 95, Windows NT, Solaris, Unix	Development kit for building applications based on Java	Java central, enhanced support for JavaBeans and Java Security	Free
NetDynamics 4.0 NetDynamics, 650-462-7600, http://www.netdynamics.com	Windows NT, Solaris, AIX	Application development for integrating platform-disparate systems	Rapid integration with ERP systems from PeopleSoft and SAP	$14,000 per server
Netiva 2.5 Netiva Software, 408-379-2100, http://www.netiva.com	Windows 95, Windows NT	Building databases for corporate intranets	Off-line development, automatic backup and recovery	$5000 for starter kit
PowerSite Enterprise 1.0 Sybase, 800-879-2273, http://www.sybase.com	Windows 95, Windows NT	Building mission-critical Web applications	Emphasizes thin-client and large-team development	$2995 per developer
Salvo Simware, 800-267-9991, http://www.simware.com	Windows 95, Windows NT	Integrating Internet or intranet with enterprise applications	Information Object technology quickly finds, extracts, and consolidates data	$50,000 for 50 concurrent users
SQml Web Agave Software Design, 972-424-6662, http://www.agave.com	Windows NT, Unix, Solaris	Creates HTML pages on the fly by leveraging database information	Automation features provide fast database access over the Internet	$495 for five concurrent users
Suite Tools 2.0 Netscape, 650-937-2555, http://www.netscape.com	Windows NT	Building cross-network, cross-application software	Based on open standards, ease of use	$945
Tengah WebLogic, 415-659-2600, http://www.weblogic.com	Java VM, Windows NT and 95,Solaris, Unix	Java-based application-development platform	No middleware required, high degree of scalability	$2000 per seat, plus $400 for annual maintenance
VisualAge, WebRunner, Beanery, Distributor Bean, Servlet Express, DSSeries LDAP IBM, 888-520-3991, http://www.ibm.com	Windows 95, Windows NT, OS/2 Warp, Solaris, AS/400	A range of development tools for building Java-based business applications	Tools for building Java-based applications	$200–$8000
WebApp 1.04 HyperAct, 402-891-8827, http://www.hyperact.com	Windows 95, Windows NT	Building Web-based business applications	New remote-administration tools	$495 for single-user license
WebHub HREF Tools, 707-542-0844, http://www.href.com	Windows NT	Framework for building scalable Internet and intranet applications	High-level HTML-page generation, rapid development time	$365
WebSpeed 2.1 Progress Software, 781-280-4000, http://www.progress.com	Windows 95, Windows NT	Developing business applications meeting the Internet Transaction Processing standard	Applications that achieve subsecond transaction processing	$995 for single-user license
Windows NT 4.0 Option Pack, Visual InterDev 1.0 (to be 6.0) Microsoft, 425-882-8080, http://www.microsoft.com	Option Pack: Windows NT InterDev: Windows 95 and Windows NT	Option Pack: Delivers Internet Information Server and upgrades InterDev: Visual tool for data-driven Web applications	Option Pack: Enhances NT investment InterDev: Rapidly build Web applications	Option Pack is free; InterDev is $499

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Penetration testing provides vital data when evaluating and assessing system security. By Stephen Cobb and David I. Brussin

Hackers in White Hats

Do you remember the opening sequence in the movie *Sneakers*? What looks like a bank robbery turns out to be a test of the bank's security system, executed by Robert Redford's "tiger team." When you apply a similar technique to information systems, it is typically referred to as *penetration testing*. The basic principle is the title of one of the seminal papers on this subject, "Improving the Security of Your Site by Breaking Into It," written by Dan Farmer and Wietse Venema more than five years ago.

Penetration testing continues to be a preferred technique for confirming the effectiveness of security measures when designing and implementing systems, and this article explains why. Indeed, given the rapid pace at which new systems get exposed to the world via the Internet, and the extent to which such systems rely on immature and undertested software, we would argue that penetration testing is even more important now than when the Farmer/Venema paper was written. This article also offers pointers to get you started performing such tests on your own systems. However, as we explain, there is a good case for having some or all of your penetration testing performed by an outside entity.

"Even with the best system engineers working on a project, it is unwise to go 'live' without some form of penetration testing to evaluate the security of your design."

—John Kirkwood, Siemens

Why Penetration Testing?

What distinguishes penetration testing from other forms of system security review is the fact that it looks at things from the point of view of an attacker. To state the obvious: Performing a penetration test with the tools that real attackers have available to them will demonstrate how your system is likely to fare in a real attack.

As such, penetration testing can be a valuable technique to use when it's your responsibility to protect sensitive systems and information. This type of testing consists of using contemporary hacking, scanning, and cracking tools and techniques to defeat security. These range from commercial packages with penetration capability, such as Internet Security Systems' Internet Security Scanner and Secure Networks' Ballista (see the screen on page 112P), to widely available freeware, such as SATAN (see "Useful Links" on page 112P). In addition, a good penetration test will exploit all known vulnerabilities in the target system. To

accomplish this, testers draw on a wide range of databases of vulnerabilities. This includes those that are publicly accessible—such as past Computer Emergency Response Team (CERT) Advisories and X-Force—and proprietary sources—such as those compiled by the testers themselves, representing the real-world wisdom of previous penetration tests.

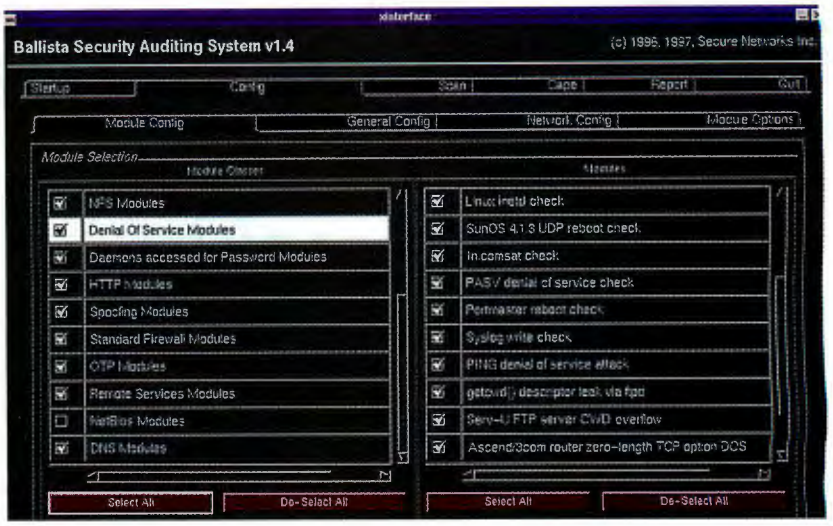
Allowed Paths and Serial Mode

You can see this wisdom at work in allowed paths and serial-mode attacks. Penetration testing provides you a unique opportunity to work around perimeter defenses, such as firewalls, by exploiting allowed paths. Allowed paths are those services that a system provides intentionally and by design. You can often manipulate them to compromise security.

For example, user responses to a CGI script on a Web site are an allowed path. However, if the script does not perform an adequate bounds check on the user's response, it is possible for you to crash the script and gain privileged access to the server on which it is running.

In terms of system penetration, serial mode means linking two or more attacks in sequence, as opposed to simply trying individual attacks one after another (see the figure "Attacking One Hole After Another" on page 112R).

To illustrate, consider the results of a penetration test on a large telecommunications company. One department in the company had put into place a sophisticated Internet architecture. But the architecture was configured in such a way that hackers could exploit a combination of several problems to thus compromise the internal network.



You can configure the Ballista Security Auditing System scanner to find security weaknesses in intranets, Web servers, and firewalls.

Individually, the problems presented minor weaknesses that were of no great concern. Even had anyone identified them through other means, such as a review of the architecture, they might not have caused much concern. But a small team of independent outside consultants, which the company hired in the role of penetration testers, approached the problem with an attacker's "serial" perspective and were able to combine the smaller vulnerabilities to create a major security breach.

How did they do this? Well, the architecture did not have a properly isolated internal and external Domain Name System (DNS). In and of itself, you would consider this to be a weakness in an Internet architecture, but not enough, on its own, to compromise the architecture. But the architecture also had a weak HTML/CGI combination that let an attacker send arbitrary e-mail from the Web server. Even this problem, although more serious, was not enough, on its own, for a compromise.

However, the combination of these two problems let the penetration testers target specific internal systems—which they could identify through the DNS misconfiguration and which contained sensitive company information—for sendmail attacks using e-mail from the Web server. The potential was there to disrupt the internal network and compromise data. At that point, they halted this branch of testing, having established the fact that a hacker would be able to systematically attack systems behind the firewall using these techniques.

Exploiting the Paradigm Shift

The contrast between defender and attacker is not the only factor that makes penetration testing by an outsider beneficial. The fact that an outside attacker is not involved with the development, or

Useful Links

http://www.cs.purdue.edu/coast/archive	Farmer/Venema paper on breaking into networks.
http://www.iss.net	More about the ISS scanner.
http://www.sni.com	More about the Ballista scanner.
http://www.tds.com	More about NetRisk, from Trident Data Systems.
http://ciac.llnl.gov/ciac/ToolsUnixNetSec.html	SATAN and a good collection of Unix security tools.
http://www.cerf.net/cerfnet/security/satan/docs/satan_doc.html	On-line SATAN documentation.
http://www.securityserver.com	Links to security testing sites and other security information.
http://www.intrusion.com	More about Kane Security Analyst.
http://www.tucows.com	Access to various port-scanning tools.
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concerned with the intended purpose, of a system allows a paradigm shift in the testing approach.

For example, we used this approach to expose a flaw in an Internet architecture designed by a health-care company. The design incorporated a Web server that would authenticate users and present various pages and forms, and a number of internal back-end components. The Web server, which existed within a firewall architecture, was to make requests of back-end database systems and present the results to the Internet user.

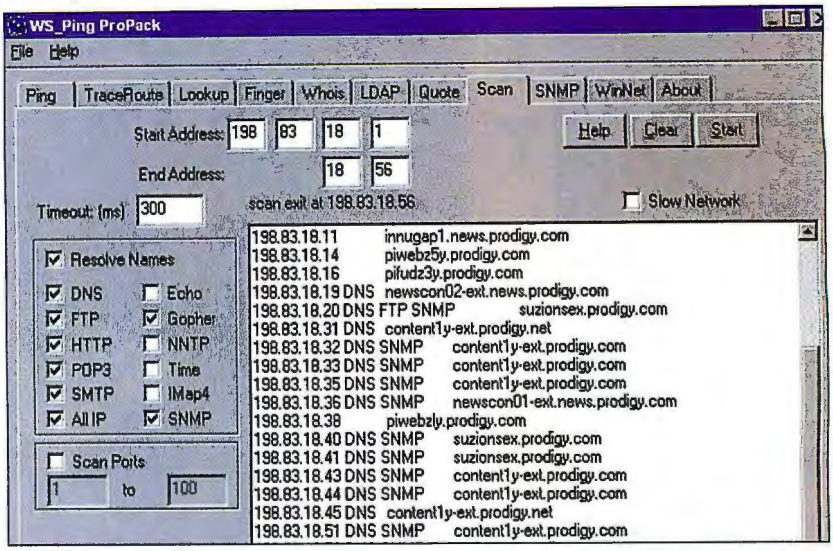
Considered purely from a design paradigm, this model makes sense. The Web server performs authentication and authorization based on its user database, and then requests information as required from the internal systems. The Internet user is prevented from directly querying the internal systems.

But from within a penetration-testing paradigm, certain security issues immediately become apparent. First, the fact that the Web server also contains authentication information is a serious design problem, given the growing body of tools and techniques that hackers currently use to attack various types of Web servers.

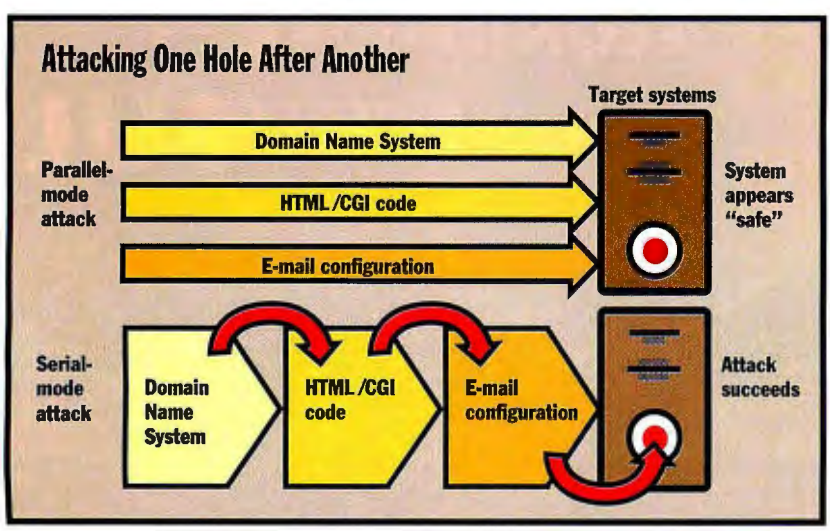
So, while designers believe they've constructed a secure system, the penetration tester knows that Web servers are a young and volatile class of application. If a weakness does not exist today in that specific Web server, it's likely that one soon will.

As a matter of fact, as we suggested earlier, one of the main qualifications for the job of penetration tester is a familiarity with the hacking tools that are available from Web sites and also with sources of information about new hardware and software weaknesses that an outside attacker may exploit.

In the case of the health-care company's Internet architecture, the penetration-testing paradigm revealed that once the testers had compromised the Web server, they would be able to send arbitrary requests to the internal systems and compromise confidential data. The penetration-testing paradigm itself revealed the necessity of a truly firewalled Internet architecture, containing a proxy stage between the Web server and the internal systems. In this case, it did not require any software tools or actual tests for us to convince the company of the kinds of damage the hackers could have wrought.



An IP port scanner (Ipswitch's WS_Ping Pro) tells what Internet services are running on Internet hosts, in an address range you specify.



Attacking a system in serial mode reveals weaknesses that a parallel-mode attack does not.

Further Along Allowed Paths

While a security administrator is busy monitoring firewalls for inappropriate traffic, an attack on an architecture's allowed paths can continue unnoticed, and often with a high level of compromise. Penetration testing is one of the best ways to expose vulnerabilities in the allowed paths that a system or architecture offers.

When you sit down to test a system, you want to find out what services it offers. In the case of Internet-connected systems, this process usually begins with a TCP/IP port-and-address scan (see the screen above). Tools to accomplish this are widely available (*http://www.tucows.com* is a reliable place to find lists and descriptions).

If a TCP/IP port-and-address scan doesn't immediately provide vulnerabilities for further exploitation, attention will shift to the allowed paths. For example, when you discover that you're prevented from making a telnet connection to hosts behind a firewall, you will soon realize there's probably no trivial way to make such a connection if there is no

known vulnerability in the firewall itself. At this point, you can focus on the allowed paths behind the firewall, which might include TCP/IP port 80 (HTTP), port 21 (FTP), or port 25 (SMTP)—on one or more addresses—to test the internal systems for weaknesses.

If you find that a Web server running behind the firewall has a CGI script that's known to be vulnerable to buffer-overrun attacks, you will be able to use the legal, allowed path to that server to effect a compromise (see "Useful Links" for sources in this area).

A recent penetration test we conducted provides an excellent example of the benefits of this type of testing. The target technology company depends on its Web site to supply secure access to sensitive company, client, and project information. In probes of the company's Unix-based Web server, no system-level vulnerabilities were immediately obvious.

Because we knew that the target information was available via the allowed HTTP path, our testing quickly focused on the Web server's authentication and authorization systems. In other words, how did the Web server know which user was allowed to see what data, and how could the Web server be sure of a user's identity?

As a result of these investigations, we were able to exploit several problems with the Web server's content to compromise all the sensitive target data, without ever achieving root access to the system. Here's how:

1. The testers took advantage of inconsistent HTTP access controls to gather information about legitimate user names.
2. They then used this information to manipulate the behavior of the CGI scripts that actually retrieved documents for display, obtaining access to the sensitive data.

Lessons Learned

This example of problems with allowed paths reinforces the importance of independent penetration testing. The domains of responsibility associated with most Internet projects actually hamper the ability of IS professionals to secure Internet applications. As was illustrated above, a traditional focus on the components of the architecture resulted in a minimum of vulnerabilities and presumably a high level of security.

But what would traditionally be considered the data contained on the components—here, Web content—contributed

Practical Testing Tips

Preparation is critical. Like painting a house, most of the work involved in a successful penetration test is in the preparation. You begin by making some key decisions:

1. Do you perform the testing yourself, or do you hire someone to do it for you?
If the former, you have to decide whether you are able to think far enough outside the box to make the test objective. If the latter, you need to be sure that the people you hire are reputable and trustworthy, because you are about to ask them to find the weaknesses in your defenses.

2. What is the target of the test?
The answer might be less obvious than you think. For example, are you going to use a war dialer to check all the company's phone lines for modems? Will you have permission to probe partner companies or clients that have access to the target company's systems?

3. What are the limits of the test?
You need to decide if the test is purely logical, using remote systems to attack, or if a physical element is appropriate. For example, the target company may let you use social-engineering techniques—such as dumpster diving and bogus calls to users—or sanctioned site access—such as an after-hours walk-through at the site.

If you are going to perform the test as an outside consultant, you will need a clearly defined set of objectives and the appropriate legal contracts in place before you begin. If you are going to perform the test as an insider, be absolutely sure you have full executive authorization before proceeding. In several cases, employees have been fired—or worse—for performing tests that they assumed were authorized. And in any event, be prepared to use tact and diplomacy when presenting the results of your tests. Few people enjoy finding out that they have security holes.

to the compromise of those systems. Because the IS security professional often has control over the OS, application, and network configuration—but not the content—you need other means to confirm the security of the architecture.

As John Kirkwood, information security manager for Siemens, notes, "Even with the best system engineers working on a project, it is unwise to go 'live' without some form of penetration testing to evaluate the security of your design."

While some IS managers still see penetration testing as an unconventional approach to security, the technique is analogous to the types of testing in other areas. After all, in software testing, individuals who were not involved with the coding of an application attempt to find conditions where a program will fail or behave unexpectedly.

Similarly, penetration testers look for situations where the security of a system can be defeated or circumvented. This technique is critical for confirming the validity of security designs and implementations in the context of available hacker techniques and tools. Furthermore, penetration testing can provide several unique approaches to evaluating and testing designs, providing for more robust and elegant security solutions. B

WHERE TO FIND

Internet Security Systems
Atlanta, GA
770-395-0150
http://www.iss.net
info@iss.net

Intrusion Detection, Inc.
New York, NY
800-408-6104
212-348-8900
http://www.intrusion.com

Siemens Nixdorf
Munich, Germany
+49 89 636 01
http://www.sni.com

Trident Data Systems
Los Angeles, CA
310-645-6483
http://www.tds.com

Stephen Cobb (**scobb@miora.com**), *a Certified Information System Security Professional, is the director of education and research at Miora Systems Consulting. David I. Brussin* (**dbrussin@miora.com**), *a Microsoft Certified Professional, is the director of MSC Labs and also a senior consultant at Miora Systems Consulting.*

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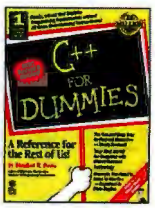

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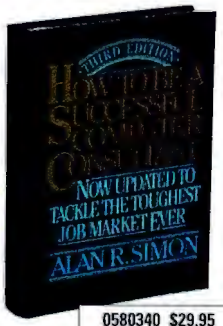

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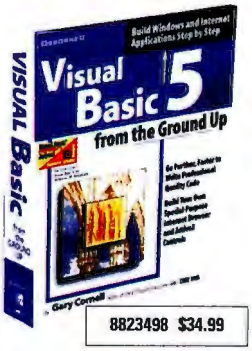

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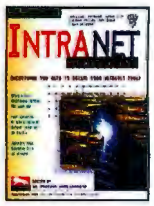

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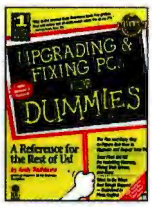

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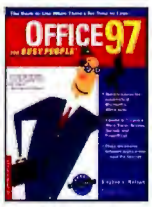

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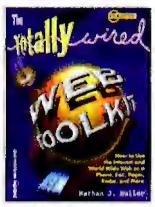

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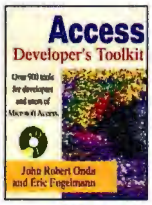

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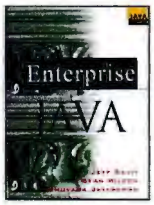

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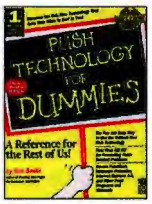

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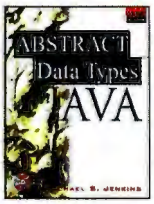

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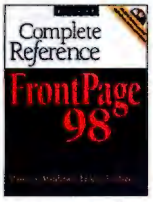

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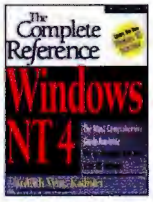

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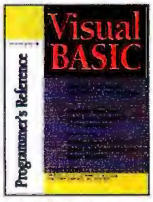

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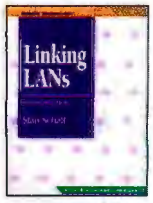

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Eight-Way Servers Race for the NT Prize

SMP servers equipped with six and eight Pentium Pros are ready to go. Here's how they stack up as computing muscle for the power-hungry enterprise.

