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brain freeze

BYTE

BYTE magazine.
It's not for everyone.
Maybe the hard drives in their cerebellums were overloaded. Or maybe it was just overexposure to BYTE's 15 pages of charts and graphs on Java tools.

Maybe they'll let us know when their brains thaw a little.

**brain-power**

This sort of thing happens from time to time. A casual get-together. Friends and acquaintances gathered for some lively conversation. And a BYTE magazine lying innocently on the table. Sooner or later, of course, a BYTE reader will steer the idle party chit-chat into a spirited discussion of BYTE's hard-hitting expose on the new generation of broadband satellites.

And the room will just freeze. Literally.

Now, don't get us wrong. We understand that for a typical BYTE reader, there is magic in a 27-page review of the top 25 emerging technologies. And it's definitely better than small talk about the weather with a tipsy siding salesman. But BYTE readers have speedy, powerful CPUs in their heads that can handle intense tidbits of high-tech better than a power drinker can handle the party punch. After all, they're not called the "Technology Elite" for nothing.

For mere mortals, however, too much megahertz hurts and can easily send their minds screeching to a brake-squealing halt.

So, let this be a bit of party etiquette to all the so-inspired BYTE readers out there: In between influencing million dollar technology decisions for your company and analyzing the latest web-to-legacy solutions, please be considerate of the less cyber-savvy around you at your next soirée. The brain you save just might belong to someone you know.
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By Tom R. Halfhill

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Coping with Change

The pace of change has shattered old PC buying models.

Moore’s Law has finally pushed the pace of PC hardware development through the sound barrier. A product manager for one of the Big Three PC companies recently pointed to one of his latest systems and told me, “In 12 months, everything in this machine will be different.” And he meant everything: processor, memory, video, bus speed, network card, disk drive interface, and high-volume storage modes.

“Where’ve you been?” I hear some of you saying. “It’s always been this way.” To a degree, yes, but I’d submit that the increasing quantity of change has finally turned into a different quality of change. While everything in the aforementioned computer will be different in 12 months, the changes will happen continually, not just annually. What ever happened to the idea of a computer design you could settle on for a year?

Intel, which is driving much of this change, concedes that many new technology developments are pushed forward by intra-industry competition, not customer demand. But it’s not all technology for technology’s sake—if you’re a smart shopper, you can increasingly find just what you need among all the variants of PC technology. Buy that financial analyst a $3500 dual-processor system if she needs it, but don’t shrink from spending a mere $999 on a system for the receptionist to get his e-mail. Got a dog of a Web server? Faster multiprocessor hardware’s cheap compared to losing customers.

Nonetheless, Intel’s attitude has a certain run-it-up-the-flagpole-and-wait-until-they-save quality. Witness universal serial bus (USB) and MMX, two technologies that have waited long for third-party support. When one-third of your three-year life cycle is spent waiting for the very thing you bought a system for, can the words “investment protection” have any meaning? After all, if you’d waited those 12 months, last year’s $2400 200-MHz Pentium MMX would have cost you $1200. So before you buy a new technology, ask yourself if it’s really compelling.

Compelling, to me, means at least the following:

• A technology must have an impact on the specific needs of users. Now that we’re hitting 300-MHz clock speeds, for example, raw power alone is unlikely to be compelling for mainstream business users. Unless office suites go on another binge, users have clock cycles to burn. But if you’re planning to implement voice recognition within a year, then horsepower is critical. In the end, is there a business case for the latest PC technology?

What ever happened to the idea of a computer design you could settle on for a year?

• A technology must be compelling in that it will change, within a reasonable time frame, the way you do computing. Power management was such a change for notebooks; the various management features built in to PC98 motherboards will be such a change for some shops.

While you don’t want to get stuck buying the last vestiges of a technology (tried to buy an ISA video card lately?), there’s no longer a coherent case to be made for habitually riding the front part of the wave. I’m no surfer, but I hear they give points for choosing the right wave.

So planning for the future has definitely become more difficult. In the coming months, we will be giving you some new tools to analyze the likely shelf life of systems for future applications from a performance perspective. But you’ll have to add to that your own calculus of business need, tolerance of (or hunger for) change, and ability to support multiple technologies.

In the long run, the industry needs to find a saner way to introduce technology. We recently did a live survey at Comdex in which 74 percent of respondents felt that technology is moving too fast. But you’re not powerless in this situation. When the industry tries to force a new technology before you’re ready, take the bull by the horns and let system vendors know which enhancements you can live without. In today’s build-to-order world, the message will be received quickly.

Mark Schlack, Editor in Chief
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The Good Stuff
I am very thankful for all the good stuff that appears in BYTE, especially your coverage of Java. The editorial in the November 1997 issue was to the point. Also, "CORBA, Java, and the Object Web" in the October 1997 issue was excellent. I'd like to see more in-depth coverage of topics such as JavaBeans and remote method invocation (RMI).

Milan Zimmermann
mzimmermann@worldchat.com

Watch for our JavaBeans coverage in 1998.—Mark Schlack, editor in chief

Who's Out in the Cold?
“Raising the Java Standard” (November 1997 editorial) made some very good points about Java and standardization, but I don't understand this statement: "Sun executives talk quietly about revoking Microsoft's license if it ships its version of the Java classes. Who will be left out in the cold then? The few hundred thousand Java users or the hundred million Windows users?"

Actually, neither group would be left out in the cold. Such a comment implies that Microsoft is the only Java solution for Windows. In fact, there are multiple Java solutions for Windows, and only one comes from Microsoft. I agree that it would be a good thing if Microsoft were to comply with its contract; however, it's perfectly understandable why it instead chooses to spend money in court.

In addition, my company's experience is that the Microsoft Java solution is currently inferior to those provided by Sun and other vendors. We would have liked to use Microsoft Java since the compiler is very fast, but an instantaneous compiler is useless if the virtual machine is not reliable.

Dave Boydstun
Solutions Consulting
daube@sc-systems.com

A Déjà Vu Nightmare
What a relief to find that someone else has come to the realization that Windows NT security is not secure. Déjà Vu All Over Again” (November 1997) was fantastic! It was really nice to see someone else also note that the NT security bugs were discovered and patched in Unix long ago.

But one thing was missing from the article. A very large number of holes exist that obviate the need for password-cracking programs, ActiveX, and other tricks: Anyone who logs onto an NT machine with the default configuration has potentially hundreds of ways of gaining access as an administrator.

First, the SYSTEMROOT directory is full control for the group Everyone. This allows the replacement of Notepad.exe and other programs with a trojan horse.

You don't even need a compiler, since you can rename it Notepad1.exe and create a batch script that adds your user to the Domain Admin group when an administrator starts Notepad from the Start menu. In addition, there are dozens of DLLs and other executables that are at least changeable by Everyone, again allowing easy creation of a trojan horse.

File associations can be changed by the user and then effective for the administrator. Thus, the next time an administrator double-clicks on a .txt, .doc, or other file on this system, the user becomes a member of the Domain Admins group.

The worst is that this is the default state, and you need no special programming skills or tools. The holes are just there.

Jim Mohr
Author, Linux User's Resource
djmm@blitz.de

Same Nightmare, Different Bed
There’s no excuse for the security problems in Windows NT, but after following computer-security issues and using Unix (as well as NT) for some time, I’m surprised to see Unix being held up as a standard. Many of the same sorts of flaws discussed in the article “Déjà Vu All Over Again” are still present in Unix 25 years later. (See http://info.cert.org/pub/cert_advisories.)

And because the flaws are so obvious, no one even bothers to talk much anymore about how the configuration of typical Unix-based NFS servers leaves them exposed to the simplest kinds of attacks, including those that can result in the destruction of data. By default, NFS servers simply trust—without
Don't Like Your ISP?

“Batter Up for Broadband” states that “there’s no dial tone, and your connection to an ISP or corporate network is hard-wired, so you won’t be able to change service providers without hav-

The Chip That Ate My Batteries

No sooner do battery developers give us a better power-to-weight ratio than CPU makers chew up the extra power to give us a constant 1-hour notebook-battery life. Why not give us a simpler, less powerful processor that gobbles less power?

In “Keeping It Simple” (October 1997 Core), Tom R. Halfhill says the C6 is sim-

resolving any cryptographic or password-based proof of identity—that their clients are who they say they are. The computer industry and computer users have a long road ahead of them to reach the goal of a truly secure computing environment.

Nathaniel Mishkin
mishkin@worldnet.att.net

RMI Lives!
But Where?

In “CORBA, Java, and the Object Web” (October 1997), the authors’ assertion that “JavaSoft will abandon the proprietary ORB on which RMI is currently built” is refuted by the folks at JavaSoft. If by this the authors mean that the ORB possibilities will no longer be “limited” to a proprietary Java Remote Method Protocol (JRMP), then I stand corrected. But I believe most folks would take it to mean that JavaSoft intends to join the herd and dump JRMP, which most of us have been led to believe is not true. Those who are developing under RMI and need pass-by-value capability and an “all-Java” implementation of distributed objects believe that there is a comfortable market position for RMI.

Hal Arnold
harnold@telegroup.com

JavaSoft will continue to support RMI over JRMP until the Internet Interoperable ORB Protocol (IIOP) is fully RMI-ready. This is consistent with what’s stated in our article. JavaSoft will first deploy a subset of RMI on IIOP as it is today. JavaSoft is also working with Netscape/Visigenic’s Caffeine is an example of this architecture.) Hopefully, the specifications will have been presented—in final form—to the OMG by the time this appears in print.

When IIOP is fully RMI-ready, JavaSoft might continue to support JRMP for backward compatibility. But JavaSoft’s partners intend to support RMI over IIOP only in their virtual machines. Of course, Microsoft doesn’t support either. Enterprise JavaBeans support only the RMI/IIOP subset. They need IIOP to pass Java Transaction Service (JTS) transaction contexts.

JRMP is dead. Microsoft doesn’t support it, and neither will BEA, IBM, Netscape, Oracle, and so forth. However, it shouldn’t matter to you if IIOP is the only ORB that JavaSoft (and friends) support as long as it provides full RMI semantics. RMI will have a long life, but on top of IIOP.—Robert Orfali

Now Showing

“Batter Up for Broadband” (October 1997) states that separate dishes are required for DirectPC and DirectTV, as well as that “Hughes will someday offer a method for using one dish for both, although no target date has been announced.” Actually, that system is now available; DirecDuo was unveiled on July 15.

The article also mentions that DirecPC is offered by Hughes Communications. Both DirecPC and DirecDuo are products of Hughes Network Systems, a Hughes Electronics company. For more information, see http://www.direcduo.com/.

Mitchell Derman
Edelman Public Relations
mderman@dc.edelman.com

The reason why the C6 has more transistors than a P55C-series Pentium (5.4 million versus 4.3 million) is indeed the larger caches. The C6 has 32 KB each of instruction cache and data cache.

It’s possible to estimate how many transistors that 64 KB accounts for: 64 KB = 524,288 bits. Static RAM (SRAM) cells typically have six transistors per bit when used this way. That totals 3.1 million transistors, without considering the control logic associated with the caches.

The large proportion of transistors in the caches (more than 50 percent of the chip’s total) indeed does account for the C6’s tiny die size. As you correctly point out, memory occupies less space than logic because it’s more dense, but you’ve underestimated the amount of memory.

Despite the C6’s simpler design, the new Tillamook-class Pentiums still consume
Well, maybe Edison said it differently. But he wouldn’t if he’d had a copy of Microsoft® Office 97, Developer Edition. It enables you to turn Microsoft Office applications into hundreds of fully customized solutions without starting from scratch. The Microsoft Visual Basic® for Applications development environment is one you’re familiar with so you’ll be up and coding just as soon as you get the shrink-wrap off. And with Microsoft Office currently residing on millions of desktops worldwide, you’ll be sure to find a market for your work. For more info about Microsoft Office 97, Developer Edition go to www.microsoft.com/officedev/
less power at the same clock frequency. That's because the Tillamooks are manufactured on a 0.25-micron process, while the C6 is still at 0.35 micron. The Tillamook can run at a lower voltage.

You make a good point about simple designs rarely remaining simple. The C6, for instance, will add branch prediction, a better FPU, and better MMX capability this year, as well as an integrated L2 cache. However, its die size and price will remain small, because Centaur is aiming the C6 at the low-end PC market.

Note the new address for Centaur's Web site: http://www.winchip.com/.

—Tom R. Halfhill, senior editor

Fixes

In “PowerSite Straddles the Object World” (January Eval), the URL given in the contact information should have been http://www.symbase.com.

In the table “Ultraportables at a Glance” (December 1997 Bits, page 28), the starting price for the IBM ThinkPad 560X was given as $1999. The correct price is approximately $4200.
Paradyne Corporation, a pioneer and leader in digital network access, has customers who not only want fast network access, they want fast answers on the status of their orders as well. And that used to mean the company had to process thousands of individual phone calls and manual queries against mainframe transaction data. The company knew the answer was a self-service application on the Web; but how could they integrate a Web reporting system with mainframe legacy data? The answer... EDA middleware and WebFOCUS from Information Builders.

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Windows Slimfest

Several forthcoming products promise to bring thin-client computing to today's Windows applications, but experts warn: Look (and test) before you leap.

Microsoft's Terminal Server (MSTS, code-named Hydra) software promises to bring the benefits of thin-client computing to today's Windows applications. But managers who have successfully rolled out thin Windows implementations warn that you should plan and test before you deploy. And at least one Microsoft competitor, Corel, is rewriting its business applications suite to work better when running in multiuser mode.

MSTS adds multiuser capabilities and support for thin-client devices to applications that run on version 4.0 and future versions of NT Server. MSTS recently entered its first round of beta testing and is currently slated for release during the first half of this year, although that date could change, depending on how the first round of beta testing goes.

A thin MSTS implementation differs from a Java-based network computer.

**MultiWin: More than One Way to Skin a Cat**

**Microsoft's Terminal Server**

All application processing occurs at the server.

Microsoft officials say that this architecture will place less strain on a network’s bandwidth than a Java-based network computer, which downloads applications over the network.

With Terminal Server, only changes to the graphical interface are sent to the client.

**Corel's Remagen Technology**

Most application processing still occurs at the server, but some processing occurs at the client for even more efficient network operation.

Word processor/spreadsheet editing operations are implemented via custom editing tools on the client, which process mouse and keyboard events locally. This eliminates the need to send every mouse-move message to the server.

GUI objects (e.g., toolbars, controls) that are implemented on the client as JavaBeans perform all processing and rendering locally.

**Thin Windows Solutions at a Glance**

<table>
<thead>
<tr>
<th>Product</th>
<th>Server OS</th>
<th>Clients/apps supported</th>
<th>Network protocols supported</th>
<th>Server requirements</th>
<th>Server performance</th>
<th>Client requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Microsoft Terminal Server</td>
<td>NT Server 4.0 (x86 version only) and future NT and future NT NT/any <em>well-behaved</em> Win32 application</td>
<td>Current beta supports TCP/IP only, although this could change</td>
<td>32 MB of base memory, plus 4 to 8 MB per user on the server</td>
<td>About 15 to 25 simultaneous users per 200-MHz Pentium Pro</td>
<td>386-based PC with 4 MB of RAM or Windows terminal device</td>
<td></td>
</tr>
<tr>
<td>Corel Remagen</td>
<td>NT Server 4.0 and 5.0; native NT for Alpha CPU: Sun Solaris in the future</td>
<td>Native clients for Win 3.1.95 and NT, plus numerous Java clients/any <em>well-behaved</em> Win32 application</td>
<td>TCP/IP</td>
<td>32 MB of base memory, plus about 6 MB for each user</td>
<td>At least 30 simultaneous users per 200-MHz Pentium Pro</td>
<td>68-MHz or faster 486 with 16 MB of RAM; moderate-speed Mac, Unix, and NC devices</td>
</tr>
<tr>
<td>Citrix pICAsso</td>
<td>Same as MSTS (also requires MSTS add-on)</td>
<td>Same as MSTS, plus Mac, Unix, OS/2, DOS, ActiveX, and Java clients/same as MSTS</td>
<td>TCP/IP; IPX/SPX; NetBIOS; SLIP/PPP direct/asynchronous</td>
<td>Same as MSTS</td>
<td>Same as MSTS</td>
<td></td>
</tr>
</tbody>
</table>

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(NC) in several key areas. For instance, an MSTS terminal doesn’t download the OS or applications over the network, and it doesn’t execute application logic locally. Plus, MSTS works with Windows applications that already exist.

MSTS has three components: the terminal server, the remote desktop protocol, and the terminal-server client. Microsoft says that any well-behaved.32-bit Windows application that runs on NT Server 4.0 is a candidate for multiuser deployment using MSTS. With MSTS, all application processing takes place on the server; only changes to the user interface are sent to the client.

In its base configuration, MSTS supports Windows-based terminal devices (available from a variety of vendors, including Boundless, Neoware, Network Computing Devices, and Wyse Technology, at prices as low as $500) as clients, plus PCs running Windows 3.11, 95, or NT. Support for 16-bit Windows clients means that MSTS can usher into the Windows 95 age meek, older hardware that has minimal RAM and is capable of running only Windows 3.11.

Microsoft’s Windows-only client support is bolstered by a forthcoming extension to MSTS called pCasso, from Fort Lauderdale–based Citrix (whose WinFrame technology already delivers capabilities similar to those of MSTS). pCasso, which is slated to ship in the same timeframe as MSTS, adds important enhancements, such as load balancing and support for a wide range of network protocols and non-Windows clients and devices (see the table below for more information). Both products promise to reduce the cost of ownership through centralized application management and deployment and reduced hardware costs, without requiring you to rewrite your current applications.

But it’s not quite that easy. Managers who have rolled out multiuser Windows implementations based on Citrix’s WinFrame say such an exercise can be positive, but you need to plan for and test a number of components before deploying successfully. The same will be true for MSTS and pCasso, they say. One potential area of concern is the Windows applications themselves.

One issue will be whether the application you want to deploy is reentrant. If it’s not, then the server must launch a separate instance of it for each simultaneous user, which can quickly add up to a major load on the server.

In addition, Microsoft says that applications must be written correctly to run on MSTS. They need to properly separate global registry data from local (i.e., user) registry data, store user-preference files in the correct directories, and so on. Microsoft officials admit that they don’t know how many of today’s applications will work correctly in an MSTS environment. “That’s one of the things we’ll be looking at during Hydra’s beta testing,” says Craig Cumberland, Windows NT Server product manager.

Another consideration: With MSTS and other MultiWin environments, all graphical output and keyboard/mouse input flows over the network. Overlaid images, on-screen animation, and splash screens take longer to display over the network on an MSTS client. And memory leaks, which are troublesome enough in a single-user environment, are intensified in a multiuser environment. These troubles are serious enough that, as men-

### Availability and Price for MSTS

<table>
<thead>
<tr>
<th>Availability</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Slated for release in first half of 1998</td>
<td>To be determined, but similar to other BackOffice programs</td>
</tr>
<tr>
<td>First half of 1998</td>
<td>To be determined, but probably less expensive than MSTS</td>
</tr>
<tr>
<td>First half of 1998</td>
<td>To be determined</td>
</tr>
</tbody>
</table>
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tioned earlier, Corel is currently rewriting some of its applications for smoother multiuser performance.

"With today's Windows applications, there's a lot of unnecessary redrawing and other activity that goes on," says Paul Skillen. He is the director of software development at Corel, whose multiuser Remagen technology will be bundled with WordPerfect Suite 8, Enterprise Edition, an applications suite being rewritten for multiuser deployment and slated to ship this year (see the table for more information). "If you're using [current] Windows applications in stand-alone mode, you don't notice all this activity, but if it occurs over a network, applications can run a lot slower."

Making sure your application runs efficiently in a MultiWin scenario is just one of the things you need to consider, according to George Morris, senior LAN specialist at Bell Mobility. "Network capacity, network latency, the process for rolling out applications, application performance—these all need to be evaluated," he says. Morris adds that his company currently has approximately 120 WinFrame 1.6 servers in two production clusters and that Windows-based terminals can be an inexpensive and reliable way to deploy Windows applications. "It can be extremely positive, provided it's been designed properly," he explains. "But you have to take a systems approach. This is not just another PC that you're dropping on the desktop."

Microsoft officials say that once MSTS is commercially available, applications will have to run correctly with the technology in order to qualify to bear the Windows logo. This is welcome news for current WinFrame users, as the logo will indicate that an application works correctly in multiuser mode. Says Bell Mobility's Morris: "It sure would make life a lot less painful."

-D. A.

I2O Getting Ready to Go

As vendors continue to prepare and test forthcoming I2O software and hardware, the I2O special-interest group (SIG) is considering making additions to the current standard to make it more appealing to enterprise computing.

I2O, which stands for intelligent input/output, promises to increase PC server performance by reducing the main system processor's involvement in I/O functions. By having an I2O processor, such as Intel's 960, relieve the main CPU from the burden of handling I/O-related activity, such as interrupts, I2O promises to improve overall server performance. I2O's modular software architecture also promises greater drive stability and more flexibility and competition in the server arena.

But exactly what the performance improvement is, or how flexible I2O will be in the real world, remains to be seen. At press time, Microsoft, Novell, and SCO were preparing to release either

Future Watch

Java, NCs, MultiWin Rank High Among Top Technologies for 1998

Although they weren't rated quite as high in importance as antivirus technology by respondents to a recent survey conducted by BYTE Research, Java, Multiuser Windows (MultiWin), and network computers (NCs) were ranked among the top technologies for 1998. Java ranked ninth overall, and MultiWin (eleventh) and NetPC/NCs (fifteenth) weren't far behind. By way of comparison, Extensible Markup Language (XML) was ranked twenty-fifth overall by respondents; antivirus technology was ranked first. Although MultiWin isn't a new technology, it has attracted quite a bit of attention lately due to Microsoft's beta release of its first Terminal Server software for implementing multiuser Windows on NT Server.

The majority of the survey respondents didn't predict the mainstream use of Java, NCs, or MultiWin during the first half of 1998: As the figure "Mainstream Adoption by Mid-1998" illustrates, Java, the highest-scoring of these three technologies, scored just 19 percent in this regard, compared to 42 percent for antivirus technology. The implication: Many users are interested in Java, MultiWin, and NCs, but they still need to evaluate these technologies before making an organization-wide commitment to them.

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One benefit of 120 is the ability to scale servers. "Servers that do not have intelligent adapters spend a tremendous amount of CPU power managing I/O in the system," says Harry Mason, director of host marketing at Symbios, which is developing numerous 120 products. "Often a user finds that he or she has adequate performance in a server in its original configuration but finds that the system bogs down when additional host adapters or more LAN cards are added."

Mason estimates that with traditional device drivers and nonintelligent adapters, you could expect to see 8000 or more I/Os per second in today's Pentium Pro-class machine. At those levels, the machine might use close to 90 percent of the available CPU performance.

But with 120 and other intelligent approaches, a server might only use 40 percent of its CPU power for 8000 I/Os, and adding more storage-adapter cards could allow the system to scale to well beyond 20,000 I/Os before saturating the CPU. "This ability to grow the server to serve a wider range of departmental or enterprise needs—and to do this in the environment of industry-supported standards—is the real value that 120 provides to the end user," says Mason.

However, the concept of off-loading I/O tasks from the main CPU is not a new one. Supercomputers, mainframes, and other big-iron systems have done it for years. "120 is not doing anything more than intelligent peripherals have been doing for some time," says Keith McAuliffe, vice president of engineering in Compaq's server-product division. "120 does not make an equivalent [non-120] implementation go faster." What it does do, according to McAuliffe, is establish an infrastructure that will permit hardware and software vendors to spend more time innovating and less time re-writing drivers.

Currently, in a non-120 scenario, a hardware vendor has to write, integrate, test, and distribute a device driver for each OS and OS revision, each new controller board, and sometimes revisions of the controller. 120's split-driver model can potentially eliminate all that busy-work. With 120, an OS vendor, such as 120 SIG member Microsoft, Novell, or SCO, writes an OS-specific module (OSM) for each class of device supported.

Then, companies making devices such as SCSI adapters, hard drives, and network interface cards (NICS) write one driver that works with any 120-compliant OS that supports that class of device. "We would rather see innovation in other areas than have to use programmers' time to write and rewrite drivers for different OSes," says Tamar Newberger, director of product management for UnixWare 7 at SCO.

Proponents say that 120, by freeing vendors from the chore of writing and rewriting their drivers, could result in a more horizontal PC industry, where every layer has competition. Vendors would be able to concentrate on writing the best driver or the best RAID software.

The latter is exactly what Mylex hopes to do with the 120 RAID software it plans to release in the first quarter of this year. "Thanks to the modularity of 120, our RAID software doesn't have to be intertwined with the SCSI chip," says Doug Fields, senior product-marketing manager for Mylex. "The software does not have to know the details of the hardware, so you can use it with a variety of SCSI chips." And, by taking advantage of the 1960, Mylex's RAID software can deliver better performance than a software-only solution.

Vendors caution that 120 will not eliminate the need to write native device drivers, as 120 is not supported in Win95, nor will it be supported in Win98. In addition, due to the enterprise nature of 120, software programs will require extensive testing before they are released, which could slow products' commercial arrival.

Meanwhile, 120 members are discussing adding even more features to future versions of 120 that will make it more robust. These features include support for peer-to-peer (where a NIC gets a file from a Web server's hard drive with minimal interruption to the CPU), Fibre Channel, clustering, ATM, WANS, and the hot replacement of peripherals. -D.A.
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USB Products Arrive in Force

Months after the first PCs with universal serial bus (USB) ports started shipping, peripherals for the low-to-mid-speed peripheral-connection bus are finally becoming widely available. At the same time, vendors are developing products and solutions that allow older PCs and peripherals to plug into the USB environment.

A variety of USB products—ranging from keyboards, joysticks, and mice to USB ports, videoconferencing cameras, monitors, and other peripherals—were shipping or expected to begin shipping by the end of 1997. Some of these products include new USB speakers from Altec Lansing; new videoconferencing cameras, including Kodak's DVC300 (about $199); Xirlink's $199 VideoPhone; and Connectix's QuickCam. Also available for USB are monitors (including flat-panel displays) from Compaq, Mitsubishi, Samsung, and others.

USB enables you to connect as many as 127 USB devices to your system; its total bandwidth of 12 Mbps is sufficient for low- to medium-speed peripherals, such as keyboards, mice, joysticks, scanners, cameras, phones, monitors, and so on. The technology allows you to plug and unplug devices to and from a system, and it will eventually eliminate the need to have multiple parallel and serial ports coming out of the back of your PC.

Other benefits of USB vary, depending on the product. For example, Xirlink officials say the company's Video Phone camera can deliver improved frame rates, not only because of its onboard video-compression chip but because one mode of USB guarantees delivery for time-sensitive applications, such as videoconferencing.

Another benefit: With monitors such as Samsung's SyncMaster 700Up 17-inch CRT (with 15.7 inches of viewable area, $1019), there's no need to twiddle knobs to adjust the image; instead, you do all the necessary adjustments via the mouse or the keyboard. The monitor also has three powered USB ports. This lets the monitor act as a hub for other USB devices without requiring each device to have a separate power cord.

Expect to see USB keyboards coming out with on-board USB ports, too, although many keyboard makers are waiting for less-expensive single-chip solutions (e.g., USB controller and hub chips combined) to arrive from the likes of Intel and Cypress Semiconductor. USB game devices, such as Alps' forthcoming GamePad, which supports a wide variety of PC games, will benefit from USB's support for multiplayer participation.

PC telephony can also benefit from USB, says Bill Beck, head of the Mitel Personal Assistant Program at Mitel (Kanata, Ontario, Canada), which plans to release two new USB-enabled PC phones in the second quarter of this year. Mitel's single- and dual-line phones will join the company's already-available "USB-ready" Personal Assistant product, which adds computer telephony to

Windows 95 Ranks Low in Security

Windows 95 is a popular OS, but users don't rate it as highly as other OSes when it comes to security. According to a recent survey performed by BYTE Research, users ranked Win 95 as the OS or application with the highest security risk.

Due to the security holes in Win 95, Netscape Navigator, and Internet Explorer that have been documented and publicized over the past couple of years, it's not surprising that those products were rated as high security threats. What is somewhat surprising is that Win 98—the next version of Windows—was also deemed a relatively high security risk. Win 98 will have new features, such as security zones, that let IS managers or users set different default security policies for different classes of sites (e.g., intranet, trusted Web sites, Internet, and restricted Web sites). But respondents are either unimpressed with or uninformed about those features. Unix was deemed as the lowest security threat, although NT 5.0 was a very close second.
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So, if you just bought your first computer, or run a company that needs hundreds, you can depend on the reliability and peace of mind that comes with APC products.

Why? It’s simple. APC protects more computers for more companies in more countries than anyone in the world.

Now, that’s a reason to smile.
An emerging new version of the digital subscriber line (DSL) technology promises to deliver faster Web access in a package that's easy for consumers and service providers alike to implement. But, as usual, standards are an issue. Whether it's Rockwell's CDSL (the C stands for consumer), Aware's DSL Lite, or another implementation of the technology, the basic idea is the same: Make DSL available in a package that doesn't require a splitter at the customer's house or work site.

With full-rate ADSL (the A stands for asymmetric), a splitter is required to prevent interference between the phone service and the DSL service on the same copper line. That means someone from the DSL service provider needs to travel to a customer's site to install the splitter equipment, which increases the cost on signal-processing techniques to filter out interference. Another benefit: The light version of DSL could be implemented in a software-only solution on a Pentium-based or faster PC, or in a modem that end users can buy through normal retail channels. Dual-mode modems could even support DSL light and regular 33.3- or 56-Kbps analog connections. Such modems would get DSL service providers out of the business of supplying—and supporting—their end users' access equipment.

One caveat with these lighter DSL implementations is slower connections—about 1 Mbps downstream to the customer, compared to about 6 Mbps with

---

**DSL Gets Consumer-Friendly**

A future version of DSL, without the splitter, could be easier to roll out to end users.
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**A Computer to Love**

Imagine you’re nervous about an upcoming presentation. Your computer senses your fast heartbeat, the sweat on your palms, and your halting speech. It scans your schedule and deduces the cause of your concern. It then calls up positive e-mail that you received after your last presentation and offers helpful pointers for delivering a relaxed, effective speech. Sensing that your confidence is growing, the computer loads up the presentation you’ve been preparing, suggests an opening joke for breaking the ice, and asks if you’d like to practice. You watch your image on the screen as you deliver the presentation, also noting the feedback about your pacing, intonation, speech clarity, and physical responses. Your computer laughs heartily at your opening joke and responds enthusiastically to your best points. You thank your computer for the help.

As we embrace the idea of personal assistants, intelligent agents, and computers that understand our needs, work styles, and preferences, we must consider instilling computers with emotional intelligence. As Rosalind Picard points out in her book *Affective Computing*, although we’re conditioned to view emotions as a hindrance to clear reasoning and intelligent judgments, research supports the importance of emotions in critical thinking. Computers are little more than savants, and yet we expect them to behave like human assistants. A truly personal, interactive system must learn to associate relevance and context to the facts it holds and to make judgments based on experience and intuition.

The first part of the book covers current research on human emotion, delving into the mystery of what makes up emotions and how to recognize, test, and differentiate among a range of emotional states. Picard makes a convincing argument about the role of emotions in intelligence and suggests some compelling applications, such as computer interfaces, tutorials, and personal data assistants. Correctly developed and applied, emotions could enrich the computing experience and advance it to new levels of utility.

Of course, human emotion, especially in intricate areas such as creativity, is not well understood. Building emotions into computers can seem like a daunting challenge. I certainly sensed the forbidding complexity of the problem as I read the book. The most encouraging areas of research, at least in the near term, involve emotional recognition and imitation. In the aforementioned presentation scenario, a truly emotive computer would not be required. The system would need only to infer a likely emotional state by monitoring your physical responses and then react in an emotionally supportive way. Sensors in a computer could track discrete signals, such as electromyograph (EMG) waves, blood-volume pressure, galvanic skin response, and respiration, to infer emotional states. The next step is to map emotional patterns to appropriate reactions by the computer.

Researchers are applying a variety of theories about human emotions to computer architectures. Picard depicts many models in the book, “deliberately not trying to establish one model or one theory of emotion.” Again, it’s the nebulous nature of emotion itself that constrains her; after all, there is not “sufficient understanding of human emotions to justify a comprehensive model at the level needed for computer implementation.”

This book works best as a solid framework for ongoing research and development. Picard offers criteria for quantifying emotional intelligence, for verifying its effectiveness in computers, for recognizing the properties of emotional behavior and implementing appropriate computer responses, and for characterizing affective patterns and recognizing them algorithmically. She also lays the important groundwork for building the models and software architectures of the future.

I might only suggest that Picard should have used fewer references to the homicidal HAL from 2001: *A Space Odyssey.* Every time I launch my Web agent, I keep hearing HAL’s ominous echo: “I’m afraid you’re afraid...”

**Stanford Diehl** is a frequent contributor to BYTE and former director of BYTE reviews. You can reach him at Sdiehl@nebs.com.

---

**Affective Computing** by Rosalind Picard; The MIT Press, 1997; 276 pages; ISBN 0-262-18170-2; $27.50 (cloth)

---

ADSL. But with more-capable digital signal processors (DSPs) or, in the case of a software-only implementation, faster CPUs, the speed of DSL light could improve. Even so, this version of DSL is faster than analog modems and ISDN, and it provides an easy upward migration path to full-rate ADSL, provided that the customer’s and central office’s equipment is based on the same standard.

Another caveat is the question of standards. Aware and other companies base their line-encoding schemes on the discrete multitone (DMT) standard, but Rockwell says its CDSL scheme is based on a proprietary line-encoding standard.

In addition, vendors worry that if the International Telecommunications Union (ITU) group responsible for setting the new standard for this brand of DSL adopts something other than DMT, it will hinder acceptance. “If the ITU chooses something that’s not DMT, that could result in years of work getting delayed,” says Greg Whelan, director of business development at Aware. If this new DSL is based on DMT, that would provide an easy migration path to faster DSL speeds, DMT proponents say.

Whelan comments that adding the proper equipment for DSL at each central-office site is a big enough commitment for telephone companies and that it’s unlikely the phone companies would want to support two standards: DMT and something else. (Rockwell officials say that although their initial proposal to the ITU is not based on DMT, they will adopt whatever the standard is; DMT proponents will lobby to ensure that a DSL-light standard is based on DMT.)

When such modems will appear is currently unclear. Rockwell and Toronto-based Northern Telecom recently announced that they will offer a CDSL modem for about $200 in the second half of this year, but other vendors, such as Aware, could offer them sooner. -D.A.
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[Woof!]!

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Unified Software Building Blocks

Rational Software's Jerry Rudisin discusses the present and future of component-based development.

BYTE: How does the Unified Modeling Language fit in with this trend?
Rudisin: Using the hardware example again, there's only one notation used to design electronic circuits. Until recently, there was no standard way of expressing how software components are defined, what the interfaces were, and how the pieces could snap together. Instead, you had a lot of different methodologies: Coad-Yourdon, Booch, Object Modeling Technique, Shlaer-Mellor, and so on. What we saw is that people liked the idea of object technology, but the absence of any common language was a real impediment to the rapid growth of the market.

Rational Software set out to remove this fragmentation and drive the creation of a single, open standard for describing objects and components. That's now called the Unified Modeling Language, which the Object Management Group has formally accepted as a standard.

BYTE: What does that mean for programmers?
Rudisin: We now have the equivalent in the software world of the standards for circuit design or for describing how buildings are built. It's one of the few things that Microsoft, Oracle, and IBM agree on.

So, if you're building an application with components from IBM, Microsoft, or Oracle, before, it was awkward to model a system that had a CORBA and ActiveX piece. Now, with UML being a universally adopted standard, it's a lot easier to design and model systems that have components from any one of those sources.

BYTE: How is Rational delivering UML technology to the market?
Rudisin: We're building a strong family of tools to automate different elements of component-based development—for example, modeling the requirements for a system, modeling the component, doing various kinds of software-quality testing, automating configuration-management aspects of software, and automating the software process.
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Adjust to the Jitter

Audio applications that can adapt to Internet congestion will deliver much higher sound quality.

Better Sound over the Internet

The architecture of the Internet is not a good environment for real-time audio and video transmissions. The delay between the arrival of subsequent packets, known as jitter, depends on the traffic conditions on the Net. Packet-loss rates often vary between 15 percent and 40 percent. Delays between packets can be as much as 1.5 seconds, seriously compromising the quality of conversation over the Net.

New protocols, such as the Resource Reservation Protocol (RSVP) and the Real Time Transport Protocol (RTP), might eventually improve the quality of service on the Net. However, they are not yet widely used.

Another approach is to adapt applications to the jitter present on the network. A group of researchers at the French National Research Institute, INRIA (Sophia-Antipolis), has developed an extended, adaptive loss-recovery and rate-control system that gives reasonable quality to audio transmissions with loss rates as high as 50 percent.

The INRIA audio tool adjusts the audio packet send rate to the current network conditions, adds redundant information to packets when the loss rate surpasses a certain level, and establishes a feedback channel to control the send rate and redundant information. Simply put, the scheme minimizes the impact of packet loss and delay between subsequent packets on perceived audio quality.

In a process called forward error correction (FEC), the system adds to each packet a highly compressed version of the previous packet. When the network load and packet-loss rates are high, the process increases the amount of redundancy carried in each packet. It does this by adding to each packet compressed versions of the previous three to four packets.

The complete process is controlled by a feedback loop that gradually increases the send rate if the loss rate is above a certain threshold. In 5-second intervals, the receiver returns quality-of-service requests to the sender to adapt the amount of redundant information being sent.

"Adaptive Internet telephony might eventually provide better voice quality than the standard 8-kHz sampling on today's telephone networks," says Jean-Chrysostome Bolot, a project manager at INRIA.

-Rainer Mauth

WHERE TO FIND

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Alpha’s Future

What the Intel deal means.

Digital Equipment’s Alpha architecture has been the CPU performance leader for almost the entire time since its arrival in 1992, and it’s the only non-x86 NT architecture. Yet it accounts for a relatively small share of the workstation and server markets. Will the recent Digital-Intel settlement change anything?

In this settlement, Intel licensed the right to use Alpha technology (which remains under Digital ownership) and its related patents. The company also purchased the Digital Semiconductor manufacturing and sales operation. This settled the existing patent-infringement issue between Digital and Intel.

The deal generated both pessimistic and optimistic comments. Pessimists warned that it’s the end of the Alpha, as Digital will now support the IA-64. Optimists believe that Digital will now have more resources to accelerate Alpha designs for multiple foundries. “This agreement meets both companies’ needs,” says Craig Barrett, president and chief operating officer at Intel.

According to Syed Ali, executive director of Alpha marketing at Samsung Semiconductor, “Samsung is now poised to take the lead in Alpha manufacturing, on both the price and the performance fronts.” He adds that Samsung is not alone in its long-term Alpha support, noting that “Mitsubishi will also offer current and future Alpha PC processors, and AMD will use the ultrafast 21264 Alpha bus for its K7.” That could make possible future chip sets and mainboards that support both the K7 and the 21264 Alpha families, according to Ali.

However, if the Alpha is to survive the Merced attack and take a significant market share away from Intel, the CPU needs to not only be priced affordably but also widen its performance delta against future Intel products. Ali expects his company’s Alpha chips to reach the 1-GHz level by the end of this year, providing performance of well over 60 SPECint95 and 90 SPECfp95. Looking at Intel’s rough Merced performance road map, the 1-GHz 21264 should be faster than the initial Merced, which will appear a year or so later.

Aaron Bauch, Alpha technical marketing manager at Digital Semiconductor, says the Intel deal enables Digital and other Alpha partners to accelerate the performance road map because they will be able to make use of new CMOS processes faster. For instance, the jump to the 0.18-micron process, which was originally slated for late 2000 or early 2001, is now due to take place in late 1999. This will enable both higher operating frequencies and better features sets.

Jesse Lipcon of Digital stated in his keynote speech at DECUS Anaheim 1997 that the schedule for 0.18-micron Alpha microprocessors has accelerated by roughly a year (to late 1999, according to other sources). He said that this change in scheduling is a result of the recent Digital-Intel agreement.

Besides maximizing the performance of the EV-xx Alpha family and enabling it to offer twice the performance of Intel chips at a similar price, Samsung is also tuning several new-generation chip sets for specific PC, workstation, or server use. According to Ali, Samsung is also using its expertise with fine processes for next-generation memories to accelerate the Alpha’s move to smaller processes and greater speeds. In addition, the 64-bit version of Windows NT 5.0, running on an Alpha as a 64-bit architecture, will give the Alpha a huge time-to-market edge over the Merced.

With foundries and partners gradually embarking on designing their own CPU derivatives, chip sets, and other support, the Alpha processor is now less dependent on Digital for both its technical and marketing development. Whether all this will make the Alpha a serious alternative to the IA-32 and IA-64 remains to be seen: The ball is now in the Alpha-powered alliance court.