By Robert L. Hummel

It's not an unfamiliar scenario: Your business is simultaneously drowning in data and starved for information. The task of rending raw data into productive information requires increasingly more processing power. Finding and applying that power in an environment of growing processing demands is a Herculean task—and you want solutions.

Given the obvious need for more processing power, the market has responded, rapidly advancing the state of the art. Servers using two- and four-way symmetric multiprocessing (SMP) architecture are now so common they are commodities. Windows NT Enterprise, which supports more than four processors, inspired the development of servers with six, eight, and more processors.

Clearly, this much processing power in a single package is a solution searching for an application. IT managers, looking to simplify administration chores and cut costs, might be tempted to consolidate applications from a number of smaller servers. And the headroom provided by larger SMP servers promises a cost-effective way to manage applications that need scalability, such as databases, messaging systems, and Web servers.

We examined six- and eight-way enterprise servers for NT. While doing so, we made a not-too-surprising discovery: The features, configuration, and applications that go into a large SMP server are far more important than raw performance.

Missing Pieces

But there's a dark cloud surrounding SMP's silver lining. Consolidating a number of smaller applications on a single eight-way server might save administration costs, but it also multiplies the impact of a server failure. For hosting separate smaller applications, industry analysts say that deploying many four-way or smaller commodity servers is preferable to having one larger server.

The effective system scalability of large SMP servers is also nebulous. Common sense tells you that simply adding processors to a system is an effective solution only when the system in question is CPU-bound. Unless you take into account other typical bottlenecks—such as disk, memory, and network bandwidth—and balance those resources, you could wind up with a system that's both inadequate and expensive.

BYTE BEST
LARGE SMP SERVERS

HP NetServer LXr Pro 8
This was the top eight-way server, posting the highest TPC-C throughput, best price/performance, and top usability and implementation scores.

ALR Revolution 6x6
Delivering proportional performance, a competitive price/performance score, and the lowest price, this system proves that six-way SMP is a viable alternative to eight-way SMP.

At the enterprise level, mission-critical computing also depends on more than just scalability; equally crucial are availability, reliability, and manageability. Until distributed processing and clustering failover solutions for NT become more mature, larger SMP servers will continue to be a weak link.

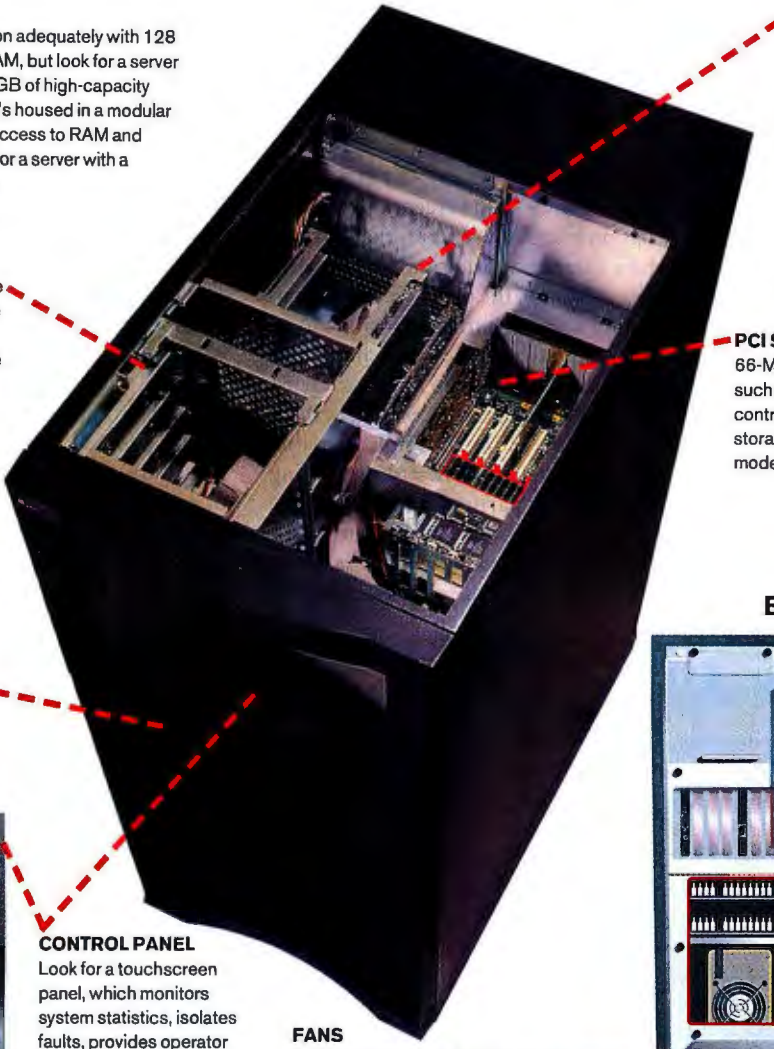
Another dose of cold water on the SMP fire is the applications themselves. Until the software catches up, scalability and expandability are mostly just promises. For an application to truly leverage an SMP platform, it has to be written for that configuration from the ground up.

In some cases, Unix solutions are more robust, reliable, and scalable. But while Unix variants still dominate high-end server operations, that's no longer true for the entry-level and midrange server markets. The ability to migrate NT up the server food chain—and preserve your expertise and investment—is one that should figure heavily into your decision.

Cost Justification

If you expect your computing needs to grow, it makes sense to invest in a machine that can be expanded—at least that's how IT departments are justifying the purchase of large SMP servers. Specifying the largest box with the fewest installed processors keeps you ahead of the saturation point—and disaster. The bottom line: An eight-way server with four processors and headroom is a better investment than a fully loaded four-way server with no future.

Having empty processor slots is cheap insurance. If you underestimate application growth or overestimate the performance of your hardware and software, you can drop in a few more processors or more memory. On the other hand, if large SMP Deschutes-based servers appear



RAM
Databases will function adequately with 128 to 256 MB of ECC RAM, but look for a server that can offer up to 8 GB of high-capacity SDRAM. Make sure it's housed in a modular unit that allows easy access to RAM and processors. And opt for a server with a 1-GBps memory bus.

DRIVE BAYS
You'll need extra drive bays (top) to upgrade a server's mass-storage capacity. The system pictured has room for 24 hard drives (bottom) but typically comes with 12 4.5-GB drives. Choose hard drives with fast controllers and access times at or below 13 milliseconds for database applications that query thousands of times per day.

CPU
Two to eight 200-MHz Pentium Pro processors power large database servers. These are in turn powered by Intel's 450GX chip and can include 512 KB of L2 cache, although you'll get better performance if you opt for 1 MB of integrated L2 cache. Make sure the processor cards can be easily added or swapped out, without any tools, for system upgrades.

PCI SLOTS
66-MHz PCI slots can house such components as SCSI controllers for external mass storage, video cards, and modem cards.

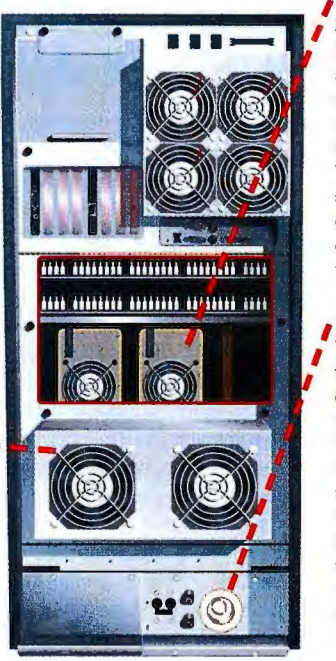
FRONT

CONTROL PANEL
Look for a touchscreen panel, which monitors system statistics, isolates faults, provides operator control, and allows users to enter a password for electronic locking doors.

BANKS OF HARD DRIVES

FANS
Four large fans provide air flow to memory boards and dual power supplies. The smaller ones work in conjunction with heat sinks to cool the processors.

BACK



POWER SUPPLIES
Make sure power supplies are hot-swappable, redundant, and easy to install or swap out. Two will generally suffice, but a third can be used for custom configurations.

POWER
The power connector attaches to a dedicated and properly grounded 190- to 240-VAC 20-amp outlet, which must be a NEMA L6 20R, 20A, 250 VAC, twist-lock female receptacle for mating with the system.

Illustration based on Axil Northbridge NX801

more quickly or less expensively than predicted, you can make a midcourse correction without blowing your budget.

Manufacturers confirm that very few SMP systems are purchased with the maximum number of processors installed and *that only* a relative handful are ever upgraded. Rather than upgrade, most managers follow a reassign-and-replace strategy. Today's mission-critical Web server is tomorrow's print server.

Defining the Field

We evaluated four systems from manufacturers that have solid reputations in the SMP server market: ALR, Axil Computer, Data General, and Hewlett-Packard. At their hearts, the three eight-way servers we examined bear more than just a passing similarity. The Axil Northbridge NX801, Data General AViiON AV 8600, and HP NetServer LXr Pro 8 are all based on the Adaptive Memory Crossbar technology developed by Axil Computer, a subsidiary of Hyundai. The ALR Revolution 6x6 was the only six-way server we examined. It has two CPU cards, each with a three-processor SMP bus joined by ALR's Dynamic Orchestration arbitration technology.

Several SMP server manufacturers are notably absent from this Lab Report. Unisys, a customer and codeveloper of ALR's SMP technology, declined to participate. The lack of audited TPC-C benchmark numbers excluded NCR's OctaScale-based eight-way Pentium Pro server, a system resold by Sequent Computer. Digital Equipment, another OctaScale technology customer, also refused our invitation.

Finally, neither IBM nor Compaq plans to make a server with more than four Pentium Pro processors. Both say they're targeting their new SMP designs exclusively at Intel's Deschutes (Pentium II) chip.

Contributors
Michelle Campanale, BYTE Technical Editor
Al Gallant, BYTE Lab Manager
Robert Pickering, BYTE Lab Assistant
Robert L. Hummel, BYTE Consulting Editor

A small number of demanding server applications have created a small market for large SMP servers. If you're considering one of these high-end NT servers, it's because you need, or anticipate needing, more power than you can wring from the current crop of four-way servers. At the same time, you don't want to overcommit yourself to a technology based on the soon-to-be-obsolete Pentium Pro. Minimizing the trade-offs of what is sure to be a relatively short-term investment means emphasizing value.

In determining our Best Overall score, we weighted value at 45 percent and performance at 30 percent. This combination brings the systems that have the best balance of price and performance to the front of the pack. We kept our usability weighting to 10 percent to avoid overemphasizing gee-whiz characteristics that might not be appropriate for everyone's application. Similarly, the 10 percent weighting for implementation recognizes the fact that shortcomings specific to a particular user's requirements in a high-value system can often be overcome by working with the vendor or by integrating third-party solutions. The final 5 percent weighting rates a system's level of technological innovation.

Best Overall

The HP NetServer LXr Pro 8 posted the highest performance of all the systems we examined. With a tpmC throughput score of 16,257, it is, simply put, a screamer. Much to our surprise, the NetServer also provided the most bang for the buck, turning in an aggregate system cost of only $33.67 per tpmC. The NetServer's high implementation and usability scores cemented its position as our Best Overall winner.

Been There, Done That—The Unix Alternative

You need performance, scalability, dependability, and reliability on your SMP server—now. But it might not be safe to expect technology and performance longevity from one of these large SMP Windows NT servers. If you need another solution, IBM has a suggestion for you: Try an AIX system.

IBM markets its RS/6000 S70, an SMP system running the AIX variant of Unix, as an unabashed enterprise server. The S70 is a modular rack-mount system with as many as 12 RS64 64-bit processors, 16 GB of ECC synchronous DRAM (SDRAM) memory, and up to 56 PCI slots. The S70 supports a terabyte of address space and native 64-bit integer computation. Up to 48 hot-swappable internal drive bays can hold up to 218 GB and a whopping 14 TB of external storage.

An impressive laundry list of capacities and room for growth are important psychological selling points, but IBM admits that very few customers buy a system fully loaded. That's easy to understand when you consider that such a system can cost $2 million. And IBM says that up to 75 percent of its SMP customers never add processors to their current hardware, opting instead to buy an entirely new system.

"Customers buy these machines at less-than-maximum capacity," says Bill Smith, product marketing manager for the RS/6000 product line. "They want the promise of growth capacity in the box."

Nonetheless, IBM insists that the maximum capacities of a system are an important factor for you to consider when making a purchasing decision. "When you list your capacities, it's a gee-whiz thing," Smith explains. "But some isolated applications are using those capacities, and the number is growing."

Vendors also aren't shy about touting the superiority of Unix to Windows NT. The ability to exploit an SMP system must be designed into an OS from its inception—as these vendors say is the case with Unix. In addition, they claim that the maturity of Unix naturally makes it a better system. "You can't have a system environment that's prone to reboots and crashes," says Smith. "AIX has a strong history of hardening over time."

Granted, the S70 system is different, but does different mean inherently better? Proving that to a potential customer can be problematic. IBM notes that its systems don't always do well on what it calls abstract industry-standard benchmarks, such as those conducted by the TPC, but it adds that the best configuration for any particular customer's application is unlikely to be represented by a benchmark.

Eventually, Smith says, customers realize that they can't solve their problems with commodity systems that are purchased based on reviews they see in magazine articles. "It's a very complex world," he explains. "Customers are looking for more than just hardware from their vendor. They're looking for a relationship."

RS/6000 Enterprise Server Model S70

Standard configuration ($125,000)
- Microprocessor: four-way 125-MHz PowerPC RS64
- Level 1 (L1) cache: 64 KB data/64 KB instruction
- Level 2 (L2) cache: 4 MB per processor
- RAM (memory): 512 MB
- Memory-bus width: Dual 512-bit
- Internal disk drive: 4.5-GB SCSI-2 F/W (hot-swappable)
- Expansion slots: 14 PCI (11 available)
- PCI bus width: 32- and 64-bit
- Memory slots: 20

AIX OS
- Version 4.3 (a one- or two-user server license is standard)

System expansion
- Internal PCI slots: Up to 56 per system
- Internal media bays: Up to 12 per system
- Internal disk bays: Up to 48 (hot-swappable)
- Internal disk storage: Up to 218.4 GB
- SMP configurations: Up to two additional four-way processors
- RAM: Up to 16 GB
- External disk storage: Up to 1.3 TB SCSI; up to 14 TB SSA

Warranty
- One year (limited)

LAB RATING RESULTS

BEST OVERALL EIGHT-WAY SERVER

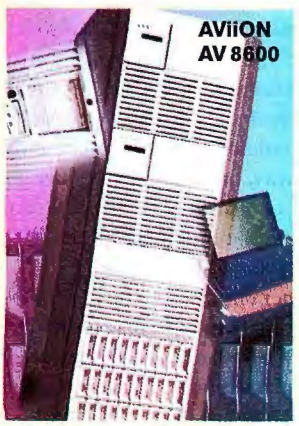
HP NetServer LXr Pro 8

If you're looking for a cost-effective eight-way server that supports powerful OLTP computing with plenty of headroom, the NetServer should suit you nicely. The setup and service policies simplify system administration, and the physical overengineering, typical of HP products, makes maintenance an easy task.

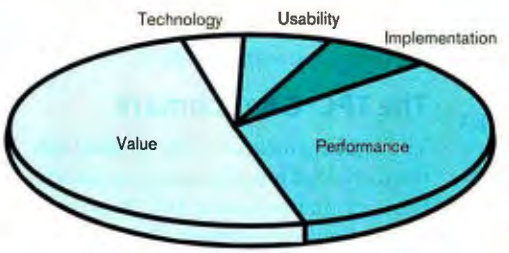
BEST ECONOMY SMP SERVER

ALR Revolution 6x6

If your current four-way servers won't hold you until the new Deschutes systems appear—but you have modest expansion requirements—you can save money without sacrificing much performance by getting ALR's six-way server. With proportional performance and competitive price/performance, this server represents an excellent value.



WEIGHTING



	TECHNOLOGY	IMPLEMENTATION	PERFORMANCE	VALUE	USABILITY	OVERALL RATING
HP NetServer LXr Pro 8	★★★★	★★★★★	★★★★★	★★★★★	★★★★★	★★★★★
ALR Revolution 6x6	★★★★	★★★	★★★	★★★★★	★★★★	★★★★
AViiON AV 8600	★★★★	★★★★	★★★★★	★★★	★★★★	★★★★
Axil Northbridge NX801	★★★★	★★★	★★★★	★★	★★★★	★★★

★★★★★ Outstanding ★★★★ Very Good ★★★ Good ★★ Fair ★ Poor

The most direct performance threat to the NetServer was the Data General AViiON AV 8600, which trailed just 1 percent behind with a tpmC score of 16,101. Performance, in this case, comes quite dear. The AViiON's $897,290 price tag (for the TPC configuration)—nearly 64 percent higher than that of the NetServer—drove its dollar-per-tpmC rating to $55.73.

We were pleasantly surprised by the ALR Revolution 6x6, the only six-way server we evaluated. The Revolution achieved about 81 percent of the eight-way NetServer's throughput using only 75 percent as many processors. The Revolution's system price was similarly proportional, yielding a value score of $35.11, just a few percent higher than the NetServer's.

The Axil Northbridge NX801 had the dubious honor of being part of the most expensive system configuration in this group, pricing out at an eye-popping $1,138,717. The NX801 is an object lesson that high cost alone doesn't guarantee performance. With a tpmC score of 14,501, the NX801 ranks just 10 percent higher than the six-way Revolution, which sells for less than half the NX801's cost.

Next Steps

Should you invest in one of these Pentium Pro SMP servers now or hold off until Deschutes-based servers appear in early 1999? If your mission-critical application is going to outgrow your current computing infrastructure before Deschutes is ready, your decision is already made: The alternative is to stop doing business.

If you can confidently predict that the projected growth of your application over the next 18 months won't exceed the capacity of a six-way server, consider the ALR Revolution. Its lower price will save you money up front, but its minimal expandability and omission of fault-tolerant features may negate your initial savings.

If limited expandability isn't a viable part of your future, you might be better off buying an eight-way system and populating it with processors as your needs grow. The HP NetServer's modular design encourages orderly growth, and its superior manageability and no-tools, high-reliability design make it a cost-effective option.

Benchmarking large SMP servers can be an intimidating prospect. Varying the processor count, installed memory, and peripheral combinations on just a single system results in literally hundreds of possible configurations.

We examined, and subsequently rejected, a number of candidate benchmarks. One test exercised and graded subsystems, such as disk and I/O performance, but it didn't lend itself well to generalization at the system level. Another test simply lacked the depth to stress a system running eight 200-MHz Pentium Pro processors. One promising benchmark was still in development and wasn't available to meet our publication deadline.

Hardware vendors are sometimes loath to submit their systems for benchmarking. Poor performance numbers resulting from a less-than-optimum configuration or a poor benchmark design can be a public-relations nightmare; it's safer to decline to participate. Unfortunately, a vendor can also use this excuse to camouflage poor performance, taking a "trust me" approach with customers.

It's impossible to construct a test—either real-world or abstract—that can be generalized to every application in every environment. Nonetheless, it's possible to use objective benchmarks to make a subjective decision if you use them wisely. That was one of the tasks taken on by the Transaction Processing Performance Council (TPC).

The TPC is a nonprofit consortium of computer system vendors, software database vendors, market-research firms, system integrators, and end-user organizations. There are currently more than 40 members worldwide. The TPC's mission is to develop and enforce computer system benchmarks. Complete descriptions of the TPC benchmarks and sample programs are available from its Web site (*http://www.tpc.org/*).

The TPC-C Benchmark

The TPC benchmark C (TPC-C) simulates the work load found in complex on-line transaction processing (OLTP) system application environments. A TPC-C session includes simultaneous execution of multiple transaction types, on-line and deferred transaction-execution modes, multiple on-line terminal sessions, heavy disk I/O, and contention on data access and update.

To give these basic operations a real-life context, they are combined to represent the business activity of a wholesale supplier. The TPC-C work load centers around the activity of processing orders and provides a logical database design, which can be distributed without structural changes to transactions.

There are, of course, some common-sense limitations on the TPC-C model design. It doesn't attempt to exactly depict any particular business or purport to be a template for an actual application. Instead, it emulates, in a controlled and verifiable way, businesses that must manage, sell, or distribute a product or service, such as a car-rental firm, food distributor, or parts supplier.

The benchmark models a wholesale supplier managing 10 districts that each serve 3000 customers. Customers interface by placing new orders or requesting the status of existing orders. Orders comprise an average of 10 line items. One percent of all order lines are for items not in stock at the regional warehouse and must be supplied by another warehouse. The system must also record payments from customers, process orders for delivery, and examine stock levels to identify potential supply shortages.

Defining Performance

Completion of the TPC-C benchmark produces two measurable results: sustained system performance (i.e., throughput) and price/performance. Throughput is defined as how many new-order transactions per minute (tpmC) a system generates while executing four other transaction types (payment, delivery, order status, and stock level). Time constraints on all five transactions ensure that the system is adequately servicing the entire transaction-mix work load.

The TPC-C price/performance number is derived by dividing the price of the entire system by its tpmC throughput. System cost includes not only the host machine but also terminals, communica-

TECH FOCUS | WINDOWS NT

NT: Victim of Success?

Detractors of Windows NT—and there is no shortage of them—are quick to brand the OS as suffering from poor scalability and poor reliability, pronouncing it unsuitable as an enterprise OS. In many ways, NT has been a victim of its own success.

The abundance of features available in NT has caused some problems, according to Jeff Price, Microsoft's product manager for Windows NT. In the initial port of several major server-based applications from Unix to NT, vendors found these new features and tried to incorporate every one of them—without weighing their effect on performance. This caused a drop in performance compared to the same application on the simpler Unix architecture. "Vendors that bring applications to NT have to go through a few revisions until they get it right," Price explains.

Scalability is one dimension of a mission-critical server. Lack of reliability is another area where NT has taken some deserved criticism. Does NT crash more than Unix does? Perhaps, Price admits, attributing the problems, whether they are real or perceived, to four causes: immature administration, uncertified hardware, application clustering, and bugs in the OS.

More attention is being paid to the perception of reliability and manageability in upcoming versions of NT. Configuration changes that require a system reboot under NT 4.0, for example, can be changed on the fly under NT 5.0, according to Price.

What's ahead for NT? According to Price, better memory management, improvement in I/O, and support for 32 GB of RAM on the Alpha platform. NT's capabilities have to catch up with expectations, but the hardware platforms have to evolve as well.

"We're also working on the 64-bit version of NT for Intel's Merced," adds Price. "That's our opportunity to do a complete kernel rewrite. NT will be an entirely new OS."

tions equipment, software (i.e., transaction monitors and database software), backup storage, and maintenance cost for three years.

It's rare for any benchmark result to come without a warning to the effect that your mileage may vary—and TPC-C is no exception. TPC-C can't possibly represent every OLTP application or specific work load accurately. Unless you have entire teams of vendor technicians devoting themselves solely to tuning your system for optimum throughput, chances are slim that your system will be as tuned as those in the TPC-C test. TPC-C should be viewed as a yardstick for comparing the relative performance of different architectures and system designs rather than a precise tool for capacity-planning for your specific application environment.

System Configurations

The TPC produces test specifications and audits the benchmarking process to ensure its integrity. But specifying the configuration of the system to be tested is up to the discretion of each vendor. One might load a system heavily to produce the highest tpmC score, sacrificing value for bragging rights on performance. Another might submit a more balanced system to acquire the lowest dollar-per-tpmC throughput cost. Each of the four systems we examined has undergone the rigorous TPC-C benchmark and audit processes.

All systems were tested with the maximum supported number of processors installed. The ALR Revolution hosted six Pentium Pro 200-MHz chips, each with a 1-MB L2 cache. The Axil, Data General, and HP machines ran eight 200-MHz Pentium Pro processors, each also with a 1-MB L2 cache. All systems had 4 GB of error correction code (ECC) memory installed—a maximum load for the ALR Revolution and half-full for the other systems. All were running Microsoft NT Server 4.0 Enterprise Edition and hosting Microsoft SQL Server 6.5 Enterprise Edition.

Storage for the ALR Revolution comprised 139 hard drives arrayed across seven three-channel PCI SCSI caching RAID controllers and totaled 813 GB. The system also included an uninterruptible power supply (UPS). The HP NetServer LXr Pro 8 included nine Mylex Fast/Wide three-channel PCI SCSI caching RAID controllers handling 155 hard drives, providing 1.16 TB of disk storage. Additional equipment included an 8-GB internal digital audiotape (DAT) drive and a UPS.

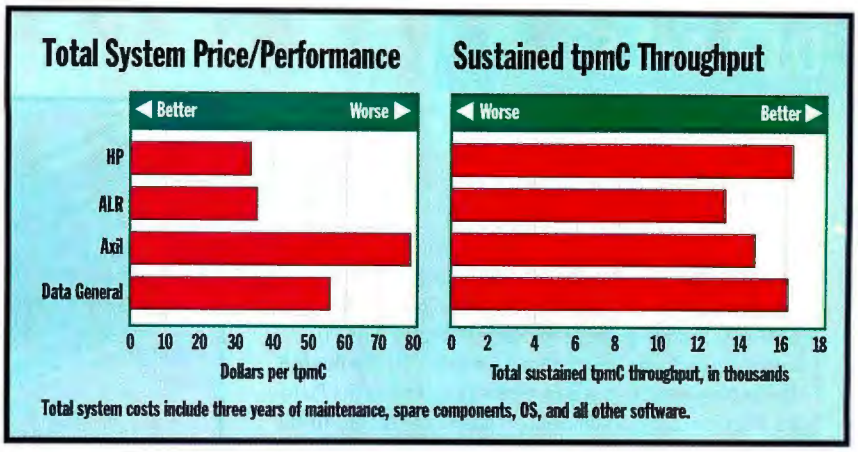
The Data General AViiON AV 8600 system raised the ante to 1.47 TB of disk storage. Seven integrated SCSI controllers and six Mylex RAID controllers power the 188-disk high-availability disk array. And the Axil Northbridge NX801 tipped the scales with a 200-drive array, totaling a whopping 1.8 TB of storage. The drive system was configured as six RAID storage-array subsystems. A UPS and a 17-inch monitor were also included.

Benchmark Results

Of the systems we examined, the HP NetServer was the performance leader. With a tpmC score of 16,257, it squeaked past the Data General AViiON's second-place 16,101-tpmC score. The Axil NX801's 14,501-tpmC score trailed the HP by about 10 percent—good enough for third place. And, putting in a respectable performance, the six-processor ALR Revolution turned in a healthy 13,089 tpmC, or 81 percent of the HP NetServer's throughput score.

The highest-cost system doesn't necessarily translate into the best performance or the best value, as the TPC-C price/performance numbers in the table above illustrate. To arrive at these numbers, the total system cost is divided by the tpmC throughput score. A low system cost and a top tpmC score combined to give the NetServer the most cost-effective dollar-per-tpmC rating of $33.67. At $35.11, the ALR Revolution wasn't far behind. Despite their higher tpmC scores, the higher prices of the Data General and Axil machines bumped their price/performance scores to $55.73 and $78.53, respectively.

Evaluations in this Lab Report represent the judgment of BYTE editors based on tests conducted by the Transaction Processing Performance Council (TPC). For full documentation of the benchmarks, see the TPC Web site at http://www.tpc.org.



The graphs (above) offer two perspectives—price/performance and transactions per minute (tpmC)—of the same results.

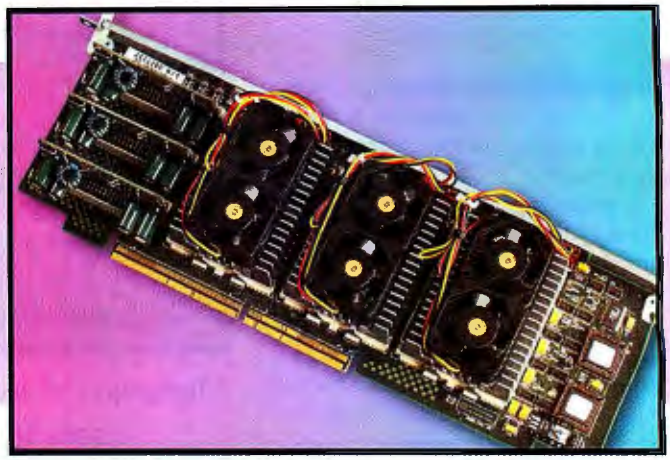
TPC-C Test Configurations and Results

	ALR Revolution 6x6	Axil Northbridge NX801	Data General AViiON AV 8600	HP NetServer LXr Pro 8
5-year cost of ownership	$459,524	$1,138,717	$897,290	$547,374
tpmC	13,089.30	14,501.00	16,101.27	16,257.20
Cost per tpmC	$35.11	$78.53	$55.73	$33.67
Maximum number of users	10,650	12,000	13,000	13,500
Pentium Pro CPUs	6	8	8	8
Memory (GB)	4	4	4	4
Storage	813.47 GB	1.8 TB	1.47 TB	1.16 TB

DETAILS

Phantom Processor

The guts of the ALR Revolution 6x6 are based on two processor cards, each with three processors. These two "clusters" of processors are then plugged into a 64-bit-parity SMP bus. The design keeps the Pentium Pro's 2-bit CPU addressing scheme, which allows for four-CPU IDs. But ALR has implemented two sets of three CPUs; the fourth CPU in each set is actually a stand-in, or "phantom," for the other entire group.

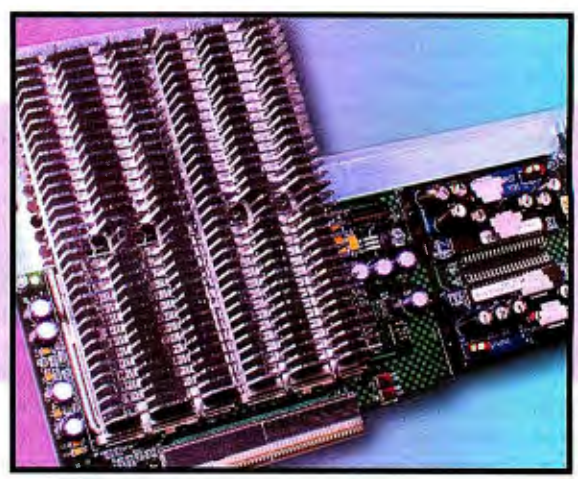


Reach Out and Touchscreen

The Axil Northbridge NX801's control panel includes a touchscreen that monitors system statistics, isolates faults, and provides overall operator control. It's located on the upper front of the system. There are no buttons anywhere on the system, except for those on the CD and floppy drives, which are located to the left of the control panel. The CD/floppy door can be electronically opened through the control panel.

Hot Stuff

Data General's AViiON AV 8600 contains two motherboards that house the system's eight Pentium Pros, each with 512 KB to 1 MB of L2 cache. The system buses are tied together with "glue logic" ASICs, sometimes known as interconnects. The Pentium Pro processors run so hot that, in addition to the six fans that cool the processors, each processor needs a large heat sink with an embedded copper heat pipe.



Tool-Less Two-Step

The HP NetServer LXr Pro 8's processors and RAM are housed within the satellite and docking station. These are modular and slide out of the back of the system for easy access. The satellite houses the I/O cards and the processors, and the docking station holds the RAM and other electronics. HP makes it a two-step, completely tool-less process to get at the RAM or the processors. First, you remove the sheet-metal covering. Then you pull out the memory and processor boards. (If the docking station and satellite are locked to each other—a security feature added to prevent the theft of RAM and other components—you must unlock it first.)

LARGE SMP SERVERS FEATURES

	Advanced Logic Research, Inc. ALR Revolution 6x6	Axil Computer, Inc. Axil Northbridge NX801	Data General Corp. AViiON AV 8600	Hewlett-Packard Co. HP NetServer LXr Pro 6
Typical price*	$54,793 (list)	$59,499 (street)	$66,000 (street)	$110,285 w/o NOS (list)
EQUIPMENT INFORMATION				
SMP architecture	MPS 1.1– and 1.4-compliant	Adaptive Memory Crossbar	Adaptive Memory Crossbar	Adaptive Memory Crossbar
Graphics card	STB Powergraph 64 (2 MB)	2-D PCI graphics card with 2 MB of video memory	SVGA video card with 2 MB of DRAM	PCI card with 2 MB of standard memory
Tool-less component removal	CPU and memory boards; hot-swappable disks; power supplies	Easy-swap components	Yes (most components)	Yes
PROCESSORS AND MEMORY				
Number of 200-MHz Pentium Pros, minimum/maximum	1/6	2/8	2/8	2/8
L2 cache	512 KB/1 MB	512 KB/1 MB	512 KB/1 MB	1 MB
Standard/maximum RAM	128 MB/4 GB	128 MB/8 GB	256 MB/8 GB	256 MB/8 GB
Speed	60-ns FPM ECC DIMM	66-MHz ECC SDRAM	100-MHz ECC SDRAM	100-MHz ECC SDRAM
EXPANDABILITY				
Number of slots	7 PCI, 4 EISA, 1 shared PCI/EISA	8 PCI	8 PCI	8 PCI
Standard number of hard drives	None	Optional	One included in base model	None
Maximum number of hard drives (internal/external)	12 internal/22 external	28 internal/greater than 45 TB external	4 internal/1440 external (13 TB)	3 internal/up to 2.1 TB external
Capacities offered	4.5, 9.1, 18.2 GB	4, 9 GB	2, 4, 9, 18 GB	4, 9, or 18 GB at 7200 rpm
Interface	UltraWide SCSI	Fast Wide Ultra-SCSI-3	SCSI, Fibre Channel	UltraWide SCSI
Hot-swap capability	Yes (with controller)	Yes	Yes	Yes (on optional HP NetServer Rack Storage/8)
Standard 3½-inch 1.44-MB floppy drive	Yes	Yes	Yes	Yes
Ethernet adapter manufacturer, model	Adaptec/Cogent, Adaptec 6911	Intel, EtherExpress 10/100Base-T PCI	OSICOM multiport 10/100 LAB Controller, 2340 TX	HP, PCI 10/100 TX
Total 3½-inch drive bays	2 external/1 internal	24	1 (expandable to 5)	1 (occupied by floppy drive)
Total 5¼-inch drive bays	5 external	6	4	4 (CD-ROM occupies one)
CD-ROM drive (speed)	13X/32X SCSI (standard)	12X	12X	12X
Remote-administration card	Available	N/A	Yes (standard)	Built-in remote console capability
POWER				
Redundant/hot-swap power supplies	1035 W standard (1400 W optional)	Up to 3 hot-swappable N+1 (900 W)	Yes (standard)	Hot-swappable redundant N+1 200–240 V
Power outlets required	Two 110- or 220-V (international)	200–240 VAC; 20 AMP	180–264 V; 50–60 Hz	200–240 VAC
INSTALLED SOFTWARE				
Monitoring and troubleshooting software or ASICs	ALR InforManager 2.0	AxilVision	NTAlert; Server Management Card (included)	HP Top Tools for Servers
Network-management software included	N/A	AxilVision	Nterprise Manager (single-server version included)	HP OpenView's Network Node Manager; HP NetServer Navigator start-up CD with installation scripts for hardware and NT configuration
WARRANTY				
Length of standard warranty	5 years (major components); 3 years (installed options)	1 year (next business day on-site) limited warranty	1 year on-site hardware	3 years; next day on-site; same-day (6-hour) parts replacement
Extended warranty available	Yes	Yes	Yes	Yes
Free technical support after purchase	Yes	Yes	Yes (included with installation)	Yes
On-site service available, cost for first year	No charge	Free for first year	Hardware included in warranty	Next-day on-site service included in standard 3-year warranty
Phone	714-581-6770	978-371-8100	508-898-5000	650-857-1501
Toll-free phone	800-257-1230	800-284-2945	800-344-3577	800-752-0900
Toll-free support hours	24 hours/seven days per week	24 hours/seven days per week	8–5 local time; 7 × 24 avail.	6–8 MST; 7 × 24 available
On-line address	http://www.alr.com	http://www.axil.com	http://www.dg.com	http://www.hp.com/go/netserver
HotBYTEs No.	**1065**	**1066**	**1067**	**1068**

✔ = yes; N/A = not applicable.

BYTE = BYTE Best

★★★★★ Outstanding

★★★★ Very Good

★★★ Good

★★ Fair

★ Poor

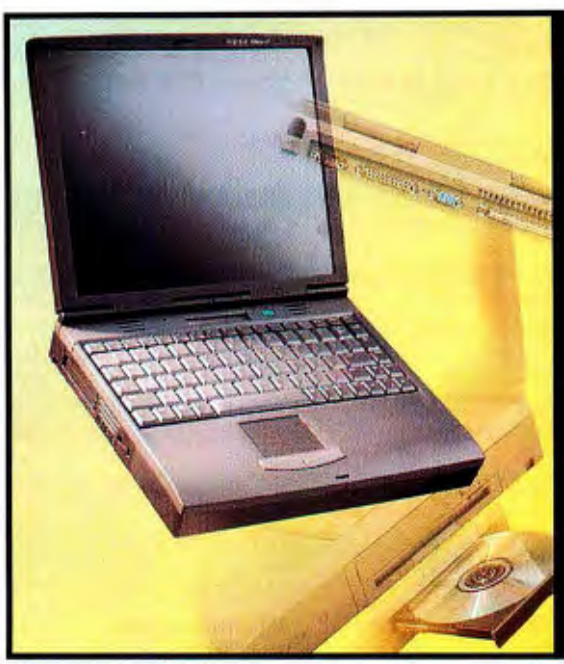
*Typical price is based on six to eight processors using Intel's 450GX chip set; 2 GB of system SDRAM; and 12 SCSI drives, a CD-ROM drive, a floppy drive, a graphics card, and Fast Ethernet PCI 10/100Base-T. Configuration also includes a rack and Windows NT 4.0.

Powered by the latest Intel CPU and chip set, the HiNote runs at 266 MHz but doesn't pay a penalty in battery life. By Michelle Campanale

A Pentium II Notebook That Talks to You

Digital's HiNote VP 765 is one of the first notebooks powered by Intel's new 266-MHz mobile Pentium II processor and 440MBX chip set. It's a fast multimedia machine with 512 KB of L2 cache and a 66-MHz system bus.