—Nebojsa Novakovic

### New-Generation x86 and Alpha Processors*

<table>
<thead>
<tr>
<th>Processor</th>
<th>Time of introduction</th>
<th>Frequency range (MHz)</th>
<th>Process technology (microns)</th>
<th>Instruction set Architecture</th>
<th>Internal cache (KB)</th>
<th>External cache bus (bits)</th>
<th>External memory bus (bits)</th>
<th>Frequency range (MHz)</th>
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* Road-map estimates according to independent sources.

OO = out-of-order execution; N/A = information not available.

Pentium MMX and Alpha 21164x4 CPUs have shared external cache and memory paths.

For the sake of clarity, not all processor models and bus speed combinations are included.
"I have absolutely no time to get into a rut"

Tom Uijldert, systems architect at CMG Telecom Products

"I have absolutely no time to get into a rut. To my utter amazement I discovered one day that I'd worked at the same place already for more than three years. And that at CMG, by the way. The reason was, I became involved in various internal projects in the area of mobile telecommunications, and it just got a little out of hand. In a positive sense, to be sure, because we've been so successful in this area that in a few years' time we grew from a ten-person project into a group of 130 people working on several projects. Naturally, this was partly attributable to the market itself: privatization, competition and the great boom of mobile telecommunications with the growth percentages from 40% to 60% a year. But to a large degree we owe this growth to our products. I'm really proud that we've developed systems which have set industry standards internationally. Real-time distributed systems, special concepts for high availability of systems, systems on mixed platform, etc. At present, I'm working on a product recently launched: VASP, CMG's Value Added Services Platform. This system will enable our customers to be quick to offer new services to mobile telephone users. It could concern interactive voice response, mobile connections to the Internet or stock exchange information obtained by mobile phone. As an architect, you give shape to the structure of such a product and monitor its consistency. You think up and develop the best possible infrastructure. The nice thing about it is, you don't look at technical aspects alone, but also at such areas as purchasing, logistics, sales, the market and customers. That often results in heated yet animated discussions with colleagues.

At CMG, they really put your experience with real-time systems to work, and your knowledge of telecom and datacom protocols. Knowledge in breadth and depth, that is. Only then can you cope with the continuously arising, technical challenges. So there's no chance to get into a rut."

CMG Telecom Products develops and supplies advanced and successful products that meet the requirements of major players in the rapidly expanding, international telecommunications market in more than 30 countries. CMG's products are operational in the areas of network security, mobile message traffic and interactive communications services. The challenges lie in the areas of high performance, high availability, high reliability, security, standardization (ETSI/ANSI) and connectivity.

For our telecom products, we are seeking professional software engineers all with Technical College/Technical University education. They will have an above-average salary, extensive career opportunities, professional colleagues, and ample possibilities for further personal and professional development. And as a result: pleasure in their work. For more information please contact Mr. Peter Boschman, Associate Director, +31 (0)30 23 39 300 or +31 (0)20 44 80 558 (private). Or send him your résumé. CMG Telecommunications & Utilities Mail Box 8038, 3501 AA Utrecht, the Netherlands, Internet: http://www.cmgi.nl

Excellent at IT? One day you will be at CMG.
Multicolored Faxes

A new software program brings exact color reproduction to faxes, printers, and scanners.

Does color faxing sound like a solution to an important business problem? If your answer is no, then you're probably not in the graphics, interior-design, or clothing-manufacturing business. "A calibrated color fax would save us both time and money," says Tim Voegele-Downing, a design consultant for the Gucci, Christian Dior, and Burberry fashion firms.

Faxing that offers the exact reproduction of colors regardless of the devices involved might come to market later this year, thanks to color-calibration software developed by the French company Couleur Communication Ecrirure. CCE's AffiColor system provides a way of recalibrating color peripherals without using expensive colorimetric instruments.

The system maps the color values used by monitors, printers, scanners, and fax machines to and from the device-independent CIELab color space. CIELab, in contrast to computer and printing industry standards, such as RGB and CMYK, includes all the colors that the human eye can perceive and represents them as mixtures of the three primary colors. AffiColor also includes a test suite that can display variations in colorimetric quality in 2-D or 3-D.

It uses a color target or a CIELab reference file to analyze any color areas that might be reproduced badly.

-- Dick Fountain

Color Calibration

AffiColor allows you to calibrate your own color peripherals by using your scanner as a colorimeter. First you calibrate the scanner itself by scanning CCE's test target to create a scanner-calibration profile. You can have multiple profiles for different ambient conditions, such as temperature or time of day. Then you calibrate your printer by printing a CCE-supplied target file and scan the printed result to create a printer profile. You can recalibrate as often as needed and keep different profiles for different ink cartridges or paper stocks.

It's also possible to create monitor profiles. Ideally, this requires the use of a spectrophotometer to measure the CIELab x and y values for red, green, blue, and white pixels. But you can also use the monitor manufacturer's x and y values or a visual comparison with a scanned CIELab color target.

Notice the deviation of color reproduction of a printer and a reference.

AffiColor
Domont, France
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Harvesting the Fruits of AI Research

By applying rule- and case-based reasoning, induction trees, neural nets, and genetic algorithms, new optimization, filtering, and control software is now solving serious business problems.

Such applications include case-based reasoning tools from Acknosoft, Recall from ISoft, Neuron Data's rule-induction components, Logic Programming Associates' ProWeb Prolog Server, and Autonomy's Content Server 13, which is based on neural networks. Most of these programs have their roots in the AI research of the 1980s.

Acknosoft, for example, developed a diagnostic and fault-monitoring system called Cassiopeïa for Boeing's 737 airliners. A maintenance engineer can describe a problem to Cassiopeïa via a question-and-answer session and get back a list of the most similar previous cases and their solutions. Clicking on a case brings up a workshop manual with diagrams and part numbers to help fix the problem.

Neuron Data's business-rules-development framework provides components for creating and maintaining a rule base and distributing applications via messaging middleware. It has helped organizations such as American Express, Boeing, NASDAQ, and Walt Disney World to centralize all business policies and procedures into a single repository.

The popularity of the Web has added new impetus to classic pattern-recognition algorithms. There's an increasing need to sift intelligently through reams of random data. Autonomy's Agentware 13 uses linear adaptive filters, a neural-net variant, to learn Web site visitors' preferences and present them with news clips and links that match their interests.

Logic Programming Associates' ProWeb Prolog Server package contains a complete Prolog compiler that has the ability to run server-side Prolog programs to perform searches and manipulations on Web data. In one application, the system provides insurance quotes based on a user's answers to an HTML form.

-- D. P.
picture this: At a supermarket checkout counter, you pay for your merchandise with money stored on a small electronic card. To reload your electronic purse afterward, you plug the card into your Global System for Mobile Communications (GSM) phone and dial up your bank account. Then, on the metro, the same card gives you access to the train home because it holds your prepaid monthly ticket. Once you get home, the card identifies you as a subscriber of your favorite TV channel as you plug it into the set-top box.

Portions of this multifunctional smartcard scenario are reality today in, for example, Swedish Postgiro Bank's and GSM network operator Telia's remote banking application, in Dutch Postbank's and PTT Telecom's Chipper project, and in Singapore City University's and Hang Seng Bank's CitySmart program.

In about two years, however, smartcard technology will be mature enough to offer yet another level of convenience. At that time, you'll be able to decide what kind of ticketing, payment, and loyalty programs you want to have running on your card. All you'll need to do is get a so-called white card, or lifestyle card, and load the applications you want.

Rapid advances in the design and manufacture of components have driven the growth of the smartcard industry. Smartcard technology will mushroom into what analysts estimate will be a $16 billion market by the year 2005. "The smartcard industry's investments in research have led to improvements that, just a few years ago, no one would have dreamt about," says Russell McCullagh, a senior technical marketing manager with Motorola Semiconductors (Glasgow, U.K.).

But on the other hand, proprietary card OSes and incompatible standards are hampering the growth of the industry. To ensure the success of multiple applications on one card, interoperability is indispensable. Several standardization initiatives are addressing the interoperability of cards, readers, and applications (see the text box "A Group of 'Standards'" on page 4018).

Java's Pivotal Role

Not surprisingly, Java's multiplatform capabilities and inherent security features will play a pivotal role in the next generation of multifunctional cards. Through the Java Card API standard, this programming language entails shorter development and testing cycles because it relieves developers from the traditional chip-masking process, which can take up to four months. Because of its popularity in the developer community, Java is open to anyone who can develop applications using common development tools.

The Java Card 2.0 API includes an object-oriented programming model, which allows for the definition of classes, interfaces, and packages with dynamic and static fields and methods. "Thousands of Java developers have the opportunity to write high-level, object-oriented applications that run securely on smartcards," says Fabien Thiriet, Cyberflex product manager at Schlumberger Electronic Transactions (Montrouge, Cedex, France). Any smartcard that integrates with a Java Card 2.0-compatible virtual machine (VM) can run these applications, even if the microcontroller and card OSes are different. This concept enables multiple applications to run on one card.

"The ultimate opportunity for Java Cards lies in the possibility of cryptoographically separating the card issuer from the application issuer," says Jet van der Heek of DigiCash (Amsterdam). Capitalizing on Java Card applets, called cardlets, consumers can use their white card and decide which cardlets they want to put on a card. Although application issuers might guarantee has-
ple-free and secure interoperation only with certified cards, the choice remains with the user.

Schlumberger's second-generation Java-based Cyberflex card can be dynamically added to or updated at any time. In this case, the white-card issuer provides the service of adding applications, but the user can download or update new services as well. Early Cyberflex adopters report that typical applications, such as single-sign-on password management and remote banking authentication, require between 1.5 and 2 KB of memory, making it possible to store up to three applications on a white card.

Due to the very limited resources of today's mostly 8-bit-processor cards, the Java Card API lacks some of Java's important features, such as unicode characters, floating-point numbers, double data types, exceptions, threads, and garbage control. The use of floating-point numbers alone requires about 2 KB of memory, which application writers today would rather use for mission-critical purposes.

Thus, the Java Card interface is no more than a smartcard-specific subset of the Java programming language. But new hardware improvements, due to arrive on the market in the next 18 to 24 months, will enable 32- and even 64-bit data types, making Java Cards viable multifunctional systems.

### 32-bit Processor Cores

Traditional smartcard microprocessors typically use the Motorola 6805 or Intel 8051 instruction set, which allows them to address 64 KB of 8-bit memory. But because of the cost constraints of large applications and the limitations of the microcontrollers' plastic housing, most applications in use today offer only up to 20 KB of memory. But better cryptography and more sophisticated OSes and VMs require more memory resources and the ability to perform real-time operations.

In an attempt to solve this problem, Gemplus's GemXpresso Java Card uses an implementation of ARM's 32-bit RISC ARM7 processor. This processor not only provides for 32-bit computations but also offers 20 MIPS of computing power, which can allow applications to run up to 60 times faster than on existing 8-bit processor cards. "This extra computing power is definitely an advantage in the context of Java," explains Arnaud Chain, multimedia marketing director at Gemplus.

### A Group of "Standards"

Several years ago, in an attempt to promote smartcard interoperability, the ISO developed the 7816 standard. It focuses on a smartcard's size, weight, and electrical and data-link-protocol levels. Later industry standards, such as the Global System for Mobile Communications (GSM) and Europay, MasterCard, and Visa (EMV), adopted the ISO standard and defined their own application-specific data and encoding rules. Application-interoperability issues, such as cross-industry standard interface and command set, were not addressed in these later standards.

Building on these existing standards, the PC and Smart Card (PS/SC) Workgroup, whose members include Bull, CP8 Transac, Gemplus, Hewlett-Packard, Microsoft, Schlumberger, Siemens, Nixdorf, and Sun Microsystems, two years ago began addressing the interoperability between PCs and smartcards. The result is a standard interface and a set of command-set specifications for platform-independent and application-neutral solutions for hardware and software developers alike.

The PS/SC specification allows for interoperability between cards and readers from different manufacturers. It also reduces software-development costs by making resource sharing across multiple applications possible.

Microsoft's announcement that Windows 98 and NT 5.0 will include a PC/SC-based API and interoperate with smartcard hardware solutions at the device-driver level is a strong indication that PC/SC will gain broad acceptance in the industry.

Java Card 2.0, an API supported by a consortium of smartcard manufacturers, was specified by JavaSoft. Java Card applications run on top of a Java virtual machine (VM) that, to a large extent, shields the card's OS details from the application.

The fundamental strength of the Java Card 2.0 API is that it offers both security and integrity. By making use of Java's security features, each application occupies its own allocated memory space, thus avoiding interference between applications. With a card issuer's authorization, it's possible to securely add and remove applications on a single card. The OpenCard Framework, which is supported by companies such as IBM, Netscape, Oracle, and Sun, originally aimed at introducing smartcard standards into the network-computer (NC) arena. Sun says it will incorporate OpenCard into its network-management and NC strategies as a complement to Java Card. In addition, the recent work of the OpenCard group aims at an interoperability with the PC/SC specification.

MULTOS, a multiapplication-card OS, enables a number of different products or services to be held securely and independently on a single card. It builds on the ISO 7816, EMV, and GSM standards, so products from different industries can coexist on the same card.

MULTOS and the Java Card API share the same goal, but they cannot coexist on one card. Only one interpreter can in control of application execution at any one time. However, Sun and Mondex International are working on interoperability specifications for both platforms. In the end, Java Card and MULTOS might make it possible for developers to sell truly hardware-independent applications.
MULTOS-Based Multiapplication Card

MULTOS is compatible with most international standards so that different applications can coexist.

(Émemos, Cedex, France). “Dealing with high-level objects requires a lot more resources than directly addressing low-level functions on the card.” The new ARM processor, for example, allows application developers to deal directly with 32-bit integers, which is a lot easier than cutting 32 bits into many 8-bit parts.

In addition, GemXpresso rapid application development (RAD) tools offer advanced memory management and a partial garbage-collection algorithm to increase programming flexibility. These features allow for Java stacks up to 1 KB, thus eliminating a severe constraint of the Java Card platform.

Patrice Peyret, director of the Smart Card group at JavaSoft, believes that the introduction of these 32-bit processor cards will accelerate the creation of new applications. “The combination of more-powerful hardware and Java Card’s advanced software architecture will allow the speedy development of more advanced smartcard applications,” she says.

Faster Memory

The industry’s current move to replace EEPROM memory technology with ferroelectric RAM (FeRAM) will further propel the efficiency of smartcards. Companies such as Motorola and Matsushita have been working on the development of FeRAM for five years. Now several manufacturers are furnishing their next-generation cards with this technology. The first FeRAM-based cards will become commercially available by the end of 1999.

FeRAM is a nonvolatile technique that speeds memory access so as much as 20 times faster than EEPROM technology. Also, FeRAM-based smartcards offer a significant increase of memory capacities—up to 128 KB. These features—coupled with very low power consumption, greater endurance, and a cell programming method ideally suited for large memory arrays—make FeRAM an alternative for smartcard manufacturers.

This increase in computing power and memory, as well as the use of a high-level programming language, will allow the processing of more complex mathematical functions, which is simply not possible with 8-bit processor cores. However, the extra MIPS will also help smartcard manufacturers capitalize on advances in biometrics and cryptography. This, in turn, might allow the creation of single-application banking, GSM, and health-insurance cards.

But there are questions concerning the uptake of multiapplication cards. “The current growth of the market is predominantly driven by closed systems, single applications, and national programs,” says McCullagh. “The key to a real market expansion is an open software scenario, and this requires true multiapplication standards, much like in the PC world.”

Adds DigiCash’s van der Hoek: “With the current Java Card standard release, there’s still the problem of loading the smartcard. The issuer must still create a download instruction for an application on a specific card.” This defeats the purpose of standardizing on a common API, because if card issuers have to be involved before an application can be added, then the card might as well be programmed in a manufacturer-specific language.

As a result, this limits a consumer’s freedom to mix and match applications and cards. “Only when Java Card apps can be downloaded with public-key technology and when processing inside the card is publicly verifiable by consumer organizations will the real power of Java surface,” says van der Hoek.

A Not-So-Open Standard

The potential problems of a not-so-open Java Card standard might be avoided by vertical-market solutions. The Java Card Forum is now working on Vertical Market Extensions for banking and telecommunications. For example, cards issued by banks might come with additional subsidiary applications that allow consumers to tailor cards to their needs. A multiapplication card issued by, say, a health-care organization piggybacking an insurance program and a government agency’s identification application would no doubt be a useful product.

Tom Lebsack, director of marketing and business development at Schlumberger’s Austin Product Center, says that “it’s just logical that issuers control cards.” According to the Java Card Forum, such multiapplication cards are close to a commercial introduction.

Today’s applications are specifically tied to the card OS (COS) of a particular card, which in turn is usually tied to a specific chip. Most existing COSes allow only one application per card. Last May, however, eight of the leading card manufacturing and issuing companies, including Gemplus, Hitachi, Mastercard International, Mondex International, Motorola, and Siemens, announced a new open multiapplication COS, called MULTOS. Although MULTOS is not the only multiapplication COS, it has the widest industry support today.

MULTOS enables a number of different products or services to be held securely and independently on a single card. Because MULTOS is compatible with most international standards, such as ISO 7816, GSM, and EMV (short for Europay, MasterCard, and Visa), products from different industries can coexist on the same card. MULTOS makes it possible, for example, to combine subscriber identification data for GSM phones with EMV credit or debit products and an airline’s frequent-flyer scheme.

To securely download or delete appli-
cations, MULTOS uses Application Load Certificates (ALCs) and Application Delete Certificates (ADCs), which are specific to cards and applications. By using ALCs, MULTOS verifies that an application was initiated correctly after download. It checks the validity and integrity of the application, allocates a protected and isolated memory area, and locks the new program into this secure space. This way, applications are strictly separated from each other so they cannot interfere with one another.

Due to MULTOS's security architecture, card users can customize their cards and download new services via phone or the Internet. This architecture also lets card issuers add applications and introduce security upgrades without discommoding their customers. Applications on the card are kept separate by secure firewalls, allowing for only the selective disclosure of private (but not secret) information.

This identification-verification scheme allows the operation of only authorized applications and ensures that applications have access only to their specific information base. It also guarantees the security and integrity of each application.

MULTOS includes the MULTOS Executable Language (MEL) and an API that developers can, for example, access from the C programming language. This, together with the COS's interpreter concept, might enable developers to sell hardware-independent applications. In addition, because of MULTOS's wide industry support, it might eventually become a standard for issuers operating in the finance, retail, media, and telecommunications sectors.

Although MULTOS and the Java Card API share the same goal of an open industry platform, they are not 100 percent compatible. Therefore, they are competing models. Today it seems that, for security reasons, developers must choose one or the other because MULTOS and Java interpreters cannot coexist. Only one interpreter at a time can be in control of application execution.

But Sun Microsystems and Mondex have already announced that they are working on a Java Card 2.0 API for MULTOS, which would allow Java or MEL to act as a primary application-development language. Java Card-based applications would then be able to run on Java's VM on top of MULTOS. Says Lebsack: “We believe that Java, in combination with an open, multiapplication OS, is where the industry should go.”

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I2O's Promise

For certain enterprise applications, the new breed of I2O servers will compete favorably with Unix-based servers—and at a much lower price.

By Stella Kao

Windows NT servers are rapidly achieving new levels of scalability. Dual-processor and four-way symmetric multiprocessing (SMP) servers are now common. And with improvements in Intel's microprocessors and new I/O architecture, performance has improved dramatically at significantly lower costs.

Aiming at the high-end application-server arena, which was once exclusively dominated by Unix servers, new Intel-based servers now support full redundancy and manageability. Features such as hot-swappable power supplies, redundant cooling fans, voluminous hard disk expansion chassis, and massive memory support are all enabling these systems to provide performance similar to that of departmental servers, but at prices closer to those of desktop PCs.

"It's hoped that all these efforts will push NT systems deeper into corporate enterprise networks," says Tony Chen, director of the PC department at Amaquest Computer (Taipei, Taiwan).

Although server-class processors developed by Intel offer more speed, overall system performance is still hampered by I/O bottlenecks because these chips are not specifically geared for handling device interrupts. I/O interrupts occur at a server when a communication request is issued by, say, a client/server transaction application. Depending on how the I/O device is implemented, it can interrupt the CPU once or many times during a single I/O operation.

The I2O architecture, due to its ability to diminish these network bottlenecks, is viewed as a key technology for boosting the performance of PC servers. With I2O, interrupt-intensive I/O processing is off-loaded from the host/server processor onto I/O devices, allowing the host CPU to concentrate on its primary job, data retrieval. Vendors say that high-speed I/O performance is important for a growing class of I/O-intensive applications, such as video, groupware, and large databases.

In addition, I2O puts an intelligent device between a peripheral and the OS. Therefore, peripheral vendors need to write only one driver to the I2O standard; the OS then communicates with the I2O subsystem.

Network servers that support both the Intel 960 RISC chip and the I2O architecture are expected to appear in volume this year. Many server vendors, including those from Taiwan, began showing their first full system implementations of the I2O architecture at Comdex in November. During that show, three Taiwan companies—Acer, Amaquest, and Tatung—unveiled I2O-compliant systems, and Asustek Computer demonstrated its I2O server motherboard. "I2O will give Intel and Microsoft their first real shot at competing head-to-head with Unix servers," says Chen.

Hardware integration is not the only factor that's important to the success of I2O; full support from Windows NT is a bigger issue, according to Cliff Chou, director of the networking systems business unit at Acer. "Giving the OS the ability to take advantage of it is the real challenge," he explains. "NT isn't there yet." Microsoft isn't expected to offer full I2O support until Windows NT 5.0 ships sometime this year, Chou adds.

Currently, Microsoft offers I2O support for Windows NT 4.0 in the form of a Service Pack. Several server vendors in Taiwan have been working with an early version of I2O running on NT 4.0 since late 1997. In addition, Novell, together with IntranetWare, endorses the I2O standard and NetWare 4.11, which should be available early this year. Novell has also promised to build I2O support into its next server OS. SCO's Gemini NetWare supports the Intel architecture as well.

continued
Modern information technology is one of the keys to competitive success, and every IT system breakdown is both annoying as well as expensive. Maximum security is provided by grouping servers together in clusters. If a particular server in a cluster should fail, the others take over instantly. The availability of vital data and programs is maintained – around the clock, day after day. And when the number of users grows, or when new software requires more system capacity, Siemens Nixdorf clusters simply grow to meet such requirements. Economically and step-by-step.

When united in a cluster configuration, the computing power and reliability of servers increases dramatically. With increased power and availability, the possible areas of application for these systems also expand. PRIMERGY clusters are becoming the economical basis for running business-critical applications under Windows NT. Clusters of UNIX systems from the RM family work tirelessly for large numbers of users. BS2000 cluster configurations have a reputation for ensuring uninterrupted power and system availability in computer centers. And innovative high-end technology is at the heart of the Reliant Cluster Servers, which are setting new standards in this market segment.
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The big question, of course, is: How much of a performance gain can users expect? The short answer is that it depends on the application, but I/O-intensive databases could see performance gains of 60 percent or more, according to server vendors. Testing is done by server makers to see how much of the I/O work load the i960 processor can handle.

Ideally, the new I/O architecture will significantly improve overall performance by having the i960 processor be responsible for all the I/O processing. But the initial rollout of the technology is not likely to achieve that goal, according to Jerry Lee, Asustek's associate vice president for product marketing and technical support. Some benchmarks show an improvement of around 10 percent to 15 percent.

Fault-Tolerant Designs

PC server vendors are responding to user demand by moving some degree of fault tolerance into their low-end and mid-range systems. A host of new NT servers now includes error-correction-code (ECC) memory and an optional RAID controller, both of which are unusual in entry-level systems.

Chen says that servers are now being used more in distributed environments, where more fault-tolerance features are required. Downtime costs, coupled with data loss, are just too pricey for small-to-medium-size businesses. Equipped with RAID and “hot plug” technology, fault-tolerant servers can continue operating if any of their processors or other parts fail. Users can simply swap out the drives, power supplies, fans, and other parts while the server is still working.

Another quality that makes these Intel servers suited to client/server applications is their use of the Highly Parallel System Architecture (HPSA), which enables computer makers to incorporate two independent PCI “buses” — one of which is then bridged to an EISA bus for support of older peripherals — to eliminate data bottlenecks between peripherals, such as hard drives and the system's memory and processor. Hence, these systems include at least five — and up to eight — PCI slots.

Many servers devote a significant portion of their resources to the maintenance of high availability in their disk arrays. Most servers now come with two separate SCSI processors, a mirrored cache, battery backup, and a redundant power plant. This approach eliminates most single
points of failure in the disk channel. In addition, Acer, Asustek, and Tatung have all included in their server solutions environment-monitoring sensors that monitor temperature, voltage, and fan speed; prevent crashes; and detect intrusion.

Asustek's P/I-P65UP8 motherboard, for example, provides server manufacturers with seven PCI slots, as well as Symbios 53C876 and AHA-7880 PCI Ultra Wide SCSI controllers, plus the hardware required to implement I2O functions. The Asus SMP server motherboard will be targeted at Internet/intranet applications and database-server markets. Asustek offers a wide selection of CPU daughterboards that contain one or two Pentium Pro or Pentium II processors. A quad-processor daughterboard will be available by June. Other features of the Asus server motherboard will include as much as 1 GB of extended data out (EDO) DRAM, ECC memory for reliability and data security, and redundant hot-swappable power supplies.

Remote management is an essential component of a workgroup server. A good management program lets an IS manager monitor server status from a remote office. Intel's LANDesk, which is included with many workgroup servers, is a powerful utility that monitors a server's vital signs, such as the power supply's output voltages and the temperature inside the chassis. Some companies also offer proprietary vendor-developed solutions, such as the AcerAlto 9100 Advanced Server Manager (ASM) Pro and Remote Diagnostics Manager, and Asama's SNMP remote-control software.

True Clustering
Clustering is a technology for connecting separate computers, each running its own copy of an OS. For example, two separate four-processor Pentium Pro servers, each running its own copy of NT, can be connected to form a cluster. Currently, clustering is used primarily for high-availability and failure purposes, so vendors can offer a degree of fault tolerance in Pentium Pro servers.

Clustering essentially creates a quick-response, intelligent backup system in case one of the servers, or one of its components, fails. As a result, users are subjected to far fewer network outages. Until recently, clustering has generally been available only as a proprietary technology on Unix platforms.

Microsoft's Server Cluster server brings this technology to the growing NT server market by providing computer vendors,
One of the first clustering servers to be developed in Taiwan is Amaquest's VPro "Cluster-in-a-Box" system. The server includes two separate 200-MHz Pentium Pro or 233-266-MHz Pentium II system boards connected via 10/100-Mbps Ethernet. The Ultra Wide SCSI controllers are configured as an independent bus, with each system's SCSI bus terminating at the storage processor in the disk subsystem.

The VPro system can run in shared-bus mode. Each system can function independently of the other and can run all standard NT applications. This configuration provides service to one clustered system's connection without interruption to the other clustered system and prevents a total failure if a SCSI cable comes off and breaks the SCSI bus.

Amaquest plans to introduce four-way servers that use the Intel 440NX chip set. By the second quarter of this year, the company also plans to offer a new clustering server that contains three nodes in a box running Windows NT 5.0.

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resellers, and IT managers with the means to tie systems together in a fail-safe bond. Late last year, Microsoft released Windows NT Server 4.0 Enterprise Edition, which includes Cluster Server (MSCS).

Previously code-named Wolfpack, MSCS is a part of the set of APIs currently being developed to turn Windows NT Server and the BackOffice suite of applications into a clustering platform. Microsoft has said that a two-node variant, which will address failover fault tolerance, will be the first to arrive. Still another form of clustering at a higher level is currently being explored by Microsoft.
Better Control with PDM

Product data management is most efficient when it's combined with enterprise-wide applications.

By Adele Hars

Manufacturing companies are usually good at recording component and assembly drawings; it is, after all, part of their daily business. However, they often fail to keep comprehensive records of related product data. This makes it difficult—and often impossible—for product designers and engineers to access pertinent information when they need it. It's estimated that in the manufacturing industry 50 percent of product-development time is spent tracking down information, maintaining multiple revisions of design studies, and checking relationships among 2-D drawings, 3-D solid models, assembly instructions, and process plans.

This is where product data management (PDM) comes in. PDM aims at bridging the gap between product and design data, typically through a relational database system. It also provides procedural control of product data by facilitating approvals and notifying team members of a project's status. In other words, it supports project coordination and allows companies to implement concurrent engineering schemes and compress the product-development cycle.

For example, a PDM system permits a project leader to control the progress of a project via "states" using "triggers" and a routing list that reflects a company's organizational hierarchy. Or, to coordinate a particular work flow effectively, a worker can define the interdependence of tasks to match a project's structure, time frame, and goals.

"PDM helps engineers manage both data and the product-development process," explains Ed Miller, president of CIMdata (Godalming, Surrey, U.K.), an international PDM consultancy. "However, it's not designed to help individuals do a better job, but rather to facilitate an organization's management initiatives." Such initiatives might include concurrent engineering or conforming to the "design anywhere, build anywhere" philosophy.

An organization moves to PDM primarily because such a system can help cut the time it takes to bring a product to market. But PDM is not restricted to the manufacturing industry. Its ability to manage a vast amount of different data types benefits other industries as well. For instance, 20 percent of the installations of Hewlett-Packard's WorkManager PDM system are in the health-care, insurance, construction, telecommunications, and software-development industries, according to Dietmar Jenuwein, a member of HP's German PDM marketing group.

As a concept, PDM has been around for more than a decade. Early PDM systems were not successful primarily because they were not flexible enough to handle the uncontrolled proliferation of data within an organization. But as consistent data modeling becomes more prevalent throughout the entire development process, PDM stands a good chance of delivering on its promises.

Today an increasing number of companies are installing PDM systems. The global PDM market, which is currently worth over $900 million, expanded by 31 percent in 1996, according to CIMdata. The company expects a total market volume of $2 billion by the year 2000. CIMdata also says that Europe accounts for just over a third of this volume and that the European market is faster-growing than, for example, the U.S. market.

Results from the most recent survey issued by the British Department of Trade and Industry (DTI) reveal that PDM users experience several important benefits from using these systems. These include a 10 percent reduction in engineering costs, a 20 percent decrease in product-development time, 3 percent faster reactions to changed orders, 40 percent fewer changes in the development process, and, in combination with concurrent engi-
neering methods, a time-to-market decrease up to 50 percent.

"Considering only our increase in engineering productivity and our reduction in costs related to quality defects, we've had a 14-month return on our investment," says Philippe Martin, IS director at Schlumberger (Paris, France), which implemented an enterprise-wide PDM system in 1996.

Many previous generations of PDM were based on relational database systems. Now that PDM applications include more object-oriented features, systems are a lot easier to manage. As Mark Horne, general manager of Quillion Systems, a PDM vendor in the U.K., notes, "Object technology is the only way to efficiently manage product data, although you still have to comply with the relational-database world."

With object orientation now being used, the type of data used for a PDM application no longer matters. A CAD drawing, process information, bills of materials, and an engineering-change order can all be different kinds of objects and still used in the same system. In addition, objects support dynamic data, which facilitates rule-based process flows.

**European Variations**

But even though object technology is heralded as one of the big liberators of PDM systems, some conceptual problems between engineers and process managers remain. For instance, engineers tend to prefer straightforward working practices and do not appreciate the formal object definitions of PDM systems, according to Patrick Piekoilek, product manager for Matra Datavision's Design Manager, an object-based PDM system.

Most of the big players in the PDM market, including CoCreate Software (a subsidiary of HP), Computervision, Dassault/IBM, Metaphase, Parametric Technology Corp. (PTC), SDRC, and Sherpa, are focusing on enterprise-wide installations in international companies. This leaves a big opportunity for local PDM vendors to address the data-management needs of engineering departments. To the extent that the industrial structure in Europe varies from one country to another, there are also substantially different local requirements for data management. In Germany, for example, the national DIN standards closely dictate design and manufacturing conditions—and therefore, for example, component-classification schemes. PDM systems have to reflect these local standards.

Today, one of the most important issues facing a PDM system is its ability to work with an enterprise-resource-planning (ERP) system and enterprise-management applications, such as SAP’s R/3 and Baan’s Triton. "In two years, you won't find any reasonable system without an SAP or Baan interface," says David Hodgson, general manager for AIM Systems, a PDM system vendor in Karlsfeld, Germany.

For example, Matra Datavision’s new Euclid Design Manager for Windows NT connects to enterprise-management systems from SAP and Baan via an interface based on the ISO's Standard for the Ex-

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**STEP and Product Data Management**

Data exchange and data sharing between different PDM systems can be efficient only if both systems support the same data model or their data models have the same level of richness. The ISO's Standard for the Exchange of Product Data (STEP) aims at providing methods for storing and exchanging product configurations, bills of materials, engineering-change orders, and organizational and personnel data throughout the product development cycle.

An important and difficult area in PDM is the interaction between a PDM system and the applications that create and change product data. STEP addresses this issue with a data-management layer between applications and the STEP repository. This approach offers two key advantages: Data is independent of the application that generates it, and applications that use STEP's Standard Data Access Interface (SDAI) can communicate with all other compatible applications. In addition, a universal data-management layer reduces storage space because only one version of an entity needs to be stored.

Large industrial projects in the aerospace, automotive, and energy sectors are increasingly demanding STEP-compatible applications.

Says Patrick Piekoilek, Matra Datavision's PDM product manager, "We chose STEP because it lets us communicate with, for example, manufacturing-resource-planning systems."

Although STEP’s consistent data model offers some obvious advantages, critics argue that it's still not in place today. They see the current ISO draft, AP 214, as an outgrowth of the European and Toyota automobile initiative. Crucial subsets of the standard, such as those for product structuring, versioning, and parts ownership, are not fully defined yet. "STEP is not ready. The data model is changing almost daily," says Norbert Reimann, director of SDRC's PDM business unit for central Europe.

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**Application Integration with STEP**

A **Logical STEP database** includes STEP-conforming PDM system and other STEP-enabled applications. The Standard Data Access Interface (SDAI) enables PDM systems to communicate with other enterprise applications.
Implementing a PDM system in a large, international company requires an enormous amount of planning and reengineering of business processes. "You really need to look at the corporate work flow and optimize it. It's no good just to apply PDM to old, bad flows," explains SDRC's Norbert Reimann.

To make implementation easier, PDM vendors are providing streamlined options. For example, SDRC is introducing templates to standardize process implementation in specific industries, as well as encouraging other PDM vendors to adopt these templates for regional and industry-specific needs. For the same reason, PDM vendor Sherpa has developed industry-specific object libraries so that new users needn't start from scratch. This avoids each company's having to define objects, processes, and data relationships when there are often many similarities between processes within an industry.

Diepold says that standardized interfaces between systems solve only part of the problem. Other points of friction between a PDM system and a business-management system include the management of engineering changes and the modification of processes within a running, complex engineering project.

### PDM/Web Integration

As with everything else that it has touched, the Internet has brought big changes to PDM as well. "Web technology has had a terrific impact on this industry," enthuses CIMdata's Ed Miller. "With an intranet in place, you can get a lot of information in return for a small investment."

For example, CoCreate's Dynamic Conferencing modules for the WorkManager PDM system enable virtual 3-D modeling over the Internet. Design sessions can be shared across the Web, and users can discuss changes or make annotations to a model that was just designed in another location.

PTC's new Pro/Intralink product also includes tools for communications in a concurrent engineering environment, as well as an open architecture that permits

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*Adelle Hars is a freelance writer based in Paris. You can contact her by sending e-mail to AdelleHars@compuserve.com.*
A robot that can handle the e-mail deluge, a hardware firewall that protects your hard disk from viruses, plus other new tools.

Protect Your Hard Drive

Do you trust today's operating systems and firewalls to securely shield the data on your computer from hacking attacks and viruses? As recent incidents show, software is vulnerable to bugs that compromise security. That's why Calluna developed a "hardware firewall" that monitors all level disk activity and protects against illegal disk writes and accesses.

Called Hardwall, the card plugs into an ISA slot and operates separately from the processor. It sets up firewalls at the boundaries of every partition on your hard disk and lets you define different levels of access. Because these firewalls operate separately on a low physical level controlled by Hardwall, the vendor says, they are impossible to penetrate and cannot be circumvented.

Hardwall also efficiently shields your system from viruses and accidental configuration changes. For example, it can set the boot partition of your hard disk to "write many recoverable" mode. This means that you may write to the partition as often as required during a session, but each time you reboot the machine, all changes are set back to the initial state. If information in this partition is infected by a virus or corrupted, the defect will be removed automatically upon rebooting. Hardwall is not virus-specific, so you don't need to update virus-scanning software.

Hardwall is an intelligent virus isolator and antihacking device that can work in a desktop PC as well as in a Windows NT server. Its big advantage is that it operates separately from CPU and OS and therefore doesn't degrade system performance.

-Rainer Mauth

Displays

Moveable LCD Monitor Saves Space on Your Desk

SPACESAVER, a new 13.8-inch color LCD monitor, may be a good way to clear your desktop of bulky screens, peripherals, and cables. You can set the device on your desk and still move it around three axes to optimize your working environment. Its 90-degree viewing angle, in both horizontal and vertical planes, provides good contrast and brightness over the entire screen area. This monitor also serves as a hub for mouse, infrared keyboard, and serial ports, and it has two stereo speakers.

Price: Starts at $1200.
Contact: Source Development, Lognes, France,
+33 1 64 62 63 63;
Enter HotBYTES No. 1033.

Printers

New Laser Printer for Small Workgroups

KYOCERA'S NEW FS-600 SMALL WORKGROUP LASER PRINTER OUTPUTS SIX PAGES PER MINUTE AT 600 DPI. THIS COMPACT (225 X 353 MM, 7 KG) PRINTER INCLUDES A 150-SHEET CASSSETTE PLUS MANUAL BYPASS. THE PROCESSOR IS A 50-MHZ POWERPC 416F.

You can upgrade the device with an additional paper cassette for a second paper type or with a network interface. Standard emulation includes PCL 5e, Epson LQ-850, KCGI, and line printer. You can also upgrade to PostScript 2.

Price: DM 860.
Contact: Kyocera Electronics, Reading, U.K.,
+44 118 931 1500;
Enter HotBYTES No. 1034.

Communications

Complete Video-Conferencing Solution

FOR VIDEOCONFERENCE LIESEGANG U.K. BUNDLES THE RSI VIDEO FLYER ROCKSTAR, EQUIPPED WITH BUILT-IN MICROPHONE AND SPEAKERS, WITH A SONY CAMERA AND A 128-KBPS ISDN SWITCH. THE SYSTEM RUNS ON MACS, PC'S, AND NOTEBOOKS AND OFFERS REAL-TIME VIDEOCONFERENCE ON UP TO THREE PARALLEL ISDN LINES.

Price: £799.
Contact: Liesegang, Birstall, U.K.,
+44 1924 423 331;
http://www.liesegang.co.uk.
Enter HotBYTES No. 1037.

Motherboard

Internet Server for Small Businesses

COMPLEMENTING OUVETI'S NETSTRADA SERVER FAMILY, THE NETSTRADA 1200...
offers a Pentium II CPU running at 300 MHz and sophisticated Ultra-Wide SCSI peripheral bus technology. Equipped with on-board Ethernet and Fast Ethernet adapters, 512-KB L2 cache, and RAM expandable to 384 MB, it is built for use as an intranet or Internet server in small businesses. NetStrada 1200 ships with monitoring and network management software on CD-ROM.

Price: Starts at £1200.
Enter HotBYTES No. 1039.

EPOC Device Includes Touchpad

Gefox-One, an EPOC32-based hand-held computer, is powered by an 18-MHz ARM-7 CPU and is fully compatible with Psion’s Series 5 devices. An integrated e-mail client supports POP3 mailboxes and regular PC Card modems. For data input, the device features a soft-touch keyboard and a touchpad. The 17-cm LCD panel offers a resolution of 640 x 320 pixels. Two standard AA batteries let you use the gadget for up to 25 hours without changing the battery, the vendor says.

Price: £399.
Enter HotBYTES No. 1038.

Web Appliance

Surf the Web on Your TV

SurfTV, a multimedia set-top box, lets you read and answer fax or e-mail messages and browse the Web on your TV screen. The device has a small digital camera for videophone services. The box connects to the TV or to the Internet (via a built-in modem). SurfTV runs the QNX real-time OS and includes a Web browser with video plug-in technology.

A high-end version comes with a CD-ROM or DVD drive.

Price: Starts at FF.999.
Contact: Com One, Cesta, France, +33 556 788400; http://www.com1.fr.
Enter HotBYTES No. 1044.

Surfing/TVuner, a multimedia set-top box, lets you read and answer fax or e-mail messages and browse the Web on your TV screen. The device has a small digital camera for videophone services. The box connects to the TV or to the Internet (via a built-in modem). SurfTV runs the QNX real-time OS and includes a Web browser with video plug-in technology.

A high-end version comes with a CD-ROM or DVD drive.

Price: Starts at FF.999.
Contact: Com One, Cesta, France, +33 556 788400; http://www.com1.fr.
Enter HotBYTES No. 1044.