Still, I was surprised when NSTL's Power Monitor battery life tests ran the system for an average of 3 hours and 13 minutes before the battery went dead. This exceeded my expectations for a notebook running Windows NT 4.0 with 64 MB of SDRAM. (Intel says PII laptops are expected to have a maximum battery life of 2 hours.) Compare this to the results from when we ran the same tests on 166-MHz mobile Pentium and 200- and 233-MHz mobile Pentium MMX-powered laptops (see "26 No-Compromise Power Portables," November 1997 BYTE). Their average battery life was 3 hours, 2 hours, and 2.5 hours, respectively. This proves there's no battery-life trade-off for a higher clock rate.



Digital HiNote VP 765
$4299
(266-MHz mobile PII with 440MBX chip set, 4-GB hard disk, 2-MB Neomagic PCI graphics accelerator, 20X CD-ROM, 13.3-inch XGA TFT screen, 64 MB of SDRAM, Windows NT 4.0)

Digital Equipment Corporation
Maynard, MA

800-344-4825
978-493-5111

http://www.windows.digital.com

Enter HotBYTEs No. 1056.

Digital's HiNote VP 765 has a 13.2-inch XGA display, fast internal battery charger, and lithium ion battery with indicator lights.

TECH FOCUS

What's Ahead for Pentium II Notebooks

According to Intel's road map for mobile chips, a 300-MHz version of the mobile Pentium II is due by year's end. Intel plans to produce the chip on a 0.18-micron process. The company will also address the mininotebook segment with new packaging options and lower-voltage processors in the second half of this year. With a high-performance platform, code-named Colfax, Intel expects to make breakthroughs in power consumption and battery life. The chipmaker hopes to deliver new packaging and processors for mininotebooks and integrated processors for low-cost basic mobile PCs, an initiative code-named Geyserville, in the first quarter of 1999. –Stella Kao

While running battery-life tests, I was surprised to hear a human voice alert me, "Your battery is low." Digital says WAV files are tied to the power management part of the Phoenix BIOS. Another shocker was the battery recharging time. I drained and charged the HiNote three times; the built-in recharger took an impressive 30 to 40 minutes to refuel the battery.

This is not a svelte notebook. With a large 13.3-inch XGA TFT screen, 20X CD-ROM, and 4-GB hard disk, the HiNote weighs in at 7 pounds, 10.1 ounces and measures 2.1 inches tall, 11.9 inches wide, and 9.3 inches deep. But it's powerful. The BYTEmark test clocks the HiNote at a 3.67 integer and a 4.22 floating-point index. A Compaq Armada 7792DMT with a 266-MHz Tillamook CPU turned in a 2.97 BYTEmark integer score and a 3.10 floating-point index. Intel expects a 30 to 35 percent performance gain. Our tests reflect a 29.84 percent performance increase over the 266-MHz system.

Digital's HiNote has almost everything you'd want in a laptop except a network interface card, less heft, and a graphics subsystem with more than 2 MB of RAM. And the impending buyout by Compaq might also make you pause. However, Digital says its standard warranty covers parts and labor for three years. B

RATINGS	
TECHNOLOGY	★ ★ ★ ★
IMPLEMENTATION	★ ★ ★
PERFORMANCE	★ ★ ★ ★

Michelle Campanale is a BYTE technical editor. You can reach her by e-mail at **michelle.campanale@byte.com.**

★★★★★ Outstanding ★★★★ Very Good ★★★ Good ★★ Fair ★ Poor

New biometric recognition software can help authenticate the identity of a speaker's voice over a phone line. ***By Judith Markowitz***

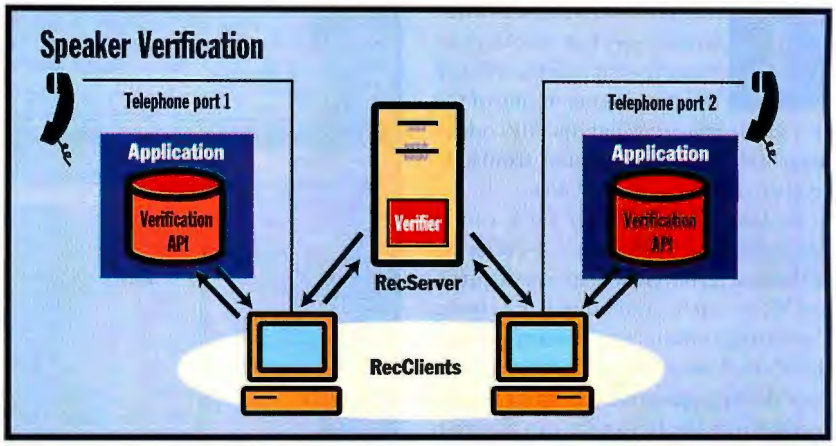
Is That Really You?

Speaking is a universal human behavior, and each person's voice is unique. This makes the voice an ideal vehicle for security and authentication—as courts of law have recognized for years by accepting voiceprint-analysis testimony.

Automated speaker-verification systems now secure access to phone and proprietary data networks, authenticate individuals making financial transactions, prevent the cloning of cellular phones, and help track convicted felons.

Nuance Verifier, a new speaker-verification system, will be released this summer with version 6.2 of the Nuance toolkit for telephony applications. I tested a current beta on a 233-MHz Pentium II (256 MB of RAM), Solaris 2.5.1, a Sound Blaster 64 AWE card, and Dialogic Antares and D41/ESC analog telephony boards.

The Nuance Verifier is a part of the recognition server (RecServer) that houses speech-recognition and speaker-verification algorithms (see the figure). One or more recognition clients (RecClients) support applications, manage audio I/O and phone functions, and communicate with the application and the RecServer.



With speaker verification, a server authenticates identity to a recognition client and the applications it services.

The RecServer supports three speaker-verification methods (see the Tech Focus box). The Nuance Verifier uses speech recognition to verify content and avoid a false rejection of valid users who utter the wrong words. When I defined a spoken password that wasn't in the recognition dictionary (or wasn't a real word), the system was able to teach the recognition component the new word as well as enroll my voice.

To enhance accuracy, the Verifier employs six "impostor" models. Each one is a group voiceprint for male or female speakers using a specific type of phone (e.g., cellular). The system compares spoken input with the claimed identity's stored voiceprint and the composite models. The idea is that, even for poor-quality audio, the real user's input will match his or her own voiceprint better than voiceprints for other people.

Effective use of Verifier requires training plus C programming knowledge. For a system integrator, interactive-voice-response provider, or telephony programmer, Nuance Verifier is a flexible tool for developing more-secure telephony applications using both speech recognition and speaker verification. B

TECH FOCUS

Talking to a Speaker-Verification System

You can communicate with a speaker-verification system in three different ways. The most common, "text-dependent" verification, has you say a predefined password, phrase, or personal ID number. With "text-prompted" or "challenge-response" verification, you repeat what the system tells you to say. But users don't always give the expected response; they might transpose digits or say, "I forgot my password." This won't match well to the stored voiceprint and usually results in rejection. Finally, "text-independent" verification lets you say anything you want, but it's extremely difficult to achieve because of unpredictable noise and phone-line quality.

RATINGS

TECHNOLOGY	★ ★ ★ ★
IMPLEMENTATION	★ ★ ★

Judith Markowitz (Evanston, IL) is a speaker-verification and speech-recognition consultant. You can contact her by sending e-mail to **jmarkowitz@pobox.com.**

PRODUCT INFORMATION

Nuance Verifier
$1300 per telephony port (average cost)
(requires a 100-MHz Pentium with 64 MB of RAM [128 MB recommended] running Solaris; supported telephony platforms include Dialogic, IBM DirectTalk RS6000, and Periphonics)
Nuance Communications
Menlo Park, CA
650-847-0000
fax: 650-847-7979
http://www.nuance.com/
Enter HotBYTEs No. 1055 at http://www.byte.com/hotbytes/.

★★★★★ Outstanding ★★★★ Very Good ★★★ Good ★★ Fair ★ Poor

Borland's C++ Builder 3.0 helps keep C++ relevant as a language for writing distributed, browser-based applications. **By Peter Wayner**

C++ Forever!

Java has stolen the focus away from C++, but that doesn't mean C++ is fading, as Pascal did. C++ remains one of the best tools for writing high-quality code to control all parts of a computer, from low-level drivers to high-level GUIs.

Borland's C++ Builder 3.0 is a solid upgrade that will help keep C++ relevant in the near term. Most of its new features are Web-centric and aimed at helping C++ programmers grab some of the distributed client/server glory from Java. New debugging options make it easier to track down the bugs that can flourish when programs interact.

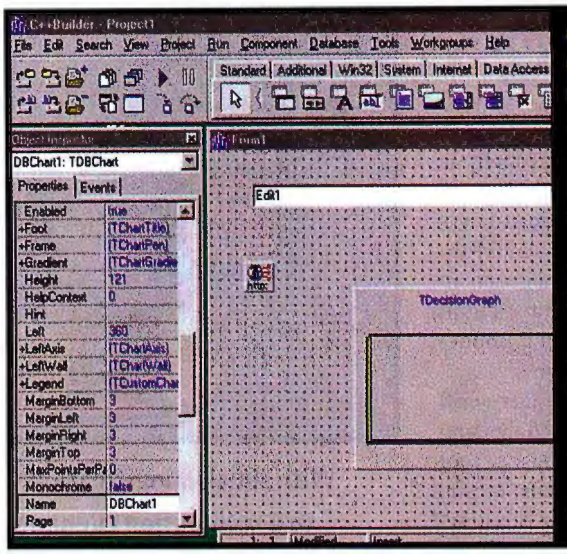
Internet classes wrap all the basic protocols into objects that handle most of the interaction with the TCP/IP socket layer. They also make it easier to grab a file from an FTP or HTTP server than it would be from scratch.

This version more strongly embraces Microsoft standards and techniques than previous versions did. The Microsoft Foundation Classes (MFC) are included, and there is strong support for building and deploying ActiveX components. In fact, the whole process of turning a Borland form into an ActiveX control on a Web site is nicely automated.

Debugging features are also improved. Now you can keep multiple projects open and debuggable at one time, meaning you can follow calls between your main application and a DLL without using another debugger. This will make life easier for programmers chasing bugs throughout a multipart project. Advanced corporate developers will also be interested in the ever-widening array of tools for supporting database access and maintenance.

C++ Builder feels like a "traditional" Borland product. Its ASCII-code-centered approach makes it easier to incorporate your own code or tweak the results produced by the visual editor. It also provides the lowest-level access necessary for handling small details. Still, I don't like the way C++ Builder puts metaphorical icons on the form to represent objects that won't be visible in the application's GUI. There ought to be a third level between the ASCII source code and the form.

C++ Builder resembles Borland's J++ Builder in offering fast compilation, a straightforward interface, and a large collection of sophisticated tools. Both products help programmers access distant databases and distribute their code throughout a client/server world built around IP. C++ programmers who want a place in this world should give serious consideration to C++ Builder 3.0. B



C++ Builder 3.0 Client/Server
$2499
(also available in Enterprise, Standard, Professional, and AS/400 versions)

Borland International, Inc.
Scotts Valley, CA

408-431-1000
fax: 408-431-1320

http://www.borland.com

Enter HotBYTEs No. 1036.

C++ Builder 3.0, like Delphi, lets you create forms containing a variety of objects, including several for connecting to the Internet.

RATINGS	
TECHNOLOGY	★ ★ ★ ★
IMPLEMENTATION	★ ★ ★ ★

TECH FOCUS

C++ vs. Java

The new C++ Builder makes it much easier to distribute a program to a distant Web browser—formerly unique to Java. But it remains an open question whether C++ *can compete with Java* as an enabling language for thin clients. C++'s biggest limitation: The x86 code generated for ActiveX controls is not cross-platform—a plus if you're writing code only for a smaller x86 environment such as the typical office.

Security and the availability of libraries are other C++ liabilities. ActiveX controls give programmers access to everything, and they are more likely to link with DLLs and other libraries that may not be present on the local system. Both are pitfalls in distributing C++ code everywhere.

Peter Wayner (**pcw@access.digex.net**) *is a Baltimore-based freelance writer and a BYTE consulting editor.*

★★★★★ Outstanding ★★★★ Very Good ★★★ Good ★★ Fair ★ Poor

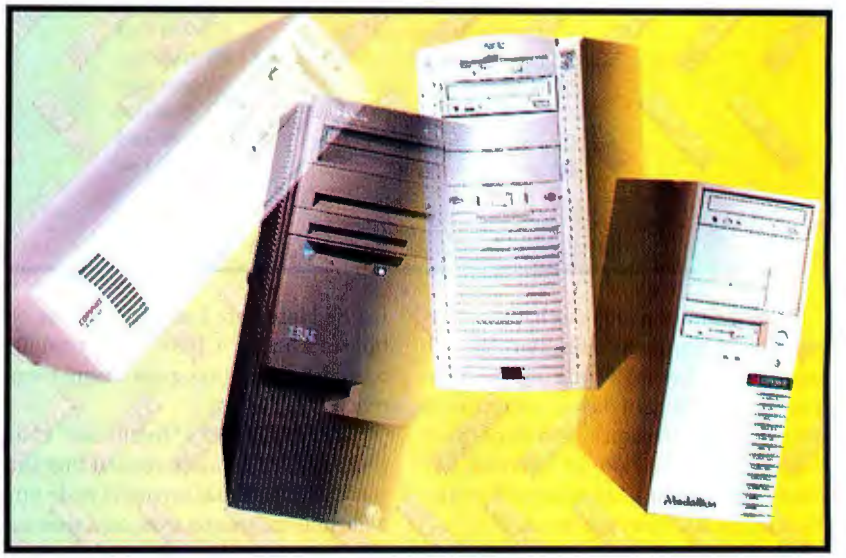
Can Intel's speedy new 100-MHz system bus really turbocharge today's computers? By Michelle Campanale and Dan Tanner

100-MHz: A System Bus for Tomorrow

Every PC generation sports hardware features that outstrip current software capabilities. The latest innovation, the fast 100-MHz system bus made possible by Intel's new 440BX chip set, is no exception. While on paper it's as much as 50 percent faster than today's 66-MHz bus, the applications—and the components—needed to utilize the extra speed simply aren't there yet.

BYTE Lab tested four new 350- and 400-MHz machines that have the 100-MHz bus. Our conclusion: The performance gains we saw come mostly from the faster processor and more powerful components, not from the speedier system bus.

We've yet to find applications that truly exercise a 100-MHz bus. Of course, that doesn't mean these new machines aren't worth considering. The PCs we tested here offer exceptional performance and the promise of upgradability when the 100-MHz system bus finally comes into its own.



From left: Compaq Deskpro EN, IBM Intellistation, NEC PowerMate Enterprise 8100, Tangent Medallion B.

Compaq Deskpro EN Series

This heavy, sturdy-feeling 400-MHz system is well-engineered and comes with easy-to-follow, well-illustrated documentation. Disk expansion is a major drawback, however: Our test system had just one free 3½-inch bay left, which would force an upgrader to choose between, say, tape backup or a new DVD drive.

The Deskpro EN sports a 10/100 Ethernet card and a 200-watt power supply, adequate but definitely on the puny side. The EN includes two PCI and two shared PCI/ISA slots and an EIDE drive controller on a two-sided riser card. Memory modules fit under the drive bay structure—not the easiest location to access.

IBM Intellistation

The 350-MHz Intellistation proved the most expandable, and most expensive, of our test systems. It came with one shared PCI/ISA slot and four PCI expansion slots and can accept a second processor. The machine had Ultra Wide SCSI on board, and came loaded with a whopping 256 MB of synchronous DRAM (SDRAM), which partly accounts for its whopping $4899 price.

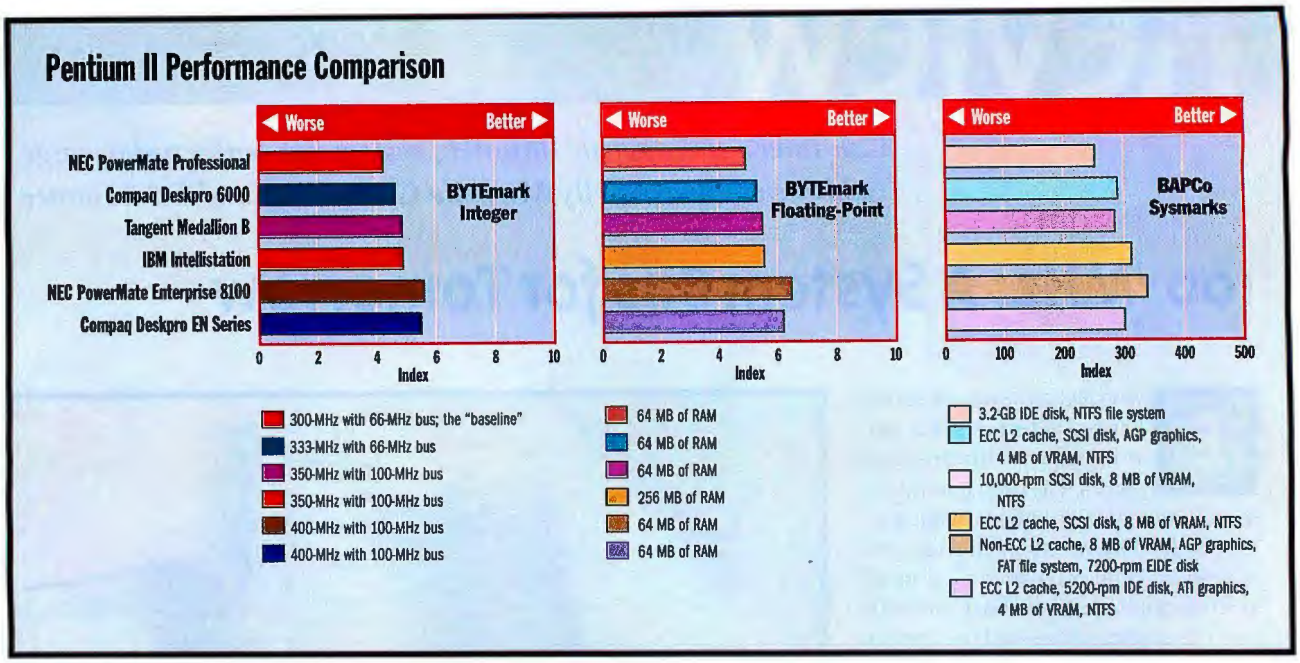
continued

TECH FOCUS MEMORY

100-MHz System Bus: The Faster Way to Travel

The 100-MHz system bus offers 50 percent more bandwidth from CPU to memory in a Pentium II PC than the older 66-MHz bus. And the 440BX chip set boasts queues and buffers about twice as deep as today's 440LX. The 440BX can hold 32 memory pages open at once; 440LX keeps only two. The 440LX limits memory page size to 2 KB; 440BX pages vary according to synchronous DRAM (SDRAM) organization. The 440BX also supports 1 GB of main memory (double that of the 440LX), the Wired for Management baseline spec, better power management, improved data integrity with PCI parity, and ECC hardware scrubbing.

There's a minor downside to all this bounty: higher prices for 100-MHz-compatible memory. The SDRAM chips used in our test machines offer higher performance than older fast page mode or extended data out (EDO) RAM. But the tests required to certify these chips for 100-MHz use (a spec known as PC100) are far more rigorous than old 66-MHz standards. Manufacturers have been ramping up production of the new chips for several months, in densities from 16 MB to 128 MB—the maximum currently supported under the standard—but relative scarcity is liable to boost the price of memory for the near future. While that's not much of an issue for the high-end PCs and servers most likely to use the 100-MHz system bus, it's something to be aware of.



The Intellistation offers six bays for storage: two 5¼-inch externals, two 3½-inch externals, and two 3½-inch internals, although the SCSI hard disk that came with our evaluation unit consumed three-quarters of the entire 3½-inch internal bay space. The system's 330-watt power supply is ample for most purposes.

It's a snap to get at components inside the roomy chassis. Reaching the CPU is a three-step, tool-less process.