Accounting Package for Macintosh

With features like cash management, accounting, and calculation of early settlement discounts, Bottom Line aims at small- and home-office users who need to satisfy auditors, banks, or VAT inspectors. The Mac OS-based bookkeeping software produces VAT returns and EC sales lists so users can prepare invoices and maintain credit control. It offers flexible reconciliation procedures, departmental breakdowns, and budgetary control features.

Price: £99.
Contact: Forecast Systems, Bristol, U.K., +49 117 950 5033; http://www.forecast.co.uk.
Enter HotBYTES No. 1059.

Security

Firewall Handles Address Translation

CIPRO-FW, A HARDWARE-BASED FIREWALL, guards intranets from illegal access, allows VPN tunneling over the Internet, and controls access to corporate LAN and WAN environments. Its Fast Ethernet capability offers communication speed up to 100 MBps and supports standard IP applications as well as remote user authentication, network address translation, and advanced security auditing.

Price: Starts at £69.90.
Contact: Radguard, Tel Aviv, Israel, +972 364 5489; http://www.radguard.com.
Enter HotBYTES No. 1045.

Embedded Systems

48 I/O Channels on One Board

BLUE CHIP TECHNOLOGY’S NEW PC/104 form-factor module provides up to 48 digital I/O channels on an embedded Pentium board. The APX-PIO board offers a reliable mechanism for implementing additional digital I/O channels in embedded control applications. Maintenance and configuration of I/O channels is possible via software.

Price: Call company.
Contact: Blue Chip Technology, Chester, U.K., +44 1829 772 000.
Enter HotBYTES No. 1046.

Robot Filters E-Mail Influx

For most businesses, e-mail has become as indispensable as the telephone. As the number of users grows, companies are struggling to efficiently manage and expedite e-mail traffic. Emailrobot 2000 routes, answers, archives, and tracks messages automatically. It stores and analyzes e-mail on a central server, capturing such details as response time, responder, and answer to a message. The program provides a retrieval mechanism for complete communication with a customer. Using Emailrobot’s reporting function, you can calculate the amount of e-mail received per day, check correctness of replies, monitor response time per department, and find out whether the load is evenly shared.

Emailrobot easily automates routine e-mail tasks. For example, it sends out personalized responses on the basis of keywords or e-mail domain names and routes incoming messages to specific databases. Defining routing functions is easy. All you have to do is follow a series of setup wizards. For more complex conditional routing, you can use a straightforward scripting language.

The program comes in versions for SMTP and POP3 mail servers as well as for Microsoft Exchange Server. Individuals can use the Emailrobot client as a plug-in for Eudora or Microsoft Outlook.

—Rainer Mauth
Communications

WinPhone Manages PSTN and Internet Telephony

With version 4.5 of MegaSoft's telephony program WinPhone, you can operate analog, ISDN, mobile communications, and Internet telephony calls in one program. Even in the middle of a call you can switch between PSTN and Internet telephony or use the H.323 videophone capabilities. Additional features include whiteboards, application sharing, remote access, file transfer, chat, and least-cost routing. WinPhone lets you dial from any application and displays incoming caller IDs in all running applications.

Price: Call company.
Contact: MegaSoft, Vienna, Austria, +43 4702022.
Enter HotBYTES No. 1053.

Watch Web Site Hits

If you want to know how effective or popular your Web site is, check out RealTime Spy. It allows you to monitor routes taken by visitors, the origin of traffic, frequency of hits, and efficiency of links on a mirror site. Details are stored in a password-protected relational database and are instantly available from your intranet.

Price: Call company.
Contact: The Gauge Group, London, +44 1717171553; http://www.gauge.co.uk.
Enter HotBYTES No. 1052.

Data Mining

ActiveX Components Control Neural Nets

NEUfuzzy, a full-featured neural network program, combines the benefits of intuitive rule-based modeling with the trainable intelligence of neural networks. It offers a Rule-Fire Matrix that can be interrogated from within an ActiveX application. The system enables ActiveX developers to study how a neuro-fuzzy network makes decisions and lets them build ActiveX applications for data mining.

Price: Call company.
Contact: NCS, Totton, U.K., +44 1703 667775; http://www.ncs.co.uk.
Enter HotBYTES No. 1058.

Unified Messaging

UMS Manages All Corporate Communications

The new Unified Messaging Server (UMS) integrates fax, voice, GSM, and telex communications in one single environment. You can send faxes and GSM messages from any Windows application and access incoming voice mail from standard phones or your GSM handset. It is also possible to redirect faxes and e-mail to temporary fax machines. UMS supports Internet-Mail, MS Exchange, Lotus Notes, cc-Mail, and Novell GroupWise.

Price: Call company.
Contact: Digisonic, Holm, Germany, +49 410 388 672; http://www.digisonic.de.
Enter HotBYTES No. 1055.

Document Management System for CAD

DM for AutoCAD 14 helps AutoCAD users manage technical documents. It integrates into AutoCAD's menus and toolbars and displays lists of drawings and documents. The DM server synchronizes concurrent access to document repositories via an intranet. To preserve the integrity of drawings, DM requires engineers to check-out drawings for revision. A revision control system makes sure users can assess how the changes in one drawing affect other drawings.

Price: Call company.
Contact: Cimage, Bracknell, U.K., +44 1344 860 055; http://www.cmage.co.uk.
Enter HotBYTES No. 1057.

Software International

Ecopad Speeds Up Internet Access

Ecopad speeds up Internet and intranet applications by compressing HTML pages on the fly. It uses a variety of adaptive compression methods. For example, it compresses pictures differently than text, removes redundant information, and uses tricks like preparing (but not prefetching) links out of the page. It speeds up arbitrary page access between two and five times, SynchroBPI says. To capitalize on this improvement, the vendor adds, you need the Ecopad software both on the server and on the client.

Price: $1250 for professional version.
Contact: Vitec Multimedia, Chatillon Cedex, France, +33 1 46730606; http://www.vitecm.com.
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A Different Desktop for the WorkPlace

A server-based desktop that provides just 20 percent of "normal" office-suite features could change the way many people work. Lotus's JavaBean-based eSuite, aimed first at network computers, offers an elegant user interface and sophisticated development tools. Whether you're moving from green screens to intranet work flow, or using Web servers and thin clients, eSuite gives you a great deal more than the sum of its parts.

WorkPlace is the task-oriented user environment, and DevPack is a set of tools for Web application developers. The two share word processor, spreadsheet, and presentation-graphics components. WorkPlace also has e-mail, calendar, address book, browser, and file manager components. The desktop gives you a taskbar and a work area that first displays a set of categorized tasks.

Below the work area, the InfoCenter combines Windows 95's taskbar with Notes' InfoBox properties control panel. It's a context-sensitive, single-click action bar with pop-up menus for some commands and a floating panel for setting properties (fonts, etc.). Windows users will feel at home, and shortcut keys perform as expected.

At log-in, a registry restores your desktop to its previous state, including preferred mail and file servers. Most eSuite components are less than 750 KB, for fast downloading. There isn't yet a local-replication version for mobile use.

With the DevPack you can program access to all WorkPlace components but mail, calendar, and address book. The package adds Chart and Project Scheduler, plus JDBC and CGI data-access applets. Using Lotus' InfoBus technology and JavaScript on an HTML page, for example, a pie-charting component can graph numbers taken from an embedded eSuite spreadsheet. AppletContainer lets you preload applet instances and manage InfoCenter layouts, and InfoBusBridge converts between JavaScript-generated strings and InfoBus data.

Notes users will like eSuite's small footprint, but they will need Notes 4.6.x to support component embedding and persistence. I added Project Scheduler to a Notes form, but it didn't save my data. eSuite's JavaBeans architecture gives developers an easy way to add features, and handing computation to the client minimizes network traffic and speeds response. As Java moves to the enterprise, Lotus has carved out a niche that clearly challenges Microsoft and ActiveX.

Steve Gillmor is with Southern Digital, in Charleston, South Carolina, and at http://www.southerndigial.com.

Tech Focus: InfoBus for the Infobahn

The InfoBus provides events and bound properties for directly interconnecting Java components that produce, consume, or control data. eSuite's spreadsheet publishes data to the InfoBus by explicitly naming a range of cells. Give that name to the Chart applet and you've established a data flow between them. In complex applications, data controllers can help manage requests and announcements, caching broadcasts and funneling messages to their destination. Once a link is established, data flows directly, not using the InfoBus.
Graduate to the Next Level.

9.1 X 9 X 10 = 73

Other entry-level RAID systems require you to anticipate your future storage needs due to confusing choices in controllers and enclosures. Graduating to the next level becomes difficult, if not impossible. LynxArray gives you true scalability by featuring the same controller and enclosure architecture whether you have 9 drives or 90 drives. You can start with a desktop tower using 9.1GB drives, increase your capacity ten times and move to a 73.5" rack with 100% investment protection.

From any entry point to a multi-terabyte RAID solution, each LynxArray component can be used toward your system's move to the next grade. Multiple hosts are supported, allowing for numerous configuration options. So you can really show that you've done your homework when you need to increase your storage capacity with Artecon's LynxArray.

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- **Package Density** - Configure up to 82GB of total capacity and still have room for hot-swappable failover controllers in only 7" (4u EIA).

- **JBOD/Tape Inline** - Backup your RAID system inline with DLT or hot-swap 8mm tape devices all within the same LynxArray chassis.

- **LynxArray subsystems** are compatible with Sun, HP, SGI, IBM, Macintosh and PCs. Custom configurations and -48VDC telco models are also available.

So, if you are looking for a new and better way to solve your RAID storage problems, study up on Artecon's New RAID Math. Check out our website or give us a call to see how it all adds up!

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Alpha PCs

With Pentium II-humbling performance and affordable prices, these Alpha systems are irresistible. By Tom Yager

Three Vendors Make an Alpha Bet

ow that Intel has taken the Alpha processor into its fold, we can be more hopeful about the future of Digital's former chip in Windows systems. Yet issues of software compatibility and cost remain. With so much to consider in deviating from the no-brainer Intel x86 course, why should anyone bother?

Spend time with any of the three workstations we reviewed from Aspen Systems, Polywell Computer, and Tri-Star Computer—all based on Digital's smaller, lower-cost Alpha 21164PC chip—and you'll have your answer: speed. According to the BYTEmark tests, a 300-MHz Pentium II will do the work of four to five 90-MHz Pentium machines (the BYTEmark baseline). Based on the same tests (results shown below), these 533-MHz Alphas give you 7 to 9 times the performance boost. If you're running compute-bound applications or services, that's a leap worth taking.

Aspen Systems Durango II

Aspen Systems sent me a machine built around its Durango II base, an adaptation of the Digital 1645X motherboard. IntraServer Technology supplied Aspen's dual-channel Ultra Wide SCSI adapter, which cleverly shares a 32-bit PCI card with a 10/100-Mbps Ethernet adapter. The rest system also included a 64-bit PCI AccelGraphics AccelPro TX2500 OpenGL accelerator with 16 MB of RAM.

Running on a 3Dlabs Glimt 500TX chip set, the AccelPro pulls Windows NT's OpenGL shading operations into hardware. Using the native Alpha version of Lightwave 3-D 5.5, the AccelPro had no trouble tumbling shaded, moderately complex 3-D models in real time. Its 2-D performance is excellent as well. Resolution reaches up to 1600 by 1200 pixels, but oddly, true color is only available up to 1152 by 864. This may limit the card's appeal for publishing and image-manipulation applications.

Aspen's machine impressed me by having nothing plugged into its CPU-hogging IDE controllers. Instead, the IntraServer Ultra Wide SCSI adapter drives everything, from the dual 4.55-GB Seagate hard drives to the 12X CD-ROM.

The cabinet, which Aspen has in common with Tri-Star, is this system's worst feature. The DIMM sockets are obscured by the ¾-inch drive cage. The inside of this system feels crowded. Upgrading it takes plenty of time and light.

However, the Aspen Systems Durango II was tops in the BYTEmark tests. The cabinet aside, I like the way this system is built. At $6424, it's not your average home computer, but anyone with the
need for serious CPU and graphics performance will be well served by this machine.

### Polywell PolyAlpha 533SX

While Aspen shipped me its 3-D power desktop configuration, Polywell sent its commodity contender. That’s no slight. I was pleased to see it, and it was until I discovered that all its drives are connected to the 164SX’s on-board IDE controllers. Pairing the mouth-watering performance of the 533-MHz Alpha chip with department-store IDE hard drives leaves me cold, even if it does save the buyer money. Like most integrators, Polywell sells and configures SCSI adapters and drives for its customers. At this performance level, however, perhaps it should make SCSI hardware standard.

In other regards, I found much to like about the PolyAlpha in addition to its price. The cabinet’s interior is open and spacious; nearly the entire motherboard is viewable, and adding RAM and full-length cards is no trouble.

I approve of Polywell’s choice of the Matrox Millennium II 4-GB video card. It’s a 32-bit card, and it doesn’t accelerate OpenGL, but it does deliver superb 2-D performance at an affordable price. The standard 64 MB of RAM is adequate for basic applications, but you may need to upgrade to 128 MB to accommodate larger Alpha applications (which are typically 30-40 percent bigger than their Intel counterparts).

Inexplicably, this system lagged behind the Aspen Durango II in the BYTEmark tests. The Polywell is very respectable, considering the price, but the speedier Durango II can also be trimmed to a lower-cost configuration. Still, the PolyAlpha is a worthy, competitively priced system. If you order one, I’d suggest asking Polywell to replace the IDE drive with SCSI. Unless you do, you’ll never experience true Alpha performance.

### Tri-Star PowerStation SX

Somewhere between the commodity Polywell and the lavish Aspen rests Tri-Star’s 164SX-based Alpha PC. As configured for this review, Tri-Star’s desktop Alpha (which took a BYTE Best of Show award at Fall Comdex ’97) is an affordable 3-D graphics workstation. Like Polywell, Tri-Star makes its workstation affordable by using IDE drives and cutting back on RAM.

The Tri-Star system’s cabinet is just as crowded inside as the Aspen’s. The motherboard is Digital’s 164SX, like Polywell’s, so all slots will accommodate full-length cards without trouble. The Quantum 6.4-GB hard drive performs as well as any IDE drive, but again, it’s a poor match for such a fast machine.

The ELSA Glorya-L 64-bit PCI graphics card is based on the 3DLabs Glint 300TX chip set, so it has available resolutions and 2-D performance, not surprisingly, mirror that of the AccelPro found in Aspen’s workstation. ELSA adds a system tray utility that purports to optimize the card’s settings for the application you’re running. Selecting ELSA’s “Lightwave 3D” setting, however, caused Lightwave to crash reproducibly until I disabled the Gloria-L’s 3-D acceleration. The Gloria-L card caused no problems with ordinary applications, but Lightwave is the only native Alpha OpenGL application I tested.

In performance, the Tri-Star and Polywell don’t differ significantly. In attempting to commoditize the Alpha PC, Tri-Star and Polywell have cut corners that seriously affect the perceived value of their systems. These two systems would benefit from a SCSI controller and a stripped pair of Ultra Wide drives.

My “best of group” nod goes to Aspen’s Durango II, not for its muscular (and more costly) review configuration, but for its workstation performance. The Intrawarv SCSI/network controller and the AccelGraphics 3-D accelerator add to the system’s stable, capable feel. If you think the Pentium’s pace of improvement is too slow, any of these Alpha systems will raise your interest. Just take care how you configure them; saving money shouldn’t mean giving up what’s best about a high-performance computer.

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**PRODUCT INFORMATION**

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Profilers for a Component World

rapid application development doesn't often, unfortunately, lead to the development of rapid applications. NuMega's TrueTime and Rational's Visual Quantify seek to remedy this by analyzing the performance of component-based Windows software. Both profilers "instrument" Windows programs: They add instructions that unobtrusively time each line of source as the program runs (see the Tech Focus), then provide timing results in a variety of formats.

TrueTime's strength is its clear, immediate presentation of the most relevant data. It displays a tree view that splits modules in your code from the rest of the system, then ranks each module by the amount of time it consumed. You can see line-by-line timing results presented alongside your source, or detailed function analysis that shows pie charts ranking each caller and callee by call frequency. TrueTime's straightforward analysis gets you to the performance bottlenecks in your code within a few mouse clicks.

TrueTime works with Visual Basic only, and it can time ActiveX components written in VB, but it can't instrument components developed in Visual C++, even with the source. Fortunately, TrueTime can delve deeply into those components, providing timing for ActiveX interfaces exported from controls.

Visual Quantify works equally well with VB, VC+++, and Java. To test a VB or VC++ application, you run Visual Quantify and point it at the executable. Instrumentation is faster with Visual Quantify than with TrueTime (14 seconds versus 35 in our test program), but because so many modules are instrumented the first time through, the initial load process is long. You can profile your own VC++ components from within your VB application right down to each source line.

Visual Quantify's main results screen is a call graph, which I found harder to use than TrueTime's results display. Visual Quantify does have unique analysis tools; the best of these, a "delta" analysis, lets you visually compare different runs on the call graph. This is the easiest way I've seen to evaluate the effects of making performance-oriented changes.

Both TrueTime and Visual Quantify do the job, delivering much the same information. Both products are evolving: Versions of TrueTime for Visual C++ will give it better coverage, while Rational plans a clearer user interface in upcoming releases. Right now, TrueTime's better presentation gives it an edge, making it the better choice for VB developers.

Steve Apiki, a programmer and BYTE consulting editor, can be reached by e-mail at apiki@AppropriateSolutions.com.
Real-Time Queries in the Enterprise

Increasing the speed and accuracy of business execution translates into a significant competitive advantage. Corporations are thus transforming themselves into real-time enterprises, where they can immediately communicate, analyze, and act on business information as it occurs.

Last month, I explored event communications services (ECSes) and how they enable the scalable, real-time communication of business events. Together, the ECS and a new type of real-time/decision-support service (RT/DSS) form a Web-like infrastructure of real-time information. This infrastructure allows for rapid decision making, and it enables new business-automation services that respond automatically to specific business events. In this article, I explore these RT/DSSes.

Decision-Support Services

The advent of relational databases enabled general-purpose DSSes. With these tools, you could simply ask decision-support queries instead of having to program them. Similarly, the advent of event-driven technology enables new decision-support tools that can consume and analyze events almost instantaneously. With these tools you can ask powerful, real-time queries, using a high-level query language, instead of having to program them.

General-purpose tools providing real-time query processing, referred to as RT/DSSes, are becoming commercially available, such as Vitria's Martini product. Now, the manager of a large shipping hub for an express package-shipping company can request "to monitor shipment volume and changes thereon as new packages are picked up and existing packages rerouted." Unlike database queries, real-time queries typically are long-lived—a query may live from hours to months, depending on the information being monitored. Also, an RT/DSS must support concurrent query processing, because it's common to have thousands of real-time queries active all at once.

RT/DSS query processing is fundamentally different from traditional query processing. Rather than optimizing the bulk evaluation of a single on-line query across a large number of records, an RT/DSS optimizes the incremental evaluation of a single event (i.e., a single data change, say, a transaction) against a large number of continuous queries. Hence, an RT/DSS has to solve two hard query-optimization problems not found in traditional query processing.

The first problem is incremental query optimization, consisting of algorithms for optimizing the ongoing evaluation of a single query (i.e., track the sales of red shirts sold in Copenhagen). The second problem is multiquery optimization, consisting of algorithms for optimizing the simultaneous, incremental evaluation of multiple queries (i.e., separately track, for each market in Europe, the sales of all red shirts).

To illustrate just how an RT/DSS works, consider a real-time query. Using the package-shipping example, you monitor package information that changes on a real-time basis, particularly as shipments...
are delayed or rerouted. At every destination city, it is important to monitor package volume and weight to properly allocate delivery equipment. Consider the real-time query: “Monitor the total weight, per destination city, of all large, priority packages.”

This is expressed in SQL as:

```sql
select city.name
sum(package.weight)
from package
where package.weight > 100
and package.service = 'priority'
and package.zip = city.zip
group by city.name
```

Although it's simply expressed, this query is subtly complex. It joins real-time, dynamically changing shipping-information events (the packages en route) with stored information (cities) that resides in a traditional database system. It contains a number of query constraints (priority service and weight over 100 pounds). It requires the grouping of this information by city and also the incremental computation of weight.

Real-time query optimization consists of three steps, as shown in the figure “Anatomy of an RT/DSS.” The first step is to build a discrimination network that evaluates the query constraints. When a real-time event is received, the RT/DSS evaluates the event information against the discrimination network to efficiently identify all real-time queries whose constraints match the new information.

Note again that a potentially large number of constraints from a large number of concurrent queries might be tested. Hence, the discrimination network must be optimized so that constraints are tested in such a way that quickly identifies matching queries and discards those that don't match.

Step two is to derive incremental algorithms for computing the final query result. Once a query's constraints have been matched against the incoming event, the query's result needs to be incrementally evaluated. Continuing with the shipping example, if a package is rerouted to a new destination city, its weight must be subtracted from the old destination city's total and added to the total for the new destination city.

Step three is to prefetch and precompute, whenever possible, query expressions involving stored data and to cache the results in memory. This is done because directly accessing a database on each receipt of a real-time event is expensive, and, at high data rates, a database system simply can't keep up. Prefetching and precomputation let the RT/DSS overcome this bottleneck, speeding up both constraint matching and incremental result computations.

**Scaling**

An RT/DSS service must be scalable in two dimensions: the ability to increase the number of concurrent queries, and the ability to share the results of processing a query to an increasing number of consuming applications and users. An RT/DSS uses the underlying ECS to both receive the events that drive real-time query processing and deliver the results of those queries to interested consumers.

For the package-shipping example, the RT/DSS processes a large number of queries (evaluating the number of heavy packages being shipped from various cities) and distributes the results (to all destination cities). Hence, as an RT/DSS computes the query results, it simply publishes the results on the underlying ECS.

A beneficial side effect of using an ECS is that this enables real-time queries to be composed. That is, the results of one query can be the input to another query, as shown in the figure “Building Complex Queries.” Such daisy chaining of results permits the building of complex queries incrementally by leveraging the results of simpler queries.

To scale the number of current real-time queries, an RT/DSS uses a federated architecture. If more processing power is required, you simply deploy new RT/DSS servers and recombine the concurrent queries among the new servers.

**Real-Time Reaction**

One of the most practical results of an RT/DSS is that it enables business automation. For package shipping, an application with the proper event hooks could immediately respond to too many heavy packages delayed at Chicago by rerouting an aircraft there. Also, if the problem persists, the program could notify a supervisor to investigate, so that the company could change certain shipping routes.

In either case, responses to problems are immediate, rather than taking days or weeks for the problem to be discovered, much less resolved. By using Internet-based, distributed object standards, these new RT/DSS technologies can change the speed of business computing.

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Dr. Dale Skeen (skeen@vitria.com) is CTO and cofounder of Vitria Technology, Inc.
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Glasgow Enhances JavaBeans

The JavaBeans component model has been one of the most successful enhancements Java has seen during its short life. Beans took Java and its object-oriented principles to a higher level by introducing a consistent framework in which Java components (Beans) could interact with each other. Glasgow is the code name for the next generation of JavaBeans.

JavaBeans’ purpose is to take Java to the distributed-object world, where it has to compete with other component models, such as ActiveX. Therefore, certain enhancements, which are encompassed in Glasgow, became necessary.

The current specification of Glasgow consists of three parts. The first is an extensible run-time containment-and-services protocol. The second is the JavaBeans activation framework. The third is a drag-and-drop subsystem.

Bean Containers

The extensible run-time containment-and-services protocol is a component that lets Beans learn about their environment and the services it provides. This protocol addresses two fundamental issues related to a component model. The first is the establishment of a hierarchy relationship among the Beans. In a Windows-based environment, a well-defined relationship exists among an application’s windows.

A dialog box, for example, is a child of a main window object. The focus for receiving events doesn’t return to the parent window until the dialog box is dismissed. These types of relationships can and do exist among Beans, but no standard hierarchical arrangement is defined for them.

The second issue is the ability of a container to provide services to its components. A container is referred to as the embedding context in the Glasgow specification, and it’s expected that it will provide a variety of services to its components. For example, a parent window may not let its components exist outside its boundaries.

Going back to our Windows environment, each component (perhaps a dialog box) has a container. Once again, Beans can manage the relationship between a Bean and its containing environment, or other Beans.

To accommodate the hierarchical structure required by BeanContexts, Glasgow defines other interfaces, java.beans.BeanContextChild and java.util.Collection, which pro-
Glasgow Enhances JavaBeans

Handling Data

The second part of Glasgow is the JavaBeans activation framework. In principle, it is similar to how helper applications in a browser work. When a browser receives a piece of data, it looks at the Multipurpose Internet Mail Extensions (MIME) type to determine the data's type. The MIME type was transmitted as part of the HTTP header. Once a browser determines the data type, it searches a table to see what helper application must be invoked to decode and display the data.

The activation framework brings this flexible capability to JavaBeans. The services provided are categorized into the following groups: the determination of an arbitrary data type, the encapsulation of access to the data, the discovery of available operations on the data, and the instantiation of an object (Bean) that performs the desired operation on data.

A DataHandler is an object that acts as the main interface between an arbitrary piece of data and a client wishing to use the activation framework. A DataSource is an object that contains both the data and the MIME type of the data. A CommandMap is a mapping between the operations available on a data type and a series of CommandObject that implement the operations.

The figure “Dealing with Data” shows a typical usage scenario. A client object has a piece of data (the DataSource), and it uses the activation framework to determine what to do with that data.

Drag and Drop

The last part of Glasgow introduces a drag-and-drop (D&D) subsystem, something long desired by GUI developers. Enhancements to the Java Foundation Classes (JFC) provide a standard method for performing D&D in the Java environment. This lets Bean-based applications integrate nicely into environments where D&D operations are supported. For example, you could drop an object from OpenLook into a Bean.

The D&D mechanism is an extension of the Uniform Data Transfer Mechanism introduced in JDK 1.1. Its goals are twofold. The first is to keep the implementation platform-independent. This is possible because the mechanism uses the Abstract Window Toolkit (AWT) and JFC, which are already standardized among different Java implementations. The second goal is to provide integration with platform-dependent D&D facilities. For example, this means potentially you could drag and drop an OLE object onto a Bean as if it were a native OLE object.

All D&D operations can be managed based on a series of distinct states of the objects involved. A single Drag Source and one or more Drop Targets must exist, and all could be Beans. The usage of terminology such as Drag Source and Drop Target points to a familiar naming convention associated with the new event model in JDK 1.1.

In fact, the D&D operation is very similar to what happens during an event. The DragSource class defines the responsibilities of the source (the object initiating the operation). DropTarget does the same for the recipient object of the operation. Both objects also have a listener (DragSourceListener and DropTargetListener) that listens to events fired by their counterpart object. Collectively, these components are able to complete the D&D operation in a standard platform-independent manner.

While Glasgow consists of only three enhancements to JavaBeans, they are very significant ones. The run-time extensions allow the construction of hierarchies of objects, which is crucial in forwarding application events. The activation framework provides an infrastructure where Beans—and future applications—can transparently handle diverse types of data. Last but not least, D&D lets users simply drag data information around the screen, wherever they need it.

Java's Object-Oriented Communications

Java's remote method invocation (RMI), introduced in the Java Development Kit (JDK) 1.1, is a powerful mechanism that enables flexible and scalable distributed communications among Java programs. Last month I covered the ins and outs of IIOP, the Internet Interoperable-ORB Protocol that CORBA object request brokers use to communicate with each other. This month I focus on RMI, paying particular attention to Java's Remote Method Protocol (JRMP), its closest equivalent to IIOP.

Unlike CORBA, which is a programming-language-neutral architecture, RMI is designed exclusively for Java. Created by JavaSoft, its aim is to let Java programs invoke remote methods in a simple and natural way while ensuring it remains powerful enough to handle complex distributed systems. In addition to passing object data back and forth between clients and servers, RMI can pass object implementations across system boundaries. Thus, a server can send an object for client-side execution, and a client, perhaps wishing to take advantage of greater computing power, can upload objects to a server for execution.

But RMI has more feathers in its cap: It sports a distributed garbage collector, preserves Java's strong security features, and takes advantage of Java's multi-threaded nature for the enhanced concurrent processing of requests. Furthermore, it makes good use of Java's Object Serialization to send objects across systems without resorting to more complex encoding schemes, as found in CORBA.

The RMI Layers

The figure above shows RMI's layered structure. An invocation appears to travel between client and server, but in reality it passes through the RMI "stack" on both systems. All remote objects (i.e., objects whose methods can be remotely invoked) are represented by stubs on the client side and by skeletons on the server side. As with other remote-procedure-call (RPC) systems, this layer is responsible for marshaling method arguments and return values into a format suitable for sending between systems. For RMI, that format is Object Serialization. Only remote objects are passed by reference; all other objects are passed by copy.

The Remote Reference layer handles the behavior of remote objects and manages the Transport layer. Its task is to provide various types of method invocation, relaying stubs and skeletons from dealing with these complexities. The only type that is currently provided is point-to-point, where one object invokes another's method.

The Transport layer deals directly with the network protocols that provide the actual communications mechanism between systems. This layer sets up, manages, and monitors connections, including listening for and initiating them.

A big difference between RMI and other RPC systems is dynamic class loading. This mechanism lets clients and servers load classes over a network during runtime. Dynamic class loading downloads not only remote object classes but also stubs, skeletons, and classes used as parameters, as well as return values in remote method invocations. For example, when a client receives an object of a class for which it has no implementation, it can download the class's bytecode dynamically (typically from the same server).

Since security is a major concern, RMI uses the stringent applet security manager restrictions for RMI-enabled applets.
and provides its own security manager for applications. If no security manager is defined, RMI does not load classes from network sources at all.

Garbage collection, and freedom from the memory-allocation woes that it provides, is one of Java's strengths. RMI implements a distributed reference-counting garbage collector to keep track of remote objects. As the first reference to a remote object enters a system, a call is made back to that object's server to indicate that the object is in use, or referenced. When the last reference to the object is discarded, an unreferenced message is sent to the server, which can then safely garbage-collect the object (assuming there are no other outstanding references to it).

To deal with problems such as crashed clients and network partitions, each remote object is "leased" by clients from its server. Clients must periodically renew their leases with a server, which might otherwise assume that a client is no longer using an object.

JRMP

The Transport layer employs JRMP, also known as the RMI Wire Protocol, to send method invocations and associated parameters and to return values and exceptions from one Java virtual machine (JVM) to another. JRMP is a simple protocol consisting of five messages, plus an extra five for multiplexing flow control.

All JRMP sessions consist of a header followed by one or more messages. The header contains just the ASCII codes for the characters/JRMI, the protocol version, and the "subprotocol" to be used. There are three subprotocols: SingleOpProtocol, StreamProtocol, and MultiplexProtocol. SingleOpProtocol signifies that only one message follows a header before the end of a session (i.e., the connection closes). StreamProtocol and MultiplexProtocol can transfer one or more messages. The latter is used when multiplexing calls from both client and server on a single socket, as described below.

Communicating clients and servers typically each open a socket to the other (i.e., both systems connect and listen for connections). The client's socket typically invokes methods on server-side objects, and the server's socket calls client-side objects (e.g., backcalls). The figure above shows a hypothetical StreamProtocol situation. The client sends the Call message to invoke a server object's method; the server then invokes this method and replies with a Return containing any results. Assuming that a remote object is returned, the client then sends a DgcAck message to let the server's garbage collector know that it has received the remote object. On another socket, the server sends back to find out whether the client is alive, which replies with a PingAck.

Default applet security restrictions deny applets the right to open sockets back to any server other than their originating host; they also block any attempt to listen for socket connections. This being the case, how do clients listen for server connections?

Enter the MultiplexProtocol and its group of five messages: Open, Close, CloseAck, Request, and Transmit. They allow client and server to simulate the StreamProtocol's two-way communication using a single socket. In the current implementation, up to 256 virtual connections can be opened, each identified by a unique ID.

Unfortunately, connecting via a socket back to the server is not always possible for applets running behind firewalls (e.g., on a corporate intranet), which typically block any attempt to open a socket back to the Internet. Should it fail to open a connection, an RMI client wraps its method invocation inside the body of an HTTP request (which is the protocol browsers use to communicate with Web servers), and the RMI server sends any results as an HTTP response.

This workaround is a smart solution, since HTTP is a firewall-trusted protocol. Still, performance takes a hit due to the time needed to convert messages to HTTP requests. In addition, no multiplexing of invocations can be accomplished, because keeping the connection open between client and server is not part of HTTP 1.0. The primary reason for SingleOpProtocol's existence is to encapsulate RMI through HTTP.

The Future of RMI

RMI extends Java's strengths into the realm of distributed systems. In the future, we can expect to see RMI offer replicated method invocation and possibly transport layers other than TCP/IP.

RMI has been criticized for its lack of interoperability with CORBA. To address this, JavaSoft is implementing a subset of RMI on top of IIOP, enabling Java programs to access CORBA objects via RMI. It's also working to incorporate RMI's features into IIOP. Maybe RMI will indeed become the future of object-oriented communications.}

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Motorola's latest RISC processor is small, yet it delivers big computing power. By Bill Moyer and John Arends

RISC Gets Small

Battery life has become a major competitive force in handheld computing products, perhaps as important as a low weight and a small form factor. Motorola's newest 32-bit offering, the MCore RISC processor, targets cost-sensitive embedded control applications that demand high performance yet must consume little power. MCore processors minimize power consumption by combining a fully static CMOS design with low-voltage operation. Initial versions of the chip operate at 1.8 volts, feature several low-power operating modes, and provide dynamic power management. These capabilities make the MCore ideal for battery-operated portable products.

MCore's first production version is implemented in a 0.36-micron, triple-level-metal static CMOS process. The result is an 80,000-transistor CPU that occupies just 2.2 mm² of die. MCore products come in low-cost plastic ball grid array (PBGA) and thin quad flat pack (TQFP) versions that support 100 to 200 pins, depending upon the application. The low pin count eliminates additional signal lines from a product's design, thereby reducing its size and cost.

Processor Architecture

The MCore processor core is divided into a data-path section and a control section. The data-path section consists of 50,000 transistors, while the control section uses the remaining 30,000 transistors for control circuitry and clocking. The data-path section consists of a program counter unit, an execution unit, a register file unit, a memory interface unit, and a hardware accelerator interface (HAI) unit, as shown in the figure “MCore Microarchitecture.” The control section manages the overall sequencing and coordination of the execution units and interfaces. Additional logic in the data-path section minimizes power consumption by automatically powering down unused internal function units on a clock-by-clock basis. Doze, Wait, and Stop power-conservation modes provide comprehensive system power management.

The execution unit contains a 32-bit arithmetic logic unit (ALU), a 32-bit single-cycle barrel shifter, a multiply/divide unit, a find-first-one unit (a priority encoder), and result-feed-forward hardware. All arithmetic and logic operations execute in a single cycle. The exceptions to this rule are, of course, the multiply and divide operations. The multiply instructions use a modified Booth's algorithm with early-out capability that reduces execution time for operations with small multiplier values. The divide instructions also offer minimized execution timing.

The program counter unit has a dedicated program-counter incrementer and a dedicated branch address adder that minimize the execution time required to deal with a change in program flow. Branch target addresses are calculated in parallel with the branch instruction decode and branch condition checking. Thus, a conditional branch executes in only two clock cycles, while branches not taken execute in one.

Memory load and store operations execute in two clock cycles, where one cycle

This processor offers performance features such as hardware multiply/divide and registers for low-latency interrupt handling.
adds a scaled displacement to a base address pointer value and the second cycle performs the memory access. Load and Store Multiple Register instructions allow low-overhead register file save and restore operations. These instructions execute in \((N+1)\) clock cycles, where \(N\) is the number of registers to transfer. The memory interface unit provides a full 32-bit address bus and a 32-bit data bus, along with access attribute indicators for transfer of instructions and data operands. The memory interface unit monitors these attributes along with the logical address to provide memory protection.

MCore has sixteen 32-bit general-purpose registers. Programs operating in the chip’s supervisor mode have access to a second set of sixteen 32-bit registers, which normally serves as an alternate register file. The register file unit contains both the 16-entry general register file and the alternate register file, plus 13 status/control registers available to supervisor software.

**Throughput Optimization**

System cost and power consumption are strongly affected by an application’s memory requirements. While MCore is a 32-bit load/store RISC architecture, it adopts a compact 16-bit fixed-length instruction format. Benchmark results on a variety of application tasks indicate that the code density of MCore programs is higher than many CISC designs, in spite of the fixed-length instructions. The high code density lowers an embedded product’s cost, since the most expensive parts of a design are memory. The 16-bit instructions also reduce the amount of fetch traffic on an external bus, further reducing power consumption. Finally, the instruction

an autovector (default vector) capability is provided.

MCore processors support two independent interrupt requests: a normal interrupt and a higher-priority fast interrupt. The fast interrupt request uses a dedicated set of shadow registers that eliminates having to preserve the processor’s context on the stack before the interrupt handler executes. Software can reserve the alternate register file for exclusive use by interrupt handlers. This enables support of extremely low-latency interrupts, and it makes real-time processing possible.

MCore’s hardware accelerator interface supports tightly coupled hardware function blocks that extend the MCore architecture. For flexibility, the interface is generic in nature and makes few assumptions about the actual processing being accelerated. The HAL operates independently of the memory and peripheral interfaces to allow overlapped execution. A base set of instruction primitives allows the explicit transfer of operands and instructions to and from external function blocks. Hardware handshaking can control the rate of the instruction and data transfers. The function blocks are tailored to boost processing for application-specific purposes. For example, such a block might act as a DSP arithmetic unit or a graphics accelerator; another block might handle speech processing or handwriting recognition.

**Small Die, Big Performance**

Initial MCore processors use supply voltages ranging from 1.8 to 3.6 volts. The chips operate at 50 MHz. The “sedate” clock rate dramatically lowers power consumption—critical for a hand-held device. At 50 MHz, MCore delivers 48 Dhrystone 2.1 MIPS yet consumes only 20.5 milliwatts. The inexpensive packaging, support for 16-bit memory devices, and low power consumption, combined with high performance, make the MCore processors attractive for the cost-sensitive consumer and embedded-control markets. It also provides a migration path for existing 8-bit and 16-bit controller applications.

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Writing JavaScript Applications

On September 12, 1997, an industry newspaper reported that Microsoft is giving Java applets “the boot” on its Web site. Clearly something is afoot at the company that cared enough about Java to write its own Java interpreter rather than use one licensed from Sun. Some reports have it that this “something” is JavaScript. For most Web browser uses, JavaScript loads faster, runs faster, and produces pages that are more “Web-like” than equivalent Java applets.

Traditionally, Java has been seen as the language for writing browser-based applications. However, JavaScript implementations have reached a level of sophistication and stability so that JavaScript can be used to write useful applications. Since JavaScript is much more closely wedded to the fabric of the browser, applications can be written in fewer lines of code. This smaller code footprint consumes less processing power and fewer network resources than Java.

JavaScript Basics

What is meant by the term “application”?

For the purpose of this article, an application is code that executes in the client and enables calculation, presentation, manipulation, and saving of results (with minimal interaction) to a server. An application may manipulate complex data structures and display multiple screens of output without requesting new pages from the server.

JavaScript provides many capabilities that are useful to support browser-based applications. These include:

- general-purpose computations
- general-purpose data structures (strings, arrays, and hashes)
- dynamic HTML-based content generated on the fly
- data loaded as JavaScript
- interval timers

Note that JavaScript does not provide any support for graphics capabilities beyond those provided by HTML. This is a key point: JavaScript must leverage the capabilities of the browser and HTML to display content. Other than a few dialog-box functions, JavaScript provides no direct display capabilities.

JavaScript is no panacea. It has characteristics that work against developing full-fledged applications. For example, it has severely limited communications (read-mostly) with a server and severely limited means of storage. Unlike most languages, there’s no global variable and function namespace available. In addition, JavaScript relies on a complex browser object model, and there’s no protection from external manipulation by the browser. Until recently, JavaScript lacked a standard, which resulted in some implementations of patchy quality. Fortunately, this is changing: The European Computer Manufacturers Association has developed a specification for Java-

![Diagram of Maintaining a JavaScript Application's State]

You can store application functions and preserve variables in a window with static content.

[Diagram showing the process of maintaining a JavaScript application's state]

1. Function fn1() writes HTML into adjacent frame (child window) and floating window.
2. The HTML written into these windows register fn2() and fn3() as event handlers.
3. User interacts with HTML elements that cause fn2() and fn3() to be executed. These functions modify the application’s internal state, which is stored in the source window.
4. Fn2() and fn3() execute fn1(), which updates the two child windows to reflect the application’s current state.
Window Tricks

As mentioned earlier, JavaScript associates variables and functions with the windows they are defined in. There are no global variables in JavaScript. If the HTML in a window reloads, all the pre-existing variables and functions in that window get erased. This effect is the single greatest hurdle to overcome in order to move JavaScript beyond simple dynamic pages into the realm of a full-fledged application. The key is to create a window that remains constant throughout the application’s lifetime. You do this by defining a window with static content (and that can’t be resized) or by creating a (usually) hidden zero-size window. Place all variables and functions that define the core of your application in this stable window, as shown in “Maintaining a JavaScript Application’s State.”

Since your application is subject to the whim of the user, make sure that the window you choose for storage won’t be deleted by making it obvious that this is the application’s main window. Ensure that your JavaScript application handles unexpected events properly. If multiple windows are in use, supply a window.onload() handler that closes any child windows if the user does the unthinkable and deletes the main window. Since windows can be loaded in any order, and the user might start using windows before they (or windows they depend on) are fully loaded, consider adding an onload handler to FRAMESET definitions to let you know when all windows have been loaded. Practice defensive coding by testing to verify that windows, frames, variables, and functions exist before attempting to use them. It is usually best to ignore inputs until all the windows of the application are loaded and initialized.

JavaScript has a severe limitation: It can load data only by loading a URL into a window. At first glance, this would seem to make JavaScript totally unsuitable for writing any kind of application. However, the URL that loads a JavaScript file contains definitions, so simple variables, arrays, and hashes. Once these variables load into a window, they can be accessed by other windows. Browsers that support JavaScript 1.1 or later can load JavaScript source files directly via the syntax <SCRIPT LANGUAGE=“JavaScript1.1” SRC=“file.js”>. Multiple statements of this kind can occur in a single HTML file. The effect is additive, so one source file may define JavaScript functions, while other source files define data. If the data the application requires is static, it may be loaded from a pregenerated HTML file. If the data is dynamic, the referenced URL can be a CGI script that returns data (and possibly additional functions) formatted as JavaScript source code.

Cookies and Forms

The only means that JavaScript has for saving state are local JavaScript cookies and HTML form submissions. Cookies are used for keeping track of user information between sessions. Forms are best for submitting final data to a CGI application on the server where results are stored. If you want to add Java to the mix, versions of Netscape Communicator 3.0 or later support the ability to communicate between JavaScript and Java. Since Java communicates efficiently with the server, it can be used as a bridge between JavaScript and the server.

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New technology, fragmenting standards, and a revolt against rapid obsolescence will radically change the PC landscape over the next two years. Are you ready?

By Tom R. Halfhill

The old vision that disparate computer and medium technologies would converge on a single platform is fading fast. Features are converging, but existing platforms can't stand the strain. They're splintering into new platforms and subplatforms to satisfy an exploding computer market that's extending its reach from TV Internet terminals and $300 Windows PCs to 64-bit workstations and enterprise servers. One-size-fits-all PCs can't cut it anymore.

The dominant standard that we've taken for granted for a dozen years, the x86-based PC clone, is showing clear signs of these fractures. It's becoming a victim of corporate rivalries and a strange technological paradox—hobbled by too much old technology to keep up with new technology, and swamped by too much new technology to justify large investments in current technology.

In its place, a looser, more stratified PC "standard" will maintain a semblance of software compatibility while addressing a much broader range of users. And users who are overwhelmed by all these changes are beginning to revolt by spending less on computers that they know will be instantly obsolete.

Some market watchers think this trend is the inevitable culmination of the PC's success. "What you're calling platform fragmentation is what I call market segmentation," says Steve Tobak, vice president of corporate marketing at Cyrix. "Did anybody really think that when PC volumes climbed to 100 million that there would be only one kind of PC?"

Four Layers

Here's how the new world order will look:

IA-64 will be Intel's next-generation CPU architecture for high-end PC workstations and servers. (See "Beyond Pentium II," December 1997 BYTE.)

"XC" is an umbrella term for low-cost, specialized PCs. Acer is planning to introduce a series of XCs, including a KC (Kid's Computer), a GC (Games Computer), an IC (Internet Computer), an HBC (Home Banking Computer), and an STC (TV Set-Top Computer). Prices: $200 to $500.

Highly integrated CPUs based on x86-compatible cores are ideal for low-end home and office PCs. Today, you can buy a Windows PC (without a monitor) for $499; in a few months, they'll drop to $299. (See the text box "System On A Chip" on page 64.)

The new IA-64 will be Intel's next-generation CPU architecture for high-end PC workstations and servers. (See "Beyond Pentium II," December 1997 BYTE.)

Four Layers

Here's how the new world order will look:

IA-64 will be the next-generation CPU architecture for high-end Windows workstations and servers. And the first...
The New World Order

Even after IA-64 debuts in late 1999, expect the 32-bit x86 to survive and thrive for years to come. It will continue to be the chip of choice for mainstream PCs, notebooks, and department-level servers.

For those who neither want nor need a full-powered Windows PC, network computers and TV Internet terminals will rule the bottom of the market. Ease of use, not just low prices, will be their main selling point.

1998
- 586-class CPUs (MMX)
- EDO DRAM
- Socket 7
- 66-MHz CPU bus
- CPUs < 200 MHz
- RAM < 32 MB
- ISA

1999
- AGP-2x
- SDRAM
- Socket 7
- CPUs < 300 MHz
- RAM < 64 MB
- Serial and parallel ports
- ISA

2000
- CPUs < 500 MHz
- RAM < 128 MB
- IA-64 (Merced)
- Pentium II (Katmai-MMX2)
- AMD Slot A
- AGP-4x
- RDRAM

FFBRUARY 1999 877 63
The key to inexpensive Windows PCs is higher integration, and Cyrix is leading the way. Its MediaGX processor delivers Pentium-class integer performance while integrating the functions of an SVGA graphics card, a DRAM controller, a PCI controller, and other parts of the system core logic. A companion chip, the Cx5510, emulates a 16-bit Sound Blaster while bridging to the ISA bus, a two-channel IDE bus, and other system devices (see the figure "MediaGX Architecture").

When paired together, these chips enable very-low-cost PCs. For one thing, the system doesn’t need a dedicated frame buffer, because the MediaGX uses about 2 MB of main memory for graphics. Usually, a unified memory architecture degrades performance by 10 percent to 15 percent. But because the MediaGX integrates the graphics controller with the CPU, graphics data doesn’t flow over a 32-bit, 33-MHz PCI bus. Instead, the data travels between the CPU and the graphics controller over a 64-bit internal bus clocked at the core frequency. The chip also compresses the graphics data on the fly to reduce bus traffic.

Similarly, the MediaGX does without a Level 2 (L2) cache. The integrated memory controller communicates with the CPU core over the internal bus, slashing the time required for memory accesses. Although the chip might run a little faster with a cache, the difference isn’t great enough to justify the extra cost in a low-end system. The MediaGX does have a unified 16-KB Level 1 (L1) cache, and it supports extended data out (EDO) RAM expansion to 128 MB.

When Cyrix began shipping the MediaGX in late 1996, the core speed was 133 MHz. Since then, Cyrix has introduced versions that run at 150 and 166 MHz, with a 200-MHz chip due soon. These cores don’t support MMX and have relatively poor floating-point performance, but they can match or beat the Pentium when running common integer-intensive applications.

In the second half of this year, Cyrix plans to introduce a next-generation integrated chip known as the MXi. It’s built around Cyrix’s Cayenne core, which has a 64-KB L1 cache, a superscalar FPU, MMX support, improved integer units, and 15 new instructions for speeding up 3-D graphics (see "Beyond MMX," December 1997 BYTE). The MXi will also integrate the Accelerated Graphics Port (AGP), digital versatile disc (DVD) playback, and a synchronous DRAM (SDRAM) controller. Cyrix claims that the MXi will match the performance of Pentium II processors running at 300 to 400 MHz, and that the integrated 3-D graphics controller will render more than 2 million pixels per second.

National Semiconductor’s recent acquisition of Cyrix opens the door to even higher levels of integration in the future. National is a leading supplier of the Super I/O chips that control keyboards, mice, I/O ports, and other motherboard interfaces. As far as is known, no other vendor of x86 chips is pursuing such high levels of integration with the latest CPU cores.
Disposable PCs

Cover Story

have the hardware or the desire to keep up. Meanwhile, Microsoft struggles to unify the driver models, user interfaces, feature sets, and APIs for all those variations of Windows.

Microsoft's well-publicized plan is to eventually converge the PC platform on Windows NT, with Windows CE as the scaled-down solution for palmtop computers, WebTV boxes, and other alternative devices. But to paraphrase an old Army joke, that would leave Microsoft with only two sizes: too large and too small.

The increasing segmentation of PC hardware will probably force Microsoft to abandon its grand unification theory and continue to offer one or possibly more medium-size choices. Unless Microsoft manages that process uncommonly well, it will fracture the PC platform still further. Someday, you might need Java just to write a program that runs on every version of Windows.

Meanwhile, outside the world of Windows, there are still tens of millions of users who think the idea of a one-size-fits-all OS is as quaint as a one-size-fits-all PC. Contrary to shortsighted beliefs, there will always be alternative platforms such as Java, Linux, Unix, the Mac OS, OS/2, BeOS, and Rhapsody. If Microsoft stubbornly pushes its plan for convergence on Windows NT, one of these upstarts will fill the gap.

Drilling deeper, down to the motherboard and microprocessor levels, even more cracks are appearing in the PC platform. The leading vendors of x86 processors are introducing mutually incompatible CPU interfaces to replace today's standard Socket 7 (see the text box "The Slot Thickens" on page 66). To accelerate multimedia performance, they are also promoting mutually incompatible extensions to the standard x86 architecture. (See "Beyond MMX" in the December 1997 BYTE.) Both of these fundamental changes will lead to more diversity in processors, motherboards, and chip sets—and more hazards to compatibility.

As if all that weren't enough, there's also an alphabet soup of new technologies intended to completely overhaul today's PCs: 100-MHz system buses, the Accelerated Graphics Port (AGP), AGP-2x, AGP-4x, synchronous DRAM (SDRAM), Double Data Rate SDRAM (DDR-SDRAM), Rambus DRAM (RDRAM), DVD-ROM (digital versatile disc), DVD-RAM, the Device Bay...
Users Revolt

There's growing evidence that computer buyers, both consumer and corporate, are reacting to the uncertainty over these changes. Although they're buying more computers than ever before, they're spending less money on each computer—often, much less.

According to market researchers at Computer Intelligence (La Jolla, CA), about 70 percent of the PCs sold through U.S. retail stores in recent months cost less than $1500. Even more remarkable, 30 percent to 40 percent cost less than $1000. A year ago, only about 5 percent of PCs cost less than $1000. What was once an insignificant crumb has suddenly become the whole cake.

In the dealer channels that serve mainly corporate buyers, average prices are a little higher—but still, a third of these PCs sold in recent months cost less than $1500. In December, Hewlett-Packard introduced a Vectra-series PC for the corporate market at a base price of $999.

Of course, everyone likes a bargain. But in the past, users resisted low-priced PCs because they feared the machines would become obsolete too quickly. Now they're resisting high-priced PCs because they fear those machines will become obsolete too quickly.

"People have fought this fear of obsolescence for a long time, and they've given up," says Matt Sargent, an analyst at Computer Intelligence. "No matter what kind of PC they buy, it's going to become obsolete in two years anyway. They'd rather spend less on the PC and replace it more often."

This signals a major upheaval in PC purchasing habits. For years, the standard computer-magazine advice has been to buy the most powerful PC you can afford as the Slot Thickens

Jerry Sanders, founder and CEO of Advanced Micro Devices, dropped a bombshell during his keynote speech at the recent Microprocessor Forum: In 1999, AMD's future K7 processor will come in a cartridge that's physically compatible with Intel's proprietary Slot 1. But AMD's new CPU interface, tentatively dubbed Slot A, won't be electronically compatible with Slot 1.

Before the audience of stunned engineers could digest that information, Sanders continued. The K7 will abandon the x86-standard Socket 7 bus in favor of the I/O bus on Digital Equipment's Alpha 21264 processor. And to wrap up the surprise, Sanders added that future 21264 chips will adopt the same cartridge and will work interchangeably with K7 cartridges on Slot A motherboards.

Even Digital was caught off-guard. Although Digital and AMD had worked out the deal, Digital didn't know Sanders was going public so soon. Sanders probably wanted to launch a preemptive strike against the growing speculation that AMD wasn't prepared for life after Socket 7. The new alliance with Digital will bring a blazingly fast I/O interface to AMD's processors while opening up a larger market of commodity-priced motherboards to Digital's RISC chips.

AMD had to do something, because Intel's P6-series processors (the Pentium Pro and the Pentium II) introduced a proprietary CPU interface that's protected by numerous patents. Cloning it is technically easy, but it's legally difficult. And even if the patents did not exist, AMD is forbidden to clone the P6 interface by a 1996 settlement ending a long-running court battle over Intel's intellectual property.

Intel's P6 interface takes several physical forms, all adhering to the same electrical-bus protocol. Pentium Pro chips use Socket 8. Pentium II chips come in a Single Edge Contact (SEC) cartridge that fits Slot 1, Slot 2, or a smaller slot for notebook computers. The SEC cartridge is really an enclosed daughterboard with a heat sink that slides down through a pair of vertical channels into a slot on the motherboard (see the above photo).

The P6 interface has a 64-bit-wide system bus that runs at 66 MHz, which will soon increase to 100 MHz when Intel releases the 440BX chip set. It also has a separate 64-bit-wide back-side bus for the Level 2 (L2) cache.

In Slot 1 systems, the back-side bus typically runs at half the frequency of the CPU core. In Slot 2 systems, it can run as fast as the core (333 MHz and higher with Deschutes).

Because Intel isn't licensing the P6 interface to competitors who make x86-compatible processors, nobody else can make chips that work on the same motherboards as Intel's processors. That's a big change from Socket 7, which any vendor can use.

However, Intel's patents cover only the P6s-bus protocol, not the physical cartridges or connectors. Those parts are available from multiple suppliers. AMD's plan is to leverage the growing infrastructure for the parts by introducing a CPU interface that's physically compatible. It's less costly than inventing a new interface and lobbying suppliers to support it.

Also, Slot A motherboards would be very similar to Slot 1 motherboards, requiring only a different core-logic system chip set and some minor layout changes. That would make life easier for motherboard manufacturers. (Actually, Slot A probably won't be exactly the same as Slot 1. To prevent accidental damage to motherboards and CPUs, Slot A will almost certainly be keyed in a slightly different way so users can't insert an Intel cartridge into AMD's slot or vice versa.)

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Obsolescence is a relative term, of course. If you don’t install any software that was written more than a year after the machine was made, it will last virtually forever. However, few users are so disciplined. Each new software “upgrade” gradually turns their big, fast computer into a small, slow computer. Eventually, the performance becomes so intolerable that the only solution seems to be the purchase of another big, fast computer. Another vicious cycle starts.

The new philosophy calmly accepts the inevitability of this cycle—and, in fact, speeds it up. However, because each replacement machine costs less, users spend less money per year to stay current. Prices are plunging so fast that one computersales chain is selling a custom-designed Windows PC for only $499, and it’s not as stripped-down as you might think. By the end of the year, similar systems will retail for $299. (See the textbook “How Low Can You Go?” on page 72.)

**The Slot Thickens continued**

I/O interface to go along with Slot A. The company chose Digital’s 21264 interface (which is known internally as EV-6), because it offers significant advantages over Socket 7: much higher clock frequencies and better support for multiprocessing.

While Socket 7 currently runs at 66 MHz and will soon step up to 100 MHz, EV-6 can run at a blazing 333 MHz. That’s over three times faster than Socket 7 or Intel’s P6 bus. And although EV-6 doesn’t define a separate backside bus for an L2 cache, designers are free to add one if they wish—allowing more flexibility for different markets. For instance, Digital’s high-end 21264 implements a 128-bit-wide backside bus, twice as wide as Intel’s.

How can EV-6 run at 333 MHz when even a 100-MHz motherboard is difficult to engineer? Because EV-6, strictly speaking, isn’t a bus. It’s a 64-bit, point-to-point I/O channel between the CPU and the system chip set. That’s a major departure from today’s x86 buses.

In a Slot 7 system, the CPU, L2 cache, main memory, and PCI bus all hang off the same local I/O bus. P6 systems are similar, except that the L2 cache is on a backside bus. In both those systems, the local I/O bus must also handle the Accelerated Graphics Port (AGP), if one is present. In a multiprocessor system, additional CPUs also share the bus. This all adds up to a great deal of bus traffic.

In an EV-6 system, the CPU talks directly to the chip set over a private channel. The chip set, in turn, branches off to all the other buses: main memory, PCI, and AGP. Each of those buses runs at its own speed. Main memory could run at 66 or 100 MHz while the PCI bus runs at 33 MHz and AGP runs at 86 MHz. In a multiprocessor system, each CPU has its own private channel (clocked as high as 333 MHz) to the chip set. (See the figure “Digital’s EV-6 Architecture” above.)

At 333 MHz, EV-6 has 2.6 GBps of raw bandwidth, more than three times as much as a Socket 7 or P6 bus at 100 MHz. That’s an enormous advantage, because the prime factor limiting performance in modern CPUs is the time they take to access memory. A high-end system could exploit EV-6’s extra bandwidth by hanging the memory on a 128-bit-wide bus on the chip set. That would double the amount of raw bandwidth to memory. Even if the memory is on a conventional 84-bit bus, EV-6’s headroom should mean fewer stalls while the CPU refills its cache lines.

The downside: EV-6 chip sets are more complicated to design, and chip sets for multiprocessor systems will be expensive, because they’ll need at least 64 additional pins for each CPU. AMD is working with third-party vendors such as VIA to design EV-6 chip sets.

For Digital, the big win is that future Alpha processors that have EV-6 and a Slot A cartridge will plug into the same mother boards as AMD’s K7 processor. Only the BIOS needs to change. Since modern BIOSes use flash ROM, it’s a quick software upgrade.

Today, Alpha systems are relatively expensive because they require special motherboards and chip sets that aren’t made in large volumes. If AMD is successful, there will be a lively commodity market for Slot A motherboards. Together with lower-priced Alpha CPUs (such as an EV-6 variant of the 21164PC), this could bring Alpha system prices down to the $1500 range. The Alpha would be a mass-market product, such as the x86.

“The Alpha will benefit from the economics of scale of having a large-volume infrastructure,” says Aaron Bauch, Digital’s technical marketing manager.

Some observers wonder if the
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Welcome to the disposable computer. Even if you get only one year out of the machine before handing it down to somebody or donating it to a school, the amortized purchase cost is only half as much as a $2000 system that lasts two years or a $3000 system that lasts three years. And for many common tasks, a $499 PC is fast enough.

Indeed, cheap PCs have the same attributes that made the Volkswagen Beetle popular in the 1960s: basic transportation, no complicated frills, and freedom from fashion anxiety. You never have to worry about it becoming obsolete because it's already obsolete.

**Buying Smart**

However, it's equally obvious that a Volkswagen PC isn’t the ideal machine for everyone. Some users need more power to do their jobs efficiently, and anything less than the fastest available system isn’t a worthwhile trade-off.

Another huge consideration—especially for businesses—is the less-visible cost of setting up a new PC. Low prices save money up front but do little to address the total cost of ownership. An often-quoted study by the Gartner Group estimated the total business cost of owning a PC with Windows 95 at $38,900 over five years.

That includes administrative expenses for technical support, requisitions, purchasing, legal reviews of contracts, security, policy enforcement, and asset management. Gartner assumed a new PC every three years.

If a company replaces its PCs every year, the administrative overhead could consume the purchase savings. That's why cheap PCs don't necessarily threaten NCs, which reduce the total cost of ownership on the administrative end.

So here's the amended computer-magazine advice: Minimize your investment in transitory technology and administrative costs while carefully matching the computer to the user.

That's hardly radical advice, but it does open more options. In some cases, the best solution will be a 333-MHz scream machine loaded with all the latest trimmings. In other cases, it will be a $500 disposable PC or an NC. You might recommend a $300 WebTV to a technophobe friend, even if you wouldn't buy one yourself. The goal is to keep up with traffic, not with the Joneses.

By applying this template to the stream of new technologies, you can filter out the ones that aren't relevant. For instance, users who aren't multimedia developers, graphics designers, or game players probably don't need things such as MMX, MMX2, or AGP.

Writers and accountants probably don't need a 100-MHz system bus, a 300-MHz CPU, a FireWire interface, or the latest DRAM technology—at least, not within the life expectancy of the next system they purchase. Workers who spend all their time interacting with a centralized database might get by with an NC.

Not only can buyers save money, but they can also acquire new technology sooner than they would have otherwise. This happens when the technology churns so fast that users get new features essentially for free merely by purchasing a new system, whether they sought those features or not.

For example, Intel and other x86 chip vendors have stopped making non-MMX processors. All new PCs this year will have MMX at the same prices (or even lower prices) than last year's non-MMX PCs. Someone who bought an expensive pre-MMX system in 1996 might still be amortizing the high cost over a longer period, while the bottom-feeders are snapping up sub-$1000 boxes with MMX.

Technology churn will accelerate the trend toward the cheaper PCs. Why should users lock themselves into costly systems that will not have next year's features?
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**COMPUTER ASSOCIATES®**

Software superior by design.
How Low Can You Go?

Not long ago, skeptics ridiculed the idea that a network computer (NC) could cost less than $500. Today, you can buy a real Windows PC for under $500 and consumer NCs for under $300.

The $499 Windows PC isn’t a refurbished 486 with stripped-down features. The PowerSpec 1660 has a 166-MHz Cyrix MediaGX processor, 16 MB of extended data out (EDO) RAM, a 1-GB hard drive, a 12x CD-ROM drive, a 1.44-MB floppy drive, a 33.6-Kbps fax modem, and a pair of stereo speakers. It also has two serial ports, two PS/2 ports, a parallel port, a joystick port, and a shared PCI/ISA slot. It comes with Windows 95, Microsoft Works, Microsoft Money Home Banking, Microsoft Entertainment Pack, and a one-year on-site warranty for parts and labor. All you need to add is a monitor and a printer.

Although the PowerSpec 1660 clearly isn’t a power-user system, it’s a reasonable machine at a remarkable price. It’s sold by Micro Center, a chain of computer stores that covers eight states. Elitegroup Computer Systems, a Taiwanese company, manufactures the PowerSpec 1660 for Micro Center. Elitegroup makes the motherboards in Taiwan and assembles the boxes in Fremont, California.

Elitegroup says it can deliver a $299 Windows PC by the end of the year. “It might be sooner, but this is a safe prediction,” says Ann Vo, a public-relations specialist at the company’s Fremont office.

Compaq, one of the top three PC vendors, helped pioneer this trend with the Presario 2100 in February 1997. Based on a 133-MHz MediaGX, the 2100 came in a sleek black desktop case and sold for $999. Soon afterward, Compaq introduced the Presario 2200, which has a faster 166-MHz MediaGX and a more aggressive price of $799.

To put these bargain-basement systems into perspective, compare them with two of the most popular low-end computers of all time: the Commodore VIC-20 and the Commodore 64. The VIC-20 cost $299 at its introduction in 1981; the C-64 cost $595 when it first appeared in 1982. Adjusted for inflation, the $499 PowerSpec 1660 would cost about $271 in 1981 dollars and about $295 in 1982 dollars.

The difference in horsepower, of course, is immense. The VIC-20 had a 1-MHz 6502 processor and 5 KB of RAM; the C-64 had a 1-MHz 6510 chip and 64 KB of RAM. Neither Commodore machine came with any kind of mass-storage device at their base price, while today’s low-end systems come with three (hard drive, floppy drive, and CD-ROM drive).

On the other hand, the Compaq computers had several features that most of today’s PCs still aspire to: instant-on power; a plug-and-play serial bus for external peripherals; an easy-access, external expansion slot; integrated sound chips; integrated graphics; built-in joystick ports; an uncompromised OS in ROM; a high-level programming language interpreter that was integrated with the OS (BASIC, not Java); no interrupt conflicts; no software conflicts; and no need to ever install software. With any luck, Windows PCs will catch up to most of those features by the next century.

Meanwhile, technophobic consumers might consider a home NC. For under $300, you can buy a WebTV Plus Receiver from Sony or Philips that plugs into your TV and lets them browse the Web and exchange e-mail. This box has a built-in Rockwell K56flex modem, a 1.1-GB hard drive for caching Web pages, and the ability to download Web pages and software upgrades at 1 MBps by decoding data in hidden TV scan lines. You can even hook up an ink-jet printer.

What’s important is that these low prices revive a market that PC clones haven’t addressed for years. An amazing number of today’s computer professionals started on a cheap home computer when they were youngsters in the 1970s and 1980s. The new low-priced PCs will seed another generation of technicians for the future.

Paradoxically, this motivates the industry to churn the technology even faster. Vendors make less profit on low-end systems; new whizbang features justify higher prices. But when the technology churns so fast that users can’t amortize a high-end system before it becomes obsolete, they tend to buy less expensive systems. It’s a feedback loop.

So if you don’t like the idea of planned obsolescence, don’t get mad—get even. Buy a new PC every year.

Tomorrow’s Tributaries

“There’s obviously a battle shaping up over what the mainstream PC is going to be,” says Don Clegg, vice president of marketing at Tyan Computer, a major motherboard manufacturer.

Time was, you could easily recognize a mainstream PC on sight: It was a big, ugly beige thing that took 3 minutes to turn on and sounded like a vacuum cleaner. Soon, that concept will be obsolete. Already, some PC vendors are trying to change that image to further the illusion that PCs are user-friendly consumer appliances. You can buy PCs with charcoal-gray cases, built-in stereo speakers, and “instant-on” power buttons (which, to be more accurate, are really “never-off”).

More significantly, leading vendors such as Compaq and Gateway 2000 are experimenting with wildly different types of PCs that are hybrid TV-PCs, DVD-PCs, or home-theater PCs.

“Culturally, the industry is very limited in what it thinks is a PC,” says Paul Pascarelli, Cyrix marketing manager for the MediaGX chip. “MediaGX is an architecture for devices that need x86 intelligence but don’t necessarily have to resemble ordinary PCs or run the same kind of software as traditional PCs.”

It’s not just an issue for the home market. In the business world, the need for more alternatives has spurred the evolution of NCs, NetPCs, Windows CE palmtops, the PalmPilot, and a wider variety of notebook computers. In nerd-speak, segmentation lets users match the computing device to the task with a greater degree of granularity.

Don’t be fooled into thinking that everything is converging on a single platform: x86 and Windows. Superficially, it looks that way, especially with the decline of alternative platforms such as the Mac. However, no platform can be all things to all people. The apparent winner of the platform war is unmistakably splintering into subplatforms.

In terms of system architecture, for instance, a MediaGX PC requires a specially designed motherboard that won’t work with any other CPU or standard core-logic chips. It doesn’t need a sound card, a graphics card, or an I2 cache. It runs Windows and works with standard peripherals, but
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Rapid obsolescence is forcing BYTE readers to replace their home and office PCs more often. Readers are also sharply divided on the question of proprietary CPU interfaces and are more likely to buy or recommend a non-Intel processor for home use than for office use. Those are just a few of the conclusions we reached from a telephone survey that gauged how 115 BYTE readers perceive current changes in the PC market. BYTE's research department conducted the survey in November by randomly calling readers from the magazine's subscription list.

We wanted to determine how readers are coping with rapid obsolescence. Not surprisingly, 84 percent told us they're replacing their office PCs more often, and 68 percent said they're replacing their home computers more often. The largest number of readers—43 percent—say they keep their office PCs for three to four years. About 25 percent get only two to three years out of a PC at the office, and 13 percent get less than two years. All together, 81 percent of our readers' office PCs are obsolete within four years.

At home, readers tend to keep their PCs a bit longer before considering them obsolete. Again, the largest number—39 percent—say they keep a home PC for three to four years. About 10 percent get two to three years out of a machine; 16 percent get less than two years. All together, 84 percent of their home PCs are obsolete within four years.

About 40 percent of the readers said they upgrade a machine as much as possible before replacing it, while about 58 percent said they buy a whole new computer.

We also asked what readers think about PC motherboards that have nonproprietary CPU interfaces—in other words, motherboards that can accept a CPU chip from any vendor, as Socket 7 motherboards can. The answers were remarkably distributed. For office PCs, 34 percent answered that open interfaces are "very important," 33 percent answered "somewhat important," and 31 percent answered "not at all important." For home PCs, 35 percent answered "very important," 32 percent answered "somewhat important," and 32 percent answered "not at all important." The results show that two-thirds of the readers think open CPU interfaces are somewhat important, but it's not a black-or-white issue.

Another question measured how many readers would buy or recommend a PC with a non-Intel x86-compatible processor. For office PCs, 17 percent said they would be "very likely" to buy or recommend such a system. Another 43 percent answered "somewhat likely," while a significant 41 percent said "not at all likely." For home PCs, readers were a little more open to the idea: 27 percent answered "very likely," 33 percent said "somewhat likely," and 38 percent answered "not at all likely." Interestingly, the three major vendors of non-Intel x86 chips—AMD, Cyrix, and Centaur—together command only about 10 percent of the market.

We asked readers to assess the importance of 14 new or emerging technologies. Because these technologies are major factors in the accelerating obsolescence of PCs, the answers give some indication how readers will determine when their systems become obsolete. We asked readers to judge the technologies on a scale of 1 to 5 ("not very important" to "very important"). The results suggest that readers are more concerned about system performance than local storage capacity. Convenience, represented by USB, also did well.

### How BYTE Readers Rank New Technologies

<table>
<thead>
<tr>
<th>Technology</th>
<th>Rank</th>
<th>Score (1-5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>100-MHz system bus</td>
<td>1</td>
<td>3.98</td>
</tr>
<tr>
<td>100-Mbps Ethernet</td>
<td>2</td>
<td>3.92</td>
</tr>
<tr>
<td>CPUs &gt; 300 MHz</td>
<td>3</td>
<td>3.67</td>
</tr>
<tr>
<td>USB (universal serial bus)</td>
<td>4</td>
<td>3.34</td>
</tr>
<tr>
<td>AGP (Accelerated Graphics Port)</td>
<td>5</td>
<td>3.32</td>
</tr>
<tr>
<td>IA-64/Merced processor</td>
<td>6</td>
<td>3.28</td>
</tr>
<tr>
<td>SDRAM replacing EDO RAM</td>
<td>7</td>
<td>3.24</td>
</tr>
<tr>
<td>Device Bay interface</td>
<td>8</td>
<td>3.09</td>
</tr>
<tr>
<td>100-MB internal Zip drives</td>
<td>9</td>
<td>3.02</td>
</tr>
<tr>
<td>DVD-ROM replacing CD-ROM</td>
<td>10</td>
<td>2.97</td>
</tr>
<tr>
<td>120-MB floppy drives</td>
<td>11</td>
<td>2.94</td>
</tr>
<tr>
<td>Intel's MMX2 extensions</td>
<td>12</td>
<td>2.93</td>
</tr>
<tr>
<td>PCs without ISA slots</td>
<td>13</td>
<td>2.38</td>
</tr>
<tr>
<td>AMD/Cyrix/Centaur</td>
<td>14</td>
<td>2.34</td>
</tr>
</tbody>
</table>

The first time, Microsoft has direct control (as opposed to de facto control) over a system architecture. What will Microsoft do with it? Future WebTVs could always remain WebTVs, or they could grow upward to become more like regular PCs—an evolution that's already apparent in the latest WebTV Plus models, which come with hard drives and printer ports.

The same opportunity is open for video game consoles such as the Sony PlayStation and Nintendo 64. These devices are more powerful than many PCs and are made by companies that have vast experience in consumer marketing.

In the past, rogue architectures found it difficult to survive, even when they offered breakthrough features. (Remember the Amiga?) However, as the computer market continues to broaden and grow into the hundreds of millions of units, there will be further room for alternatives—as long as they don't challenge the status quo too radically.

Tom R. Halfhill is a BYTE senior editor in San Mateo, California. You can contact him at tom.halfhill@byte.com.
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Each year at Comdex, new innovations share the floor with remakes of old products. BYTE editors separate the wheat from the chaff and tell you what really matters in several categories.

We were impressed with the maturity of some technologies that we've been following for a while. Chief among those were alternate input systems, which dominated our productivity applications category with voice and handwriting-recognition systems. The computers on the show floor ranged from very-low-end $300 PCs to near-$10,000 multimedia entertainment centers. And IBM demonstrated a new car. (In each category, the winner is the first item, followed by runners-up.)

**Systems**

**TriStar StarStation SXE**

If you're looking for the ultimate entry into the world of great 3-D graphics, look no further than Tri-Star's StarStation SXE. This $2600 system is built on the 533-MHz Alpha 21164PC and sports a 16-MB Elsa Gloria graphics card and a 6-GB IDE drive.

Tri-Star
Phoenix, AZ 800-800-7668
http://www.tristar.com

**IBM IntelliStation M Pro**

This Windows NT workstation features one or two 300-MHz Pentium II processors, is Accelerated Graphics Port-ready (AGP), and has a price starting at $3500.

IBM PC
Research Triangle Park, NC
800-426-7255
http://www.pc.ibm.com/intellistation

**Gateway Destination DMT**

Gateway improves on a good thing with its Destination DMT. It offers a marriage of PC and home theater in one system. The new version offers a 16-inch display, a DVD-ROM (digital versatile disk) drive with an MPEG-2 decoder, and a six-piece surround-sound stereo system. Prices range from $3100, for an entry-level system with a 166-MHz processor and 32 MB of RAM, to $4999, for a unit powered by a 300-MHz Pentium II.

Gateway 2000
North Sioux City, SD
800-946-2000
http://www.gateway.com

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**Best of Show**

**Hewlett-Packard LaserJet 4000**

It's not anything you can see that makes the top-of-the-line HP LaserJet 4000 our Best of Show winner. Instead, implemented inside the LaserJet 4000 is Hewlett-Packard's JetSend protocol. This is a TCP/IP-based protocol that enables network devices to talk to each other without using a computer as an intermediary. If you want to send a document that you just scanned on a JetSend-enabled scanner direct to a JetSend-enabled printer, all you have to do is select the printer from the scanner's control panel and off it goes.

Hewlett-Packard
Palo Alto, CA 800-527-3752
http://www.solutionsjet.hp.com/LJ4000/

www.byte.com
Jackpot at Comdex

**Multimedia Hardware/Software**

**ATI All-In-Wonder Pro**

The addition of ATI's 3-D Rage Pro chip increases the All-in-Wonder Pro's 3-D graphics performance by a factor of three over its predecessor, setting up 1.2 million triangles per second. This PCI card also has competitive 2-D graphics acceleration. But its multimedia capabilities are what set the All-in-Wonder Pro apart. A TV tuner with NTSC output, video zooming and 10-second instant replay, still- and full-motion video capturing to disk, and close-captioned text searching and recording top this list. The suggested retail price is $325, with street prices under $300.

ATI Technologies
Thornhill, Ontario, Canada 905-882-2600
http://www.atitech.com

**Creative Labs Sound Blaster AWE 64D**

Here's a PCI sound card with a unique twist: a special motherboard connector that improves backward compatibility with programs that expect to find ISA sound cards. The Sound Blaster AWE 64D's motherboard component tricks the software into thinking the PC has an ISA sound card installed, so DOS games and other older programs should run without balking. A large number of motherboard manufacturers support the special connector—including Intel, the leading motherboard maker, A-Open, Asus, Chaintech, FIC, and Gigabyte.

Creative Labs
Creative Resource, Singapore +65 895-4000
http://www.soundblaster.com

**Pinnacle Systems' miroVideo DV300**

The miroVideo DV300 is a hardware/software digital-video editing package that has an amazing range of professional-level features for $799. The DV300 lets PCs communicate with digital-video camcorders through an ISO-1394 FireWire interface to enable frame-accurate control of the camcorder. It automatically retrieves and replaces dropped frames, so the DV300 can create error-free digital-video captures. An on-board SCSI controller frees up the PCI bus, delivering better disk performance. It has a plug-in for Adobe Premiere that renders only the newly added special effects and transitions in recorded scenes.

Pinnacle Systems
Mountain View, CA 650-526-1600
http://www.pinnaclesys.com

**Storage**

**Sony HiFD**

It's easy to ignore the good old 3½-inch floppy drive. Fujifilm, along with Sony, the inventor of the 3½-inch floppy drive, has released the HiFD. It offers 200-MB capacity in drives that can read 1.44-MB disks.

Sony
San Jose, CA 800-352-7669
http://www.sony.com/storagebysony

**IBM Desktop 16GP**

IBM has had its share of patents in hard drive technology. One of the latest is giant magneto-resistive (GMR) heads, which are two to three times more sensitive than existing heads and thus able to handle higher medium densities. This $875, 5400-rpm drive is the first in a line that IBM says could lead to affordable desktop drives of 32 GB or more by 1999.

IBM Storage Systems Division
San Jose, CA 800-426-7777
http://www.ibm.com/storage

**Iomega clik**

Iomega says it wondered how small a Zip disk could be. The answer is 2 inches wide—small enough to fit in most hand-held PCs (HPCs) and digital cameras. The clik disk holds 40 MB and sells for $10. Add a cell-phone-size external drive (for about $100) and you have the most portable storage device yet.

Iomega
Ray UI 800-697-8833
http://www.iomga.com

**Server Systems**

**Axil Northbridge 1024c**

The eight-way multiprocessing battles have been joined, and Axil has a serious force. Axil's unique motherboard design plans for future Intel processor upgrades, allowing customers a longer product life cycle. Its rack design includes three power supplies with hot-swap capability and a hot-swap fan tray.

Axil Computer, Inc.
Concord, MA 978-371-8100
http://www.axil.com

**Land-5 Icebox**

Land-5's 1.0-capable Icebox server sports unique disk and tape RAID components that do not require drivers for any server OS. The RAID 3 tape-drive array is capable of 20-MBps data transfer.

Land-5
San Diego, CA 619-566-2514
http://www.land-5.com

**Productivity Applications**

**ParaGraph Calligrapher 5.0**

HPC keyboards are too small for most of us. Enter Calligrapher 5.0, the product of years of research into handwriting recognition. Designed to interpret cursive handwriting—even the particularly inscrutable handwriting of BYTE
senior contributing editor
Jerry Pournelle—Calligrapher is one package no
HPC should be without.
ParaGraph
Mountain View, CA
650-933-3000
http://www.paragraph.com

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bilities set it apart from
the pack. After transcrib-
ing what you say, it's a snap
to format your text with
simple voice commands,
changing properties such
as fonts, point size, and
alignment.
Lernout and Hauspie
Waltham, MA 781-238-0960
http://www.lhs.com

Lexicus Japanese
Handwriting Recognition
The Japanese Handwrit-
ing Recognition software,
from Motorola's Lexicus
division, works with sev-
eral Japanese character
sets, including kanji and
katakana, and recognizes

roman characters that fre-
quently appear in Japanese
writing. The software
comes bundled with a
graphics tablet, and it lets
you insert the characters
directly into applications
such as Microsoft Word
and Eudora Pro.
Motorola (Lexicus division)
Palo Alto, CA
650-494-0800
http://www.mot.com/lexicus

Portables
Sony MCR-309
Some vendors had mini-
notebooks, and others had
ultrathin systems, but only
Sony, using a magnesium
alloy and a 10.4-inch thin-
film transistor (TFT) SVGA
LCD, created a system as
small and powerful as the
amazing PCG-505. Hold it
in your hand and feel its
0.95-inch-thick, 2.97-
pound case. Boot it, and
play with its 133-MHz
MMX Pentium and usable
keyboard. This is the sys-
tem most mini-notebooks
aspire to be.
Sony Electronics
San Jose, CA 800-325-7669
http://www.sony.com

IBM ThinkPad 560X
IBM's ThinkPad 560X puts
a 233-MHz Pentium with
MMX in a highly portable,
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inch TFT SVGA screen for
$4299. When locked into
its docking station, it has
all the functionality of its
heavier, bulkier, high-end
competitors.
IBM
Armonk, NY 914-288-3589
http://www.ibm.com

Sharp Mobilon
You think all Windows CE
2.0 computers are the
same? Think again. The
Sharp Mobilon uses a cam-
era add-on to double as a
640-by-480-pixel screen. It
comes with either a color
or monochrome LCD and
starts at $599.
Sharp Electronics
Mahwah, NJ 800-237-4277
http://www.sharp-usa.com

Peripherals
Hewlett-Packard
LaserJet 4000e
BYTE's Best of Show win-
ner, the 1200-dpi, 17-ppm
HP LaserJet 4000 comes
with two 250-sheet paper
trays and up to 8 MB of
memory. What's most
important for us, it uses
the revolutionary JetSend
protocol, which allows
devices to communicate
over TCP/IP.
Hewlett-Packard
Palo Alto, CA 800-527-3753
http://www.solutionjet.hp.com/
L4000e/

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the base of the phone on virtually any
phone.
Osiotech Communications, Inc.
Guelph, Ontario, Canada 888-674-8324
http://www.ositech.com

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convergence, enhanced elliptical correc-
tion, and active signal correction. You
get high-quality picture with superb clar-
ity across the entire screen.
Sony Electronics
San Jose, CA 800-426-7255 http://www.sony.com

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demonstration, Cyrix added
a new wrinkle to the network
computer versus personal
computer debate by
developing an affordable
PC-compatible
information appliance.
The Cyrix Media Center is
built around
Cyrix's integrated
200-MHz Media-
GX chip. It adds a 56-Kbps modem,
universal serial bus (USB), IEEE-
1394 FireWire, stereo speakers,
accelerated 3-D graphics, video
capture, and a TV and FM radio
receiver. It supports legacy
devices like a floppy
drive, keyboard, mouse, and
serial
and parallel ports. This will allow
full-
featured PCs for under $1000.
Cyrix Corp.
Richardson, TX 972-968-8388
http://www.cyrix.com

www.byte.com
Cable modems promise some of the biggest pipes for most of us. But infighting over standards is holding products out of the reach of most of us. No longer. First to market with an MCNS-standard cable modem, 3Com uses either your own modem or an included 33.6-Kbps modem to provide upstream communication, while letting cable companies deliver up to 27 Mbps downstream. Pricing is $199 for cable only or $250 with the modem.