PowerMate Enterprise 8100

Unlike the other machines in this review, NEC's 400-MHz PowerMate Enterprise 8100 arrived with its L2 cache's error-correction code (ECC) turned off, which resulted in slightly better performance scores for this machine. (For more on the ECC tactic, see "Trick of the Trade?" in our May issue's Hardware Lab Report.) The NEC boasts a huge 14.1-GB, 7200-rpm EIDE hard drive that uses giant magnetoresistive (GMR) heads.

The PowerMate's "Intellicase" chassis houses an NLX motherboard that slides out easily. Internal layout is wide open. NEC puts expansion slots on a riser card. The PowerMate has four PCI slots, two ISA slots (despite Microsoft's PC98 initiative to phase out ISA), and one Accelerated Graphics Port (AGP) slot.

NEC has chosen to include DMI, Magic Eye (an ASIC on the system board that watches things like temperature), and Smart Drive compliance. The company also bundles LANDesk Client Manager 3.1 and, like the other PCs in this review, its 3Com network card supports Wake On LAN (WOL).

Tangent Medallion B

Tangent's 350-MHz machine, a beefy configuration for a lean price tag, is aimed at high-end enthusiasts. Besides the standard 10/100 Ethernet card and WOL, it comes with a 4-GB, 10,000-rpm Ultra Wide SCSI hard drive and five 32-bit PCI slots, one ISA and one shared PCI/ISA slot, as well as an AGP slot.

Tangent's STB Glyder Maxx-2 128-bit AGP 3-D accelerator, powered by the Permedia II chip, supports both OpenGL and Direct3D. Although you can open the chassis without tools, ribbon cables obscure quick access for DIMM replacement.

The Bottom Line

The 100-MHz system bus is definitely a technology for the future; if you're the type who needs the faster bus, you'll probably want as much expandability as possible. IBM's loaded Intellistation fills that bill nicely, although at $4899 for a 350-MHz model without a monitor, it's by far the most expensive system tested.

The Compaq Deskpro and Tangent Medallion B offer good value, but at the cost of some serviceability. If you simply want hot performance and a good upgrade path at an excellent price, we think NEC's $2999 PowerMate will more than satisfy. ■

Michelle Campanale and Dan Tanner are BYTE technical editors. Additional testing by Al Gallant and Robert Pickering.

PRODUCT INFORMATION

Compaq Deskpro EN series
$2800 (ESP without monitor)
400 MHz PII, 64 MB of SDRAM, 6.4 GB Ultra ATA hard drive, ATI 2x AGP graphics card with 4 MB of SGRAM
Compaq
Houston, TX
281-370-0670
http://www.compaq.com
Enter HotBYTEs No. 1058.

IBM Intellistation
$4899 (ESP without monitor)
350-MHz PII, 256 MB of SDRAM, 9.1-GB EIDE hard drive, Matrox Millennium II 2x AGP graphics card with 8 MB of SGRAM
IBM
Research Triangle Park, NC
919-543-5221
http://www.ibm.com

NEC PowerMate Enterprise 8100 Series
$2999 (ESP without monitor)
400-MHz PII, 64 MB of SDRAM, 14.1-GB IDE hard drive, ATI Xpert@Work AGP graphics card with 8 MB of SGRAM
NEC Computer Systems Division
Boxborough, MA
888-475-8952
http://www.necnow.com
Enter HotBYTEs No. 1060.

Tangent Medallion B
$2495 (ESP without monitor)
350-MHz PII, 64 MB of SDRAM, 4-GB Ultra Wide SCSI hard drive, STB Glyder MAX-2 AGP graphics card with 8 MB of SGRAM
Tangent
Burlingame, CA
800-800-5550
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Accessible components and a standard configuration build distinguish Toshiba's Equium 7000 series. ***By Dan Tanner***

A "Box" Designed for Manageability

For its Equium 7000S desktop PCs aimed at the corporate market, Toshiba used a mechanical design aimed at simplifying the information technology (IT) manager's job and cutting costs in configuring, deploying, managing, and upgrading these PCs across an enterprise.

Toshiba says the key is the pop-out NLX form-factor motherboard, with its integrated audio/video in/out, universal serial bus (USB), serial and parallel ports, and Accelerated Graphics Port (AGP) slot. The company can build to order a full range of computers using different CPUs with a single small box. Then, administrators can learn, preinstall, and qualify one machine and know how the rest of the product line behaves. Everyone can stock fewer service parts, and the NLX board helps avoid cable mix-ups.

The Equium 7000S (slimline) chassis sports a quick-access door for popping out the motherboard and upgrading or repairing it without tools. I found the pop-out motherboard to be a good idea poorly executed, at least in the sample I tested. I couldn't reinsert it successfully in any one try. It got stuck both inbound and outbound, and two editors cut their hands trying to free it.

RATINGS	
TECHNOLOGY	★ ★ ★ ★
IMPLEMENTATION	★ ★ ★ ★
PERFORMANCE	★ ★ ★

The board has no grip area or push points, which could lead to broken components. Toshiba is adding a thumbtab to fix this. The company says it will also lengthen the motherboard guides to make them visible and improve the eject lever's retainer and pivot.

The door also lets a user or technician upgrade RAM or video memory in place, without removing the case. The motherboard mates with a riser card containing an integrated 10/100-Mbps Ethernet adapter and providing two external slots, one a shared PCI/ISA. I needed no tools to slide the case off for disk drive access.

The default file system is file allocation table (FAT), providing speed and DOS/Windows 3.1/95 compatibility. However, a Windows "double-click on me first" icon brings up a dialog box for converting to NT File System (NTFS) for network-oriented file security features and greater than 2-GB disk addressing.

Complementing the package and making life easier for users and managers, an optional InTouch keyboard incorporates extra dedicated function keys. One key launches an extensive Web browser–like help facility from the hard drive.

You can lay the box flat, stand it as a mini-tower, or hang it on a wall or partition. For vertical orientation, I'd prefer a CD-ROM drive with a media slot to the pop-out-tray unit that Toshiba says it chose for reliability.

The system boots up quickly and wakes up instantly at the touch of a key or on command from the LAN.

The 7000S is available with 233-, 266-, 300-, and 333-MHz CPUs. On our 266-MHz system, we got an integer BYTEmark of 3.74 and a floating-point BYTEmark of 4.34. For comparison, a 266-MHz Pentium II Intergraph TD-225 scored 3.8 and 4.5, respectively. The estimated street price for a 233-MHz system with 16 MB of RAM and a 2-GB hard drive is $1229.

With its feature integration and network orientation, the Equium 7000S is a nice workstation for corporate use. But its design may be a two-edged sword. Systems managers might prefer to keep that access door padlocked! B

Dan Tanner (**dan.tanner@byte.com**) *is a BYTE technical editor for hardware reviews.*

Equium 7000S
$1884
(as tested, without a monitor)

Toshiba America Information Systems, Inc.
Computer Systems Division
Irvine, CA

888-588-7802
949-583-3000

http://computers.toshiba.com

Enter HotBYTEs No. 1064.

The Equium 7000S side-access door simplifies memory upgrading and provides motherboard access for system upgrading.

PHOTOGRAPH: STEVEN GREENBERG © 1998

★★★★★ Outstanding ★★★★ Very Good ★★★ Good ★★ Fair ★ Poor

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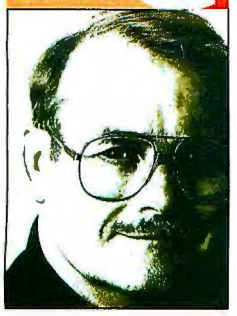

A Smarter Windows 95

Cyrus gets a CPU transplant, and Jerry gets to experiment with the other Windows 95.

Well, Cyrus the Cyrix 6x86 P-166 system no longer has a Cyrix chip. Admittedly, this was more experiment than necessity: the Cyrix 6x86 P-166 was certainly fast enough for almost anything you'd want to do.

On the other hand, the BIOS for that system has a couple of Plug and Play glitches—I can say that calmly now, but there was a time when I was going mad—and cannot be upgraded because Cyrix never released it to Phoenix. My Plug and Play problems got so bad that it was simpler to scrub the system down to bare wood and reinstall Windows 95.

I figured that if I were going to that much trouble, I might as well do a bunch of experiments at once. First, I installed Windows 95b, aka OEM Service Release 2 (OSR2). That's the main story in this column; stand by. Second, once I proved that OSR2 worked with the Cyrix chip, I installed an Evergreen MxPro 200-MHz chip, not so much for the increased speed as for the MMX capability. That, too, went without a hitch.

I now have Evergreen upgrades in three machines. In every case, the installations were simple, and everything has worked without problems. If you have lots of time and you know what you are doing, a motherboard replacement is cost-effective. Otherwise, if you want more speed, drop in the appropriate Evergreen chip; they have one for nearly any system you'd want to upgrade. The Evergreen upgrades are well designed, the instructions on which systems to use them with are clear, and they work.

It began with a game, Seven Kingdoms, from Interactive Magic. It wasn't really the game's fault. Cyrus has been my main Windows 95 machine for about a year, and over time accumulated an astonishing patina of old DLLs, remnants of incompletely uninstalled programs, and the electronic equivalent of barnacles. Attacking it with CleanSweep helped—but not much. Those uninstall programs can do wonders if they've been allowed to watch while programs are installed, but going in cold is another matter.

Eventually Cyrus got so confused that the Copy Disk command vanished from the File pull-down menu. Apparently, one of the programs that like to add to that menu had done it improperly. I looked in all my books and talked to a bunch of people, but no one could tell me how to restore the Copy Disk command without reinstalling Windows.

My problems got so bad that it was simpler to scrub the system down to bare wood.

Then I installed Seven Kingdoms, and after a few minutes' play, the system locked up entirely. It wouldn't shut down, Ctrl-Alt-Del did nothing, and I had to power down—after which Windows wouldn't boot at all. Reinstalling Windows helped a little. Now I could get to Windows, but Plug and Play was all fouled up. I could have either a network or my external Zip and Fujitsu DynaMO drives, but not both.

This sounded like a virus, but the latest version of Dr. Solomon's didn't detect one. It was clearly a Plug and Play problem. A call to Phoenix about BIOS updates got me the information that there wasn't one for Cyrus; and, of course, Cyrix no longer makes the machine.

Since I did have a network and lots of empty disk space on Fireball, the new dual Pentium Pro server, I copied everything over the network, booted up in DOS, and used FDISK before I could change my mind. Then I installed OSR2 by copying the Windows 95 subdirectory (including setup.exe and all the CAB files) of the installation CD to C:\windows\options\cabs and invoking setup.

Fifteen minutes later I was done. The installation went smoothly, Plug and Play worked just fine to find all the internal and external devices, and the network appeared like magic.

OSR2 is smoother and smarter than the earlier Windows 95. It has more up-to-date device drivers and an updated list of devices. It offers the choice to "browse" in more places. It knows about FAT32 (file allocation table) and universal serial bus (USB), although I'm not using either of those just now. Best of all, Plug and Play works well.

THROUGH A SERIES OF MISTAKES I'm ashamed to detail, I had to reinstall OSR2 on Royal Armadillo, a new 266-MHz Compaq Armada 4220T laptop. (It's new enough that it came with OSR2, and I mucked it up something awful playing around with odd devices.) After the reinstallation, I had problems getting it to recognize the docking station that connects it to Ethernet.

Eventually we looked at each device in Systems Device Manager and found a few nonworking devices in an "unknown devices" category. We could not see them until we opened each category manually. We removed those and all other devices that weren't working exactly right, put

the machine in the docking station, shut down, and turned it back on. Plug and Play went through and installed everything perfectly: sound, infrared (IR) port, proper screen drivers, Ethernet, modem card, and all automatically.

More: there's a gizmo that lets you replace the floppy drive with a battery and then install the floppy drive in a carrier that connects to the computer by cable. When you attach the now-external floppy drive to the system, Poof!, the A device appears on your desktop. Disconnect, and the icon goes away. I've never had that smooth an experience with Windows 95a.

The bottom line is, if you can get OSR2, do so; it's a significant update to Windows 95. Fair warning: OSR2 *really* wants to install the Internet Explorer browser. You can still use Communicator as the primary browser, but you will not easily kill off Explorer, nor should you.

It's also hard to get OSR2. I don't know why Microsoft doesn't sell it as an upgrade, although I have heard rumors that the company is sulking after enduring so many accusations of dinging users for upgrades. In any event, OSR2 is in theory distributed only with new hardware. There may be older systems it won't work with, but we've had no problems with anything, and it's fine with the Cyrix chip as well as the Evergreen upgrade chip. If you can get OSR2 (legally, of course), you'll probably be glad you did.

Sometime in the near future, you'll be able to get Windows 98, which incorporates all the advances of OSR2 as well as some new features. That supposes, of course, that Ralph Nader and company haven't been able to suppress Windows 98. Apparently they're trying. Also, Nader recently sent letters to most of the major hardware companies urging them to bring out systems with "alternative" OSes such as Linux and BeOS.

This is silly. BeOS is a useful development environment aimed at multimedia applications, and Linux is a useful form of Unix; but how many people are there who can make use of those OSes and don't already know about them? Linux can be tricky to install, but that's hardly beyond anyone who's capable of using it. The reason we don't use it here at Chaos Manor despite considerable enthusiasm for it is the lack of application software relevant to what I do. There are certainly times when Windows drives me crazy, but not so crazy that I'll give up my applications—

and games—that I've become fond of.

I'd also have to install NetWare or another network. It seems to me that the result would be a great deal more maddening than Windows.

Once I got Cyrus running properly again, I installed CleanSweep, and I've been letting it watch as I install other programs. Mostly that works, although once in a while CleanSweep gets confused. With Seven Kingdoms, for instance, CleanSweep seems to have interfered with the final stage of installation.

My remedy was to install again, this time with CleanSweep turned off. When I start to play Total Annihilation, CleanSweep believes I've started an installation, and I have to tell it to go back to sleep. I've had minor problems with other installations as well, but nothing that persistence and common sense didn't handle. Of course, I haven't had much reason to use CleanSweep since I installed it. We'll see. At least it seems to do no harm.

IF YOU HAVE AN OLDER LAPTOP with no CD-ROM drive, get a backpack bantam parallel-port CD-ROM drive with sound, from MicroSolutions. It works with Windows 3.1 and 95, and you can use it to install a new OS. It's slim and trim, about the size of a paperback book; it adds decent Sound Blaster–compatible sound (in Windows) to laptops that don't have it; and the only thing we can object to is that it needs a power supply. They're said to be doing a battery pack, but that doesn't exist yet.

The Libretto and backpack combination have earned the "Cold Dead Fingers Award."

Otherwise, it's hard to improve. We've tried it on several systems, including the Toshiba Libretto 50CT, and it works with all of them. It's a stone natural for the Libretto, adding both CD-ROM capability and improved sound to what is, after all, full Windows 95 (not just Windows CE) on a palmtop. Highly recommended. (If they get the threatened battery pack ready for the backpack bantam, this might be the smallest full-featured combo on the market—certainly among the coolest.)

The Libretto and backpack combination have earned the "Cold Dead Fingers Award": the only way I'm going to get them away from Eric Pobirs, our sometime intern. He's taking them to CeBIT, where he's assisting my son Alex in producing the BYTE Best of CeBIT awards show; maybe I can get Customs to waylay him on the way home. If you want full-function computer capability in a small package, this is the combination to have.

We also used the backpack bantam to install OSR2 when I decided to test it on SpaceCalf, my ancient Gateway Liberty, an obsolete but wonderful full-service laptop that previously had only Windows 3.1. That installation went well, with no problems getting SpaceCalf to recognize the CD-ROM drive. OSR2 then found everything: PC Card ports, the IR port, power management features, 3Com and Megahertz Ethernet cards, the full Monty.

continued

We had one disastrous loss: we inadvertently erased the only copy I had of the Cow on the Moon background screen that came with SpaceCalf. If anyone has a copy of that .bmp file, I'd much appreciate it. About the only thing we couldn't get working was the internal Crystal Semiconductor sound chip, but the backpack bantam adds Sound Blaster capability.

Another portable device we can recommend is the SyQuest SparQ drive. It comes in two flavors, an internal Enhanced IDE (EIDE) connection and external parallel. You will need an Enhanced Parallel Port (EPP) or preferably an Extended Capabilities Port (ECP), but most systems (including the Liberty and Libretto) have one or the other; you may need to go into the BIOS to activate it properly. Given that, it installs easily, and it's very fast, even in the parallel version.

If you want to get back to where you were an hour ago, the SparQ is a way to do it.

The internal EIDE version is indistinguishable in speed from a normal hard drive. The SparQ 1-GB cartridges are relatively cheap. Your system sees this as just another hard drive. You will have to run the guest software to let DOS see the parallel version, but you can run that from a floppy disk.

In a word, this is the right system to do a full disk backup. The right software to do it with is PowerQuest's Drive Image. Drive Image makes an exact image of a drive partition. Since it's a sector-by-sector image, if you get in trouble, you can boot up in DOS and restore the drive partition complete with whatever OS it used. Drive Image understands removable media and will restore to multiple disks, although given its compression capability, you may be astonished to see how large a partition you can back up to a 1-GB SparQ cartridge. Many test labs use this combination.

If you've ever wished you could get back to where you were an hour ago, this is a way to do it. Drive Image and a supply of SyQuest SparQ cartridges may not end all your adventures, but it will certainly make them more tolerable. Recommended.

Regarding SyQuest versus Iomega: there is no substitute for an Iomega Zip drive, and everyone ought to have at least one parallel-port Zip drive. I have two, Larry Niven has one, and we routinely use them to sneakernet files. They aren't terribly fast, and they hold "only" 100 MB, but they are marvelously convenient, and nearly everybody has one. I couldn't live without at least one Zip drive.

For a full gigabyte, I prefer SyQuest. I have not had a bad experience with Iomega's Jaz drive, but I have heard many stories from people who have. I do have personal experience with SyQuest drives, and it has all been good. The media are a bit harder to obtain than Jaz cartridges—Fry's has SyQuest cartridges, but my local Staples does not—but if you buy SparQ cartridges in three-packs, the medium cost is around $33 a gigabyte, a bit less than a hard drive. The SparQ is fast and convenient, and the cartridges are rugged.

There are also lots of intermediate-size removable-medium drives. Of those, I like the Fujitsu DynaMO and Olympus Sys.230 magneto-optical (MO) drives best. The DynaMO comes in a 640-MB configuration, but in fact I have never seen a 640-MB MO cartridge for sale. I do see 230-MB MO discs at Fry's, and MO has the lowest cost per megabyte of any rewritable mass storage other than tape. The Olympus and Fujitsu drives read each other's files just dandy, and I use MO discs to store photographs peeled off my Olympus and Agfa digital cameras.

There are also CD Recordable (CD-R) and CD Rewritable (CD-RW), both of which I have discussed before. I'd certainly rather have either of those than one of the intermediate-size removable-medium hard drives.

Finally, SyQuest makes a 1.5-GB SyJet removable drive. Mine is an external SCSI device—it comes in other flavors, too—and works without fuss. I have one on Princess, the dual Pentium Pro Compaq Workstation 5000, where it serves as the backup and overflow storage medium. I suppose it's slower than the internal hard drives on Princess, but I have to say I don't notice; fast enough is fast enough. Unfortunately, the SyJet and SparQ drives can't read each other's cartridges, which is a pity.

Given the 1-GB SparQ, the 1.5-GB SyJet, and the 1-GB Jaz, I would take the SparQ first and the SyJet next, largely on considerations of reliability and speed. On the other hand, you are more likely to find someone or some place that has a Jaz drive

before you'll find either SyQuest drive.

With all these great removable storage devices available, there's no excuse for being caught without a backup. And with their speed, there's no reason not to do so early and often.

I GO TO THE ANNUAL AMERICAN Association for the Advancement of Science (AAAS) meetings to recharge my intellectual batteries. I also test road-warrior equipment. This year, I carried Armadillo, my earlier Compaq Armada laptop. I also carried the Olympus D-320L and Agfa ePhoto 1280 digital cameras, choosing from about a dozen that come and go here at Chaos Manor.