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Instant Internet (100) offers the lowest-cost proxy server and firewall yet for small IPX and IP networks. For $750, this modem-size box provides easy installation and configuration for small workgroups to connect to the Internet quickly at 56-Kbps analog modem or 128-Kbps ISDN speeds, using a low-cost ISA-card design.
Bay Networks
Santa Clara, CA 408-988-2400
http://www.baynetworks.com

AT&T WorldNet Virtual Private Network Service
Virtual private networks have traditionally been obscurely priced, and service guarantees have only begun to emerge. AT&T’s contribution is clearly priced, including flat-rate dial-up service starting at $34.95 for 20 hours or $103 per month for a 16-Kbps frame-relay service. Customers with outages as short as 10 minutes can receive refunds.
AT&T
Bridgewater, NJ 973-231-4000
http://www.att.net/worldnet

The Damnedest Thing We Ever Saw
It runs on gaa and Java. It has power steering and multiple processors. Fuel injection and five LCDs. It’s the IBM network vehicle. A joint project of Sun, Delco, and IBM, the network vehicle is a ramada Chevy Blazer. The user interface is written in Java and appears on several LCDs around the vehicle. Passengers can check e-mail, browse the Web, or download a movie, all courtesy of a DirectPC satellite connection that comes in through the vehicle’s phased-array antenna. Voice recognition gives drivers control over a heads-up display and lets them ask for directions.
IBM North America
White Plains, NY
570-674-4800
http://www.ibm.com/TradeShows/comdex/Fall97/11175.htm

Network Applications
Citicorp pICasso
These days, it seems everybody’s doing the thin-client thing (even if they aren’t sure what thin client means). Citrix has been doing it since long before it was the flavor of the week. You’ve probably been hearing quite a lot about Microsoft’s Hydra—a technology letting thin clients access applications on Windows NT servers. Hydra is built on the core technologies inside Citrix’s WinFrame, and pICasso is the code name for an enhancement to Citrix’s ICA technology that enables cross-platform connectivity (i.e., it runs on Mac, OS/2, and Unix systems) and audio to run over ICA.
Citicorp
Fort Lauderdale, FL
954-267-3000
http://www.citrix.com

Novell Storage Services
Novell Storage Services (NSS) represents the future file system for NetWare. Its main feature, aside from its high capacities (Novell has already created a 2-TB file and a 3-TB volume), is its reliability. If a server goes down, NSS can rebuild a volume quickly—in a demonstration for BYTE, it was able to rebuild a 100-GB file system in a little over a minute.
Novell
Orem, UT
801-861-7000
http://www.novell.com

Inferno 2.0
Inferno is a small-footprint, extremely modular, highly portable operating system for embedded applications. Version 2.0 enhances the previous version with full support for Sun’s PersonalJava, a subset of Java designed for network-connectable products used in homes, while traveling, or in the office. It also includes a suite of general-purpose productivity apps for small devices.
Lucent
Murray Hill, NJ
317-322-6848
http://www.lucent.com

Development Tools
NuMega Technologies
trueTime V8 Edition
Is your code feeling sluggish lately? Debugging-tool vendor NuMega Technologies attacks the problem with TrueTime Visual Basic Edition. This code-optimization tool puts AVCEX components in its sights. It spots the sluggards in your code—even components without source code.
NuMega Technologies
Nashua, NH
603-576-8400
http://www.numega.com

GEO Publishing Emblaze Web Chargers
On the Web, the most notorious bandwidth hogs are those images that make sites so appealing. Rather than scaling back the images, GEO Publishing’s Emblaze Web Chargers lets Webmasters drastically reduce the size of graphics files by selectively compressing parts of images. A little snip here, a little trim there, and you can have a beautiful—and fast—site.
GEO Publishing
Woodland Hills, CA
818-576-7751
http://www.emblaze.com

NEC Systems Laboratory’s AuraLine Java Multimedia Creation Kit
Java programmers who struggle with JavaScript to animate their Web sites might appreciate NEC System Laboratory’s AuraLine Java Multimedia Creation Kit. This $500 toolkit packages popular Web-site multimedia tricks such as ticker tapes and rollover effects in Java applets that you call from a time-line interface. It can save hours of tedious coding.
NEC Systems Laboratory
San Jose, CA
408-433-1358
http://www.auraline.com
Making Components Portable with JavaBeans

JavaBeans, Java's component architecture, is far more than just a collection of components for the client. By David S. Renshaw

More OSes. More users. More applications to develop. Less time. When you're developing applications for the kinds of heterogeneous environments that make up today's information-technology (IT) infrastructure, you need to solve cross-platform development problems in a heartbeat. And JavaBeans offer a solution.

JavaBeans combine the benefits of Java (e.g., cross-platform development and execution) with the benefits of components (e.g., code reuse). A JavaBean is a Java component that can be developed on one OS and hardware platform and reused everywhere. As with Java, many people peg Beans as a client-side solution, but this simply isn't the case. Beans hold the key to integrated, n-tiered solutions using the diverse array of platforms that make up today's critical business systems. Beans take the benefits of software components beyond the bounds of the presentation tier and enable them throughout a heterogeneous n-tiered enterprise.

If you thought Beans were merely a client-side toy, you may be surprised. This article looks at just what Beans are, what it's like to develop with them, what they can do now—and what they'll be able to do in the future, as well as what role they can play in the enterprise.

Beans and ActiveX

For many of us, the most familiar component model is Microsoft's Windows-based ActiveX. By far, ActiveX dominates today's component market. ActiveX components and JavaBeans are similar on the surface, but the real, function-
Building Network Apps

Making Components Portable with JavaBeans

differences between them are numerous and deep. I'll address these differences first.

A JavaBean is a software component written entirely in Java, or at least compiled from some source language to Java bytecode. A JavaBean might encapsulate the function of some part of the user interface (using Java's Abstract Window Toolkit [AWT], for example), or it might work as something without a visible representation (e.g., a server Bean). A component constructed according to the JavaBean recipe will execute on any system that provides a Java execution environment. In other words, JavaBeans are platform independent.

This is one of the major differences between ActiveX components and JavaBeans: ActiveX is a platform-specific model. An ActiveX component is written and compiled for a particular OS and hardware and uses OS calls. It runs only on the platform that it's built for. The only platform ActiveX components initially could be built for was Windows, but Microsoft recently moved the ActiveX technologies to other platforms, such as the Macintosh and some Unix variants. However, ActiveX is still far from having support on all the platforms that are currently in widespread use.

Compared to ActiveX components, JavaBeans are lightweight. The encapsulation of function into a Java component does not cause code bloat; the executable objects are quite small, and the developer is not required to implement countless methods. Another significant difference between ActiveX components and JavaBeans is in their respective security implications (see the text box “Safe Beans” below).

There are additional areas where the advantages of the JavaBeans model are evident. One of these areas is DLLs. ActiveX components can be packaged in several different forms, but they are usually delivered as DLLs. As such, these components need to be installed, if only temporarily, into a user's system so that they can be executed.

Registering a control in a system has effects on other applications executing on the system. For instance, Windows allows only one copy of a particular DLL to be loaded. If your browser downloads an ActiveX component that loads a DLL, that DLL is shared by all the processes that are running. If you start another application that uses the same DLL, it will be linked to the DLL already in memory. If the two applications need different versions of the DLL, problems can result. However, with JavaBeans executing in separate sandboxes (for more information about the Java sandbox, see the text box “Safe Beans” below), this problem does not happen.

Cooking Beans

So Beans are cross-platform, small, and safe. But how do you create them? The answer: pretty easily. Essentially, a Bean is a Java class that abides by a few relatively simple rules and design patterns. The

infrastructure for executing Beans is provided by version 1.1 of Java. What are the basic parts of a Bean that we are required to provide?

- Beans must have null constructors.
- Beans communicate with each other by raising and listening for events, so they must define event interactions.
- Beans must have persistence mechanisms.
- Beans must be easy and efficient to distribute.
- Beans must provide mechanisms that enable a visual development tool to work out what methods and events the Beans have.

Apart from these five features, there is nothing special about a Bean; you could just as easily build a Java applet or application. In fact, Bean development can be a little simpler because you don't need to worry about starting, stopping, or initializing. Here's a closer look at each of the above five characteristics.

Bean creation. You create a JavaBean by using either the new instruction or the static instantiate method on the javaBeansBeans class:

```java
MyBean Bean = new MyBeans();
```

or

```java
ClassLoader cl = this.
getClass().getClassLoader();
MyBean Bean =
(MyBeans)Beans.instantiate
(cl,"xx.yyyMyBean");
```

SAFE BEANS

ActiveX has evolved from the relatively isolated environment of the desktop toward the networked computing model that includes the Internet. In a desktop computer system environment, users (or their support infrastructure) control what is installed on the systems. It comes out of a shrink-wrapped box, then it's probably safe and trustworthy. But this is not always the model for today's computer networks.

With the advent of the Internet and corporate intranets, more of the software on users' systems is downloaded on demand from a corporate network. The code is often embedded within the HTML content and arrives at the user's system unbidden. This software is almost never installed in a controlled manner and is usually intended to reside on the system only as long as the user accesses the containing page.

This model originated with Java, and, not surprisingly, the Java security model is designed for it. All Java code executes in a controlled environment called the Java sandbox. This sandbox fully controls what parts of a system are accessible. This is possible because the Java application can use only those facilities of class libraries that are loaded by a class loader that cooperates with the security mechanisms.

ActiveX has no equivalent to the sandbox. ActiveX components are compiled to hardware-specific instructions and use OS calls directly. An ActiveX component can do anything it likes to the user's system once it has been downloaded.

Microsoft has papered over this fundamental flaw by using certificates. The idea of signing a piece of code so that a user can ensure it arrives undamaged and comes from a trustworthy source simply means that the user knows whom to blame when his or her system crashes; it does not stop it from crashing.
The latter method is preferred. In order for this to work, the Bean must have a null constructor—that is, a constructor with no parameters.

Why are there two ways to create a Bean? Because a new object is not always a new object when it's a Bean; Beans can be resurrected from a persistent data stream. If you are actually creating a new Bean and you know for sure that there's no possibility of there being a saved version, then you can use the new instruction. In a normal case, though, you should use the instantiate method because it gives the system's infrastructure the chance to use a template serialized Bean or the new instruction as appropriate. Using the instantiate method creates a Bean using the default constructor and then restores its state data to the way it was when it was stored.

Why is this a big deal? Because Beans are meant to be reused with as little programming as possible. If you are a solution provider and have a set of JavaBeans that you supply to your customers, you can use templates effectively.

For example, you can create your Beans with a particular look and feel (e.g., a nice shade of blue with a company logo). When you supply solutions to your customers, each wants its own look and feel. All you have to do is create an instance of your components, adjust a few properties (e.g., colors and logo image), and then save them back into the JAR file (more on these later) as templates. When your customers use your components in their applications, the template versions are used, so they always see their company's own look (see the figure above).

Bean events. Beans raise events to show that something significant has happened—for instance, a button push. Other Beans might listen for certain events to know when to perform their particular action.

JavaBeans employ the delegation event model, which is defined in the 1.1 version of Java. Events are defined in a Java class that extends java.util.EventObject. Beans listen to each other by implementing a listener interface and then registering themselves with a source of events. In practice, the visual application builder usually creates this listener-interface implementation.

BRIDGING BEANS AND ACTIVEX

While JavaBeans might be the greatest thing since sliced bread, the reality is that the dominant desktop environment and some of the major applications designed for it are built to use ActiveX components. Thus, JavaBean developers have been quick to provide a solution: the JavaBeans bridge for ActiveX.

This solution enables any JavaBean to be used as a first-class ActiveX component—that is, it lets you mix JavaBeans with ActiveX components. The bridge run-time looks to the system like an ActiveX control, while at the same time giving the Bean a Java environment.

The package contains a utility that allows the capabilities of a JavaBean to be expressed in terms of OLE-type library and Windows-registry information. After the definition of the Bean is added to the Windows system, programs can create instances of it, and tools such as Visual Basic can interrogate its properties. The bridge run-time code then provides the mappings among the JavaBean, OLE, and method calls so that everything is transparent to both the user and the JavaBean. This is significant: Creators of JavaBeans don't need to know whether their Beans are in an ActiveX container. They don't have to write any extra or specialized code to enable their Beans to be used as ActiveX components.

JavaBeans also provides tools for taking existing ActiveX components and turning them into JavaBeans in the form of the JavaBeans Migration Assistant for ActiveX. The Migration Assistant analyzes the ActiveX control and provides the skeleton implementation of a JavaBean that exhibits the equivalent public interface. It isn't able to convert the implementation code to Java, but it provides a quick start.

You can download the JavaBeans bridge for ActiveX from the JavaSoft Beans Web pages (http://java.sun.com/Beans).
Persistent Beans. A persistence mechanism allows a Bean or a collection of Beans to be saved in a file or transmitted across a network. Persistence enables some neat capabilities. For example, you can create a complex compound document made up of text Beans, spreadsheet Beans, chart Beans, and so on. When you attach the document to an e-mail message, the message's receiver can resurrect the document and view or edit it further—you basically send a lightweight application along with the data.

Beans use Java serialization mechanisms to provide persistence. In Java serialization, all the member variables of an object can be made persistent by the Java run-time—even whole trees or networks of objects that refer to each other. All the Bean creator needs to do is implement the java.io.Serializable interface. This is a simple task, as this interface contains no methods.

There is some work that needs to be done, though. Each member variable that should not, or cannot, be made persistent must be marked as transient. This instructs the serialization mechanism to ignore the field when making the Bean persistent and to create an uninitialized field when resurrecting the Bean.

Packaging Beans. You package a Bean by putting it into a JAR—a Java archive (another Java 1.1 addition). A JAR file is basically a Zip file with the addition of a manifest, a kind of table of contents. The JAR can contain not only the Bean's own class file but also other classes that the Bean uses, icons, graphics, internationalized text, and HTML-format help files. The whole thing can be installed or downloaded across the Web as a single HTTP request (a feature that reduces load times for Beans-based applications and applets).

Packaging in a JAR requires only the creation of a manifest file that indicates the name of the class that defines the Bean. Execute the JAR utility, with some suitably obscure incantations, and you're done. Unfortunately, the JAR utility is not the greatest of programs and will often just accept your command-line options, execute quietly, and then do nothing. It can take several attempts and rereads of the help information to get this seemingly simple piece of work completed.

Introspective Beans. Introspection refers to the way in which the public interfaces to a Bean. Methods, events raised, events listened for, and public properties can be discovered at run time. This is the information that a visual builder needs in order to be able to use a Bean. The Beans introspection mechanism builds on yet another base Java feature, reflection, which provides the capability to discover method information about a class. The introspection mechanism also searches for design patterns defined in the JavaBean specification so that the events raised and listened for can be deduced.

Sometimes it isn't appropriate to sim-

The JavaBeans event model is simple to understand.

The JavaBeans 1.0 specification has been around for a while, but it's still incomplete. Subsequent versions have been in the pipeline for some time. The Glasgow specification, for example, was made available for public review last September. Some of the specification's important features are as follows:

A containment-and-services protocol that enables a Bean to discover information about the Bean within which it's contained and for the containing Bean to make services available to the Beans it contains.

A drag-and-drop subsystem that closely integrates drag-and-drop operations with the native platform facilities. This is to permit Java and the native-platform applications that are running side-by-side on the same system to cooperate.

An activation framework that enables applications to determine the type of and identify an arbitrary piece of data, encapsulate access to it, discover the operations that are available on it, and instantiate the appropriate JavaBeans component to perform these operations.

Issues such as aggregation were dropped from the Glasgow specification, so we can be sure that there will be more revisions and releases beyond the current one.
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ply assume that all public methods are to be accessible to other users. You might want to explicitly specify which methods, events, and properties constitute the public interface of your component.

To do this, you create a BeanInfo class. BeanInfo allows complete control of the definition of the public interface to a Bean. If a BeanInfo class exists, it's the definitive source of interface information, and no attempt is made to use automatic introspection mechanisms. BeanInfo hides methods and properties even if they are accessible through public methods at the Bean-class level. This means the Bean can present one view of itself in an application builder and another when used as a simple Java class.

In addition, and very important, BeanInfo allows the reuse of Java code not originally designed as a Bean. Often, existing code does not abide by the JavaBeans design patterns that identify public properties. A BeanInfo class can specify the names and types of a property and define the “getter” and “setter” method names. (You still have to provide code for the other features, such as persistence.)

These five features are the fundamental ones that most Beans define, although more complex Beans might define more exotic ones, such as customization or property editors. This might sound like a lot of work, but the use of a smart development environment can create the constructor, BeanInfo, and property fields; accessor methods; and JAR files with little effort on the part of the user.

Beans Everywhere

JavaBeans are not just execution-platform independent; they're also creation-platform, assembly-platform, and reuse-platform independent. You can build a JavaBean on one development platform and then assemble it into a solution using a different platform. Other users can reuse and extend your Bean using other tools running on other platforms. And the solutions that use the Bean can be deployed and executed on any Java platform. This is true platform independence; no other component model comes close to it.

It's obvious why a JavaBean is independent of its execution platform: It's Java. But how is it able to declare independence from the development environment? Introspection and customization.

With a typical programming environment, you purchase your development tools and install them on your system
JavaBeans technology, called Enterprise JavaBeans, includes extensions specifically targeted at these server systems.

An Enterprise JavaBean is an encapsulation of a piece of business logic. It can be executed in an environment that supports transaction-processing constructs. In fact, current transaction-processing environments, such as IBM's CICS, will support Enterprise JavaBeans in the future.

The basic structure of an Enterprise JavaBean is the same as that of any other Bean, but with a few wrinkles. First, the Enterprise Bean comes in a jar, but with more information that defines its transaction-scope rules. The basic model for the Enterprise Bean is one of client and server, where communication between the client application (probably built with conventional Beans) and the Enterprise Beans executing in the server is via remote method invocation (RMI), the CORBA Internet Inter-ORB Protocol (IIOP), or the forthcoming RMI over IIOP.

For transaction-processing monitors to provide Enterprise Bean support, these Beans will likely have to abide by further rules that limit the things they can do. For instance, they have no AWT capabilities, so they are invisible Beans. Also, to ensure that Enterprise Beans cannot cause deadlocks or denial-of-service attacks within the server, the use of threads and synchronization will be limited. These are the kinds of limitations that current applications live with in transaction processors, so they shouldn’t cause great problems; after all, this is a specialized environment.

Choosing Beans

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Which came first, on-line analytical processing (OLAP) or relational databases? Award yourself 10 points if you answered OLAP. Contrary to what many people think, multidimensional analysis tools have been around for much longer than relational databases: Today's market leader is now 28 years old. Whether or not their developers used the term "OLAP," many budgeting, sales analysis, consolidation, and planning applications have used fundamental OLAP concepts over the years. And now OLAP functions are popping up in non-OLAP applications that will probably bring them to a bigger audience.

Despite their widespread presence, OLAP tools failed to capture the attention of the mainstream user—until recently. This failure was not because of a lack of functionality. Most of the advances in OLAP have nothing to do with analytical or statistical functionality. Indeed, the earliest OLAP tools probably had more sophisticated calculation capabilities than many of the modern ones.

So, if it was not analytical functionality that kept OLAP from being as popular as 1-2-3, what was it? As “OLAP’s Former Difficulties” (page 88NA 8) shows, OLAP had problems collecting data and storing it, and problems integrating with other applications. OLAP also lacked standards, severing the market into proprietary fiefdoms. Setting up and running OLAP required expert help, and only high-level or guru types had access to its capabilities. Plus, it was all very expensive.

These negative characteristics have changed. Now that OLAP is no longer strictly a niche technology, it is worth examining how it has evolved to fit more closely with contemporary business needs in organizations large and small.

Since OLAP products cover a wide spectrum of applications, no single architecture could work optimally for the full range. Data volumes range from a few megabytes to terabytes; functionality ranges from simple aggregation to complex financial models; access ranges from read-only to multiuser concurrent read/write; and user populations range from single user to thousands of users.

So OLAP vendors have used many different approaches for how and where their products store the data for multidimensional processing, and where the processing itself occurs. Some products are more versatile than others, and inevitably, the vendors of the less versatile products attack the approaches that they don’t support. But this is unnecessary because each type of architecture is suitable for different applications.

Types of OLAP
OLAP products and vendors resist attempts to be neatly pigeonholed or compared. On a technical basis, there are a surprisingly large number of variables that differentiate the products, so no two products are identical—even in architecture.

Relational OLAP (ROLAP) uses SQL to extract data from a relational database and
create multidimensional views on the fly. Multidimensional OLAP (MOLAP) creates and stores multidimensional databases beforehand, for faster access. Hybrid OLAP (HOLAP) combines ROLAP and MOLAP by creating multidimensional models that use relational databases. But the terms “ROLAP,” “MOLAP,” and “HOLAP” are, at best, only approximate indicators of how products work.

To try to bring some clarity to our analysis, it is handy to use a two-dimensional grid (see “Different Styles of OLAP,” at right). This grid positions products by where the majority of the multidimensional processing occurs and by where they store the bulk of their multidimensional data. For each of these two dimensions, there are three basic options. Regardless of where the active multidimensional data originally came from, there are essentially three places to store it for analysis: an RDBMS (with no external storage), a shared multidimensional database on a server, or local data files on a client PC. Similarly, there are three styles of “engine” that can do all or most of the multidimensional consolidations and other calculations: multipass SQL, a multiuser multidimensional application server, and the client PC itself. (Multipass SQL performs one query, then retains the result of that query in temporary storage while it performs one or more other queries. Then it joins the results of the queries for a final multidimensional result.)

To some extent, these options are independent, so several combinations are possible. However, only some of the nine combinations make sense. For example, it would be crazy to use SQL to do multidimensional processing of data held in a multidimensional database. In practice, six of the options make sense, and in most cases, several products provide those combinations.

If a product is normally used in only one way, it appears in that box only. However, several of the products are capable of working in more than one way, which is one reason why even the most ingenious architectural classification schemes often fail. Although products that are genuinely usable in more than one way appear in all the relevant boxes, this does not mean that they are equally at home in each. Some products really belong in one category, but they have capabilities that allow them to be included in another.

If you prefer the normal bandied-about terms, you can map them to the grid. Relational OLAP products are in the first column only (squares 1, 2, and 3). Multidimensional database (also known as MIB, MDD, or MOLAP) products are in the second column only (squares 4 and 5). Desktop OLAP products are in square 6. Hybrid OLAP products are in both squares 2 and 4 and are shown in italics.

The fact that several products are in the same square, and therefore have similar architectures, does not necessarily mean that they are very similar products. For instance, DB2 OLAP Server and Information Advantage DecisionSuite are actually very different: They just happen to share certain storage and processing characteristics; technically, they both still count as ROLAP products.

Even though this grid is probably the simplest and clearest way of illustrating the architectural differences among the different OLAP approaches, it is still relatively complex. It’s hardly surprising that many people continue to be baffled by the differences among OLAP technologies and select grossly inappropriate products for their applications.

In general, products that access multidimensional data directly from SQL pay a heavy performance penalty, as there is nearly always much more I/O and CPU involved. Their retrieval performance is usually two to four times slower because SQL is not good for multidimensional data retrieval and manipulation. However, they can handle lots more data. So, if the key issue is performance, multidimensional database technology remains essential, but if capacity is the limiting factor, an RDBMS must hold at least the base-level data.

The hybrid architecture is becoming the most popular for current products because it can combine the capacity of ROLAP tools with the superior perfor-
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mance of multidimensional databases. Still, most of the initial hybrid OLAP products have acquired a reputation for complexity. The new Microsoft OLAP Server will use a wizard-driven interface with automatic tuning to avoid the 4GL programming that has been required until now.

Most of the products that include client-based processing need an extra tier for Web deployment. In particular, the desktop OLAP tools will all need a server component to work successfully with browsers. This additional server takes over the processing that would have occurred on the client—so three-tier OLAP becomes four-tier if deployed on the Web. This can sometimes work out as significantly more expensive than the conventional three-tier client/server solution.

**Spreadsheet OLAP Clients**

Traditional OLAP tools used dedicated, proprietary client tools, and most OLAP products on the market can still work this way. However, in the early 1990s, vendors began to provide add-ins to present multidimensional data via industry-standard spreadsheets (see the table “OLAP for Spreadsheets,” page 88NA.6). Initially vendors supported both Lotus 1-2-3 and Microsoft Excel, but all the more recent implementations have worked with Excel only. OLAP vendors report that, quite apart from the obvious marketing reasons, it is easier to develop Excel add-ins than 1-2-3 add-ins.

The key advantage of the spreadsheet approach is that it combines the flexible display, formatting strengths, and ad hoc calculations of spreadsheets with the data management, calculations, and performance of multidimensional database technology. No data is stored in the spreadsheet, no macros are required, and the spreadsheet’s notorious maintenance hole is eliminated. Conversely, the OLAP vendors don’t have to keep up with relentless spreadsheet GUI advances. Of course, vendors still usually have to produce different versions of their add-ins for each new release of the spreadsheet (for example, Excel 97 needs a different version than Excel 7.0, even though both are 32-bit programs).

Many OLAP applications require users to enter plans, budgets, and comments, so an increasing number of OLAP servers now allow read/write spreadsheet access. This approach to OLAP data input is particularly attractive. It allows end users to stick with their familiar spreadsheet data entry without having to manage or upload the captured data—which resides directly in a properly secure multiuser database. The OLAP engine, not the spreadsheet, manages access controls and multwrite concurrency.

Using a spreadsheet grid is very popular with end users, many of whom routinely copy data from other analysis tools into spreadsheets anyway. Financial OLAP applications tend to use the spreadsheet approach the most. But in organizations where the populations of users are spreadsheet-literate, it is a great approach for sales and marketing applications as well. Because the spreadsheet add-ins are often “free,” with licensing based on concurrent server connections, buyers don’t have to account for each desktop installation of the add-in. In fact, the economics of this approach often beats Web deployment because the hardware and software costs are usually much lower, even though the administrative effort is a little greater. (See the figure “OLAP Add-Ins to Spreadsheets,” page 88NA.6.)

**Other OLAP Clients**

Spreadsheets are by no means the only OLAP clients. Typically there are three other options: standard desktop OLAP products, specialized applications, and Web browsers.

Several vendors produce desktop OLAP tools that literally hundreds of other application providers resell. In some cases, they
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  (Java, CGI programming)
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"own label" them by removing the original product's name. However, in most cases, they do not change the product itself, and they add value by integrating data from their own application into the OLAP data structure. Typically the application vendor implements functions to generate the desktop cubes nearly automatically using the application's metadata, then resells a standard version of the desktop OLAP product.

Cognos, in particular, has been very successful in signing up both horizontal and vertical application vendors: For example, most accounting systems now come with an optional Cognos PowerPlay front end. Other vendors that provide OLAP clients on an OEM basis include Business Objects, Brio Technology, and AppSource.

**Embedded OLAP**

The other form of OLAP embedding comes when specialized applications include licensed off-the-shelf OLAP servers. For example, Comshare and Hyperion both have a history of building their own multidimensional engines, but they now license third-party OLAP servers for some of their applications.

Normally it is necessary to add an extra layer between the server component of the application and the standard OLAP server. Plus, another layer on the "output" side of the generic server handles post-OLAP processing such as exception scanning or data mining. The server performs both of these much more efficiently than the client. Sometimes there are also application components on the client, but generally it is also possible to access the server using its generic client support.

Thus, although it may seem easy to simply license a standard OLAP server, in practice a significant amount of development effort is required on the server, the client, and even the client/server communications if the application is to work properly. (See the figure "Embedding OLAP," page 88NA 4.) The work should be distributed efficiently between the client and the server and between the generic and the specialized components. Despite these complexities, the inexpensive new Microsoft OLAP Server is likely to make this a popular architecture for many applications that can use multidimensional processing. A host of new OLAP applications that embed the Microsoft server is likely to appear next year.

Using embedded OLAP servers allows complex business applications such as budgeting, consolidation, and retail systems to be "OLAP-enabled." Buyers may hardly be aware that a key component of their solution is an OLAP engine. The main multidimensional databases currently used for such systems are Arbor Essbase and Applix TM1, while Oracle Express is the most commonly embedded hybrid OLAP tool, and MicroStrategy DSS Server is the fashionable ROLAP choice.

**OLAP and the Web**

There has been a huge amount of hype about using Web browsers for OLAP access, but few sites are yet in production with Web OLAP deployment. This is one of the more difficult applications to deliver successfully in a browser environ-
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OLAP’s Former Difficulties

<table>
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<tr>
<th>Data problems</th>
<th>Collecting data from multiple sources.</th>
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<tr>
<td>Hardware limits</td>
<td>Multidimensional application data requires vast storage and memory resources.</td>
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<td>Skills</td>
<td>OLAP tools were complex to implement, especially for designing adequate database structures.</td>
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<tr>
<td>Integration</td>
<td>Usually proprietary. Necessitated complete solution, including database, engine, application, and client tool.</td>
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<tr>
<td>Standards</td>
<td>None.</td>
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<td>Costs</td>
<td>Priced for the elite, not for volume sales.</td>
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<tr>
<td>Application limits</td>
<td>Not designed to cope with large data volumes; could not do calculations fast enough; database index limits were too small; succumbed to database explosion (when sparse multidimensional structures were fully precalculated).</td>
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<td>Business style</td>
<td>Seemed to be for specialists only.</td>
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<tr>
<td>Administration</td>
<td>Intended for use only on a departmental basis: lacked the necessary administration tools.</td>
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It finally takes off, Web OLAP would probably spread first on intranets and extranets, for two reasons. First is the type of applications that use OLAP. Second is the probable technical requirement to standardize on particular browsers and plugins for sophisticated deployment.

The Next Pivot?

It has taken a long time, but OLAP has finally hit the big time. Whether lurking behind a deceptively flat spreadsheet, embedded within a budgeting application, invisibly spewing out dynamic Web pages, or providing the glitz for your ledgers, OLAP technologies are infiltrating all branches of business computing. And these are not trivial technologies: OLAP applications can stretch GUI interfaces to the limit, swap the biggest servers, and cause mysterious effects like database explosion. Despite the smartest sparsity suppression—sparsity is a condition in which a region of a multidimensional database has few entries, wasting space—megabytes of input data can legitimately explode into gigabytes of fully calculated data. (For more information on this subject, see http://www.olapreport.com/DatabaseExplosion.htm.)

Yet even after all these years, OLAP innovation is far from exhausted. Having tackled the functionality issues long ago, the surviving OLAP vendors now have to confront the more difficult problems of mass deployment. Their applications must become easier to implement, data integration must cease to be an issue, end-user training needs should be minimal, and tuning should become automated. Then OLAP could become as common as a spreadsheet.

WHERETO FIND

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<td>Wakefield, MA</td>
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<td>Information Advantage</td>
<td>Eden Prairie, MN</td>
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Nigel Pendse is lead author of The OLAP Report (http://www.olapreport.com), published by Business Intelligence, Inc. An independent consultant to buyers and sellers of OLAP, he has been involved with OLAP products for over 20 years, as both user and vendor. You can reach him at nigelp@compuserve.com.
Today's Internet, while faster than ever before and bigger each month than the previous month, is still so slow and otherwise inadequate that an army of expert minds is determined to reinvent it.

Despite broadband backbones in the OC-12 (622 Mbps) range, end-to-end throughput on the public Internet has been measured between LAN-based workstations at as little as 40 Kbps—the equivalent of what a pair of modems could do and slightly slower than the original ARPANET, a pre-Internet backbone running at 56 Kbps.

For people in the research and academic arenas, this bandwidth and its unpredictable availability are insufficient to support many of the new applications they want and need. In many cases, without adequate networking, they will be forced to buy rather than share very expensive equipment, such as high-voltage electron microscopes. Or they may have to travel to California-Berkeley's Spectro-Microscopy Lab and witness real-time presentation of large data sets from projects such as the University of Michigan's Upper Atmosphere Research Lab.

It isn't simply a question of "more bandwidth, please," either. Today's Internet does not support other features that are as essential to the next generation of networked applications as higher speeds are.

The current Internet delivers what's called best-effort service. Version 4 of TCP/IP, which is what runs on the Internet today, has no provision for specifying or guaranteeing quality-of-service (QoS) attributes and levels for these attributes. IPv4 also can't reserve bandwidth, assure maximum network latency, or provide adequate security.

Universities and research institutions need these features today. The corporate and consumer worlds have begun to feel the need and see the value for such capabilities in the commercial Internet as well.

Getting to the next-generation Internet requires a new generation of hardware (e.g., switches and routers) and carrier services. It also requires new protocols, new network management tools, and a deeper understanding of the network needs of high-performance applications. It will need major project and program management to deploy and coordinate these changes without disrupting existing Internet service. Ways are needed to make the new capabilities available to users and their applications in a simple, easy-to-specify-and-use fashion—plus educating and training developers and users.

Such a daunting task is beyond the scope of any one vendor, university, or government agency. But it's not beyond the scope of lots of these, working in teams—and that's what's happening.

Paving the Way

U.S. educational communities have been working together for more than a decade

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**The Internet Reinvented**

Tomorrow's Net, driven again by researchers and academia, will include new backbones, new protocols, and new applications.

*By Daniel P. Dern and Scott Mace*
to articulate their networking needs. Several interrelated initiatives are under way that will pave the way—and begin to construct—seminal pieces of the next iteration of the Internet. These pieces include:

- The White House’s Next-Generation Internet (NGI) initiative
- The National Science Foundation’s (NSF) Very High Bandwidth Network Service (VBNS)
- Internet2, an effort of a consortium of universities working with corporate and government partners
- IPv6, the next generation of the Internet protocol, aka IPv6

Together, these initiatives are shooting to yield new protocols, new hardware, new software, new knowledge, and new network test-beds demonstrating applications that make use of their capabilities.

NGI

NGI is a White House multiagency initiative that was announced in October 1996. Arising from the High-Performance Computing and Communications initiative, NGI is now part of the U.S. government’s Large-Scale Networking initiative. The NGI program will be coordinated in the framework of the National Science and Technology Council. High-level strategy will come from the Committee on Computing, Information, and Communications (CCIC), and implementation strategy from the Large-Scale Networking Working Group.

By last fall, researchers were already demonstrating five “precursor applications.” NGI includes research into protocols, development, and deployment of high-end test-beds, plus demonstrating applications. It is meeting some of these goals through Internet2 and/or VBNS.

Of all the initiatives, NGI is the one most on the cutting edge, especially its Class 1 networks funded by the Defense Advanced Research Projects Agency (DARPA) and the Department of Defense (DoD), where network technologies proper are being tested. Some of these networks aren’t even married to TCP/IP. They include:

- Collaborative Advanced Interagency Research Network (CAIRN) offers researchers nationwide a suite of Ascend Gigarouters for experimentation with RSVP, multicast, and other IPv6 protocols.
- The National Transparent Optical Network Consortium (NTONC) plans to build a $40 million prototype network in California to serve as a test-bed and evaluate the performance of advanced optical communications components. These technical advances are expected to lead to a network that can carry 10 to 100 Tb of data per second, a capacity well beyond anything currently planned.
- The Multiwavelength Optical Networking (MONET) network, stretching from Washington, D.C., to New Jersey, aims to figure out how to build a multiwavelength national optical network.
- Advanced Technology Demonstration Network (ATDNet) initially is an OC-48 (2.4 Gbps) network in the Washington, D.C., area. It was created to allow federal agencies to deploy emerging asynchronous transfer mode (ATM) and Synchronous Optical Network (SONET) technologies.
- The Advanced Communications Technology Satellite ATM Internetwork connects several DoD High-Performance Computing centers (a subset known as the Defense Research and Engineering Network [DREN] test-bed) and the Multi-dimensional Applications Gigabit Internetworking Consortium (MAGIC) and ATDNet gigabit test-beds. Research topics include network signaling, congestion management, ATM and IP multicast, and gateways to non-ATM LANs.

A key NGI goal is to develop and demonstrate two test-beds that are, respectively, 100 and 1000 times faster than today’s Internet in terms of end-to-end performance—meaning about 100 Mbps and 1 Gbps. Network services that NGI will be working on include areas such as transaction security and network management. Much effort is being put into making use of off-the-shelf products and services where they exist, and to making NGI easy for companies to work with. As of last fall, more than 150 Silicon Valley companies were involved as partners.

VBNS

Before NGI, before Internet2, the NSF already was working to provide its constituency with networking beyond what the commercial Internet could deliver. The NSF’s answer was to begin a dedicated network, VBNS, to provide next-generation network service to qualified researchers and academic users.

In the spring of 1995, the NSF made a five-year cooperative agreement that was worth up to $50 million with MCI for VBNS. The network, which has been operational since April 1995, links five NSF sites with the White House, various DoD organizations, and a consortium of universities and companies. The architecture is inspired by the DARPA Internet, but it is designed to carry more than 100 Gbps in each direction.

The Very High Bandwidth Network Service (VBNS) system already has 14,000 miles of OC-12 links.
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Technology the Next Internet Needs

Today's Internet is bursting at the seams. The original design never considered its current size and popularity. In many ways, it falls far short of the needs of a modern internetwork. The architects of the Internet never considered issues of data security or enormous growth.

Network Scalability: Expanded Network
128-bit Addressing
The most obvious change to the Internet protocols will be room for far more addresses than are currently supported. IPv4 has 32 bits for addressing. IPv6 will use 128 bits—enough to assign 665 septillion \((6.65 \times 10^{24})\) addresses per square meter of the surface of the earth.

While this is far more room than we can expect to need in the distant future, in reality, 128 bits of addressing will provide only a paltry few hundred million addresses per square meter. The remaining space will be used for routing and other administrative purposes. Still, this is an expansion of the space to dimensions far exceeding our needs.

Multicasting: Making Multireipient Flows More Efficient
The next change to the protocols will be support for data multicasting. This is a facility that lets a producer of information send only one copy out to the network, no matter how many recipients exist. The network will copy this one instance of data as needed, routing it to those hosts that require it.

Multicasting is presently being done on the Internet on a virtual subnet, the Multicast Backbone (MBone). However, because it's within the context of IPv4 and the Internet's relatively limited speed, this is only a hint of what can and will be done with multicasting in a next-generation Internet environment.

Quality of Service: At the Core and at the Edge
Until recently, the Internet has never had any choices in terms of quality of service (QoS) offered from providers, or that users could request—and pay correspondingly more or less for—on a basis such as per application, session, time, or parties involved. For example, there's never been a "charge me more, give me better service" icon on-screen, nor a way to say, "Give me guaranteed toll-quality voice and video for all calls from my thesis advisor, but only low-grade, cheap quality for calls from friends unless they're paying for it." Individual ISPs such as UUnet and BBN/GTE are beginning to offer some forms of guaranteed service, but a lot's still not possible with today's protocols.

Different types of applications and different circumstances have different priorities in terms of QoS. For example, real-time voice can tolerate some loss of the signal better than delay, while real-time data may tolerate either some or no "jitter"—varying delay—but usually needs 100 percent accurate delivery.

As packets flow to their destinations, several characteristics must be guaranteeable and controllable, including:

- **Capacity**—If an application requires 10 Mbps from point to point, it must be able to reserve network capacity in support of its needs.
- **Managing packet loss**—If packet loss cannot be avoided, what level is acceptable to the application's needs?
- **Packet timing**—When must the packet become available for the application? What timing constraints are acceptable?

Similarly, when packets arrive at their destinations, what characteristics must be controlled?

- **Admission control**—What packets are allowed to enter the edge? At what layers does this become an issue?
- **Packet discrimination**—Are some packets more important than others? Can we route packets to application destinations based on their contents?
- **Accounting and billing**—Who will pay for packet transfer, and how will we track usage?

The State of IPng
The Internet Engineering Task Force is developing IPng. The IETF is a loose confederation of computer researchers and other interested parties, and is the source of all official Internet standards. It will deploy IPng, in one form or another, sometime after 1999. The problems this poses are not small.

There has been much consideration of a phased rollout, where the underlying backbones are converted to IPng before the rest of the network. If this happens, the current computers at the edge of the network will communicate through IPv4 tunnels in the new IPng network.

The largest current test bed for the IPng protocols is a network of research and commercial sites in 29 countries called the 6-Bone. In the U.S., IPng is also being run on VBNS.

Robert Raisch is an on-line business strategist ( raisch@internautics.com).
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By June, MCI hopes to bring up reserved-bandwidth services. “Our initial QoS offering adds a reserved-bandwidth service to traditional IP datagram forwarding,” Lee says. “This is for applications that need a high bandwidth with assurances of very low loss or delay. It sets up, on a per-application basis, a special path through the Internet, by signaling from the end system using RSVP, and one of our VBNS routers will translate that into an ATM virtual circuit.”