I've previously written about the Olympus camera, and you can see some of the pictures I've taken with Olympus equipment on my Web site. This is a wonderful no-zoom camera. It fits in a pocket, it has lots of neat features that all work, the resolution is good enough for 3- by 5-inch printed photos and just about anything you'd care to do for a Web-site photo, and Olympus is continually improving their software. You won't find a better general-purpose electronic camera.

The Agfa ePhoto 1280 is new to me. I didn't like it at first. Let's get the bad features out in the open. Do keep in mind that I grew to like the camera despite them.

There's no lens cap. I like to carry cameras in my pocket, without a case, or dangling from a strap around my neck. The ePhoto 1280 has only a single-point strap anchor and comes with only a wrist strap. The little plastic port cover over the output sockets pops open or off with a touch. I secured it with black duct tape, which in fact is nearly invisible and did the job.

The activation switch is so easy to turn on that more times than not, you'll find the camera has been on a long time; fortunately for battery life, there's a timer that eventually turns it off if you haven't done anything with it. Finally, there's no viewfinder. You use the view screen to compose and sight your image, which has the advantage that what you see is what you get, but on a bright day, seeing it is not so easy.

That's the bad part.

The good part is there are many choices of resolution, easily controlled with a rather ingenious on-screen system. The "1280" resolution is high enough to produce decent printed photographs. The control system in general is easier to understand than that in the D-320L: there's only one button, which is also a choice dial. It's easier to use than to explain. There are more controls than the D-320L has, including several focal distances, all easily controlled from on-screen menus.

The best part is the zoom. The camera has a swivel feature so that you can carry it in a pocket, yet it has a full zoom from 38 to 114 mm, mild wide angle to not-bad telephoto, all easily controlled by buttons under your right thumb. Battery life is fairly good, about comparable to the D-320L, and the ePhoto 1280 comes with a battery charger and rechargeable batteries. (If you use an electronic camera, I guarantee you'll soon change to rechargeables.)

The Agfa software is not as easy to use as the new stuff from Olympus. If you're getting a digital camera for Aunt Minnie, Olympus is good enough, and Agfa is marginal. If you're getting one for yourself,

either will do. We have also taught Photoshop to download images from either camera, so we don't need two camera software packages on the laptop we carry with the digital camera.

President Clinton spoke at AAAS, and I was able to get quite a good picture of him with the ePhoto 1280 zoom lens despite bad lighting conditions. I could also use it to get pictures of briefing charts. All told, the Agfa camera was very useful.

Both Agfa and Olympus have new models coming out shortly. If you've been looking for a good digital camera, either of these is more than good enough.

I GOT THIS MONTHS AGO. IT ISN'T a computer; it's a neat electronic gadget: the Outback ES Digital Compass. This bills itself as the most sophisticated handheld compass on the market, and I believe it. It's a bit heavier than the little orientation compasses I used to carry when I led Boy Scout forays into the High Sierra, but it does a lot more.

Not only can you program in deviation, so that it will show you either true or magnetic north as you choose, but it's your clock, night navigator, and a bunch of other stuff. It's tilt-compensated (up to a point) and pretty rugged. Battery life is good. There are bearing sights.

It remains a little heavy compared to what I'm used to, and I suppose in a year or so they'll have a model with a Global Positioning System (GPS) receiver built in, but it's one heck of a compass. Precision Navigation also makes an auto/marine compass (Co-Pilot) with fewer features but easy magnetic compensation—it works better in my Bronco than any other compass I ever tried—and a programmable night light that goes out in 20 seconds. Get one of these, and you won't go back to those things you buy in the auto parts store.

They also have Palm Navigator. It attaches to your PalmPilot and does compass overlays on downloaded maps. I won't wait so long to tell you about that one. This is seriously good stuff.

ROBERTA POURNELLE HAS MANaged to get a commercial Web site, *http://readingtlc.com/* (her product is Reading: The Literacy Connection). I am told that the average cost of activating a commercial Web site is about $300,000. After watching her struggle for two months plus, I believe it, although aside from her time, the cost of setting it up was right around a thousand dollars.

A full story next month, but the point is, Roberta managed all this on her own with help from the technical-support people at Earthlink. If you want a commercial Web site, you can have one. Be persistent, and be prepared to insist on clear explanations from the technical-support people, and you'll get there.

THE GAME OF THE MONTH IS Myth: The Fallen Lords, from Bungie Software. Fair warning: this is a difficult game, and you'll spend a lot of time getting things right before you start winning. The clue book helps a *lot*. Billed as a real-time strategy game, it's really closer to a multiviewpoint shooter, and survival can take a lot of clicking. The graphics are realistic, meaning that some will find them distressing, as bodies are blown apart

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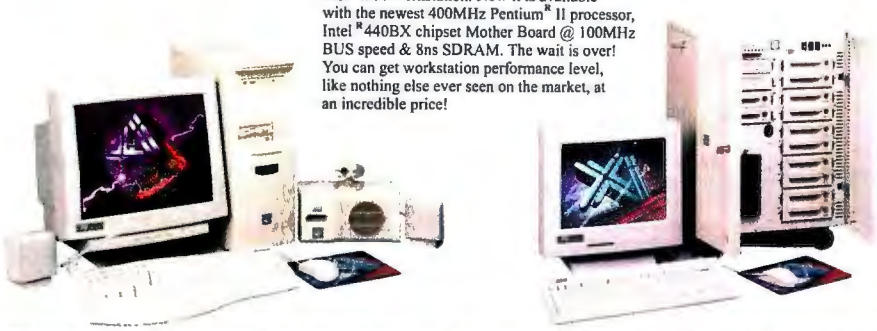

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and gory limbs scattered about the battlefield. If you become addicted to this, you will spend a lot of time with it.

The book of the month is *On Infantry* (revised edition) by John A. English and Bruce I. Gudmundsson (Praeger, ISBN 0275949729), an analytical military history of infantry in this century. Technical but surprisingly readable if you're interested in the subject. It's apparently out of print, but I was able to get a copy through Amazon (*http://www.amazon.com*). If that's not your cup of tea, there are a couple of new Terry Pratchett *Discworld* books available. Get one and laugh your head off.

The computer book of the month is by Edward and Jennifer Yourdon, *Time Bomb 2000* (Prentice-Hall, ISBN 0130952842). I tend to think of the great Year 2000 Scare as hysteria. The Yourdons have another opinion, which they calmly and soberly present, along with precautions you can take in case they're right. They frankly scared the hell out of me.

Next month, the full epic story of Roberta's Web site, more on communications, and with luck, I'll make a dent in this pile of software that has accumulated. B

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Jerry Pournelle is a science fiction writer and BYTE's senior contributing editor. You can write to Jerry c/o BYTE, 29 Hartwell Ave., Lexington, MA 02173. Please include a self-addressed, stamped envelope and put your address on the letter as well as on the envelope. Due to the volume of letters, Jerry cannot guarantee a personal reply. You can also contact him on the Internet or BIX at **jerryp@bix.com.** *Visit Chaos Manor at* **http://home.earthlink.net/~jerryp/.**

JUNE 1998, VOL. 23, NO.6

BYTE

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Essential Products and Services for Technology Experts

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Top mail-order vendors offer the latest hardware and software products at the best prices. Page 138

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Your full-color guide to in-demand hardware and software products, categorized for quick access. Page 147

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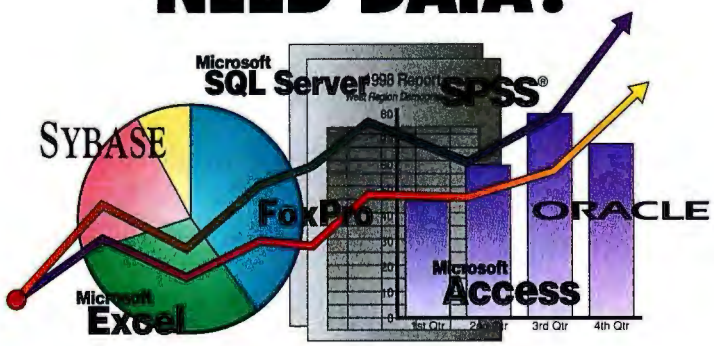

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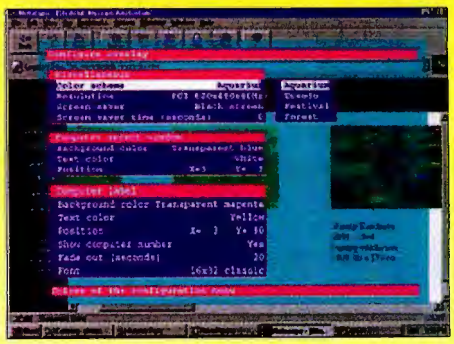

On-screen display menu–This screen shows the overlay menu with the selection for the color scheme popped up.

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View of the circuit board

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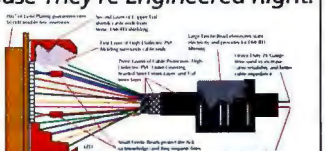

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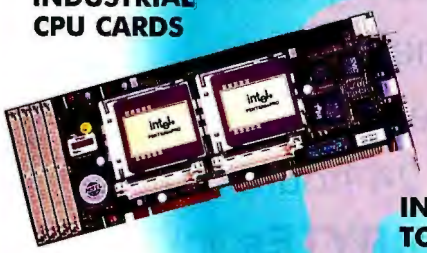

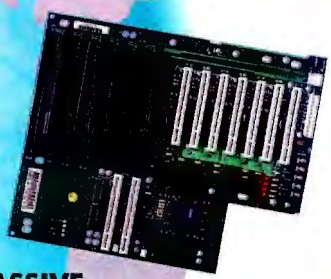

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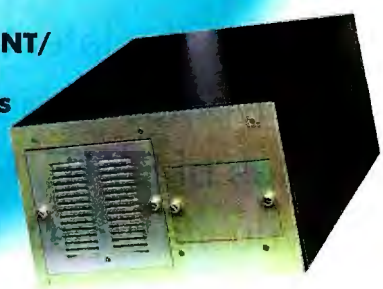

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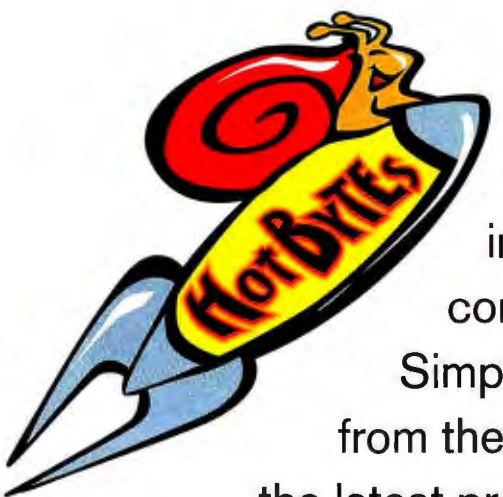

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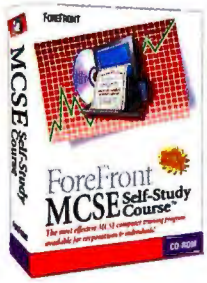

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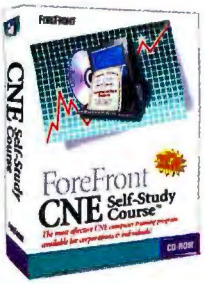

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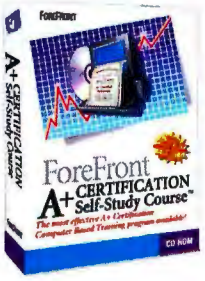

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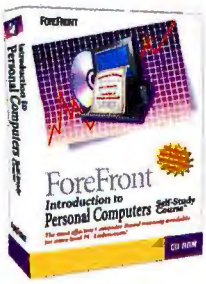

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*	BYTE RESELLER (RAS)	112N	
*	BYTE SUB MESSAGE	134	
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*	BYTE SUB PROBLEMS (IS)	40IS 18	
*	BYTE WEB SITE (IS)	40IS 7	http://www.byte.com/
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131	CARDIFF SOFTWARE	138	888-254-8919
120	CENTRAL DATA	96	800-482-0316
106	CENTURY SOFTWARE	133	800-877-3088
448	CHECKPOINT SOFTWARE TECHNOLOGIES (IS)	11	+972-3-613-1833
107	COMP USA (N.A.)	54-55	888-218-6720
*	COMPAQ (N.A.)	22-23	800-943-7656
443	COMPEX INC (IS)	CVI	714-630-7302
*	COMPUTER ASSOCIATES	2-3	888-UNICENTER
108	COMPUTER DISCOUNT WAREHOUSE	43	800-959-4239
90	CONSAN INC	149	800-221-6732
*	COSMO SOFTWARE	108	888-91-COSMO ext 282
109	CYBEX COMPUTER PRODUCTS CORP.	65	256-430-4000
450	CYBEX EUROPE (IS)	40IS 2	+353 61 471 877
	D		
*	D.E. SHAW & COMPANY (N.A.)	93	
449	DAN WARE DATA (IS)	35	+45-44-53-1551
*	DATEL INC (US)	128A-B	
458	DBTEL (IS)	40IS 19	+886-2-268-2081
*	DELL COMPUTER CORP (N.A.)	96NA 7	800-937-1420
*	DELL COMPUTER CORP (N.A.)	CV-CVIII	800-953-5618
*	DIGITAL EQUIPMENT CORP (N.A.)	8-9	800-DIGITAL
124	DISTINCT CORPORATION	134	408-366-8933
110	DISTRIBUTED PROCESSING TECH	21	407-830-5522
436	D-LINK CORPORATION (IS)	CTX 2	+886-2-916-1600
	E		
447	E-TECH (IS)	60	+886-35-777751
444	EUTRON (IS)	CV	+39 35 697001
142	EVEREX (RAS)	112I	800-EVEREX-1
433	EVEREX SYSTEMS (IS)	CTX 12	+886-2-2773-2266
140	EVEREX SYSTEMS (RAS)	112E	888-PALMPC-4
	F		
111	FAIRCOM CORPORATION	130	573-445-6833
132	FOREFRONT DIRECT INC	145	800-475-5831
*	FOREFRONT DIRECT INC (N.A.)	144A-B	800-475-5831
	G		
91	GAGE APPLIED SCIENCES INC	147	800-567-GAGE
*	GATEWAY 2000	36-37	888-217-4941
133	GRANITE DIGITAL	141	510-471-6442
445	GREY MATTER LTD (IS)	40IS 15	+44-(0)1364-654200**
123	GRIFFIN TECHNOLOGY (U.S.)	131	800-986-6578
434	GVC (IS)	CTX 10	+886-2-704-0338**
	H		
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*	HOT BYTES	144	
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*	IBM EUROPE	96A-P	
*	IBM PORTUGESE	96A-P	0800-111 426
*	IBM SPANISH	96A-P	
*	IBM EUROPE (EUR)	40IS A-D	+44-0870-601-0137
*	IBM EUROPE (IS)	40IS 7	+41(22)840 47 47
98	ICANECT	150	800-422-9213
87	ICP ACQUIRE	148	650-967-7168
146	ICS (N.A.)	96NA 2	818-885-7500
125	IOT WINCHIP C6 (N.A.)	59	1-800-WINCHIP
100	INTERLAND	150	404-586-9999
141	INTRASERVER TECHNOLOGY (RAS)	112G	888-429-0425
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*	KILA	147	303-444-7737
112	KINGSTON	31	800-435-0670
137	KONEXX (RAS)	112B	800-555-3230
*	KVM SYSTEMS (US)	128A-B	
439	KYE SYSTEM CORP (IS)	CTX 14	+886-2-2995-6645
	L		
456	LEO IMAGE (IS)	59	+886-2-25457860
*	LIBRARY OF COMP. INFO. SCIENCE (US)	128C-D	
463	LIGHTNING INSTRUMENTATION (IS)	12-13	+41-21-654-2000
*	LOTUS DEVELOPMENT (N.A.)	35	800-872-3387 ext D771
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451	MACROVISION (IS)	40IS 13	+353-1-667-1111
*	MCGRAW-HILL COMPUTER BOOK CLUB	113	614-759-3666
*	MCGRAW-HILL COMPUTER BOOK CLUB (N.A.)	112U-V	614-759-3666
138	MICRO 2000 (RAS)	112M	800-864-8008
121	MICRON ELECTRONICS	CII-1	800-362-7306
*	MICROSOFT CORPORATION	28-29	
*	MICROSOFT CORPORATION	44-45	888-229-073B
*	MICROSOFT TECH NET	149	
*	MICROWAY	85	508-746-7341
432	MITAC (IS)	CTX 20	+886-3-328-9000
431	MITAC (IS)	CTX 4	+886-3-328-9000
139	MITAC (RAS)	112Q	+886-3-328-9000
128	MODCOMP INC	20	888-846-3045
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101	9-NET AVENUE INC	149	888-9NETAVE
92	NATIONAL INSTRUMENTS	147	800-433-3488
*	NATIONAL INSTRUMENTS (U.S.)	112A-B	800-433-3488
88	NEATO LLC	148	800-984-9800
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*	OSBORNE MCGRAW-HILL	46	800-262-4729
113	OVERLAND DATA INC	95	619-571-5555
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144	PI MANUFACTURING (RAS)	112S	909-598-3718
114	PKWARE INC	132	414-354-8699
441	PLUSTEK INC (IS)	CTX 28	+886-2-26515311
95	PRECISION GUESSWORK INC	149	978-887-6570
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115	QNX SOFTWARE SYSTEMS LTD	27	800-676-0566 ext1065
	R		
134	RAIDTEC CORPORATION	142	770-664-6066
116	RAINBOW TECHNOLOGIES (IS)	7	714-450-7300
116	RAINBOW TECHNOLOGIES (N.A.)	7	800-705-5552
94	RARITAN COMPUTER INC	148	732-764-8886
96	RECORTEC INC	148	888-RECORTEC
129	ROSE ELECTRONICS	139	800-333-9343
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*	SALIX GROUP (US)	128C-D	
460	SAMS PUBLISHING (IS)	40IS 20	+44(0) 442 881 891
117	SCO	53	1-800-SCO-UNIX
453	SERCOMM (IS)	77	886-2-26961100
452	SIEMENS NIXDORF AG PC GM5 (IS)	8-9	+49-821-8043680
*	SILICON GRAPHICS	39	
97	SLIGER DESIGNS	148	800-255-0267
127	STARBASE (IS)	19	714-442-444D
127	STARBASE (N.A.)	19	888-STAR700
118	STATSOFT	75	918-749-1119
*	SUPERCOMM 98	127	800-2-SUPERC
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*	TELECOM (IS)	54-55	
89	TERN INC	149	530-758-0180
130	TRI-MAP INTERNATIONAL INC	143	510-447-2030
*	TRON INTERNATIONAL (US)	128C-D	
	V		
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	W		
123	WIBU SYSTEMS (IS)	131	+49-721-9317272**
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99	WORLDWIDE INTERNET PUBLISHING	150	800-785-6170
	X		
145	XI COMPUTER CORP	135	714-498-0858
	Z		
85	Z-WORLD ENGINEERING	147	530-757-3737
442	ZYXEL COMMUNICATIONS CORP (IS)	CTX 6	+886-3-578-3942

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RAS – Ads only appear in Reseller Edition
EUR – Ads only appear in Europe Edition
IS – Ads only appear in International Edition
N.A. – Ads only appear in North American Edition
U.S. – Ads only appear in U.S. Edition
WORLD – Ads only appear in World Edition
*Correspond directly with company
**Indicates FAX Number

BYTE ADVERTISING SALES STAFF

Michael P. Walsh, *Associate Publisher*
29 Hartwell Avenue, Lexington, MA 02173
Tel: 781-860-6714, Fax: 781-860-6179, mike_walsh@mcgraw-hill.com