The reserved bandwidth is important, Lee points out, “for when the commercial services can’t support it end to end.” Similarly, using Protocol-Independent Multicast (PIM) is enabling otherwise infeasible activity such as interconnecting to CANet, Canada’s big research network, to provide IP multicasting.

Although you can currently use the Multicast Backbone (Mbone) for voice and video, “that’s generally done by using special routers or workstations to do tunneled IP,” Lee says. “The Mbone is basically a low-performance multicast overlay. PIM on the VBNS does it with high performance.”

By the end of this year, MCI plans to further enhance VBNS with source-based routing, with more than 100 domestic connections and approximately 20 international connections. And by 2000, VBNS backbone speeds should be up to OC-48.

“We can do very-high-speed wave division multiplexing (WDM) and get very-high bandwidth,” says Rick Wilder, senior manager of Internet technology at MCI. “We have some 40-Gbps legs, and in our Reston, Virginia, lab, we have the new Cisco 12000 series routers that are built to accommodate OC-48. But you need to be able to plug it into something, and at present, OC-12 is state of the art in terms of what you can buy in IP routers or ATM switches that’s reliable.”

(WDM involves packing multiple optical-transmission streams into one fiber by sending each stream on a separate color channel.)

Meanwhile, VBNS-related activity has already borne fruit. MCI developed, and is sharing information on, a monitoring capability that lets the company look at the IP traffic inside cell streams as they flow past at high speeds. This is the first technology transfer MCI can point to from the VBNS effort.

VBNS will also be a part of the NGI efforts, providing a place for testing new applications and trying out cutting-edge network technologies.

Internet2: Academia’s Next Stand

After VBNS took flight, universities agreed to pool their resources for a new level of internetworking. The result was a project that was dubbed, misleadingly, Internet2. This was misleading in that although it was in pursuit of next-generation Internet technology, it was not intended to replace the existing Internet, nor to build a new network for general users.

UCAIID, the University Corporation for Advanced Internet Development, was formed in September 1997 to manage Internet2 and to assist other consortia, such as North Carolina’s Gigabit Point of Presence, also known as a GigaPOP (see the figure “The U.S.’s First GigaPOP” on page 96). GigaPOPs will help aggregate traffic from universities, avoiding many of the problems created by the architecture of today’s Internet Network Access Points (NAPs).

Nine of UCAIID’s corporate members—Advanced Network and Services, Bay Networks, Cisco Systems, Fore Systems, IBM, Newbridge Networks, Nortel, Starburst Communications, and JCom—have joined at the partner level. This means that they have committed to contribute more than $1 million each to Internet2 over the course of the next three to five years.

“When NSF started privatizing, there was a view that our troubles would be over,” says Mike Roberts, vice president of Educom, a Washington, D.C., consortium of 600 colleges with interests in information technology for education.

“But we didn’t get enough attention in terms of how to arrange for the continuing evolution and for the introduction of new technology into the Internet usefully incorporated. We missed that.”

“And we also failed to understand that the private sector, the folks buying up regional nets, the ISPs, would have to concentrate on the bottom line... and that automatically meant that the ‘center of gravity’ in what they would do to enhance technology would be slower than the research institutions would want.”

Internet2, VBNS, and NGI are also interrelated, although Internet2 and VBNS have self-contained missions of their own, independent of NGI or each other. At present, VBNS provides backbone network service for Internet2. Internet2 and UCAIID are also providing some of the participation by the higher-education arena in the NGI effort. Indeed, Internet2 is seen as fulfilling the first goal of the NGI program, hooking up the 100 top universities and
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developing next-generation networked applications.

Internet2's plans call for operational testing by the fall of this year, although, using VBNS, some applications have already been demonstrated, including some at meetings that were held in Washington D.C., last fall. Internet2 applications cut across all academic disciplines. Some will be collaborative environments, and others will be digital libraries. Some will facilitate research, and others will enable distance learning.

Internet2 also provides a place to test various policy issues, such as how to cost and charge for bandwidth reservation. It's also a place to experiment with ways to leverage the GigaPOPs, such as with local caches and replicating servers, and satellite up- and down-links to improve network efficiency.

Besides the remote instrumentation mentioned earlier, collaboration environments will allow for audio, video, text, and whiteboard discussions in real time. Other applications support forms of collaboration through 3-D virtual shared presences known as immersive environments. Finally, telemedicine, including remote diagnosis and monitoring, will get a boost from Internet2.

Intensively interactive graphical/multimedia applications are also prime candidates for NGR, involving things like rich scientific visualization, collaborative virtual reality (VR), and 3-D immersive environments, with names such as computer-assisted virtual environment (CAVE); CAVE research network (CAVERN); ImmersaDesk; Narrative, Immersive, Constructivist/Collective Environment (NICE); and Tele-Immersion (combining networked VR and video with a lot of computing and data mining).

Although the original Internet2 organizers thought that fewer than two dozen schools would need to be part of the new network, as the word spread, pretty much every major research university in the U.S.

North Carolina's Gigabit Point of Presence (GigaPOP) aggregates a variety of traffic onto a single high-bandwidth link.

"wanted in," according to Roberts—114 in all.

To participate, each university had to commit up front to half a million dollars to pay for their upgrade of the WAN, to pay $25,000 a year to the central group to cover coordination costs, and to create at least one new application.

Terabits to Come

Unsurprisingly, the research community continues to look ahead to still-faster networks to put to use. Educom's Roberts reports there is discussion of an OC-192 (which is nearly 10 Gbps) network for highly qualified researchers, of which there are between 50 to 100.

"Cutting-edge developers are already providing 40 to 60 Gbps in a single fiber ... and the theoretical limit of a fiber is 100 Tbps," says Craig Partridge of BBN/GTE—2000 times more than the current delivered capability and 100 times more than the lab limit.

"That could carry us perhaps for another decade, depending on how things grow... and, of course, we'll also be laying more fiber," Partridge says.

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n “On-Line Component-ware” (November 1996 BYTE), I pointed out that every Web site is a large-scale component that can call, and be called by, other Web-based components. The example I gave in that column was MetaSearch. It was a BYTE Site script that used Web-spidering technology to search AltaVista for articles in BYTE and other McGraw-Hill magazines. AltaVista itself, of course, used the same kind of technology to index our sites.

I was amazed to discover that peer-to-peer networking of Web sites was not only possible, but downright simple. This month, I’ll show how we use this technology to monitor our own site and to extract information from a secure server at a partner’s site.

Dave’s Site Monitor
The BYTE Site is a cluster of Windows NT and Unix machines that provides a growing number of public and private services. A while ago, I realized that we needed a unified way to monitor the health of these services. I also realized that the many Web servers, FTP servers, NNTP servers, and mail servers that we operate do not in themselves define the list of services that users expect us to support.

For example, our search server runs two search engines in parallel—SWISH and Excite. It’s not enough to know that the NT 4.0 machine that hosts these engines is healthy, or even that the Internet Information Server (IIS) 3.0 Web server on that machine is alive and kicking. What matters to users, ultimately, is whether SWISH and Excite are working as advertised.

By a happy coincidence, the two properties that make each of our services available to users—a URL and a corresponding Web page—are just the things you need to build a robotic tester. I put the challenge to my associate Dave Rowell. The screen on page 98 shows the incredibly useful solution Dave came up with.

Our site monitor is a Perl script, scheduled to run every half hour, that’s driven by a table of address/result string pairs. One of the addresses is our home page, http://www.byte.com/, and the corresponding result string is a piece of text that appears on that page.

The monitor fetches the page, and if it contains the expected result string, that test produces a green-light icon. If the home page takes longer than expected to arrive, the icon will instead be yellow, and

When business-to-business networking relies on secure channels, integrators need SSL-aware Web-spidering tools.
URL fetcher that alerts you when static or dynamic pages arrive slowly, incorrectly, or not at all.

This tool has revolutionized our ability to monitor the health of our site, and we've come to depend on it. Therefore, it was a matter of some concern when, a few weeks ago, the monitor began issuing a stream of spurious alerts.

Why the Site Monitor Failed

The service that the monitor thought had failed was the secure ordering system on our primary Web server. The https:// URL that defines this part of the test was triggering a red-light response. And yet, whenever we fetched that URL interactively, all was OK. Neither Dave nor I could remember installing any software or making any configuration changes on the NT 4.0 machine that hosts the monitor. What could have gone wrong?

Finally, Dave noticed that the target URL was expressed in the monitor's configuration file as an IP address rather than a Domain Name System (DNS) name. We switched to the DNS name, and that restored the errant test to green-light status. But why? That remained a mystery.

I should explain that when I proposed this project to Dave, I forgot to mention that he needn't bother trying to test the parts of our site accessed by way of Secure Sockets Layer (SSL). Not knowing that an SSL page wouldn't work, Dave included one in the tests—and to my surprise, it did work. It worked because the URL-fetching tool I recommended to him was Win32::Internet. This is a Perl module that talks to WININET.DLL.

The Winlnt library comes with Microsoft's Internet Explorer (MSIE) and is also available separately as part of the ActiveX Software Development Kit (SDK). Among Winlnt's functions are those that MSIE itself used to access FTP, HTTP, and HTTPS (secure) URLs. This is powerful stuff! When Microsoft introduced Winlnt a few years ago, it was billed as a generic Win32 component—like ODBC, but for Internet rather than SQL data sources.

True, it came with MSIE, but many important Microsoft components have debuted in an application context and gone on to become integral parts of Windows. That Dave's monitor could quite unexpectedly fetch a secure page convinced me that Winlnt was indeed, like ODBC, the kind of subsystem that makes Windows increasingly useful.

A few days later, while working on a different tool, I stumbled onto the real reason the monitor had failed. The new tool's job was to fetch reports from a partner site, over an SSL connection, and consolidate the data (see the figure on page 97). It worked on one Win32 system, but not on another. One difference between the two, I noticed, was MSIE. The tool worked on the system that had MSIE installed, but not on the one to which I had copied only WININET.DLL. Was the tool depending not only on Winlnt, but also on MSIE? It was. Moreover, I found I could break the working version of this tool by twiddling settings in MSIE's Advanced Internet Options dialog box!

Armed with this knowledge, we went back to have another look at the machine that hosts the site monitor. Was MSIE installed there? Yes. Then, suddenly, I saw what had happened. Dave and I had not installed any software on the machine the day we broke the monitor, but we had used MSIE along with Navigator to try out an experimental new feature of our site.

In the process, we had visited MSIE's Advanced Internet Options screen and changed some settings. One of these was "Warn about invalid site certificates"—the setting that causes MSIE to complain if the X.509 common name in a server certificate doesn't match the host name in a request from an SSL page. What looked to us like a small reconfiguration of MSIE was, in fact, a broader reconfiguration of Winlnt—and therefore of Win32::Internet and our site monitor. Call me old-fashioned, but I don't think system components ought to behave this way.

Maybe I shouldn't have been surprised. If MSIE is part of the OS, perhaps it makes sense that you reconfigure the OS when you reconfigure MSIE. There is precedent for this in Windows. In dial-up networking, for example, I can start by tweaking a particular dial-up connection and end up tweaking systemwide modem properties. Not a great idea to have set this precedent, perhaps, but there it is. What's more, MSIE's Advanced Internet Options dialog box does double duty as Settings > Control Panel > Internet, a systemwide configuration tool.

And yet, I can't help but believe there's something not quite right here. Suppose some database application came with a Settings dialog box that let you tweak the dialect of SQL spoken by ODBC—and thereby affect all other ODBC-dependent applications? Would anyone agree this is right and proper?

Further, suppose that you found it difficult to ship an ODBC application without also shipping Microsoft Access—because only interactive use of Access left the registry in a state where ODBC-based applications would work? That's essentially what I ran into when I tried to package my report consolidator, so that I could deliver it to a McGraw-Hill colleague.

Untangling the Winlnt/MSIE Dependencies

In theory, I should be able to build a version of the report consolidator that runs
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on any vanilla Windows 95 or NT machine (i.e., a machine with no copy of MSIE installed). In practice, I never did figure out how to do this. My WinInet-based software never seemed to behave predictably when I moved it between MSIE and non-MSIE machines.

Here's an example. At one point, I noticed that my program, given no proxy or basic authorization credentials, would pop up a dialog box soliciting this information. Further investigation showed that only the new (MSIE 4) version of WinInet does this. Maybe I just needed to distribute the newer WININET.DLL with my stand-alone program?

I tried that. However, WinInet griped that it couldn't find a routine in another DLL, SHLWAPI.DLL. Should I distribute that one, too?

Clearly, it was on the slippery slope at this point. A quick Dejanews search turned up a litany of woes related to SHLWAPI, WININET, and MSIE. And, of course, since Windows locks down SHLWAPI.DLL at start-up, this wasn't going to be a smooth installation in the best of circumstances. A prospective user of my program would need instructions such as:

1. Reboot.
2. Hit F8.
3. Pick item 6 (Command Prompt) from the menu.
4. Copy a:shlwapi.dll c:\windows\system.
5. Reboot again.

Not too nice. But in the name of science I performed the experiment, and the results looked hopeful. Now WinInet had whatever it wanted in SHLWAPI.DLL. And I got a dialog box for stage 1 of authentication: the proxy server's challenge. However, at stage 2 of authentication, the final destination SSL server, oops... error in KERNEL32.DLL.

I tried a lot of things. In addition to Perl's Win32::Internet, which apparently does not handle proxies or basic authentication in an SSL context, I experimented with a few C++ programs that used WinInet. Both worked on MSIE machines. Neither one worked on non-MSIE machines. Eventually, I gave up and went looking for some other solutions.

**Alternatives: SSLeay and IAIK-SSL**

My report consolidator is a two-stroke engine. First, it fetches secure pages, and then it launches Perl to consolidate the data. What's another way to do the first stroke? Browsers can fetch pages and can also behave like components. For example, you can drive MSIE or Navigator, on Windows, using OLE Automation.

However, this didn't look like an attractive option. I wasn't sure that OLE Automation could handle the authentication dialog boxes. Moreover, the process actually needs to fetch two secure pages, each requiring a different set of credentials. When you do this manually, you have to quit the browser after the first fetch, in order to reset the credentials for the second, and this stop-and-restart scenario would have to be replayed under OLE Automation.

Next I tried SSLeay, Eric Young's freeware implementation of SSL. It was a snap to build SSLeay on a Silicon Graphics Irix system, and equally straightforward to adapt sconnect, a sample page fetcher included with the kit, to handle proxies and basic authentication.

However, my colleague runs Windows 95, not Irix, so I next tried the Win32 make file included with SSLeay. It has been recently upgraded and is now as competent as the Unix version. In short order, I had a redistributable package that I could send my colleague—the SSLeay Win32 libraries, a version of sconnect, and a Perl script to consolidate the pages that were brought back by sconnect. Everything worked like a charm on a vanilla Windows 95 machine.

Unfortunately, I soon learned I could not send that package to anyone. When I went back and read the fine print, I realized I'd probably broken the law. Inside the U.S., use of SSLeay infringes patents held by RSA Data Security.

The right thing to do, according to Eric Young and RSA, is to link SSLeay with RSAREF, a reference implementation of the patented algorithms that RSA makes freely available. That's easier said than done, however.

Another alternative, which was mentioned in last month's Toolwatch, is IAIK-SSL. It's a snap to build an automatic SSL client with IAIK-SSL. But like SSLeay, this toolkit also does not use code licensed from RSA, and thus constitutes patent infringement if used in the U.S. What's more, there's no available Java counterpart to RSAREF. JavaSoft offers JSafe, but it's pricey.

Sun's Java Electronic Commerce Framework, which is now in alpha release, is another possibility. However, it's probably overkill for simple chores such as my report consolidator. Web-spidering technology is, from a certain perspective, the ultimate middleware. Tools that enable Web spidering are simple, universal, and powerful.

Unfortunately, and for a variety of reasons, it's not straightforward to use these tools in SSL environments. I hope that this situation improves. Many of the most interesting applications on my to-do list will benefit from, if not require, secure channels.

So how did I deliver my report consolidator? Well, actually I didn't. For now, I've delivered only the Perl postprocessor; my colleague will have to fetch the pages interactively. I make the same application available to our sales staff, but without a client component. It runs on an NT server, where, provided I'm careful about how I use MSIE, I can leverage WinInet. This certainly isn't a very pretty picture. If there are better solutions, I'd like to hear about them.

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The Federated Database

For the past two months' columns, I've been reviewing Java-based object-oriented database management systems (OODBMs). I continue this month with a look at Objectivity/DB, from Objectivity, Inc. I've been working with the beta release of Objectivity/DB version 5 for Java (developer prices range from $8000 to $12,000, run-time prices vary), running on Windows NT 4.0.

Objectivity/DB is similar to Poet (see "Poet Goes Java," December 1997 BYTE) in that an Objectivity database can be accessed either by C/C++ or Java client applications. Objectivity/DB's structure differs from both Poet and Objectstore/PSE: Specifically, Objectivity/DB is not built on a strict client/server architecture. Instead, Objectivity services are linked into the application, which accesses the actual database directly. You'd think that the result would be large applications (since code normally on the server is in the client), but Objectivity engineers report that an Objectivity application (with the "server" code linked in) is between 1 and 1.5 megabytes—not bad in this day and age.

Objectivity applications do require the presence of an Objectivity lock server somewhere on the network. The lock server doesn't perform any real database access. Instead, its job is to provide a centralized resource manager that enforces concurrency throughout the database.

"Database" is an overloaded word in the Objectivity world. What other systems refer to as a database, Objectivity refers to as a federated database—a collection of databases. Functionally, your application can access multiple databases simultaneously, all under control of the single lock manager. These multiple databases make up a federation. Most important, all the databases in the federation participate in concurrency controls. The effect is that your application can start a single transaction involving objects from multiple databases, and the coding is no more complex than had you initiated that transaction on a single database.

Objectivity recognizes a variety of "species" of objects. The fundamental storage unit is referred to as a basic object. A basic object corresponds to the classes within an application that, by being derived from persistent capable superclasses, can be stored in a database. As with Poet and ObjectStore/PSE, storable basic objects are persistent objects.

Note that some classes that are not persistent can create objects that are stored in a database as attributes of a persistent class. For example, you can use objects of the string class as attributes for persistent classes, and these string objects will be stored with the persistent object. But you cannot use a string object to create a persistent object. As it turns out, you don't simply store basic objects directly in a database; you must first place basic objects into a container object (this operation is called clustering). A container object acts not only as the storage framework for collections of basic objects, it also serves as the elementary locking unit within an Objectivity/DB database. If you lock an object, you lock the entire container for the object and all other objects within that container.

Objectivity/DB's browser provides a view into the Vrc federated database.
An application locks a container using one of two access policies: exclusive or multiple readers, one writer (MROW). The former provides strict read or write locking, such that a read lock excludes all write locks, and a write lock excludes all locks. MROW allows unlimited read locks, but only one write lock on the container (thus providing additional concurrency). Hence, you should carefully balance the structure of the overall database in terms of containers versus basic objects. Few containers, with many objects in each container, reduces concurrency because one user’s lock on an object in a container locks all other objects within the container from other users. However, having many containers with just a few objects increases overhead in the database.

In addition, containers can be defined as being garbage-collectible: Any object within a garbage-collectible container is automatically deleted when all references to that object (from other persistent objects) have been eliminated. The converse of a garbage-collectible container is a nongarbage-collectible container. Objects within this type of container must be explicitly deleted. (Note: Here’s where Java shines. Recall that Objectivity/DB supports C++ clients. However, C++ clients do not support garbage-collectible objects. The same mechanism that allows Java to garbage-collect transient objects, as part of the way that the language’s environment naturally works, gives it the ability to collect persistent objects; no such mechanism exists in C++.)

As with other OO databases, all operations that perform database access must take place within a transaction. Actions on the database are not visible to the “outside world” until the transaction completes. However, modifications to the database are visible to those portions of an application within the transaction. This aspect of a transaction is referred to as isolation.

Any access to a persistent object within a transaction proceeds along the following steps. First, the application (with the help of Objectivity methods) creates a local (transient) representation of the object. Next, the persistent object is locked in the database (safeguarding against meddng by other applications). This locking is performed for the application on behalf of the Objectivity transaction run-time code. Finally, the actual data is fetched from the database and “poured” into the waiting transient object.

Numerous options are available to enhance an Objectivity database installation. Objectivity/FTO (fault tolerant option) lets you partition a federated database into autonomous pieces so that, if a portion of the database goes down, those pieces still “alive” remain available. With the Objectivity/DRO (data replication option), you can create database “mirror images” for critical applications that cannot endure downtime. If one image goes down, the mirror takes over.

Objectivity adheres to the Object Database Management Group’s ODMG-93 standard; the company has added useful extensions, such as indexes and containment iterators. Given that an Objectivity database is accessible from Objectivity “front ends” that can be Java, C++, Smalltalk, or even SQL, Objectivity/DB is a good candidate if your enterprise’s database access must extend across language boundaries.

WHERE TO FIND

Objectivity, Inc.
Mountain View, CA
850-254-7100
fax: 650-254-7171
http://www.objectivity.com

Developers interested in the pending Enterprise JavaBeans specification (still under development at the time of this writing) can get an inkling of its final form thanks to Powersoft’s Jaguar CTS (component transaction server). The general availability version of Jaguar was released last fall and, according to Jaguar engineers, tracks closely the Enterprise JavaBeans specification. That specification promises to extend JavaBeans’ distribution capabilities into the realm of transaction coordination.

Jaguar is middleware, an application server. Components installed in Jaguar become usable across whatever network the Jaguar server is connected to (which can include the Internet). And the diversity of components that Jaguar supports is eye-opening: A single Jaguar server can juggle JavaBeans, classes, ActiveX controls, and even DLLs.

If component diversity is Jaguar’s proudest trait, transaction management is its strongest muscle. In many ways, Jaguar is like Microsoft’s Transaction Server. It removes from the developer any concern for transaction management details. Any component installed in the server is a candidate for participation in a transaction. More important, no component in a transaction need concern itself with the behavior of other components in regards to their effect on the transaction—Jaguar handles all that.

Here’s an example. Suppose you have three components—A, B, and C—that you want to use in a transaction. Jaguar provides a small but versatile API that components call in order to keep the server informed of each component’s transaction state. So, if components A and B succeed, while component C fails, the Jaguar server aborts the overall transaction and deals with the dirty work of issuing rollbacks on whatever database resources A and B were communicating with.

As mentioned, Jaguar is not limited to Java components. A Jaguar component can as easily be a C/C++ DLL or an ActiveX control. So, a client-side application written in Java can not only remotely invoke a JavaBean or class, it can as easily invoke a C/C++ routine in a DLL, or an ActiveX control. (Similarly, a Jaguar client could be an ActiveX control, calling a JavaBean or a C/C++ DLL.)

Jaguar comes with the necessary tools for generating the stub files needed for a Java client to communicate with a Jaguar component (regardless of the component’s species). The stub files contain “mirror” methods that appear to the Java client application as the methods of the remote component. Within the stub is the code that establishes a session with the Jaguar server and commands the server to instantiate the actual component. The stub also handles the client end of marshaling the data between the client and the Jaguar server.

Pricing for Jaguar starts at $135 per seat. However, developers can get a jump-start on working with Jaguar by purchasing the $295 software development kit. This is a fully functioning Jaguar system whose only limitation is the number of simultaneous connections allowed. (For details, check the Jaguar site at http://www.powersoft.com/products/jaguar.)
It's a third generation Java tool. But you've never seen anything like it.

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Vendors use it to do jobs too demanding for SCSI, and it undercuts pricey SAN solutions. By Michael Hurwicz

Swimming the Fibre Channel

Peek into your crystal ball. Can you see a cluster of Intel servers—some in one data center, some in another? Now look closer. What's the server-to-server interconnect? How about server-to-storage? Are the two interconnects the same? If so, you may be looking at a Fibre Channel future. Note: If you use a lot of these clusters, your crystal ball is probably tuned to 1999 or later.

Fibre Channel is a high-speed serial-interconnect technology, defined by the ANSI T11 committee, with roots in high-bandwidth peripherals for supercomputers, mainframes, and Unix servers. Now, Fibre Channel vendors are setting their sights on high-end server-to-server and server-to-storage connections for Intel machines. By 2000, they hope it will be common even on Pentium II machines.

Fibre Channel vendors point to the speed, distance, scalability, and flexibility of their technology. The table on page 104F compares Fibre Channel with other technologies. The comparison with SCSI is critical, because most Fibre Channel vendors now see their initial opportunity in the storage arena, where SCSI is the main competitor.

In addition, Fibre Channel is always hot-pluggable. Devices adhering to the current SCSI standard are hot-pluggable only via proprietary methods.

Fibre Channel's raw bandwidth is a little over 1 Gb/s. If you take off 20 percent for overhead, you get 800 Mb/s (or 100 MB/s). Full-duplex (dual-ported), that's 200 MB/s.

Fibre Channel has plenty of growth potential, too. We could see 10-Gb/s Fibre Channel in coming years.

Released products have not yet achieved Fibre Channel's theoretical distance limit of 10 kilometers without extenders or repeaters. Early products were often limited to 500 meters. Today's products may go up to 2 km. However, 10 km will come eventually.

SCSI is unsuited to long distances, because of the fat cables (50 to 68 wires) necessitated by its parallel architecture. Fibre Channel requires only two wires. That becomes more important as distances increase.

In addition, clocking—deciding where one bit ends and the next starts—is easier with serial technologies, where you don't
Resellers can choose from three Fibre Channel topologies, depending on system performance or packaging requirements.
Are you tired of carrying a half dozen different PC diagnostics?

Would you like full diagnostic capability, all on one disk? Are you chasing intermittent problems or occasional lockups?

Tired of swapping parts on a "sick" machine? Got PCs that refuse to boot?

Read what Jerry Pournelle has to say: "Micro 2000's Micro-Scope and Post-Probe are available separately and in a small kit (the Toolkit), containing diagnostic software and a diagnostic board. If your system fails to boot, this will tell you WHY. If anything will. If it boots but behaves oddly, this gives you a fighting chance of finding out if it's a hardware error. Software for low-level formats of IDE, SCSI, RLL, ESDI and MEM drives. Memory tests. IRQ (interrupt request) tests.... You name it, this tests it. If you maintain PCs, you'll love it. It gets a User's Choice Award."

**Micro-Scope**

- The reason Micro-Scope is so different from any other diagnostic tool, is because it doesn't rely on DOS. It has its own operating system written in Assembler and "C" language. So when you boot Micro-Scope it bypasses the resident Operating System and communicates directly with the hardware. Therefore, it won't lie to you, or give you false information on IRQs, DMA's, ports or memory. In fact, Micro-Scope will allow you to detect whether the problem lies in the supporting system, or the device itself.

- There are over 250 test routines in Micro-Scope for testing all aspects of the hardware. Micro-Scope is a very low-level diagnostic, running independent of the Operating System. Because the tests are being run at this low level, they are accurate in a way that the DOS utilities can never claim.

- Tests include: Microprocessor, coprocessor, real time clock, DMA controllers and channels, all 16 IRQs, speaker, keyboard controller, floppy drives, hard drives, serial ports, modems and parallel ports, CD ROMs, sound cards, keyboard, joystick, mouse, printers, video adapter and monitor.

- If there's one thing that makes Micro-Scope so different from the other diagnostics on the market, it's that Micro-Scope IS NOT A DOS PRODUCT. Micro-Scope has its own proprietary operating system that we designed specifically for testing the hardware and setting up and configuring the computer.

- It is also an excellent systems set-up utility, hard drive utility, CMOS editor and memory tester. The key to understanding Micro-Scope is to understand that because it is based on exact HIM and Intel specifications, it is running ALL ITS TESTS AND UTILITIES AT THE HARDWARE LEVEL, below the Operating System.

- Micro-Scope also includes a comprehensive suite of Benchmark Speed Tests that provide accurate information regarding the microprocessor, math coprocessor, hard disks, CD ROMs, memory access rates and video transfer rates. The benchmarks in Micro-Scope are based upon the Real Time Clock and not making a comparison to another system like other utilities on the market.

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economics of scale they need to compete on price.

Another big problem with Fibre Channel is its lack of integration with legacy storage devices and networks, notes Kon Leong, president of GigaLabs, which is a manufacturer of Ethernet switches. For instance, there is no Fibre Channel-to-Ethernet bridge, and you need a SCSI-to-Fibre Channel bridge to use current SCSI devices on a Fibre Channel network.

**Ethernet Rules Networks**

For server-to-server connections, Fibre Channel also faces formidable competition. For instance, Carl Howe, director of network strategies with Forrester Research (Cambridge, MA), a consulting and market research firm, thinks Gigabit Ethernet could become the standard for all but the most demanding server-to-server applications, where people want all the performance they can get and don't care what it costs.

One approach to the problem of TCP/IP processing load is the Intelligent I/O (I/O) specification, championed by the I/O special-interest group (SIG) and Intel. I/O can speed up I/O processing substantially by using a separate I/O processor to handle real-time functions. Downloadable software upgrades to IP might improve speed.

Another approach is to move TCP/IP functions into switch hardware. Rapid City Communications (acquired by Bay Networks in June 1997) has done that in its F1200 Gigabit Ethernet routing switch that performs IP route computation at switch-like speeds. Similarly, Cisco's Netflow LAN-switching technology, implemented, for instance, in Cisco's 5500 Ethernet switch, achieves near wire speeds with TCP/IP traffic.

**ServerNet and SCI**

Another option for high-speed clustering is ServerNet, from Tandem/Compaq, a full-duplex 40-Mbps interconnect optimized for clustering. Compaq has committed to making ServerNet the standard for Windows NT-based clusters. Even though ServerNet is not an official standard, Intel, Microsoft, Oracle, and Informix have all pledged support. Microsoft includes ServerNet drivers with the Microsoft Cluster Server (MCS, formerly code-named Wolfpack).

There are other players, as well. One of these is the scalable coherent interface (SCI), from Dolphin Interconnect Solutions. SCI now offers speeds of 500 Mbps (1 Gbps bidirectional) and low latencies that are valuable for supporting transaction-oriented applications such as databases. Where SCI achieves a latency of 2 microseconds, FCL might take 20 μs.

**Yes, But...**

Each of the alternatives to Fibre Channel has weaknesses. SCI's technical drawbacks are discussed above.

Ethernet may be 30 percent to 50 percent less efficient than Fibre Channel for typical server-to-server applications, says Forrester's Howe. In addition, Fibre Channel provides error handling in the chip. Ethernet doesn't, so you need a software stack, such as TCP/IP, that does. That means high latencies.

Furthermore, three years from now, Ethernet chips and Fibre Channel chips will cost about the same for comparable speeds, predicts Ed Frymoyer, president of EMF Associates (Half Moon Bay, CA), a consultancy specializing in Fibre Channel. On a cost-per-Mbps basis, Fibre Channel is already less expensive than Gigabit Ethernet today, he adds. Frymoyer also says that he expects three Fibre Channel-to-Ethernet bridges within a year.

As for SCI, it is a parallel technology,

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**Comparing Fibre Channel**

<table>
<thead>
<tr>
<th>Feature</th>
<th>Ultra-SCSI</th>
<th>Ultra-SCSI (current generation)</th>
<th>Dolphin SCI (next generation)</th>
<th>ServerNet</th>
<th>Fibre Channel</th>
<th>Fibre Channel benefit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Speed</td>
<td>40 MBps</td>
<td>80 MBps (640 MBps)</td>
<td>800 MBps (1 GBps dual-ported)</td>
<td>2.4 GBps</td>
<td>Base speed: 100 MBps; 200 MBps in dual-ported design.</td>
<td>Handle increasing quantities of data.</td>
</tr>
<tr>
<td>Distance</td>
<td>Run-of-the-mill SCAl: 3 meters</td>
<td>Differential SCSI: 26 meters</td>
<td>10 meters</td>
<td>30 meters</td>
<td>Up to 10 km with fiber-optic cabling.</td>
<td>More robust (e.g., disaster recovery by using mirrored drives or clustered servers in different data centers).</td>
</tr>
<tr>
<td>Scalability</td>
<td>Up to 15 devices on a SCSI bus. Typically, no more than two servers sharing two SCSI buses.</td>
<td>Up to 15 devices on a SCSI bus. Typically, no more than two servers sharing two SCSI buses.</td>
<td>Shared-memory architecture between compute nodes permits virtually unlimited scalability.</td>
<td>Up to 127 devices on a loop, any combination of servers and storage. Practical limit of 612 on switches.</td>
<td>Server-to-server and server-to-storage. Multiple peripheral command protocols, including SCS1, HIPPI, and IPI-3. Loop and switched architectures.</td>
<td>Growth and upgrades with less disruption.</td>
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limited to one data center. A serial version, planned for 1999, should greatly increase distances and lower costs. By that time, though, Fibre Channel may be too firmly entrenched, consigning SCI to a niche role. In addition, switched Fibre Channel may have hardware latencies comparable to those of SCI.

Step by Step

Logren sees three stages of Fibre Channel adoption: SCSI replacement (starting now); single-vendor, multiserver sites (this year); and multivendor sites (1999). The major opportunity lies in phase three. Until that happens, direct sales may predominate.

"Customers need to evaluate Fibre Channel before buying it," says Michael Dolan, national sales manager with AVDigital (a subsidiary of North American Systems, Minneapolis, MN), an integrator that resells Prisa's products and specializes in the film, video, and post-production industries. "Most of them are still in the evaluation phase."

"We're advising clients to buy from server vendors who are OEMing Fibre Channel," says Logren. "It's safer to go to systems vendors, because they guarantee the management capability."

Nevertheless, even today, customers want to be talking to an integrator with expertise in Fibre Channel, Dolan says.

Integrators will come to play more of a role as multivendor installations become more common. Vendors are working at remedying interoperability problems and testing the results at venues such as Networld+Interop. For instance, at last October's Networld+Interop in Atlanta, switch manufacturers such as Ancor, Brocade, and McData; adapter manufacturers such as Interphase and Jaycor; and storage vendors such as Ciprico all made announcements proclaiming Fibre Channel interoperability.

Fibre Channel U

Salespeople must look for opportunities to take advantage of Fibre Channel's edges over SCSI. One of these is its superior disaster recovery by putting mirrored drives in different data centers.

Fibre Channel's speed, distance capabilities, flexibility, and scalability have earned it a secure niche at the high end of the peripheral market. As it further expands in that market and into the emerging server-to-server market, it is a significant opportunity for resellers who can help customers with evaluation and bulletproof implementations of Fibre Channel technology.

WHERE TO FIND

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<th>Cisco Systems</th>
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<td>San Jose, CA</td>
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<td>612-932-4000</td>
<td>800-272-4618</td>
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<td><a href="http://www.ancor.com">http://www.ancor.com</a></td>
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<td>408-988-2400</td>
<td>800-653-6627</td>
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<td>408-487-8123</td>
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|-----------------------------| San Diego, CA   |
| Sunnyvale, CA               | 619-535-3121    |
| 800-481-3030                | [http://www.jaycor.com](http://www.jaycor.com) |

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Michael Hurwicz is a freelance writer and consultant based in Brooklyn, New York. You can reach him at mhurwicz@attmail.com.
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New wireless products give courageous resellers additional entrees into sales-force automation. By Alan Joch

Sales with No Strings Attached

Nowhere is the potential for untethered access to data more appealing than it is for sales-force automation (SFA). Wireless offers the chance to answer a potential customer's question on the spot—while the sales pitch is still hot. No need to get back to a softened customer with answers about inventory availability, the status of an order, or a new price. The information is at hand, coming at 19.2 Kbps or faster.

After years of false starts, a new collection of hardware and software is promising to give field salespeople airborne access to home-office networks. These products, many of them announced last year and now coming to market, could open up new business for ambitious resellers. But while wireless is shedding its bleeding-edge past, the market still isn't for cowards.

A Familiar Look

What's different this time around? For one thing, the hardware. Instead of souped-up pen-based computers, the hot new SFA device is a familiar-looking gadget: a portable telephone. Salespeople who want to spend their energy hunting down new orders rather than learning to use new technology are less likely to be scared away by devices that are already part of their road-warrior arsenal, says John Pennington, director of technical resources for PenTech (Atlanta, GA), a systems integrator that specializes in SFA projects.

Today's newest wireless phones, including the Nokia 9000i and AT&T's PocketNet (manufactured by Mitsubishi and Samsung), use their screens, keypads, and built-in data/fax modems for two-way data communications in addition to voice calls. The PocketNet, at just 9.6 ounces, maintains the traditional cell-phone form factor, with a tiny 1-by-2-inch screen and a keypad that accommodates only one-finger pecking. The Nokia 9000i, at a heftier 13.9 ounces, cracks open like a jewelry box to reveal a 4¾-by-1¾-inch screen and a 65-character QWERTY keypad that doesn't allow for touch-typing but is easier to use than the PocketNet for knocking out short e-mail messages. Even the PalmPilot, 3Com's big fish in the small PDA pond, has been beefed up to take on the wireless-phone players, thanks to a new wireless IP modem that cradles the PalmPilot and gives it two-way data smarts.

"You can't read War and Peace on a 1-by-2-inch screen, but you can use [a smart phone] to extract key information, such as when an order will ship."

—Gary McGuire

continued
The rest of the mobile SFA story lies in new software designed to turn wireless phones into "smart phones," with the help of the Web. Geoworks and its venerable Geoworks OS, which is for resource-crammed portable devices (including the Nokia 9000), have recently been joined by Unwired Planet, whose new markup language and mini-browser are catching resellers' attention. Add SFA publishers such as Aurum, InfoMan, and Vantive, and this team-building is happening faster than in the baseball expansion draft.

For some field sales applications, these smart phones are replacing a notebook connected to a cell phone equipped with a data modem, a cumbersome mix. The attraction of smart phones is familiarity. "You're not asking salespeople to carry around another device," explains Gary McGuire, practice director for wireless technology at Realogic, a Cleveland systems integrator. "You can't read War and Peace on a 1-by-2-inch screen, but you can use [a smart phone] to extract key information, such as when an order will ship."

McGuire says his company has developed a wireless methodology that it calls Air Strategy. "When we integrate wireless as a strategic tool for clients, we have to help them understand that wireless isn't just a matter of cutting the cord," he explains. If you try to use a smart phone as a notebook replacement for Web browsing, for example, you'll be disappointed with the performance and the monthly communications bill, he adds.

But not all resellers are ready to jump into the SFA wireless stream. "We're still a few years away from wireless becoming an important technology," says Pennington. "Our customers aren't telling us they want it." Even wireless evangelists wince at the pain of past "almost-there" wireless technologies. "The pioneers are the ones with the arrows in their backs, and I'm starting to run out of room on mine," McGuire admits.

**Wireless Web**

The latest candidate for taking wireless from the frontier to civilization is Unwired Planet's three-pronged UpLink technology package. Resellers say its unique markup language, mini-browser, and gateway help alleviate one of the biggest development problems in the wireless sector: The need to develop applications over and over again for a variety of hardware devices. UpLink takes a Web-like, agnostic approach to platforms: Develop once, run on any system.

The heart of the Unwired Planet approach is to connect smart phones and similar devices to Web servers. For developers, the company created and is pushing as a de facto standard the Handheld Device Markup Language (HDML), a knockoff of HTML designed to work within the confines of tiny end-user displays and wireless links to Web servers.

HDML's programming metaphor is a deck of cards, with each card representing a task for the smart phone to carry out. For example, there are cards for displaying data, for issuing a prompt to capture text entered by the user, and for displaying menu selections. All the cards in a deck constitute a single wireless application, and decks can exchange data and processes with other decks.

HDML's cards aren't intended for Web browsing. Instead, the technology emphasizes extracting nuggets of information by presenting end users with succeeding layers of choices that lead them to a desired phone number, inventory item, or product price. Before the information travels from a corporate database to the salesperson in the field, the Handheld Device Transport Protocol (HDTTP) automatically encrypts the data using the HTTPS and SSL protocols.

SFA applications display the information using Unwired Planet's UP.Browser, a small-footprint browser and messaging engine that can flush a message that an important e-mail is waiting for you or that you should call the office. Unwired Planet stripped down the browser by shifting some traditional browser data to an associated gateway server, called UP.Link Gateway. For example, a bookmark—say, a price list maintained at headquarters by sales and marketing—resides on the server rather than on the smart phone to keep the resource requirements to a minimum. In addition to conserving resources, the browser uses easy arrow and hot-key commands designed to help end users navigate the software within a tiny display window.

The UP.Link Gateway is the conduit that connects smart phones running the UP.Browser to commercial wireless networks and on to Internet and intranet servers. When a field salesperson enters a command into the UPBrowser, the native HDTTP request travels to a gateway, which translates the command into standard HTTP or HTTPS code, which is recognizable to Web servers. The native HDTTP request can travel on SMS, CDPD/AMPS, CDMA, GSM, PCs, and TDMA networks, according to Unwired Planet. (For an explanation of these acronyms, see "Air War," August 1997 BYTE.) A relational database within the gateway maintains configuration, registration, and logging information, the company adds.

"The Unwired Planet technology is nice to work with because it's basic Web technology," says Gary Fletcher, president of Sakura Design (Grass Valley, CA), a systems integrator. "The only proprietary component is HDML, but that's straightforward to use. If you have HTML experience, the learning curve for HDML is between a couple of days and a week to get a basic application up and running."

He says that the UP.Link Gateway installation is similarly easy if your application only requires connecting a mobile worker to the Web. "If you want to push information to the field, you need to use a secondary interface in Gateway," he explains. "It's still Web technology, but you move up a level in complexity."

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Another new tool for SFA resellers wanting to go wireless is Geoworks' recent introduction, Wireless Web Access, which tries to make Web exploration more efficient by filtering out graphics and extraneous items on Web pages before end users receive them on their smartphones. The filters, which reside on a proxy server, can convert JPEG to GIF, reformat tables into paragraphs, and remove graphical embellishments.

The result, according to the company, is a time-saving compression of Web pages from an average of 72,000 bytes to approximately 30,000 bytes for a home page with a moderate amount of graphics. The time to download each page to a small-footprint phone like the Nokia 9000i is approximately 31 seconds with compression, versus 1 minute, 16 seconds without, the company says.

**PalmPilot's Encore**

One hardware platform that's being married to the Unwired Planet constellation is the PalmPilot. The PalmPilot's success so far has been primarily as a handy electronic organizer. But its parent, 3Com, hopes to turn it into a more ambitious two-way data device—with the help of Novatel Wireless, which makes a wireless IP modem, called Minstrel, that supports Cellular Digital Packet Data (CDPD) networks. The result is that salespeople can not only carry around their computers but also log in to Web servers to download additional sales information.

The PalmPilot/Novatel duo can support AT&T's PocketNet, a CDPD network service that AT&T has sold to corporations since 1996 and recently made available to consumers and small businesses. The PocketNet service includes wireless e-mail and Internet access.

Resellers and integrators can develop or customize SFA applications with the Palm Operating System, which natively supports TCP/IP and comes with an SDK that includes Metroworks' CodeWarrior for the PalmPilot (in Windows 95 and NT and Macintosh versions).

**Wireless SFA Applications**

SFA is a hot button for wireless data applications because of two characteristics: a need for up-to-the-minute data, and a user base that shuns difficult-to-learn hardware and software, says consultant Tim Bajarin, president of Creative Strategies and a follower of SFA trends. As a result, traditional SFA vendors are announcing wireless strategies using smart phones, which opens the door for further customization by resellers.

For instance, Syclone Unwired Planet's HTML to create a wireless version of its Info Manager contact manager. Field salespeople use the application to connect CDPD-based smart phones to Nortel databases. Auranet Software announced that it's developing a new SFA application that runs under Geoworks and is designed to work with the Nokia 9000i. And Wright Strategies, the four-year-old creator of FormLogic, will develop SFA software for Contact, a handheld personal computer (HPC) with a built-in CDPD wireless and land-line modem. The software supports Windows CE 2.0 and was expected to ship late last year.

In addition, Vantive, maker of the SFA application Vantive Enterprise, has announced MiniVan, a mobile client that gives road warriors access to customer databases. MiniVan is designed to run within the PalmPilot/UPBrowser/Mini-Str�el combination. Vantive Sales is an SFA application that will use the PalmPilot, Microsoft Outlook, and MiniVan.

In most cases, wireless reseller pioneers have platforms dictated to them. For example, "Geoworks is the OS for the Nokia 9000i," says McGuire. Thus, resellers and systems integrators have to keep development staffs trained and ready for many environments. However, this challenge can be a business benefit. The wide knowledge base can make a reseller more competitive and justify charging higher rates. "We view it as an investment in intellectual property," McGuire adds.

**Still Evolving**

Today, having real-time access to corporate data is tough enough to accomplish over wireless networks. The day when field salespeople can achieve real-time order processing—filling in order forms in a customer's office and whisking away a confirmed order to headquarters with a smart phone—may still be weeks away. "There's no question that salespeople will want wireless communications, but its success depends on how the networks evolve," Bajarin says.

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Alan Joch (Francesstown, NH) is a BYTE consulting editor. You can contact him by sending e-mail to ajoch@monad.net.
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Team-Building on the Fly

Individuals, whether they work for a Fortune 500 company or a four-person firm, tend to do a lot of their work in ad hoc teams. And with outsourcing, telecommuting, and business partnerships, the demand for teamware—software that facilitates work flow in small and fluid workgroups—is growing.

Web-enabled enterprise work-flow products range from those that permit real-time collaboration, such as Microsoft's NetMeeting, to high-end structured work-flow development platforms, such as RadNet's WebShare and Lotus's Domino/Notes. Rather than casting work flows into programmed applications, teamware simplifies setup and security to allow team members to build, use, and tear down their work flows as needed across organizational boundaries.

Teamware augments existing user-interaction tools, such as e-mail, newsgroups, voice conferencing, and videoconferencing, while freeing network managers from the burden of setup and maintenance. It also obviates the need for network administrators to manage teams and team resources themselves, and it supports team-oriented activities, such as brainstorming, group discussions, scheduling, and polling, or voting.

Teamware also provides the coordination and data storage needed for team-oriented work. Conventional applications, such as word processors, are still used to create documents that might be stored as part of a team's resources. When a team is all done with a project and ready to move onto a new one, the old team room can be shut down.

The problem with just using e-mail is that each user must maintain a copy of all relevant information and determine who should be sent a copy. Newsgroups help alleviate this problem, but they normally require configuration by the network administrator, and they don't address other teamware actions, such as polling and scheduling. Real-time conferencing tools, such as a whiteboard, audio conferencing, and videoconferencing, typically augment teamware products, providing long-distance, real-time interaction.

I reviewed five teamware servers that offer out-of-the-box operation with no programming required: Changepoint's IntranetFacilitate.com's Facilitate.com, Instinctive Technology's eRoom, Lotus's InstantTeamRoom, and TeamWave Software's TeamWave Workplace. Instinctive's eRoom requires Microsoft Internet Information Server (IIS) or Personal Web Server (PWS) and supports only Windows clients, while Intranet and InstantTeamRoom run on top of the Lotus Domino server and can handle most Web clients. Facilitate.com runs on IIS or any Web server that supports CGI/NSAPI, both on Windows and the Mac, while TeamWave Workplace is a dedicated client/server application that runs both client and server on Mac, Windows, and Unix platforms. Lotus offers InstantTeamRoom service directly, as well as through other ISPs over the Internet—billed at a flat monthly rate and requiring only a Web browser as the client.

At Your Service Provider

Based on TCP/IP, these teamware products work equally well over intranets or the Internet. Using teamware through an ISP makes sense for small, mobile groups, especially those whose members belong to different organizations.

A team room can be set up in 15 minutes or less. There's no additional ISP configuration needed, and participation in a team room is by invitation only. All five products are available for intranet use except for Lotus InstantTeamRoom, which is initially available only through ISPs providing InstantTeamRoom services.

Large organizations might find that hosting their own teamware server makes economic sense. These servers typically need a minimal amount of maintenance, unlike Web servers, which have regular content updates. Organizations of all sizes can benefit from an intranet teamware installation.

Facilitate.com 4.5

Facilitate.com displays all the polish of a mature product, particularly in its administration and customization tools, which were among the best of the products reviewed. You can use any Web browser that's compatible with Navigator 2.0 or higher with Facilitate.com. I tested it with both Microsoft Internet Explorer and Netscape Navigator. I was impressed with the ease of use and the comprehensive administration of team information. For more information, visit http://www.facilitate.com/.
Despite the universality of the Web client, each of these Web work-flow programs uniquely adapts the browser interface for teamworking functions.

Explorer (MSIE) and Netscape Navigator 4.0. Topics (Facilitate.com’s default name for team rooms) are configured by a team facilitator who has facilitator privileges. The server’s administrator can limit the kinds of topics that can be created, as well as the administrative program running on the Windows NT server to tweak options such as display fonts, and thus configure the look of Facilitate.com pages.

The configuration of individual topics is handled through a browser interface.

The program lets you have three types of users: administrators, facilitators, and users. Administrators and facilitators can create topics, while everyone can access them if they have the passphrase. Each conference consists of a list of topics and subtopics that contain items, each of which can have a description as well as a URL and a file attachment. Graphical file attachments can be displayed directly within an item; a team member doesn’t have to click on an icon to view a file.

Facilitate.com conferences can have different modes, depending on what function a team is doing at a given time. For example, the conference can be set to brainstorming mode to allow members to share their ideas, or to voting mode when it’s time to come to a team decision. A chat mode is also available in Facilitate.com, although it can be a bit slow, and there’s an option to send group broadcasts to relay messages to all team members.

Facilitate.com’s lack of a scheduling option is a drawback, but it also tends to make the program easier to use and manage. Likewise, the use of conference mode-shifting might seem odd at first, but it works surprisingly smoothly.

eRoom 1.0

Despite its recent entry into the market, Instinctive Technology’s eRoom sports one of the sharpest interfaces and some of the best features of the bunch, although its interface depends on the Microsoft ActiveX interface and requires clients to run 32-bit Windows and MSIE 3.0 or higher; users of Navigator 3.0 and higher must use
a plug-in. An updated plug-in for the current version of Navigator wasn't ready in time for my testing, nor was support for MSIE 4.0. Likewise, the server runs only on Microsoft IIS or PWS.

Instinctive Technology's use of ActiveX might limit users to these supported platforms, but it significantly improves the user interface, adding juicy features such as the drag-and-drop addition of file attachments. Rooms in eRoom present a list of objects that have been added to a room, which can include folders, discussions, files, notes, URLs, polls, and versioned files. Folders can, in turn, contain any other objects, including more folders. Versioned files allow multiple iterations of the same document to be stored and accessed as necessary. Polls are single-question surveys with up to eight choices and an optional write-in vote. Multiple-poll objects can be in any room or folder, but chat and scheduling are not supported. The eRoom program supports e-mail notification of changes and invitations, with support for full-room or read-only participation.

The eRoom user interface will be very familiar to Windows users; the program's object-creation process uses a wizard-style approach, and the icons look like Windows icons. Of the products reviewed, I found eRoom to be the easiest to use. For a first release, it's a very polished program.

**Involv Intranet 2.0**
ChangePoint's use of Lotus Domino as the engine for Involv Intranet has several implications, which will also be applicable to Lotus's own Involv TeamRoom product when it's made available to organizations. First, Involv takes on important Domino features—in particular, the ability to replicate information across servers. Second, workgroup-application developers can tackle more sophisticated applications with Domino's programming environment. Likewise, Involv can integrate existing Domino applications with additional programming and configuration.

Most Involv installations will probably not make use of these features initially. Instead, Involv's extensive features set and excellent user interface make it an impressive addition to any intranet, or even the Internet, right out of the box.

The program employs a tabbed notebook presentation, using a Web browser that supports frames. The multiframe interface makes it extremely easy to navigate, but a 1024-by-768-pixel resolution is necessary to keep the sometimes-smalish and vertically tabbed text legible.

The program provides each user with a workspace that can be populated by tools shared among users. These include tools for document management, event planning, project management, and team collaboration; available tools can be viewed and selected by category, name, or type. The program sends e-mail to notify users of group-membership changes as well as to invite them to join applications. The impressive tool set still lacks real-time interaction except for its basic chat support, but it offers the most complete scheduling support of all the products reviewed.

Domino requires some hefty processing resources, and Involv only adds to that need. Luckily, Domino supports multiprocessor systems, so large Involv sites are
## Features

### Platform Support

<table>
<thead>
<tr>
<th>Feature</th>
<th>Changepoint</th>
<th>Facilitate.com, Inc.</th>
<th>Instinctive Technology eRoom 1.0</th>
<th>Lotus InstantTeamRoom 1.0</th>
<th>TeamWave Workplace 2.1</th>
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<tr>
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<td>✓</td>
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### Services

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<th>Lotus InstantTeamRoom 1.0</th>
<th>TeamWave Workplace 2.1</th>
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### Tools

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<tr>
<th>Feature</th>
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<th>Lotus InstantTeamRoom 1.0</th>
<th>TeamWave Workplace 2.1</th>
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<td>Whiteboard</td>
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<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>

* = BYTE Best

✓ = Yes; N/A = Not applicable.

1. Supports Win32/Mac OS servers with CGI/NSAPI support.
2. Support for IE 4.x and Navigator 4.x will be available by press time.
3. Application development through Lotus Domino.

Possible. Although Lotus has lowered the high cost of investing in Domino, the expense of setting up Domino plus involve on a high-end system might be more than some organizations can justify—particularly if they already have a significant investment in other intranet infrastructure products based on Windows or Unix. A Domino server will operate in a mixed environment, but Domino-based applications may not interoperate well—if at all—with other legacy systems.

At $5000 per server and as much as $90 per user, Involv Intranet can get pricey, but it's still a hands-down, no-brainer choice for Domino installations with deep pockets. Others should consider it but also check out alternatives if Microsoft IIS or budget constraints are a part of the puzzle.

### InstantTeamRoom 1.0

Lotus designed InstantTeamRoom as a service that ISPs could deliver as a value-added service to their customers, but the company might make an intranet version available to organizations as early as this year. The service is now available from ISPs Interlan, Netcom, and U.S. West, and it's also available directly from Lotus. The going rate is $14.95 per user, per month, with no limitations on the number of conferences created or the amount of storage used for file attachments. All you need to get started is a credit card and a browser that supports Java (Navigator 3.0 or higher or MSIE 4.0 or higher, on any platform).

Once you're set up, you can start creating TeamRooms simply by inviting participants, although the Room's creator pays for all invites to the Room, whether they participate or not. Included with the package but hidden from users are support for customer tracking and billing. Invitations are easy to make as long as you've got all the invitees' e-mail addresses. InstantTeamRoom generates and sends each participant (and only those participants) a message with a log-on name and password.

Like Involv Intranet, InstantTeamRoom runs on top of Domino. It provides basic discussion, brainstorming, and file-shar-
ing support, but it lacks involv's sophistication and the real-time support found in TeamWave Workplace. On the plus side, the product's limited functionality simplifies the user interface. Unlike the other products reviewed, InstantTeamRoom links anyone with a browser and e-mail from anywhere; it's an ideal extranet solution for small workgroups spanning different organizations.

If you and your workgroup can access the Internet, then you can get up and running on InstantTeamRoom with a minimal investment of time and money. Expect ISPs to jump on the teamware bandwagon once users see how easy InstantTeamRoom can be to set up and use.

**TeamWave Workplace 2.1**

TeamWave Software’s TeamWave Workplace server/client software runs on a variety of platforms, including Windows 95 and NT, the Mac, and assorted Unix flavors. For now, TeamWave Workplace is strictly TCP/IP client/server, meaning it works over the Internet or any intranet; Web-client support, via a plug-in, and integrated MAPI e-mail support are planned for sometime in the future.

Price is key to TeamWave’s success. At $50 per user—comparable to about three months of Lotus InstantTeamRoom—TeamWave includes asynchronous interaction with bulletin boards and brainstorming, as well as live interaction with chat and support for whiteboarding. Like eRoom, TeamWave allows any number of objects to be created and placed in a workgroup room. One deficiency is that objects cannot be viewed in a list mode, nor can you search for them. On the other hand, the graphical display of objects on the whiteboard allows users to see multiple objects at one time. You can add annotations directly to the whiteboard, and there are even sticky-note objects.

TeamWave’s object list is extensive, with everything from calendars to discussion groups supported. Polling objects handle only a single question at a time, but multiple polling objects can be created. A chat window is standard and sits at the bottom of the screen so users can dispense with telephone contact but still interact with each other in real time. Application developers can even customize TeamWave with the Tel script writing language.

One major drawback hobbles TeamWave: an out-of-date client interface. It uses Unix Motif–style windows management: You move windows by dragging on their edges, and you resize them by dragging on corners. TeamWave objects are functional but limited. For example, the database object allows you to add any number of fields, but it has only rudimentary forms support.

Balancing out these significant drawbacks, however, are some nice features. For instance, the program lets you know in real time who else is visiting a room. It also offers TeamWave URL and door objects, which allow users to move quickly to Web pages or other TeamWave rooms by double-clicking on the object.

TeamWave is a reasonable option for small workgroups looking for a simple teamware solution, as long as they don’t mind adding yet another client to their desktop. TeamWave could use a good bit of polish, but it’s a diamond in the rough that’s worth checking out.

**Joining the Teamware**

Each reviewed product fits into a distinctive group, which may make your purchasing selection a bit easier. For instance, InstantTeamRoom is currently the only choice for hosted Internet support. Installations already using Domino are likely to choose Changepoint’s Involv or Lotus’s InstantTeamRoom. Likewise, people using Windows NT Server with IS might gravitate to Facilitate.com or Instinctive Technology’s eRoom.

Meanwhile, TeamWave Software’s TeamWave Workplace is the only product that provides full real-time whiteboard support as part of the basic package. TeamWave’s lack of Windows NT service support might present a security issue, but it’s still a workable solution.

Finally, firewall issues might eliminate some products. For organizations that strictly use a Web server via HTTP, InstantTeamRoom and Involv can work best. Organizations interested in providing fee-based teamware services should check out Involv or InstantTeamRoom, Facilitate.com, and eRoom.

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BMW - Innovations in Automotive Safety

Commentary From
BYTE
Editor In Chief, Mark Schlack
Lab Report

Hardware

The newest hard drives are high-speed, high-capacity marvels: better, cheaper, and able to pack more data into ever-smaller volumes.

By Russell Kay

Storage: Part I

15 Disks Cover More Data Than Ever

Even years ago, I bought a hard disk I thought would be big enough to last me for years to come: It was a 3½-inch SCSI monster that held 80 MB. So much for predictions. Four years ago, a 500-MB drive was considered pretty big. Today, it's tough to even buy a new desktop computer from a discount store with less than a 3-GB hard drive. The growth of storage in our computers has outpaced even Moore's Law.

With that in mind, BYTE looks at what's available in disk drives today, and we've found that it's an impressive lot. We've organized our disk report into categories by capacity and intended use. First, 4- to 7-GB drives, intended mainly for desktop workstations; second, 8- to 11-GB drives, intended mainly for server use, though applicable to higher-end workstations as well; and third, SCSI drives holding more than 11 GB, for servers and audiovisual applications.

We asked each of the major disk vendors to submit up to two drives in each of our three categories. We received test units from Fujitsu, IBM, Maxtor, Quantum, Seagate, and Western Digital. At test time, Hitachi and Samsung said they had no appropriate models available. And Micropolis, which had shown some interesting new disk drives, was abruptly and inconveniently put out of business by its Singapore parent company.

This last event brings up an interesting point: the shrinking community of disk drive producers. According to data from Western Digital, in 1985 there were nearly 60 disk drive manufacturers in the market. Today, only about a dozen makers account for virtually all the drives sold. Ironically, even though the number of hard disk vendors has decreased, hard disk storage continues to be a thriving business. The American Stock Exchange announced last fall the addition of a new equity index (DDX) composed of companies that manufacture computer disk drives of all form factors and capacities, as well as related components.

The unrestrained growth in disk storage should raise a warning flag when it comes to backup. With disks so large, your backup system has to be equally capacious. In "The Changing Face of Backup" (page 116), we take a look at the growing array of backup options: removable media, tape and disk, magnetic and optical. Solid-state's much too expensive for backup.

For our tests, vendors submitted the highest number of drives in the middle-size, server-class category, where 9 GB is the apparent sweet spot, the size that most network administrators will be most interested in. Large capacity plus a small form factor (the standard is now 3½-inch drives just 1 inch high) combine for cost-efficient RAID arrays. Also, this amount of storage seems to represent the threshold at which a service technician can manually replace a drive and restore or reinstall its applications in a single day. Plus, you can plug in these models as direct replacements for your currently installed 4.5-GB drives.

In comparing disk drives as disparate as this current group, we considered that drive capacity would, to some extent, be an indicator of typical use. The smaller drives are more likely to be used in workstations and desktop applications, while bigger, faster drives, especially those with a SCSI connection, are prime candidates for use in servers. And then there are the two biggest drives—IBM's 18-GB Ultrastar and Seagate's 23-GB Elite—which are likely to find use in large server installations and in video production.

When it comes to disk drives, BYTE considers three factors: performance, reliability, and price. To evaluate this new crop of drives, we tested performance by measuring data throughput. Some vendors have made a lot of noise about designs with faster access times, higher rotation speeds, improved resistance to vibration and shock, and bigger on-disk caches. But, for practical purposes, all those parameters can be subsumed in one test by measuring throughput.

To test throughput, we installed each drive in a Dell Optiplex GXpro 200 with 64 MB of RAM. The IDE and ATA drives were connected to the on-board...
**MAGNETORESISTIVE HEAD(S)**
The magnetoresistive (MR) read head senses the magnetic fields emanating from the disk surface with a much greater sensitivity than conventional inductive heads. Next-generation drives will use the spin valve head, a type of giant MR (GMR) sensor, which is even more sensitive and will enable higher areal densities.

**PLATTER(S)**
This stack of disks in a high-performance server drive is spun at 7200 to 10,000 rpm by a spindle motor built into the hub. Most manufacturers put servo data all over the disks, on all the tracks, and no longer use a dedicated servo.

**ACTUATOR**
All drives need an actuator, which accurately positions the read/write head over the desired track.

**CONNECTORS**
Connectors provide the interface to ATA, SCSI, or Enhanced IDE subsystems.

**DISK DRIVE CACHE**
More memory chips on a drive’s circuit board equals a larger cache. This allows a hard disk to hold more data in cache memory and complete read operations without having to wait to read it from the disk. Some drives, such as this one, are available with a full megabyte of segmented cache buffer.

**POWER CONNECTOR**
With a brand new drive, sometimes the power connector and the interface do not slide together as smoothly as you would like. The temptation is to rock them back and forth; however, this can cause damage to the connector pins or housing.

**DRIVE ELECTRONICS**
This printed circuit board holds the actuator, motor drivers, disk drive controller, and interface electronics for storing and fetching information on the disk. The PCB also contains protective sensors to ensure reliability.

**JUMPER BLOCK**
Jumpers provide configuration and allow you to set such things as SCSI ID, parity, and hardware compression.

Illustration based on the IBM Ultrastar 18XP.

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Enhanced IDE (EIDE) controller, and the SCSI drives were connected to an Adaptec AHA 2940W/2940UX SCSI controller.

We feel that many specific design choices really don’t matter in the end to most users, provided the drive delivers data as quickly as it’s called for. Similarly, problems associated with vibration (as might be encountered in a server’s large array of drives, for example) show up mainly as thermal aspersities and, ultimately, in reduced throughput. The table on pages 118-119 details the specs for each drive.

Ultimately, we recognize that the drives we tested—big as they are now—will be considered midjits in a few years as newer and nonmagnetic technologies enter the market. Even with magnetic disk drives, as Ed DeJesus explains in “Infinite Space” (page 121), manufacturers are achieving ever-greater storage densities by using magnetoresistive (MR) and MR-extended (MR-X) heads in place of the older, thin-film technology. Western Digital was the last major disk drive manufacturer to adopt the newer head design. Now IBM, which invented MR and MR-X technology, has announced a giant MR (GMR) head that permits record/playback densities of 10 times what we’re seeing in early 1998. The company has already announced the first GMR drive, one that packs more than 16 GB into a 1-inch-high form (and one we plan to review in an upcoming issue).

So look over our test results and product specs, then buy whatever disk drives you need right now. But you should realize that the picture is likely to be radically different in another year.

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Linda Higgins, Editorial Associate/BYTE
Russell Kay, Technical Editor/BYTE
Michelle Campanale, Technical Editor/BYTE
In the desktop group, holding 4 to 7 gigabytes, mostly EIDE or ATA drives, there's a big difference in what's available. Prices cover almost a 3:1 ratio. The Maxtor DiamondMax 1280, the least expensive drive in this report, got top marks in performance. Curiously, its brandmate, the DiamondMax 1750, was one of the poorest performers in our tests. The smallest drive we reviewed, the IBM Ultrastar 9E5, was the most expensive unit in this group, which helped move it toward the bottom of the ratings.

In the midsize, server-oriented group (8 to 11 GB), we found an even bigger price spread. The Maxtor DiamondMax 2160 took top honors because of its price and good showing on the MPC benchmarks. It didn't perform nearly as well on the ThreadMark test, however, so it might not be your best choice for a server application. Here, the Seagate Medalist Pro, an ATA drive, is an excellent choice. In our tests, it significantly outperformed its speed-racer brother, the 10,000-rpm Seagate Cheetah 9, which also costs twice as much.

The two IBM drives in this group are quite different from each other. The Deskstar 8 is really designed to be a workstation drive, even though its 8.4-GB capacity puts it in with the server drives in our tests. The Ultrastar 92X, a relatively new drive from IBM, uses MR-X (magnetoresistive-extended) heads and a SCSI connector. This Ultrastar and the Seagate Medalist Pro got the highest ThreadMark scores, by a significant margin, of all the drives we tested.

The two models in our behemoth group (18+ gigabytes) are as different as they can be. The IBM Ultrastar 18XP is brand new and uses MR-X heads for high-density recording. The Seagate Elite 23 is the only 3.5-inch drive in our report, so its larger capacity isn't as much of an accomplishment as it might first seem. (But see "Details" on page 116 before dismissing Seagate.) For an overview of how all the tested drives performed, see the performance chart (page 117) showing both the MPC benchmark results and the ThreadMark scores.

**TECH FOCUS**

**Drive Architecture**

**Bearing the Load**

Last fall Seagate released its 7200-rpm, 9.1-GB Medalist Pro 9140, which features a fluid dynamic bearing motor. In December, the company unveiled a high-performance drive with this type of motor, 12 platters, and 45-GB capacity. Expect to see this technology in 2½-inch drives soon, Seagate says.

Seagate admits the technology is not new; it has been used in gyroscopes and high-accuracy machine tools for 50 years or more. However, when applied to disks, it brings a new level of mechanical damping into the drives, helps make the drives more stable, and improves their ability to read and write tracks. In a nutshell, using fluid dynamic bearing motors results in drives that are quieter, use less power, and perform better than existing drives with ball-bearing motors.

Other advantages include relative high damping, compared to ball bearings, which allows the disk to read and write at very high speeds with virtually no vibration over the tracks. This kind of drive can also read and write very accurately on a higher number of tracks per inch. Additionally, noise is lowered by fluid dynamic bearing motor technology. Without ball bearings there's no metal-to-metal contact.

Serious advances with these motors will continue within the next 9 to 24 months, according to Gunter Heine, vice president of Seagate's Motor Group. This is because Seagate (along with its three strategic supply and manufacturing partners) has a relative lock on how the drive components are made. Though fluid dynamic bearing motors offer significant advances in shock and acoustics, vibration, and fatigue life (number of hours before metal fatigue sets in and causes bearings to fail), Seagate has managed to keep the cost down to around the same as ball-bearing motors. It's just a matter of time before competing companies catch up.

- Michelle Campanale
LAB RATING RESULTS

BEST OVERALL:
DESKTOP DRIVES (4-7 GB)
Maxtor DiamondMax 1280
The top performer at a very good price, the DiamondMax 1280 easily won this category. Its fast ATA-4 interface allows it to pop right into most desktop systems.

<table>
<thead>
<tr>
<th>CAPACITY (GB)</th>
<th>INTERFACE</th>
<th>PRICE</th>
<th>TECHNOLOGY</th>
<th>PERFORMANCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maxtor DiamondMax 1280</td>
<td>5.1 ATA-4</td>
<td>$309</td>
<td>***</td>
<td>*****</td>
</tr>
<tr>
<td>IBM Deskstar 8</td>
<td>8.4 ATA-3</td>
<td>$319</td>
<td>***</td>
<td>*****</td>
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<tr>
<td>Fujitsu Desktop Series MPB3064AT</td>
<td>8.5 ATA-3</td>
<td>$429</td>
<td>***</td>
<td>*****</td>
</tr>
<tr>
<td>Western Digital Caviar 3640</td>
<td>8.4 EIDE</td>
<td>$380</td>
<td>***</td>
<td>*****</td>
</tr>
<tr>
<td>Maxtor DiamondMax 1750</td>
<td>7.0 ATA-4</td>
<td>$379</td>
<td>***</td>
<td>*****</td>
</tr>
<tr>
<td>IBM Ultrastar 9ES</td>
<td>4.5 SCSI-3</td>
<td>$719</td>
<td>***</td>
<td>*****</td>
</tr>
</tbody>
</table>

BEST OVERALL:
SERVER-CLASS DRIVES (8-11 GB)
Maxtor DiamondMax 2160
This DiamondMax took top honors in the MPC benchmark, but it didn’t fare as well with ThreadMarks. So, it’s a good candidate for higher-end workstations. For server use, consider Seagate’s Medalist Pro 9140.

<table>
<thead>
<tr>
<th>CAPACITY (GB)</th>
<th>INTERFACE</th>
<th>PRICE</th>
<th>TECHNOLOGY</th>
<th>PERFORMANCE</th>
</tr>
</thead>
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<tr>
<td>Maxtor DiamondMax 2160</td>
<td>8.4 ATA-4</td>
<td>$459</td>
<td>***</td>
<td>*****</td>
</tr>
<tr>
<td>Seagate Medalist Pro 9140</td>
<td>9.1 Ultra ATA</td>
<td>$495</td>
<td>***</td>
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</tr>
<tr>
<td>IBM Deskstar 8</td>
<td>8.4 ATA-3</td>
<td>$399</td>
<td>***</td>
<td>*****</td>
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<tr>
<td>IBM Ultrastar 9E</td>
<td>9.1 SCSI-3</td>
<td>$1245</td>
<td>***</td>
<td>*****</td>
</tr>
<tr>
<td>Quantum Fireball SE</td>
<td>8.4 Ultra ATA</td>
<td>$450</td>
<td>***</td>
<td>*****</td>
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<tr>
<td>Seagate Cheestah 9</td>
<td>9.0 Ultra Wide SCSI</td>
<td>$1099</td>
<td>***</td>
<td>*****</td>
</tr>
<tr>
<td>Western Digital Enterprise WDE9100</td>
<td>9.1 Ultra SCSI</td>
<td>$900</td>
<td>***</td>
<td>*****</td>
</tr>
</tbody>
</table>

BEST OVERALL:
HIGH-CAPACITY SERVER DRIVES (18+ GB)
IBM Ultrastar 18XP
IBM’s Ultrastar 18XP delivers a lot of data, and does it significantly faster than Seagate’s Elite 23, which is also physically larger.

<table>
<thead>
<tr>
<th>CAPACITY (GB)</th>
<th>INTERFACE</th>
<th>PRICE</th>
<th>TECHNOLOGY</th>
<th>PERFORMANCE</th>
</tr>
</thead>
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<tr>
<td>IBM Ultrastar 18XP</td>
<td>18.2 SCSI-3</td>
<td>$1745</td>
<td>***</td>
<td>*****</td>
</tr>
<tr>
<td>Seagate Elite 23</td>
<td>23 Ultra Wide SCSI</td>
<td>$1890</td>
<td>***</td>
<td>*****</td>
</tr>
</tbody>
</table>

***** Outstanding  **** Very Good  *** Good  ** Fair  * Poor  f = Cost per GB
Big and Small in One

Western Digital's Enterprise WDE9100 is the biggest small drive in our tests—small in physical terms, that is. In the popular 3½-inch, 1-inch-high form factor, this drive will be a convenient plug-in replacement to double the capacity of the 4.5-GB drives used in many server applications and RAID arrays.

The Big Guys Get Bigger

Seagate's Elite 23 has the largest capacity of all the drives we tested, but technology marches on. Seagate has now announced a 47-GB big brother in the Elite series. There's a down side to such high capacity, of course: When a bigger drive goes down, you lose a lot more data. So, we expect to see these drives used primarily in RAID applications.

The Changing Face of Backup

As disk drives get larger and larger, answers to the questions of how to back up the data on them, and how to access that backed-up data when you need it, become more complex. Consequently, each backup option serves a different purpose and exacts a different price. There really isn't a simple solution. In some situations, you actually need to use a combination of backup schemes. The information that follows summarizes your choices.

Tape Cartridges

The most traditional backup medium, magnetic tape is still important in a lot of situations. Tape-drive makers have tried to keep pace with the expanding disk capacities of our computers, and the latest inexpensive tape backup units, such as Hewlett-Packard's Colorado 5 GB and Iomega's DittoMax and DittoMax Pro, are eminently affordable. With per-cartridge capacities between 3 and 10 GB, media costs in the $25 to $40 range, and drives selling for $200 to $300, tape is a quick, readily available alternative that's well suited to individual users and small servers. More expensive, server-oriented tape backup units can store 20 to 40 GB per cartridge, with greater reliability and concomitant greater cost.

Optical Disks

Optical disk backup has a lot going for it: permanence, random-access restores, and inexpensive media. But the need for streaming, uninterrupted input to the recorder makes it still more painful to write a CD-R than to do a tape backup. And, the capacity of a single disk is still limited compared to that of a tape cartridge. When digital versatile—nèe—video—disc (DVD) becomes more mainstream, and recordable DVD (whether DVD-R or any of the rewritable formats) becomes standardized, that medium's greater capacity per disk will make DVD far more competitive with tape.

Library or Jukebox Systems

These aren't generally intended for backup as much as for reasonably quick access to databases (we're no longer talking gigabytes here, but terabytes and, down the road, petabytes). Because they are mechanically complex, with multiple drives and robotic media handling, library systems are not cheap, and they require attention to maintenance and usage. But they sure are faster and cheaper than having armies of people run around and mount tapes upon user request.

Backup Hard Disks

For the simplest of systems, one effective backup choice is to buy an additional hard disk and devote it to storing copies of data or programs. This can be very useful if you don't have to keep a long-term history of what's been done but merely need a backup copy in the event the original hard drive fails. Of course, like any on-site backup system, it won't be a lot of help if the building catches fire.

Removable Media

There's an ever-increasing crop of removable storage products that can also be highly useful and effective as backup. In the 40- to 250-MB category, the most familiar is Iomega's 3¾-inch 100-MB Zip disk. SyQuest and Iomega have lately introduced a new format called HiFD: a 200-MB floppy disk technology that is backward-compatible with standard floppies. The 1- to 2-GB arena includes products such as Iomega's Jaz Drive, various products from SyQuest, and Caslewood Systems' ORB drive, a new optical disk system that uses 3¼-inch removable media with a capacity of 2.16 GB and, the company says, an impressive transfer rate of 12.2 megabytes per second.
e measured throughput with
two different tests. The MPC
benchmark, which NSTL
developed for the Multimedia
PC Council in conjunction with Intel,
measures data throughput for both ran-
don and sequential access. It determines
how much CPU power disks need, and
indicates what impact they will have on
the delivery of multimedia content.

A second test, which uses the Thread-
Mark benchmark software from Adaptec
(available at http://www.adaptec.com), is
designed to indicate how well a disk sub-
system handles periods of high I/O activi-
ty. We deem this test important because
you're likely to find server applications
where the drive handles a large number of
requests from many different users.

ThreadMark makes a series of measure-
ments using a mixture of single and mul-
tithreaded requests across a range of
request block sizes (2 KB to 64 KB).

Both the ThreadMark and the MPC
benchmarks comprise our performance
score, which equals from 65 to 80 percent
of a drive's overall rating. Cost-per-giga-
byte is another 5 to 20 percent of the over-
all score. Reliability, which is difficult to
test, makes up the remaining 10 to 15 per-
cent of the overall score. (See the charts
on page 115.) We rated these hard drives
by warranty length and by mean time
between failures, or MTBF. (For the IBM
drives, we assumed an average MTBF fig-
ure; see the features table.) MTBF, mea-
sured in hours, is a calculated statistical
attribute, determined by combining the
MTBF numbers for all the components
that make up the unit. A problem with
relying on MTBF is that you can test it only
with large numbers of identical samples.
And even though storage densities are
increasing, track widths are decreasing,
making alignment, precision manufac-
turing, and head-motion control more
critical than ever. Today's high-capacity
drives are more reliable than ever thought
possible, with 1 million hours MTBF
being a common figure. Note that this is
not the same thing as saying that a given
drive will run without failing for 1 mil-
lion hours; this figure actually translates
to about a 99.999 percent uptime rate
over one calendar year.
## HIGH-CAPACITY DISK DRIVES

<table>
<thead>
<tr>
<th></th>
<th></th>
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<tbody>
<tr>
<td><strong>Price as tested (MSRP)</strong></td>
<td>$429</td>
<td>$319</td>
<td>$399</td>
<td>$719</td>
<td>$1245</td>
<td>$1745</td>
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<tr>
<td><strong>Overall rating</strong></td>
<td>4.0</td>
<td>4.0</td>
<td>4.0</td>
<td>3.0</td>
<td>2.0</td>
<td>1.0</td>
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<td><strong>Formatted capacity (GB)</strong></td>
<td>6.48</td>
<td>6.4</td>
<td>8.4</td>
<td>4.5</td>
<td>6.1</td>
<td>18.2</td>
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<td><strong>Number of platters (disks)</strong></td>
<td>3</td>
<td>3</td>
<td>4</td>
<td>3</td>
<td>6</td>
<td>10</td>
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<tr>
<td><strong>Number of heads</strong></td>
<td>6</td>
<td>6</td>
<td>8</td>
<td>5</td>
<td>12</td>
<td>20</td>
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<tr>
<td><strong>Interface (controller)</strong></td>
<td>ATA-3</td>
<td>ATA-3</td>
<td>ATA-3</td>
<td>SCSI-3</td>
<td>SCSI-3</td>
<td>SCSI-3</td>
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<tr>
<td><strong>Average seek time (ms)</strong></td>
<td>&lt;10</td>
<td>9.5</td>
<td>9.5</td>
<td>7.5</td>
<td>6.3</td>
<td>7.5</td>
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<tr>
<td><strong>Track-to-track seek (ms)</strong></td>
<td>2.5</td>
<td>2.2</td>
<td>2.2</td>
<td>0.8</td>
<td>0.7</td>
<td>0.7</td>
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<tr>
<td><strong>Full-track read (ms)</strong></td>
<td>19</td>
<td>15.5</td>
<td>15.5</td>
<td>15</td>
<td>17</td>
<td>17</td>
</tr>
<tr>
<td><strong>Rotation speed (rpm)</strong></td>
<td>5400</td>
<td>5400</td>
<td>5400</td>
<td>7200</td>
<td>7200</td>
<td>7200</td>
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<tr>
<td><strong>Buffer size (KB unless noted)</strong></td>
<td>Burst DMA Mode 2 &amp; Mode 4, 16.7 MBps; Ultra DMA Mode, 33.3 MBps</td>
<td>Up to 33.3</td>
<td>Up to 33.3</td>
<td>Up to 40</td>
<td>Up to 40</td>
<td>Up to 40</td>
</tr>
<tr>
<td><strong>MTBF</strong></td>
<td>500,000</td>
<td>800,000*</td>
<td>800,000*</td>
<td>1,000,000*</td>
<td>1,000,000*</td>
<td>1,000,000*</td>
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<tr>
<td><strong>Form factor</strong></td>
<td>3.5</td>
<td>3.5</td>
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<td>3.5</td>
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### POWER USAGE

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<tr>
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<th>9.9</th>
<th>18.8</th>
<th>15.4</th>
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</thead>
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<tr>
<td><strong>Read/write (watts)</strong></td>
<td>4.5</td>
<td>4.7</td>
<td>4.7</td>
<td>5.3</td>
<td>16.4</td>
<td>13.1</td>
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<tr>
<td><strong>Idle (watts)</strong></td>
<td>0.6</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
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### CUSTOMER SUPPORT

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<th>3</th>
<th>5</th>
<th>5</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Warranty (years)</strong></td>
<td>800-626-4888</td>
<td>800-426-2968</td>
<td>800-426-2968</td>
<td>800-426-7777</td>
<td>800-426-7777</td>
<td>800-426-7777</td>
</tr>
<tr>
<td><strong>Toll-free phone number</strong></td>
<td>See Website</td>
<td>See Website</td>
<td>See Website</td>
<td>See Website</td>
<td>See Website</td>
<td>See Website</td>
</tr>
</tbody>
</table>

**HotBYTEs No.**

<p>| 1064 | N/A | N/A | N/A | N/A | N/A | N/A |</p>
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<tr>
<th>Maxtor Corp.</th>
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<th>Quantum Corp.</th>
<th>Seagate</th>
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<th>Seagate</th>
<th>WD Caviar</th>
<th>Western Digital</th>
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<tbody>
<tr>
<td>DiamondMax</td>
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<td>DiamondMax</td>
<td>Fireball SE</td>
<td>Technology</td>
<td>Technology</td>
<td>Technology</td>
<td>WD Caviar</td>
<td>Enterprise</td>
</tr>
<tr>
<td>1280</td>
<td>1750</td>
<td>2160</td>
<td>9140</td>
<td>Cheetah 9</td>
<td>Elite 23</td>
<td>Medalist Pro</td>
<td>38400</td>
<td>WDE9100</td>
</tr>
</tbody>
</table>

| $309 | $379 | $459 | $450 | $1099 | $1890 | $495 | $380 | $900 |

| 5.1  | 7    | 8.4  | 8.4  | 9.1   | 23.2  | 9.1  | 6.4  | 9.1  |
| 4    | 4    | 4    | 4    | 8     | 14    | 4    | 3    | 6    |
| 8    | 8    | 8    | 8    | 16    | 28    | 8    | 6    | 12   |

| ATA-4 | ATA-4 | ATA-4 | Ultra ATA | Ultra Wide SCSI | Ultra Wide SCSI | Ultra ATA | EIDE | Ultra SCSI |
| 9.7   | <10   | 9.7   | 9.5       | 8               | 13              | 9.5       | 9.5  | 7.9   |
| 1     | 1.2   | 1     | 2         | 0.78            | 1.1             | 2         | 2    | 0.8   |
| 21    | 18    | 18    | 20        | 18              | 28              | 21        | 19   | 17    |

| 5400  | 5200  | 5200  | 5400      | 5400            | 5400            | 7200      | 7200  |
| 256   | 256   | 256   | 512       | 256             | 512             | 256       | 512   |

| PIO Mode 4, 16.6 MBps; Mode2 Ultra DMA, 33.3 MBps | Up to 33 | Up to 33 | PIO Mode 4, 16.7 MBps; PIO Mode 3, 11.1 MBps | Up to 40 | Up to 40 | PIO Mode 4, 16.6 MBps; DMA/33, 33.3 MBps | Up to 40 |
| 500,000 | 500,000 | 500,000 | 400,000 | 1,000,000 | 800,000 | 400,000 | 350,000 | 1,000,000 |
| 3.5   | 3.5   | 3.5   | 3.5 (low) | 3.5         | 5.25   | 3.5   | 3.5   | 3.5 (low) |

| 5.3   | 5     | 5     | 11       | 23       | 24.1   | 11     | 5.35  | 12.1 |
| 4.3   | 3.9   | 4     | 6        | 20.7     | 22.8   | 11     | 5.35  | 9.4   |
| 0.5   | 0.4   | 0.7   | N/A      | N/A      | N/A    | 3      | 1     | N/A   |

| 3     | 3     | 3     | 3        | 3        | 5      | 5      | 3     | 5      |
| 800-252-9867 | 800-252-9867 | 800-262-9867 | 800-524-5545 | See Web site | See Web site | See Web site | 800-832-4778 | 800-832-4778 |
| 303-447-0044 | 303-447-0044 | 303-447-0044 | 408-894-4000 | 408-438-8111 | 714-932-5000 | 714-932-4900 | 800-832-4778 | 800-832-4778 |
| 1065 | 1066 | 1067 | 1068 | 1069 | 1070 | 1071 | 1072 | 1073 |

*Data represents IBM's design objectives and is provided for comparison among IBM products. Questions or concerns about data should be referred to an IBM representative. Product data and specifications are subject to change without notice.*

*Evaluations in this report represent the judgment of BYTE editors, based on tests conducted by NSTL, Inc., as documented in a recent issue of NSTL’s monthly PC Digest. To purchase a copy of the full report, contact NSTL at 625 Ridge Pike, Conshohocken, PA 19428; 610-941-9600; editors@nstl.com. For a subscription, call 800-257-9402. BYTE magazine and NSTL are both operating units of The McGraw-Hill Companies, Inc.*
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PWRDL
Some very clever people are thinking about storage. That's good, because the rest of us don't want to think about it at all. We just want an infinite amount of space to store anything we please and be able to access it instantly. And we want it to be inexpensive. Is that too much to ask?