Lori Silverstein, *Eastern Regional Sales Director*
921 Eastwind Drive, Suite 118, Westerville, OH 43081
Tel: 614-899-4908, Fax: 614-899-4999, lorisf@mcgraw-hill.com

Jim Hussey, *Western Regional Sales Director*
1900 O'Farrell Street, Suite 200, San Mateo, CA 94403
Tel: 650-513-6861, Fox: 650-513-6808, jim_hussey@mcgraw-hill.com

RESELLER ADVERTISING
Jim Hussey 650-513-6861
jim_hussey@mcgraw-hill.com

BYTE EURODECK - East Coast & Europe
Phil Marshall 978-499-0900
phil_marshall@mcgraw-hill.com
FAX: 978-499-0901

BYTE EURODECK - West Coast & Asia
Chris Litchfield 650-513-6939
chris_litchfield@mcgraw-hill.com
FAX: 650-513-6808

NORTH PACIFIC

AK, Northern CA, HI, ID, MT, OR, Silicon Valley, WA, WY, Western Canada
Lisa Farrell 650-513-6862
lfarrell@mcgraw-hill.com
Matt Knuth 650-513-6951
matt_knuth@mcgraw-hill.com
Sarah McGregor 650-513-6952
sarah_mcgregor@mcgraw-hill.com
Chris Litchfield 650-513-6939
chris_litchfield@mcgraw-hill.com
The McGraw-Hill Companies
1900 O'Farrell Street, Suite 200
San Mateo, CA 94403
FAX: 650-513-6808

SOUTH PACIFIC

AZ, Southern CA, CO, NM, NV, UT
Neal Wilder 714-443-9314
neal_wilder@mcgraw-hill.com
Geanette Perez 714-443-9314
gperez@mcgraw-hill.com
The McGraw-Hill Companies
635 Camino de los Mares, Suite 212
San Clemente, CA 92673
FAX: 714-443-9602

MIDWEST-SOUTHEAST

FL, GA, IL, KY, MI, MN, NC, SC, SD, WI
Neil Helms 404-843-4777
nhelms@mcgraw-hill.com
Lee Jaffe 404-843-4766
lee_jaffe@mcgraw-hill.com
The McGraw-Hill Companies
4170 Ashford-Dunwoody Road
Suite 520
Atlanta, GA 30319-1465
FAX: 404-256-5962

NEW ENGLAND

CT, MA, ME, NH, NY, RI, VT, Eastern Canada
Edward Marecki 401-351-0274
ed_marecki@mcgraw-hill.com
Phil Marshall 978-499-0900
phil_marshall@mcgraw-hill.com
BYTE
One Richmond Square
Providence, RI 02906
FAX: 401-351-0276

PETERBOROUGH, NH OFFICE

One Phoenix Mill Lane
Peterborough, NH 03458
Advertising Production FAX: 603-924-7507
Advertising Production FAX: 603-924-2683

MID ATLANTIC

DC, DE, IN, MD, Metro NY, NJ, OH, PA, VA, WV
Don Calamaro 212-512-4811
don_calamaro@mcgraw-hill.com
John Ferraro 212-512-2555
jferraro@mcgraw-hill.com
Jill Pollak 212-512-3585
jpollak@mcgraw-hill.com
The McGraw-Hill Companies
1221 Avenue of Americas, 28th Floor
New York, NY 10020
FAX: 212-512-2075

SOUTHWEST-MIDWEST

AL, AR, IA, KS, LA, MO, MS, ND, NE, OK, TN, TX
Chrissy Copple 214-688-5171
ccopple@mcgraw-hill.com
The McGraw-Hill Companies
Mockingbird Towers, Suite 1104E
1341 W. Mockingbird Lane
Dallas, TX 75247-6913
FAX: 214-688-5167

ADVERTISING PRODUCTION

Advertising/Production
FAX: 603-924-7507
Advertising Production Manager:
Linda Fluhr 603-924-2551
lfluhr@mcgraw-hill.com
Senior Advertising Production Coordinator:
Lyda Clark 603-924-2545
lclark@mcgraw-hill.com
Advertising Production Coordinator:
Karen Cilley 603-924-2557
kcilley@mcgraw-hill.com
Senior Operations Coordinator:
Lisa Jo Steiner 603-924-2540
lisajo@mcgraw-hill.com
Advertising Graphics Manager:
Susan Kingsbury 603-924-2507
suekings@mcgraw-hill.com

MARKETING AND PLANNING

Marketing Director:
Mary Doyle 781-860-6283
FAX: 781-860-6307
mary_doyle@mcgraw-hill.com
Market Information Manager:
Edward Fielding 781-860-6344
FAX: 781-860-6822
fielding@mcgraw-hill.com
Market Information Coordinator:
Dylan DiGregorio 781-860-6267
FAX: 781-860-6822
digregor@mcgraw-hill.com
Assistant Manager, Trade Shows and Special Events:
Arja Neukam 781-860-6378
FAX: 781-860-6307
aneukam@mcgraw-hill.com
Marketing/Sales Information Associate:
Susan Monkton 603-924-2618
smonkton@mcgraw-hill.com
FAX: 603-924-2602
Marketing Services Associate:
Kate Woodhouse 781-860-6361
FAX: 781-860-6307
woodhous@mcgraw-hill.com

SUBSCRIPTIONS

Customer Service
U.S. 1-800-232-2983
Outside U.S. +1-609-426-7676
For a New Subscription
U.S. 1-800-257-9402
Outside U.S. +1-609-426-5526

INTERNATIONAL ADVERTISING SALES STAFF

Lori Silverstein, *International Sales Director, 921 Eastwind Drive, Suite 118, Westerville, OH 43081 U.S.A.*
Tel: +614-899-4908, Fax: +614-899-4999, lorisf@mcgraw-hill.com

BYTE ASIA-PACIFIC AUSTRALIA, HONG KONG, INDIA, INDONESIA, KOREA, MALAYSIA, PAKISTAN, PHILIPPINES, OTHER ASIA AND PACIFIC COUNTRIES, SINGAPORE, TAIWAN

Weiyee In
wei@byte.com
Jennifer Chen
jennchen@mcgraw-hill.com
#305 Nanking East Road,
Section 3, 10th floor
Taipei, Taiwan, R.O.C.
Tel: +886-22-715-2205
FAX: +886-22-715-2342

KOREA

Young-Seoh Chinn
JES Media International
6th Fl., Donghye Bldg.
47-16, Myungil-Dong
Kangdong-Gu
Seoul 134-070, Korea
Tel: +82-2-4813411
FAX: +82-2-4813414

GERMANY, SWITZERLAND, AUSTRIA

Jürgen Heise
jheise@mcgraw-hill.com
The McGraw-Hill Companies
Adam-Berg-Str. 115a
D-81735 Munich, Germany
Tel: +49 -89-680701-16
FAX: +49-89-680701-18

ISRAEL

Dan Aronovic
rhodanny@actcom.co.il
DARA International
11 Hasheldag Street
P.O. Box 2335
Kadima 60920, Israel
Tel: +972-9-8995813
FAX: +972-9-8995815

JAPAN

Akiyoshi Kojima
Japan Advertising Communications, Inc.
Three Star Building
3-10-3 Kanda Jimbocho
Chiyoda-ku, Tokyo 101 Japan
Tel: +81 3 3261 4591
FAX: +81 3 3261 6126

ITALY, FRANCE, SPAIN, PORTUGAL, SCANDINAVIA

Zena Coupé, Amanda Blaskett
A-Z International Sales Ltd.
70 Chalk Farm Road
London NW1 8AN, England
Tel: +44 171 2843171
FAX: +44 171 2843174
Emanuela Castagnetti
emanuela.a-z@wanadoo.fr
A-Z International Sales Ltd.
BP18 Les Bossons
31 rue du Lyret
74400 Chamonix, France
Tel: +33 (0)4 50 531339
FAX: +33 (0)4 50 531368

UNITED KINGDOM, BENELUX

Darren Sharp
Tel: +44 171 495 6780
The McGraw-Hill Companies
34 Dover St.
London W1X 4BR
England
FAX: +44 171 4956734

EDITORIAL INDEX

For more information on companies covered in articles in this issue, enter the HotBYTEs number in the HotBYTEs form on the BYTE Web site at http://www.byte.com/hotbytes/. Page numbers refer to the first page of the article in which the company appears.

FREE Product Information Service: www.byte.com/hotbytes/

IS and CTX pages appear only in the International edition. C and K pages appear only in the Reseller edition. NA pages appear only in the North America edition.

What's New

Hardware

Check out some beefed-up graphics accelerators, build-your-own G3 Mac clones, Web server clusters, and new Java tools.

PREVIEW

LaserJet 3100
$699

Enter HotBYTEs No. 1009.

Hewlett-Packard
Palo Alto, CA
800-527-3753
650-857-1501
http://www.hp.com

New LaserJet Does It All

Hewlett-Packard's LaserJet 3100 is the company's first multifunction device to be built around a laser printer engine rather than an ink-jet engine. It delivers a wide array of features, along with fast, crisp output. The 3100 uses a 600 x 600-dpi print engine (like the LaserJet 6 series) that can turn out sharp copy at 6 pages per minute. Results are excellent; the 3100 doesn't take a back seat to most small-business or SOHO printers in terms of print quality or gray-scale photo reproduction. Copy, scan, and fax functions are built in. You can use the device for PC-based faxing or as a stand-alone fax machine without a PC connection.

HP didn't skimp on the feature set for any of these capabilities, with niceties such as memory to hold 150 pages of received faxes, up to 175 speed-dial positions, and even a certain degree of multitasking. You can print while faxes are coming in or going out, and receive faxes while scanning or copying. The 3100 also has a 30-sheet automatic document feeder, and it comes with software for OCR, fax management, and more. At $699, the 3100 is very well priced, and it's much less expensive to operate on a per-page basis than the typical ink-jet-based fax or all-in-one unit. We've been disappointed with many all-in-ones to date; the ink-jet units produced only middling print quality, and the laser-based systems were often too big and bulky. The LaserJet 3100 addresses both of these issues in a winning product.

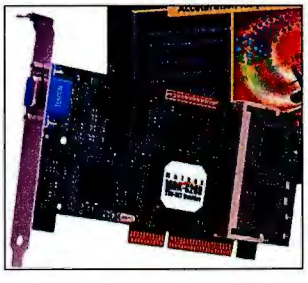
–Jon Pepper

PHOTOGRAPH: STEVEN GREENBERG © 1998

Graphics Accelerators

The New Millennium

MATROX HAS INTRODUCED GRAPHICS BOARD families based on two new engines, the MGA-G100 and the MGA-G200. The new high-end board based on this technology, the $229 Millennium G200, offers OpenGL acceleration and a hard-wired geometry/triangle setup engine. The board's Installable Client Driver supports both Windows 95 and NT. The Millennium G200 is a PCI card with 8 MB of RAM, expandable to 16 MB. The 16-MB model supports 1900 x 1280 true color resolution. The new board is based on AGP 2x and offers various options for DVD, TV-out, and video capture.



Contact: Matrox, Dorval, Quebec, Canada, 800-837-3611 or 514-969-0680; networks.info@matrox.com; http://www.matrox.com.
Enter HotBYTEs No. 977.

Muscular 3-D Accelerator

THE GLORIAT-XXL ($2399) IS ELSA'S new high-end 3-D graphics accelerator designed for CAD, modeling, animation, and visualization applications. ELSA claims the accelerator is capable of up to 3.3 million polygons per second, with full geometry transformation, lighting calculations, texture coordinate generation, and high-quality fog calculation. The GLoriaT-XXL is configured with a 16-MB VRAM frame buffer and a 24-MB DRAM (expandable to 40-MB) local buffer for Z-buffering and texture mapping. The card supports a high-resolution true color display of up to 1920 x 1080 (1600 x 1280 on a 24-inch monitor).
Contact: ELSA, Santa Clara, CA, 800-272-3572 or 408-919-9100; sales-us@elsa.com; http://www.elsa.com.
Enter HotBYTEs No. 978.

Communications

ISDN Simplified

THE ARESCOM FLASH300 PLUS ($379) external ISDN modems are built to overcome difficulties that make installing ISDN a hassle. They have parallel and serial interfaces with data speeds of up to 128 Kbps and will automatically configure themselves, including setup of SPID numbers. The Apex 1100 ISDN BRI access router ($679) is a terminal adapter, router, bridge, and Internet gateway for managing all aspects of remote access.
Contact: Arescom, Fremont, CA, 510-445-3638; sales@arescom.com; http://www.arescom.com.
Enter HotBYTEs No. 979.

Networking

Get on the Web from Anywhere

3COM'S 56K GLOBAL MODEM PC CARD comes with software that configures the modem for use in more

than 250 countries at 56 or 33.6 Kbps. The unit comes with a cable connector with adapters for the United States. Adapters for other countries are sold separately.
Contact: 3Com, Santa Clara, CA, 408-764-5000; http://www.3com.com.
Enter HotBYTEs No. 980.

Bringing LANs into the Home

FOR $299, THE AVIATOR WIRELESS NETwork offers a complete peer-to-peer Windows 95-based LAN for sharing resources between multiple PCs in a home or small office. Using wireless RF technology, systems on this LAN can transmit and receive data at 500 Kbps.
Contact: WebGear, San Jose, CA, 408-271-9888; webgear@webgear.com; http://www.webgear.com.
Enter HotBYTEs No. 981.

Deploy Fibre Channel and SCSI

BOTH SCSI AND FIBRE CHANNEL HAVE THEIR place on a network. To support both interfaces, the CrossPoint 4400 Fibre Channel-to-SCSI router provides up to two Fibre Channel ports (100-MBps each) and four Fast, Fast and Wide, or Wide and Ultra SCSI connectors. The system has a throughput of 65 MBps and transaction rates of 10,000 I/O per second, with support for fiber-optic media and up to 60 connected SCSI devices. The suggested retail price is $24,999.
Contact: Crossroads Systems, Austin, TX, 512-349-0300; http://www.crossroads.com.
Enter HotBYTEs No. 982.

Wireless Backbones

RADIOLAN'S WIRELESS BACKBONELINK connects the company's 10-Mbps wire-free LAN to a standard 10-Mbps Ethernet LAN. It supports active wireless connections of up to 128 desktop and mobile PCs. The Wireless ISA CardLink for desktop systems is $349; the portable version runs $449; and the backbone

link itself is priced at $999.
Contact: RadioLAN, Sunnyvale, CA, 408-524-2600; http://www.radiolan.com.
Enter HotBYTEs No. 983.

Servers

More Pentium Power

IBM'S NETFINITY 5500 WILL SUPPORT TWO Pentium II Deschutes processors at speeds of up to 400 MHz and bus speeds of 100 MHz using the new Intel BX chip set. For upgrades, the system offers considerable flexibility: seven slots (six PCI, one ISA), 10 drive bays, and Ultra Wide SCSI RAID and EIDE connections. Prices start at $4500.
Contact: IBM, Somers, NY, 800-772-2227 or 416-383-5152; http://www.ibm.com.

A Bigger, Smarter Server

F5 LABS' BIG/IP3 ($44,900) IS A 333-MHz Pentium II machine that can intelligently allocate Internet and intranet service requests across an array of network servers, ensuring content availability for end users. The system resides between your Internet routers and the local server array and continually monitors each local server for application availability and performance. It will automatically route queries to the most available server. The BIG/ip3 controller will function with all TCP/IP-based OSes, including Windows NT, all Unix platforms, and Mac OS.
Contact: F5 Labs, Seattle, WA, 206-505-0800; http://www.f5.com.
Enter HotBYTEs No. 1038.

Upgrades

New Life for Your Mac

NEWER TECHNOLOGIES' G3 UPGRADE CARDS take full advantage of the capabilities of the G3 processor to add power to your old Mac, Umax, or PowerPC system. The high-end MAXpowr 300 ($1999) is a 300-MHz upgrade card with 1 MB of cache. It manages to run the L2 cache bus at the same speed as the processor. The NUpowr 1400 ($999) will upgrade a PowerBook 1400 to 250 MHz.
Contact: Newer Technologies, Wichita, KS, 316-943-0222; info@newertech.com; http://www.newertech.
Enter HotBYTEs No. 985.

Systems

Build Your Own G3 Mac

UNTIL AT LEAST DECEMBER 1998, UMAX can sell Mac clones, but the company is legally prohibited from installing G3 chips in the systems. Umax neatly circumvents this legal restriction by putting a G3 card in the shipping crate; the buyer is free to install the upgrade. The SuperMac S900BASE is priced at $2995. The system ships with a 604e CPU installed and a 250-MHz G3 upgrade card in the box. The card has a 1-MB backside L2 cache running at 166 MHz. The S900BASE with G3 includes more upgrade features than current Apple systems, with eight DIMM slots for up to 1 GB of memory, seven drive bays,

and six PCI slots (minus one slot occupied by the 10/100Base-T Ethernet card).
Contact: Umax Computer, Fremont, CA, 510-226-6886; products@supermac.com; http://www.umax.com.
Enter HotBYTEs No. 986.

CD Servers

CD-ROM Central

MICROTEST'S DISCPORT TOWER MANAGES access for shared CD-ROM or DVD-ROM titles in an enterprise environment. The price of the tower starts at $1675 without drives (users choose what types of drives to deploy). With the DiscPort Executive software ($4995) for Windows NT or NetWare, the system will automatically update new titles as they are added to the CD library and create virtual CD-ROMs on high-density hard drives for faster access speeds.
Contact: Microtest, Phoenix, AZ, 602-952-6400; http://www.microtest.com.
Enter HotBYTEs No. 987.

Printers

Laser-Quick Ink-Jet Printing

INK CARTRIDGES ARE INTEGRAL TO PRINTer performance, as evidenced by the speed of the new Hewlett-Packard 2000C ($799). The printer's redesigned ink cartridges have embedded microchips to keep track of ink levels, ensure that cartridges are lined up, and allow for bidirectional communication between printer and host. HP has squeezed 1800 nozzles on each cartridge. The 2000C can print three pages of color images and text in 43 seconds (at default settings), the company says. (According to HP, the color LaserJet 5M prints the same pages in 2:39.) A networkable version with external print server and 2500-page paper tray is $1199.
Contact: Hewlett-Packard,

Palo Alto, CA, 800-527-3753 or 650-857-1501; http://www.hp.com.
Enter HotBYTEs No. 988.

Telephony

Internet Telephony for Call Centers

THE INTERNET AND TELEPHONY COMBINE IN the 10-port eBridge, letting call-center workers talk to customers and exchange data in real time over a single phone line. eBridge is installed as a front end to a PBX or an automatic call distributor. With H.232-compliant Internet phones, eBridge users can talk to on-line customers as they conduct data transactions.
Contact: eFusion, Beaverton, OR, 503-207-6300; info@efusion.com; http://www.efusion.com.
Enter HotBYTEs No. 992.

Digital Cameras

Epson's New Megapixel Camera

THE EPSON PHOTOPC 700 EMPLOYS A 1.3 million-pixel CCD sensor to achieve resolutions of 640 x 480 up to 1280 x 960 pixels. Priced under $800, the camera sports an autofocus lens; it comes with an adapter for a 37mm wide-angle, telephoto, or close-up lens. The camera has 4 MB of internal memory, but you can also buy an optional 32 MB of removable storage.
Contact: Epson, Torrance, CA, 310-782-0770; http://www.epson.com.
Enter HotBYTEs No. 991.

Digital Photography for Professionals

THE POWERSHOT PRO 70'S HALF-INCH 1.68 million-pixel CCD sensor and 28-70mm power zoom lens make this camera suitable for professional photographers, Canon says. The camera is capable of 1536 x 1024-pixel resolution and 8 x 10-inch output. The PowerShot has autofocus technology, a focal range from 4.7 inches to infinity, and a burst mode for shooting at 4 fps for 20 consecutive frames (at 768 x 512). Expected price: under $1500.
Contact: Canon, Costa Mesa, CA, 800-848-4123 or 757-413-2848; http://www.ccsi.canon.com.
Enter HotBYTEs No. 990.

Scanners

36-Bit Scanning for Amateurs or Pros

MUSTEK'S NEW MODELS OFFER 36-BIT scanning for designers who need single-pass, wide-format color scanning. The Paragon 1200 A3 Pro ($999) can scan 11.7 x 17-inch images in a single pass, capturing 68.7 billion colors with 600 x 1200 optical resolution or 9600 x 9600 interpolated. The Paragon PowerPro ($999) has optical resolution of 1200 x 4800. The scanner is capable of 36-bit color but can optimize

images for display on Windows machines limited to 24-bit color. Entry-level users can deploy the $249 Paragon 1200 SP to capture 600 x 900-dpi images (or 9600 dpi with software enhancement). These new models work with Macs or Windows PCs.
Contact: Mustek, Irvine, CA, 800-468-7835 or 714-250-8855; http://www.mustek.com.
Enter HotBYTEs No. 989.

SOFTWARE
Translation

Interpret the Web

EASYTRANSLATOR 2.0 PERFORMS MACHINE translation, meaning it doesn't just dumbly translate a document word for word but tries to obey syntactical rules. The program works on text and Web pages in Spanish, French, German, English, and Portuguese. When dealing with a Web page, it will translate the text and keep the original HTML tags so as to preserve the page's formatting. Price is $49.
Contact: Transparent Language, Hollis, NH, 603-465-2230; admin@transparent.com; http://www.transparent.com.
Enter HotBYTEs No. 999.

PREVIEW

Adobe Photoshop 5.0
$995 (list price)
(street price: $695; upgrade: $249)

Enter HotBYTEs No. 1041.

Adobe
San Jose, CA
800-492-3623
408-536-6000
fax: 408-537-6000
http://www.adobe.com

New Photoshop Adds Power, Flexibility

Photoshop, the de facto standard for professional-level image editing, is about to become even more powerful and flexible. Photoshop 5.0's new features include multiple redo and undo, better support for editable text, more precise color management, and the ability to specify spot-color channels for images.

The redo/undo feature appears in the form of a History palette that tracks and shows all editing steps. This lets you review your work, go back to a prior editing stage, and restore the image as it was. Plus, you can compare different stages of an image, or even "paint" a previous set of edits onto a current image with the History Brush tool.

You can now edit text on a separate type layer and apply edits, formatting, and character-level controls such as tracking, kerning, leading, and baseline shifts. All these enhancements make working with text far easier than with earlier versions of Photoshop.

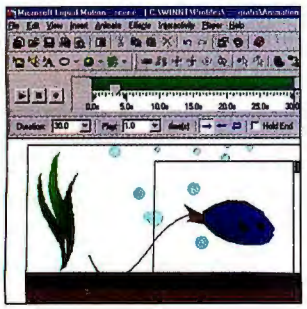
Other key refinements include a measure tool (for point-to-point distance), a magnetic lasso (for easier edge detection in sections or shapes), and a host of production and automatic features. While Adobe Photoshop 5.0 is much improved, there is little here that is revolutionary. But that isn't a major drawback in a product that was already a champ.

– Jon Pepper

Graphics

Bring Graphics to Life

LIQUID MOTION 1.0 IS MICROSOFT'S SOLUTION for doing simple graphics animation. The software allows the



user to bring 2-D or 3-D graphics to life with one-button animation. It works with any GIF or JPEG image, and it requires no plug-ins. Price is $49 for Microsoft Frontpage and Office users; $149 for everyone else.
Contact: Microsoft, Redmond, WA, 206-882-8080; http://www.microsoft.com.
Enter HotBYTEs No. 995.

Programming

Visual Studio Gets Assistance

VISUAL ASSIST ($149) IS A DEVELOPMENT tool that integrates with the Windows Visual Studio environment to enhance productivity for C++ and Java programmers. Visual Assist lets development teams share code that is easier to read and understand by giving programmers new tools that use color codes, symbol expansions, self-correcting case, context-sensitive find/replace functions, and help options.
Contact: Whole Tomato Software, Cupertino, CA, 408-439-0977; http://www.wholetomato.com.
Enter HotBYTEs No. 1000.

Bug-Detection Software

VISUAL INTERCEPT'S BROWSER WARNS PROgrammers of the incidence and impact of bugs in software development projects, documenting and pinpointing the offending code. It is designed for Visual Basic, Visual SourceSafe, and Visual Test. Prices start at $699.
Contact: Elsinore Technologies, Raleigh, NC, 713-956-1221; info@elsitech.com; http://www.elsitech.com.
Enter HotBYTEs No. 1001.

Take a Look at Your Objects

ALTRASOFT'S OO-BROWSER IS AN OBJECT-oriented code browser that reads source code only and works with a variety of languages. You can check out existing class libraries without compiling. Many operations that can be applied to a single class can be applied to a whole set at once. It will also work with other editors, such as vi. Cost is from $599 to $1350, depending on which languages and platforms you use. Languages include C, C++, Java, Lisp, Objective-C, Python, Eiffel, and Smalltalk. Altrasoft provides browser source code for customization.
Contact: Altrasoft, San Jose, CA, 408-243-3300; http://www.altrasoft.com.
Enter HotBYTEs No. 1002.

Get the Lead Out

DASHO-PRO ($1695) IS DESIGNED TO help squeeze the smallest and fastest Java executables out of your code. It removes unused methods, fields, and constant pool entries from Java programs, and will optimize and shrink class files by removing unneeded bytecode.
Contact: preEmptive Software, Euclid, OH, 216-732-5895; http://www.preemptive.com.
Enter HotBYTEs No. 1040.

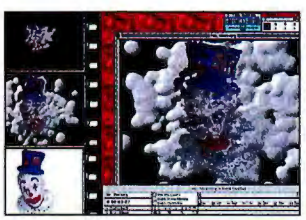
Halcyon Days for Programmers

HALCYON SOFTWARE'S INSTANT BASIC FOR Java will turn your existing Visual Basic applications into Java applications or applets. It has a compiler that converts VB source code directly into Java bytecode and will allow users to visually debug Java applications at the VB source-code level. The package costs $99. The Professional Edition ($795) can handle ActiveX components and has bundled support for JDBC.
Contact: Halcyon Software, Campbell, CA, 408-378-9898; http://www.halcyon.com.
Enter HotBYTEs No. 1039.

Video

New Video Effects

FINAL EFFECTS COMPLETE IS A VIDEO PRODuction tool that provides a set of 60 plug-in filters and transitions for generating Hollywood-style special effects. Priced at $1195, it can control compositing details for output to film, video, animation, and CD-ROM. The software works as a set of filters for Adobe's After Effects post-production package. It also offers Windows 95/NT users access to the filters contained in

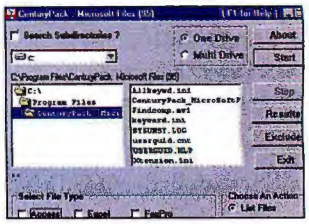


Final Effects and Studio Effects, both currently available only for Power Macintosh, as well as 14 additional filters that will be new to both Windows and Macintosh platforms.
Contact: MetaCreations, Scotts Valley, CA, 408-430-4000; http://www.metacreations.com.
Enter HotBYTEs No. 996.

Year 2000

Get Ready for 2000 A.D.

FIND OUT HOW MUCH OF A THREAT THE YEAR 2000 is to your infrastructure by scanning all content on desktop



and LAN environments. IST Year 2000 Packs ($6000) analyze content and data structures, writing a full audit-trail report of all files scanned. The software also highlights the nature of data-sensitive constructs like date entry, date calculations, and date functions.
Contact: IST Development, Boston, MA, 617-988-6251; afalcon@istdevelopment.com; http://www.ISTinfo.com.
Enter HotBYTEs No. 993.

E-Mail

E-Mail Giveaway

SEATTLE LAB'S EMURL ALLOWS ANY WEB site to provide free e-mail, like HotMail or a similar Internet service. It runs on any POP3 mail server and lets visitors to a Web site set up an account that they can access with any browser e-mail client. It costs $425 for an unlimited-user license, and it works as an extension to Microsoft's Internet Information Server software (but it will not work with other Web servers, such as Netscape's).
Contact: Seattle Lab, Seattle, WA, 425-402-6003; sales@seattlelab.com; http://www.seattlelab.com.
Enter HotBYTEs No. 1043.

Legacy Tools

One-Stop Integration Shopping

CNT'S APPLICATION RE-ENGINEERING Environment suite overhauls legacy applications for Web deployment. The software provides a communications infrastructure to mainframe applications and extends those applications to the Web. The suite includes Web-to-

host gateways and servers, as well as Java-based emulators for 3270 and AS/400 applications, which can automatically give legacy "green screen" applications a graphical user interface. Enterprise/Access is an object-oriented environment for building new front-end applications based on legacy applications. Prices start at $43,880 per module.
Contact: Computer Network Technologies, Minneapolis, MN, 612-797-6000; http://www.cnt.com.
Enter HotBYTEs No. 994.

The Web

Shrink the Size of Your Site

GIF WIZARD IS BROWSER-BASED ON-LINE software that the manufacturer claims can shrink sites 30 to 50 percent. The software, available in multiple languages, checks an individual Web site for inefficiencies such as multiple graphics use, broken URLs, and large images. It then provides you with a breakdown of poor bandwidth usage. GIF Wizard ($99 for a one-year license) will allow real-environment previews of compressed graphics. The program is platform-independent.
Contact: Raspberry Hill Publishing, Inc, Newton, NJ, 973-579-7994; http://www.gifwizard.com.
Enter HotBYTEs No. 997.

Talk Your Way Around the Web

CONVERSA'S CONVERSA WEB ($39.95) allows anyone to cruise the World Wide Web through voice commands with Internet Explorer 4.0. The software uses a proprietary speech engine, requires no voice training, and will support multiple users. It minimally requires Windows 95 or NT, a 100-MHz Pentium, 24 MB of RAM, 16-bit sound, and microphone. To go to a link using Conversa Web, you need only to say the link, or part of it. The software supports an interactive help menu with a list of navigating terms.
Contact: Conversa, Redmond, WA, 425-558-7554; http://www.conversa.com.
Enter HotBYTEs No. 998.

Security

Firewalls with Bells and Whistles

THE FORT KNOX FIREWALL FAMILY PROVIDES standards-based virtual private network and enterprise-level security with a number of extra features, like URL filtering, Web caching,

real-time monitoring, and e-mail services. This VPN/enterprise firewall doubles as an e-mail server, has a Web-based management tool, and a SQL database for custom reports. Prices start at $999. The optional e-mail server is $495.
Contact: Internet Devices, Sunnyvale, CA, 888-237-2244 or 408-541-1400; sales@InternetDevices.com; http://www.InternetDevices.com.
Enter HotBYTEs No. 1003.

Networking

Protect Mission-Critical Applications

INTEGRATED LAN/WAN LOAD BALANCING with HydraWeb 1.4 offers fault-tolerant and disaster-recovery capabilities for network applications, Internet e-commerce efforts, and networked services. A new WAN

module ($3500) can manage ATM, frame relay, T1, or T3 lines, while supporting all TCP/IP protocols on NT or Unix servers.
Contact: HydraWeb Technologies, New York, NY, 212-809-5900; http://www.hydraweb.com.
Enter HotBYTEs No. 1004.

Cluster Your Web Servers

INTERGRAPH'S WEBSCALE SOFTWARE deploys clustered, multiprocessor Intergraph systems to provide scalability and fault tolerance using Pentium II and Pentium Pro servers. WebScale combines two to eight InterServe Web 80 servers (each with up to two 300-MHz Pentium IIs) or Web 8000 servers (each with as many as four 200-MHz Pentium Pros) into a cluster for high-volume network traffic with fail-over and load-balancing capabilities. Management tools are built in. WebScale is $995 per license.
Contact: Intergraph Computer Systems, Huntsville, AL, 205-922-8346; http://www.intergraph.com.
Enter HotBYTEs No. 1005.

Software Updates

Seagate has added a client data-protection package, called Client Exec, to its Backup Exec Windows NT suite. Backup Exec is storage software for Windows NT based on the Microsoft COM architecture. Administrators using Client Exec can automatically and transparently protect data on remote workstations. It costs $695 and supports an unlimited number of workstations. Network managers can define broad descriptive categories for data, such as documents, graphics, or compressed files, and can then define which files get backed up, how often, and which users' systems to protect.
Contact: Seagate Software, Heathrow, FL, 800-327-2232 or 407-531-7500; sales@img.seagatesoftware.com; http://www.seagatesoftware.com.
Enter HotBYTEs No. 1006.

RightFax Enterprise Suite version 5.2, with two new optional modules—RightFax Docs on Demand and RightFax TeleConnect—helps users manage their flow of faxes. All RightFax 5.2 servers include an administrative tool that lets managers monitor fax volume. RightFax Docs on Demand gives companies the ability to make documents available to people 24 hours a day. With RightFax TeleConnect, users can call into the fax server and access their personal fax mailbox and deploy options like forwarding, automated notification, and automatic printing. The Enterprise Suite, with six optional software modules, costs $5995.
Contact: RightFax, Tucson, AZ, 520-320-7000; sales@rightfax.com; http://www.rightfax.com.
Enter HotBYTEs No. 1007.

Attachmate's HostPublishing System version 2.2 supports Active Server Pages (ASP), permitting Web and corporate developers to incorporate mainframe and AS/400 data into HTML, browser-based applications. Developers can deploy new applications with Microsoft Visual Basic while bringing legacy, host data into Web-based applications, or simply use Microsoft's Visual InterDev to generate HTML from host data source files. This latest release costs $25,000 for a server supporting up to 250 concurrent sessions.
Contact: Attachmate, Bellevue, WA, 800-426-6283 or 425-644-4010; http://www.attachmate.com.
Enter HotBYTEs No. 1008.

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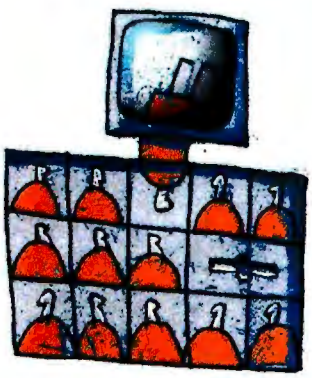
Improbable products for crowd control and instant celeb requiems.

Advances and Retreats in Computing



PACK THE PLACE

As a lecture hall fills up, most people try to keep some empty seats between themselves and everyone else. This inefficient use of space infuriates administrators. It is also a hot topic in applied mathematics. The Central European Academy of Sciences has devised a simple solution.

Computer-linked seats in the Academy's new Experimental Lecture Facility adjust themselves automatically as people fill up the room. The operation uses a least-square high-hip cellular automata algorithm. Each Pop-Up™ chair can be either "off" (it looks like a normal, empty chair) or "on" (a 2.5-foot plasticene Virtual Spectator™ inflates, and the seat looks full).

Initially, the entire room appears full, except for two adjoining empty chairs. The first two people entering the room have no choice but to sit next to each other. After they do, two new Virtual Spectators deflate, each adjacent to a genuinely occupied seat. The auditorium fills efficiently, and it always appears to be filled.

During test runs, people tried to cheat the system. They placed bags or other objects in neighboring seats. Lectures are for people, not things, so now an optical object-recognition system identifies nonhuman objects and retracts them through a trap door in the seat. The objects are sent to a storage area, where they can usually be claimed by their owners.

The Academy is also working on a device for lecturers. The computer-driven Pop-Up™ overhead display fills in the holes in a lecturer's presentation. Initial tests have drawn resistance from the speakers, but nodding approval from the audiences.

CHEAP THRILLS, QUICKIE MEMORIES

Were you one of the millions who yearned to know everything about Princess Diana the moment you heard she had died? It was frustrating to have to watch the TV, monitor the radio, scour the Internet, and troop on down to the newsstand craving, begging for little scraps of news about the poor departed's life, loves, work, and wishes (not to mention photographs, films, and fanciful tidbits of trivia about her girlhood, garments, and good deeds).

You'll never again be caught wanting — not if you get yourself a copy of Who's Next™, a handy new software package from Celebrity Systematics. Who's Next™ uses know-how from the newspaper business and technology from the anti-computer-virus industry.

Newspapers habitually prepare and update tributes to major celebrities, especially royalty, movie stars, and ailing public personages. The papers don't want to be caught flat-footed for an obituary when a celebrity suddenly shuffles off to Valhalla. Celebrity Systematics prelicenses multimedia records of more than 30,000 well-known public figures and stores them in a database that's tied to the Internet. Whenever the company receives word of a celebrity's demise, it enables access to the images of the deceased. Who's Next™ users can then download the images for their viewing pleasure.

Like other companies, Celebrity Systematics looked on in awe and envy at the sales figures for all the Diana tributes that popped up soon after the Princess's passing. Celebrity Systematics vowed not to miss out on the next celebrity smash hit. Now you won't miss out, either — not if you have a copy of Who's Next™.

Marc Abrahams is the editor of the Annals of Improbable Research. *You can e-mail him at marca@improb.com.*

IT'S HARD TO KEEP ONE OF THE FASTEST NOTEBOOKS ON EARTH A SECRET...

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- Intel Pro/100B PCI Ethernet Adapter
- 6 Expansion Slots: 4 PCI, 2 PCI/ISA
- Internal Hard Drive Bays to Support 4-1.6" or 6-1" Drives
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HESE A SECRET FOR LONG.

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- 32MB SDRAM Memory
- 4GB Ultra ATA Hard Drive
- Modular 24X Max^^ Variable CD-ROM Drive
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- 3.2GB Ultra ATA Hard Drive
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- MS Office 97 Small Business Edition
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Common features: ◆ Mini-Tower Model ◆ 512KB Integrated L2 Cache ◆ 3.5" Floppy Disk Drive ◆ Two USB Ports ◆ MS® Office 97 Small Business Edition plus Bookshelf 98 ◆ McAfee VirusScan ◆ MS Windows® 95 ◆ ***FREE* MS Windows 98 Upgrade Packet**ᵛ ◆ MS Internet Explorer 4.0 ◆ Dell® QuietKey® Keyboard ◆ MS IntelliMouse® ◆ 3-Year Limited Warranty† ◆ 1-Year On-site^ Service **Upgrades:** ◆ HP® DeskJet® 722C, add $299 ◆ HP LaserJet® 6Lse, add $429 ◆ APC Back-UPS Pro 650 PnP, add $289

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- 32X Max^ Variable CD-ROM Drive
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- 32X Max^ Variable CD-ROM Drive
- Yamaha Wavetable Sound
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FEATURING MMX TECHNOLOGY

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- 800LS 15" (13.7" vis) Monitor
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400MHz PENTIUM II PROCESSOR
FEATURING MMX TECHNOLOGY

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- STB nVidia 4MB 3D AGP Video Card
- 2X DVD-ROM Drive and Decoder Card
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400MHz PENTIUM II PROCESSOR
FEATURING MMX TECHNOLOGY

Common features listed above plus:
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- 8.4GB Ultra ATA Hard Drive (9.5ms) with Disk Performance Driver
- 1200HS 19" (17.9" vis, .26dp, 95 kHz) Monitor
- Diamond 8MB 3D AGP Video Card
- 32X Max^ Variable CD-ROM Drive
- Turtle Beach Montego A3D Sound Card
- Altec ACS-495 Full Dolby Surround Sound Speakers with Subwoofer
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FEATURING MMX TECHNOLOGY

Common features listed above plus:
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- 4.3GB Ultra ATA Hard Drive (9.5ms)
- 800LS 15" (13.7" vis) Monitor
- STB nVidia 4MB 3D AGP Video Card
- 32X Max^ Variable CD-ROM Drive
- Yamaha Wavetable Sound
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- Dell Comfort Key Keyboard
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- ★ **1000LS 17" (15.9" vis) Monitor**
- Diamond Permedia 2 8MB 3D AGP Video Card
- 32X Max^Δ Variable CD-ROM Drive
- Turtle Beach Montego A3D 64 Voice PCI Sound Card
- Altec Lansing ACS-90 Speakers
- 56K Capable** U.S.R. x2 WinModem
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