Apparently not, because hard drive manufacturers have been successfully meeting those rather demanding specs since Day One. Hard drives continue to get smaller yet more voluminous, faster yet more accurate, and cheaper yet more complex. Clearly this yellow brick road cannot continue forever. Luckily, the end leads to the Oz of computer storage: polymeic holograms, clusters of manganese molecules, and individual atoms of uranium. Oh my.

Head Case

The most expensive, and probably the most complex, part of a hard drive is the head that reads and writes data on the platter. Since heads are the primary cost of a hard drive, and since hard disk sales depend primarily on cost, the cheaper the head, the more successfully the drive will sell. This is not exactly a motivation for vendors to experiment with new, but pricier, technologies. Buyers could care less what kind of heads are in the drive: They are looking at the bottom line. (In this same issue, you can get the latest information and performance ratings of today's best hard disks. Our Lab Report tests will help you pick the best drives for workstations and servers, in capacities ranging from 4 to 23 gigabytes. See "15 Disk Drives Cover More Data Than Ever," page 112.)

Magnetoresistive (MR) heads continue to supplant older inductive heads. (Magnetoresistance is the property by which a material's resistance to electricity changes in a magnetic field. Magnetoresistive heads use this property to detect magnetic fields on hard disks.) Drives with magnetoresistive heads now claim some 50 to 60 percent of the market, and their share is growing, according to Jim Porter, president of Disk/Trend (Mountain View, CA), an analysis com-
pany that tracks the storage industry. Not surprising, given what is possible with this "older" technology. Already, MR drives are available from Seagate and IBM that hold more than 18 GB in a 3½-inch form factor and more than 45 GB in a 5¼-inch form factor. By the time you read this article, other companies will probably also be offering MR drives. Tweaking MR drives further (by diminishing the distance between MR head contacts, already measured in microns) will probably give them another 3 to 4 years of life. By then, MR will probably have run its course and not be able to support the higher areal densities possible with newer drive technologies.

What kinds of technologies? The most likely contender is the spin valve head, which uses giant magneto resistive (GMR) effects. IBM developed GMR and spin valve heads, which rely on the exquisite sensitivity to magnetism of a thin conducting (but nonmagnetic) layer between conducting and magnetic layers. Spin valve heads increase the areal density some 10 to 20 times that of MR heads, to 10 to 20 gigabits per square inch.

Naturally, the GMR heads cost more than the MR heads, which is one reason they've been biding their time in the wings for a decade (IBM first discovered the effect in 1988). Still, it seems like their time has finally come. In November 1997, IBM released its very first hard drive using GMR technology: it stores 16.8 GB in a 3½-inch form factor for PC desktops (2.6 gigabits per square inch). IBM expects to move all its hard disk products to GMR technology. Analyst Porter thinks it likely that more GMR heads will make their commercial debut in 1998, probably from IBM, Fujitsu, Hitachi, and Seagate. These devices could initially have 10 to 20 times the capacity of MR drives.

As Porter points out, this is all part of the historical trend in areal densities of hard drives. Areal density has been growing about 60 percent per year, and that trend seems to be continuing. One implication is that areal density increases tenfold every five years. Within five years we could very likely have hard drives that hold hundreds of gigabytes.

GMR and spin valve technology are not the end of the line for hard disk drives. Already scientists at IBM are talking about "colossal" MR, and MIT researchers are at work on tunnel junction magnetoresistance. Both of these technologies could provide more storage density than GMR.

There is, of course, a limit to what you can record and read magnetically. This is called the superparamagnetic limit. Basically this means that the tinier the magnetic domains are in which you record information, the less stable they become. Eventually these domains would become so small that they would not be stable enough to hold information reliably. Engineers like to argue about what this limit is, but certainly something on the order of 100 gigabits per square inch is a reasonable high-end figure.

Note that the hard disk technologies described earlier are rapidly approaching this limit.

Still, there is clearly more ore to be mined in the rotating magnetic hard disk. But there are also some other storage technologies that branch radically into different directions.

**Packaging Light**

Holographic storage is one of those technologies that experts say is about five years from becoming practical—no matter when you ask them. As of today, that would be after the turn of the century, around 2003.

This is not because holography is something new and mysterious. On the contrary, holography itself was discovered shortly after the invention of the laser. To form a hologram of an object, you shine one low-power laser at the object and an identical (reference) laser at photographic film. The laser light bouncing off the object forms an interference pattern with the reference laser light, and the photographic film records that interference pattern. The photographed pattern looks nothing like the object: It looks like gray and black smears and splotches. But when you shine a laser beam through the pattern (like a slide in a projector), you can see the entire object—in three dimensions. Weirder still, you can cut the film in half and the remaining half could still reproduce the entire original image.
Atomic Force Microscope: It's the Pits

CD-ROMs record their information in the form of tiny pits in the surface. A laser reads the information from the pits. Now CD-ROMs already hold lots of data. But what if you could make the pits really, really tiny?

How tiny? Oh, a few atoms deep. That's one of the technologies that atomic force microscopy is able to perform. An atomic force microscope (AFM) uses an extremely tiny conducting stylus that is very close to a surface. By placing a small charge on the tip of this stylus, it is possible to move single atoms around on the surface. (IBM scientists demonstrated this by spelling out “IBM” using individual xenon atoms.)

In this new use for the AFM, heat is applied to the stylus, which is placed on a cantilever that can rock up and down. When the cantilever moves down, it can gouge out a few atoms from the rotating surface. This writes recorded data. Another system uses the stylus tip itself to read the indentations. The whole AFM shebang is actually created as part of a silicon chip-like structure, with the cantilever as a tiny moving part. After you have recorded your information once, you can stamp out duplicates in much the same way as with CD-ROMs.

This write-once/read-many storage system can achieve densities of 100 gigabits per square inch under practical operating systems. The upper limit seems to be about 300 gigabits per square inch. Since the AFM mechanism is essentially a solid-state system (with its one moving part), it is also a fairly stable system. But there are even bigger (or smaller) deals to come.

AFM put data on this substrate at a density of 64 Gbits per square inch.

Eventually scientists figured out how to make the 3-D image visible to the eye with ordinary light (a white light hologram). Now these 3-D holograms appear on software boxes and credit cards to signify that they're genuine.

None of this has anything to do with holographic storage, except for one thing. The idea that you can take three-dimensional images (data) and save them in a two-dimensional format (hologram) suggests an incredible saving of space to store information. It would be like replacing your file cabinets with pictures of them painted on the wall.

Turning this into a practical storage system means overcoming several obstacles. For one thing, lasers started out as large, delicate, expensive, and ungainly pieces of laboratory apparatus, while a viable storage system would need to take the rough-and-tumble life of computer equipment. Second, since you presumably want to be able to record and read data many times, you need a material that can become dark or light—and stay that way until you change it—over and over again. Third, this material would have to be accurate, reliable, and quickly accessible. Finally, it would have to be cheap.

Each of these obstacles is being knocked down by advancing technology. For example, every portable CD player has a laser in it, in the form of a solid-state laser diode. Since these laser diodes routinely withstand motions like jogging, dancing, and reckless driving, the relatively sedentary existence of a computer should not be a problem.

At first, the problem of a suitable medium seemed to depend upon naturally occurring crystals of photosensitive substances, which would be quite expensive to find and use for holographic storage. The problem of developing a suitable storage medium has brought the Photorefractive Information Storage Materials (PRISM) program into existence, funded by the U.S. government (match) and a group of interested companies including GTE, IBM, and Rockwell. Research has concentrated on difficult-to-produce artificially grown iron-doped lithium niobate, strontium barium niobate, bismuth sili cate, and barium titanate crystals.

It might also be possible to use special polymers as the photorefractive medium. Dr. William E. Moerner discovered photorefractive polymers while working at IBM's Almaden Research Facility. In these special polymers, laser light causes an optical nonlinearity that allows the formation of dynamic holograms. The original hologram was 125 microns thick, and two laser beams could write and read the information. Dr. Moerner, now at the University of California at San Diego, is working toward improving this polymer-based holography system, including increasing the time that the polymers can retain the images.

These photorefractive polymers may change the whole holographic ballgame. For one thing, they will probably be cheaper than the previously used inorganic crystals. Also, polymers are easier to make and mold into different shapes. How voluminous could holographic storage be? Eventually you could store the Encyclopaedia Britannica on a hologram the size of a dime. Theoretically, the potential storage density could be as high as 1 terabyte per cubic centimeter (about the size of a sugar cube). More practically, densities of 10 GB per cubic centimeter seem reasonable. A terabyte would fit in the space of a paperback book, or a few cubic inches.

Access would be fast, too. Since holograms store data in two-dimensional planes (or pages or sheets), reading a hologram delivers an entire plane of information. The throughput of such a system could be on the order of 1 Gbps. That's fast, much faster than hard drives of any type, and faster than most computers can handle. Time to bulk up that RAM cache.

One strange advantage of holographic
storage has to do with the nature of holograms themselves. As noted earlier, you can lose half of a 2-D hologram and still recover the entire image. A similar effect is true with holographic storage. As opposed to hard drives, where losing a single stored bit can ruin your whole day, losing a dot in a hologram doesn't affect your ability to access your data at all. You still get everything you stored.

**Itsy Bitsy Magnets**

If you want to use very tiny magnets, you can't get smaller than a few atoms. That is precisely what researchers have done with what are called nanomagnets. For example, a collaboration of scientists in Florence, Rio de Janeiro, and Grenoble has been working with clusters of manganese ions. In particular, at temperatures of 4°K, 12-ion clusters of manganese retain their magnetization for some time. Obviously, that would be important for storage of data.

What is even more interesting for storage, however, is that this ion cluster shows **hysteresis**. This means that applying a particular-strength magnetic field to the clusters causes them to take on one of two magnetic states. This binary-type behavior is precisely what computer storage requires. And the clusters of ions, on a near-molecular level, imply amazingly large densities of information.

Naturally, there are many technical obstacles to this type of storage. Since the clusters themselves are so small, it is difficult to manipulate them. What's more, there is no easy way to access single clusters, either to apply an external magnetic field selectively or to read the state of a cluster.

**Let Me Atom**

What could be smaller than clusters of atoms? Single atoms. The atoms would have to be powerfully ionized in order to have detectable effects. Fortunately, nature provides atoms that can become powerfully ionized. Unfortunately, the atoms are uranium.

Uranium has the highest atomic number of any naturally occurring atom. Since uranium has such a high atomic number, stripping away its electrons leaves it powerfully ionized. Scientists at Lawrence Livermore National Laboratory have been able to do exactly this. If the process could ever be made practical, these highly ionized atoms could form the basis for storage on an atomic level.

Clever people keep developing clever ideas for computer storage, from products you can hold in your hand to concepts built around something as small as an atom. Whether all these great ideas ever turn into viable technologies is not important. What is important is that some of them definitely will. Lucky for the rest of us.

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Pull out the old and push in the new with reliable and scalable P&S middleware. By Pete Loshin

Publish and Subscribe Meets the Internet

When it works the way it's supposed to, middleware disappears into the background of an organizational infrastructure. Publish and subscribe (P&S) middleware, which occupies the middle ground of the middleware world (see the text box "Monkey in the Middleware" on page 126), is no different.

Sometimes referred to as pull software or smart-push software, P&S middleware enables information consumers to subscribe to particular messages (sometimes known as data events, to distinguish them from e-mail-type messages) while making it easy for information producers to publish data events. P&S products can keep a lid on network traffic, even when there's lots of data and many subscribers, by using message routers and multicast transmission to distribute information.

I examined three leading P&S solutions: Open Horizon's Ambrosia, Talarian's SmartSockets, and Tibco's Tib/Rendezvous. These products typically become an integral part of a large organization's computing infrastructure, using many different platforms, networks, and architectures, as well as different applications.

Choosing a tool is more than a matter of finding one that helps you build what you want. Most middleware tasks can be handled by most P&S solutions, but some just work better and are easier to implement than others for a particular application. Architecture, programming API, level of delivery reliability, and availability of security features, including authentication and encryption, all differentiate these products.

P&S products can solve scalability issues, but different products scale in different dimensions, depending on their architecture and design. The right publish/subscribe solution for your application depends on whether you need to add subscribers, the volume of data to be published, and the size and topology of your transport network.

Ultimately, the best approach to buying any type of middleware is to run your own tests with your own applications.

I invited leading P&S middleware vendors to install their latest products in BYTE's lab and supply test programs, but it became clear that P&S performance depends on too many variables to allow...
meaningful comparisons. Platform, message size, data type, timing, batching (i.e., the number of messages sent by the publisher at one time), system configuration, available RAM, network bandwidth, the number of publishers and subscribers, and middleware architecture all affect performance and make comparisons difficult. As noted earlier, the ultimate criterion is how well a product works for your own specific application.

I checked the products’ baseline functionality, which includes ability to publish and subscribe data, support for security and authentication, quality of service, fault tolerance, and the current de facto and de jure standards. These standards affect the products’ ability to interface with the most popular and important protocols, programming languages, OSes, and platforms.

**Infrastructure Architecture**

Traditional client/server programming employs a request/reply model, while P&S (see “Publish or Perish,” September 1997 BYTE) enables a producer to publish data and permits consumers to subscribe to it. A broker transmits these data events to its subscribers, eliminating one obstacle to scalability: the need for data consumers to periodically poll for new data. When new data comes in, the middleware delivers it to all the subscribed data consumers (and to them only).

Tibco uses a peer-to-peer multicast on a bus architecture for TIB/Rendezvous: All peers publish or subscribe to messages directly. Any peer can publish data by sending it to a subject at a multicast address, and any system can receive it by subscribing to the subject’s multicast address. Each participating system runs a Rendezvous daemon that sends and receives messages on the network. Rendezvous routing daemons can route messages to subscribers on remote LANs. These daemons act as message brokers because they forward messages to their destinations, publishing messages to and accepting messages from the bus for Rendezvous-enabled applications.

In contrast, Ambrosia employs a peer-to-peer/broker unicast approach. Using a hub-and-spoke architecture, Ambrosia-enabled applications subscribe and publish by opening a TCP connection with an Ambrosia Message Broker process that has the ability to track who’s subscribing and who’s publishing.

The distinctions between architectures are critical to performance and scalability—which are determined more by the nature of the application than by the P&S middleware being used. For example, using multicast to deliver messages means that local network traffic will be flat no matter how many subscribers there are: An event is published only once to get it out to all subscribers on the network. TIB/Rendezvous uses this model; one IS manager whose company uses this product reported that the network load flattened out after the addition of as few as two to four subscribers.

In a hub-and-spoke architecture, each message passes through a broker or a server. Here you must add message routers as you add subscribers. Therefore, if one message router is just enough to handle 30 subscribers on a LAN, doubling your subscriber base means adding another message router. To complicate matters, there’s nothing stopping you from deploying...
SmartSockets, for example, with multicasting enabled to save bandwidth—or from deploying TIB/Rendezvous using unicast transmissions, with each peer pointed to a routing daemon, to simulate a hub-and-spoke architecture.

Consider an application linking a large number of publishers, each publishing to fewer subscribers, all deployed across a WAN. Implement with a bus architecture like TIB/Rendezvous's, and you will need to have at least one routing daemon at each geographic location to forward messages. Hub-and-spoke architectures also work well for applications requiring explicit involvement of the application with message routing.

Message routers can retain a cache of old messages of variable sizes, so subscribers who miss anything due to system failure can catch up on missed messages. TIB requires each peer be running (or have access to) a Rendezvous daemon to listen for multicast content; message-routing products, like SmartSockets and Ambrosia, rely on their enabled application client software to handle subscriptions.

**Open Horizon Ambrosia 2.1**

Open Horizon positions Ambrosia as a P&S solution for the Internet. Since Ambrosia is one of the first products to be certified 100 percent Pure Java, Ambrosia peers require only a Java 1.1 virtual machine (VM) and a TCP/IP stack; the broker software runs on Windows NT 4.0 or Solaris. Ambrosia's hub-and-spoke architecture seem ideal for widely distributed systems, but version 2.1 doesn't support interbroker communications. Instead, it funnels all messaging through a single broker (version 3.0, expected soon, will support interbroker routing).

The Ambrosia message broker routes messages from publisher to subscriber, acting as an intermediary for messages and enforcing delivery reliability (see the text box “Managing Performance/Reliability Trade-Offs” on page 128) and security (it supports encryption). If a subscriber requests guaranteed delivery, the message broker makes sure the message is delivered. The broker handles all authorization tasks, including determining whether a peer is allowed to subscribe, publish, or request guaranteed delivery of events.

Unlike TIB/Rendezvous, which delegates all programmatic policy to the application itself, Ambrosia requires the developer to use the message broker to create

### P&S Features

<table>
<thead>
<tr>
<th>Feature</th>
<th>Ambrosia</th>
<th>SmartSockets</th>
<th>TIB/Rendezvous</th>
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<tbody>
<tr>
<td><strong>ARCHITECTURE</strong></td>
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<td>JavaBean wrapper</td>
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<td>$4500</td>
<td>$5000</td>
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<tr>
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<tr>
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<td>From $3000 per RTserver (Win NT/95); no per-seat charges</td>
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<tr>
<td>Miscellaneous</td>
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<td>✔</td>
<td>$1500 per client desktop and $6000 per server</td>
</tr>
</tbody>
</table>

1. Supported through Java on these platforms.
2. Can also be configured to do guaranteed delivery to some subset of all subscribers.

- ✔ = yes; N/A = not applicable.
Ambrosia builds on Java's security interfaces for user authentication, authorization of users for particular operations, DES encryption, and integrity checking via a secure digest. Expected at the start of this year is support for triple-DES encryption and public-key authentication.

**Talarian SmartSockets 4.0**

With its 14 pounds of documentation, SmartSockets scored tops in volume of support materials, including tutorials with step-by-step instructions and sample code. SmartSockets' hub-and-spoke architecture supports true message routing between message brokers for wider scalability across WANs. RTserver, SmartSockets' message broker, routes messages directly to subscribers or to intermediate message routers. Multicast transmission is available as well, for reducing traffic on a LAN.

Even so, Talarian describes the architecture as a "logical bus," which means peers publish messages into the logical bus and other peers subscribe by tapping into that bus. SmartSockets is very much a message-routing product, using OSPF (Open Shortest Path First) routing to efficiently route messages from publishers to subscribers.

SmartSockets rates high on reliability, supporting hot failover between message routers, as well as other types of load balancing. The package supports DES encryption but lacks public-key support.

**Tibco TIB/Rendezvous 4.1**

Tibco's TIB/Rendezvous event-driven middleware employs a bus architecture: Everything is published directly to the bus. Relying heavily on multicast, Rendezvous-enabled applications scale incredibly well when implemented appropriately. The publisher publishes one message, which can be subscribed to by processes running on any or all systems on the network. Adding subscribers impacts network traffic only minimally, since subscribing is a matter of the subscriber's publishing a message announcing its subscription.

Intranets, extranets, and the Internet complicate matters. Extending the TIB bus to WANS requires the routing of messages. The Rendezvous routing daemon, rrd, forwards messages subscribed to by other routing daemons on behalf of systems on other networks. TIB/Rendezvous routers use subject-based routing to minimize internetwork traffic: Only messages subscribed from outside a site are forwarded.

Creating a channel to publish data with Rendezvous is easy, but integrating existing applications can be more complicated. Reliance on a daemon means that all Rendezvous-enabled applications can share access to the P&S bus.

**Cost and Suitability**

Overall, the suitability of any of these products to your application depends on what that application is and how you want to deploy it. After deployment, these products make publishing data simple, but building the application can be trickier.

Cost considerations are also important. Although the raw cost of the software license is important, with per-seat costs for a fully functional TIB/Rendezvous peer starting at $600, the expense of developing and deploying your application must also be considered. Expect to devote considerable effort to designing your event namespace and the interfaces between legacy applications and whichever P&S architecture you choose.

**PRODUCT INFORMATION**

<table>
<thead>
<tr>
<th>Product</th>
<th>Cost</th>
<th>Details</th>
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</thead>
<tbody>
<tr>
<td>Ambrosia</td>
<td>$5850</td>
<td>Development systems start at $14,850</td>
</tr>
<tr>
<td>SmartSockets</td>
<td>$4500</td>
<td>For developer's toolkit, server starts at $3000</td>
</tr>
<tr>
<td>Tibco TIB/Rendezvous</td>
<td>$600 per desktop and $2500 for developer's kit</td>
<td>Starts at $600 per desktop and $2500 for developer's kit</td>
</tr>
</tbody>
</table>

**TECH FOCUS**

Managing Performance/Reliability Trade-Offs

A hierarchy of reliability levels exists for P&S products, which tend to trade performance for reliability. The baseline level (often called "reliable delivery") is to publish data no more than once. Thus, subscribers who miss messages due to downtime or a network error might never receive them unless a message cache is running. Last-value and cumulative caches (which store the last piece of data, or an accumulation where appropriate) can help improve reliability without affecting performance. Reliable delivery enhances performance because the publisher doesn't have to waste time listening for complaints from subscribers. It works well for both multicast and broadcast transmission.

The next-highest reliability level uses negative acknowledgments (NACKs) from subscribers to alert the publisher that a message needs to be retransmitted. This means messages are retransmitted only when a subscriber misses one and transmits a NAK asking for a retransmit of the missed message(s). The result is that every subscriber receives every message at least once, and sometimes more than that. NACKs work well for multicast transmission because publishers can depend on its subscribers to act as squeaky wheels: If they don't say anything, it's because they're getting everything they need.

For even more reliability, you can move up to what Tibco calls certified delivery, which is available in the optional TIB/Rendezvous Pro product (which also supports distributed queueing and includes a fault-tolerant API; transactional messaging is available in a separate product, Enterprise Transaction Express). TIB/Rendezvous certified delivery requires each subscriber to positively acknowledge (ACK) receipt of each message to the publisher, although the messages are published by multicast. Positive acknowledgment is also an option for unicast publishing.

You can get even higher reliability by adding a mechanism that can keep track of all messages, approaching the type of structure provided by message queues (see "Monkey in the Middleware" on page 126). Digitally signing or encrypting messages can also add a sense of security to reliable delivery.

BYTE technical editor Pete Loshin is the author of Personal Encryption Clearly Explained (AP Professional, 1998). He can be contacted at pete@loshin.com.
Laser Printer

Hewlett-Packard's LaserJet 4000 brings better performance in a smaller package and ushers in a new communications standard. By Alex Pournelle

HP Makes an Even Better Impression

Hewlett-Packard's newest workgroup printer, the LaserJet 4000, bests its predecessor, the LaserJet 5, in speed and compactness. The 17-page-per-minute printer-BYTE's Best of Show winner at Fall Comdex—also introduces a communications technology, called JetSend, that could become the lingua franca of all network devices.

I tested the 4000TN, which has two 250-sheet paper-input trays, a manual paper tray, 8 MB of RAM, and comes with JetDirect 600N print server software. Its new features include a 1200-dot-per-inch (dpi) marking engine and a 100-MHz NEC VR4300 processor.

My first impression of this printer, as usual with HP products, is that it's solid. It installed easily, and it printed every standard PCL 5 or 6 test page I threw at it without incident. With the supplied work-alike that comes on expansion ROM, it also printed PostScript. Additionally, the ProRes 1200-dpi setting, which runs the engine at half speed, produced noticeably blacker blacks than the full-speed FastRes at 1200 dpi.

I was impressed with the printer's options and parallel communication possibilities. The LaserJet 4000 offers expansion of up to 100 MB of RAM, using three 32-MB SIMMs. Options include a third 500-sheet paper-input tray, 75-envelope feeder, duplex printing handler, PostScript-clone ROMs, and local hard disk storage.

I was also pleased with the LaserJet 4000's drivers, which support bidirectional communication is also available on a Windows or a Macintosh network with the JetDirect 600N Print Server, which comes standard with the 4000TN.

JetAdmin 2.5 software provides network IP address configuration and the ability to view available printer memory and jobs queued. In my tests, JetAdmin did have some problems with NT 4.0 Server.

There's a new version, Web JetAdmin 3.0 (which is now available for downloading from http://www.hp.com/cposupport/printers/software/hpwwjnten.exe.html), but it was not available at test time.

The LaserJet 4000TN is a fine addition to HP's expansive line of departmental printers. With the PostScript-clone option, and 1200-dpi ProRes, it's also a great desktop publishing printer. For anyone needing a workgroup printer, the potent combination of speed and quality should make this LaserJet the first one to look at.

Alex Pournelle (Pasadena, CA) is a computer integrator and data-recovery specialist. You can contact him at alexp@earthlink.net.

The HP LaserJet 4000 prints up to 1200 dots per inch, at 17 pages per minute, and weighs just 45 pounds.

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RATINGS

TECHNOLOGY ★★★★★
IMPLEMENTATION ★★★★★
PERFORMANCE ★★★★★
CADzooks! What a Deal

Why is AutoCAD so popular? For 15 years, competitors have asked that question, and none of them seems to have grasped the answer. In my experience, three major factors keep AutoCAD users loyal: an intellectual investment in learning the program, a time investment in customizing the program to do exactly what they need, and a monetary investment in all the drawings they’ve created.

Many competitors have tried to emulate parts of AutoCAD’s command set, customization languages, and DWF file format. But they all started with existing CAD programs, and results were unimpressive. In the real world, “almost AutoCAD-compatible” just isn’t good enough.

But what if a company started from scratch, building a program so compatible that AutoCAD users and developers would consider it a desirable alternative? Meet Visio’s IntelliCAD, which competes head to head with AutoCAD Release 14 but is $3253 less expensive. It’s also got a nice, Microsoft Office-style interface.

I’m an experienced AutoCAD user, and working with IntelliCAD gave me an eerie feeling. Sure, it has all the basic commands. But I also tried dozens of the most obscure AutoCAD commands I know and found only a very few that haven’t been implemented in IntelliCAD. Visio provides a list of missing AutoCAD functions, most notably associative hatches, 3-D solids, and photorealistic rendering. Importantly, IntelliCAD doesn’t mess up things it can’t edit. Using IntelliCAD, I edited files created in AutoCAD 12, 13, and 14. When I saved those drawings and loaded them into AutoCAD, all the objects IntelliCAD couldn’t edit were unchanged.

IntelliCAD is more than an AutoCAD-compatible clone; it adds its own significant features. Drawing Explorer, in one window, gives control over layers, line types, blocks, text, and dimension styles. And IntelliCAD has a multiple-document interface, which AutoCAD lacks.

So, will IntelliCAD be an AutoCAD killer? Probably not, but Visio is a serious competitor and Autodesk knows it. IntelliCAD lacks a few AutoCAD features, but it’s a well done, viable, mainstream alternative. If you’re looking for an industrial-strength CAD program that works with AutoCAD files but won’t break the bank, look here.

Evan Yares teaches and writes about CAD. You can contact him at evan@yares.com.
To Cure a Failing Memory

Large drives do require good disk utilities.

The first thing I did was install PartitionMagic. That uses about 6 MB of disk space, but it's easily uninstalled. More to the point, the program will tell me how much I can gain by repartitioning my hard drive, so I can use smaller cluster sizes. Forgive me if you know all about cluster sizes. Some readers don't, so I'd better explain. It's also laid out clearly and in detail in the generally excellent PartitionMagic manual.

I'll summarize by saying that the bigger your logical disk drive, the larger the cluster size. The cluster size is the minimum space required to store all or part of a file. In particular, drives sized from 1024 to 2047 MB must, under the current DOS/Windows 95 OS, have a minimum cluster size of 32 KB—and that becomes the smallest file size on your disk.

Thus, if you have a tiny ASCII file, say AUTOEXEC.BAT, the file size may be 88 bytes, but that file will still take up 32 KB on your disk. This wastes space, typically about 30 percent. The larger the partition size, the worse it gets; the wastage can approach 50 percent on systems that have a number of small files.

The remedy is to break that disk partition down to something smaller. A partition smaller than 1 GB, for instance, can use 16-KB clusters and typically results in less than 20 percent wasted space. If you're really into disk organization, you can make one large partition for large files (e.g., the swap file and some program suites), one intermediate size for medium files (e.g., normal program files), and one small partition for little files like saved e-mail. I don't really recommend you do this. I just point out that it's possible.

I was concerned that Windows 95 showed my drives as 2.2 GB, larger than the maximum for 32-KB clusters, making me wonder if I was wasting more space than I needed to by using 64-KB clusters. There may be a way to make Windows 95 tell you what your cluster size is, but I don't know it. Thus, I installed PartitionMagic.

It told me that although Windows 95 thinks my drives are 2.2 GB each, they're really only 2047 MB, and my total wasted space is about 457 MB, or 19 percent. (It also turns out that 64-KB clusters are supported only in NT, not in Windows 95.) I could cut back on the wastage by partitioning the D drive into a D drive for program files and an E drive with 16-KB clusters for saved e-mail. However, it hardly seems worthwhile to recover at most 100
MB of disk space. Also, smaller cluster sizes come at a price: with small clusters, it takes longer to access large files, because the disk heads have to move a lot more. If you do make small partitions, don't put your swap file on one of them; it can slow your system down something awful.

There's an even more drastic way to recover that wasted space. I could get the latest version of Windows 95 (version 4.00.950 B or later; you can find your version number in Control Panel/System), which includes FAT32, the new 32-bit file allocation table (FAT) system that allows 8-GB disk partitions with 4-KB cluster sizes.

The problem here is that there's no upgrade to FAT32 yet, you have to back up all files, reformat, and start over. Then, too, the "B" version is still OEM-only. I've heard rumors of an imminent upgrade version, but there isn't one yet. I suspect this is because, while BYTE readers may understand that installing FAT32 is a one-way operation, many users won't.

FAT32 can't share a partition with normal FAT files, nor can earlier versions of Windows 95 (or NT 4.0) read FAT32 files.

I told FreeSpace I wanted to free up 20 MB.

This applies only to reading local disk partitions; it doesn't affect the ability to access files through a network. A Windows 3.1 system can see and read FAT32 files on a connected system, and vice versa. Of course, if you use a network to move files to a FAT32 system, that is all transparent.

FAT32 is built into Windows 98 (aka Memphis) and is clearly the right way to go, giving you large disk partitions without the penalties of large cluster sizes. However, retrofitting with it isn't something lightly undertaken, even for someone as networked as I am. One day I'll do it, but I'm in no big hurry.

I CONCLUDED THAT TO GET MORE space I'd have to either migrate stuff to the server or experiment with disk compression. My last experience with disk compression was pretty grim, but I have a new program, Mijenix's FreeSpace, that promises compression without pain or fuss. I was skeptical, but it sounded good.

Compression does two things. First, it squeezes redundancy out of files by encoding them. Second, it packs many small files into what the OS sees as one large file, thus eliminating wastage caused by large cluster sizes. The problem with compression is a mirror image of its virtue. To retrieve a file, something has to extract that file from the large compacted file it was stored in and then decode the file into its original form. None of this has to be unreliable, but it adds some complexities to file access.

Now suppose we want to add to that file. We have to find room for the new length and then repack everything. Finally, since many of your compressed files are stffered end to end into one large packed file, if anything happens to that large file, you could lose them all. Apparently that doesn't happen very often, but it's a chance I'm not eager to take.

FreeSpace is a file (not disk) compression utility with a nifty management structure and a simple user interface. Basically, you install FreeSpace, tell it how much disk space you'd like to make, and stand back. It will recommend which files and folders to compress to get that much. That seemed too good to be true.

First thing, then, was to defrag the disk. There are several ways to do that but only one I trust: Golden Bow Systems' Vopt. I have been using one or another version of Vopt since early DOS days, and I have not had a single problem. Vopt is very careful; it's also considerably more efficient than any other defrag program I've used.

When you Vopt a disk, it's really optimized. I ran Vopt and installed FreeSpace. I told FreeSpace I wanted to free up 20 MB. The analyzer wizard trundled and then recommended that I compress the Grolier encyclopedia folder. I told it to go ahead, and less than 5 minutes later, I had 22 MB more disk space.

The Grolier program has about 30 MB of stuff on my local disk; it gets the rest from a CD-ROM that resides on a Pioneer SCSI 6-Pack CD-ROM drive on the server. When I ran the encyclopedia, I couldn't detect any difference in its operation after the file compression. Everything works just fine, and if there's a speed difference, I don't notice it.

I was curious now. I used Symantec's Commander 95 and Explorer to look at that folder to see what FreeSpace did; and I blush to say I don't know. If you right-click on some of the files, you'll see a new menu item, FreeSpace, and that will offer to decompress the file. Otherwise, there is no clue that any files have been compressed. Still, Explorer reports 20 MB more disk space available.

It still looked too good to be true, so I told the FreeSpace wizard that I wanted another 40 MB on the C drive. For good measure, it should find me 20 MB on the D drive. It did. On the D drive, there are a huge bunch of mail files, and a lot of game files on the C drive. Once again, if there's any effect on performance, I can't find it.

Then I ran Vopt again. One of the things that used to drive me mad about disk compression on OS/2 was that I had to go to extraordinary lengths to defrag a compressed disk. With FreeSpace, I just run Vopt. When I did, it showed that the disk was seriously fragmented. Apparently, when FreeSpace compresses files, it compacts the ones it compresses, but that can leave a lot of fragmentation among the other files. Vopt soon fixed that.

The bottom line is that FreeSpace has painless compression and decompression. It's extremely easy to use. It will analyze your hard disk folder by folder to determine just how much space it can make for you; and it works just fine. None of my disk utilities know there were any changes in the disk structure; they just see some extra disk space. In fact, it's very hard to see just how FreeSpace works this magic.

FreeSpace doesn't work as well on NT, and clearly it's not going to do much for you in compressing files like JPEGs, which have already been compressed. However, as a quick-and-dirty way to make some more disk space in a hurry, this thing is a blooming miracle. Laptop users with their truly limited disk space will absolutely love this product. Recommended.

Vopt is written by Barry Emerson, who seems to know more about DOS and Windows file operations than anyone I know, including Microsoft's people. Vopt has been on my recommended list just about forever. (Truth in reporting: Elizabeth Emerson of Golden Bow has won my "bribe of the month" award several times for elaborate chocolate Christmas presents, but that's not why I like Vopt.) Anyway, about the time you read this, there will be a new version for NT as well as some improvements in the Windows 95 version.

Vopt shows you exactly what is going on, gives a map of just how fragmented
your disk is, and works at lightning speed. It's a lot faster than its rivals, despite the fact that it's also more thorough. Disk fragmentation can be a serious problem, especially if you do much Internet surfing. Internet browsers create and delete scads of temporary files. Surfing for a few nights can reduce my hard disk to chattering inefficiency bad enough to make me think the old "hesitation" curse is back with me. Vopt fixes that. Highly recommended.

Actually, I should say that Vopt is a partial cure. I have had hesitations in Word before in DOS and early Windows days, I found QEMM, Quarterdeck's memory manager, indispensable, and I said so often. When Windows 95 rolled out, it didn't look like there was much need for third-party memory-manager programs.

I was wrong. QEMM97 works like a charm, adding memory and resources to your Windows 95 system. While I haven't been using it for all that long, Richard has, and neither of us has had any problems with it so far. It works fine with FreeSpace and Norton System Doctor, its con-

I wanted to know why all the disk operations.

again. I suspected they were caused by disk operations; making disk operations more efficient reduces the time the computer's attention is turned to them. That helps. But I went further: I wanted to know why all the disk operations. What I found out makes a long story—you'll have to read it in the Web Exclusive part of the column—that ended with my installing and uninstalling Quarterdeck System's CleanSweep. The reason? I was routinely exceeding Cyrus's 32 MB of memory.

Speaking of Quarterdeck, some time ago, I said that I didn't see much improvement from their Magna-Ram. That turns out to be wrong.

Even though I managed to get my memory usage down below 32 MB by uninstalling CleanSweep, it was still hovering around there, and my stupid hesitations in Word continued. About then, my son Richard spotted the newest QEMM97 and mentioned that he thought Magna-Ram, which is included with QEMM97, had helped his system.

I figured anything was worth a try, so I installed QEMM97, which automatically installs Magna-Ram, a program that claims to do for RAM what FreeSpace does for disk space, on-the-fly compression. The results were amazing: my hesitations ceased, most disk-swapping operations ceased, and things are very stable. The decrease in disk-swapping operations has been dramatic.

One warning: by default, QEMM97 installs Update-it, a memory-resident program that will go look for Quarterdeck updates on the Internet. That uses several megabytes of memory and surely is not needed. Kill it fast.

While I was talking with Barry Emerson about improvements to Vopt, he told me something disturbing. Disk defrag programs move massive amounts of data around. To make sure that everything works properly, Vopt does cyclic redundancy check (CRC) checksums on each file that it moves. Barry has found that, in about every 500 GB of data moved, there will be one bit flip: a 0 has become a 1, or vice versa.

He has no idea what causes this; it does not seem to be specific to any kind of file or any kind of hardware. It may be temperature-dependent, but that's an impression; when an event is rare, it's hard to get decent statistics. "It may be cosmic rays for all I know," he said.

One bit flip in 500 GB is a very low error rate; but given current massive data transfers, it's frightening. The odds are pretty good that the bit flip will be inconsequential or that it will cause a fatal error requiring you to restart whatever operation you were engaged in; but there remains that tiny chance that the bit will flip in an important data file and never be noticed.

I honestly don't know what, if anything, I can do about this. Thus, I merely report it. But it disturbs me.

Now an apology: The comedy of errors started in my November column. CyberMedia's Oil Change recommended that we download DUN 1.2, a Microsoft upgrade to Dial-Up Networking. We did that. We also read about a utility called TweakDUN, from Patterson Design
Networking parameters. The result among other things is that multiple Internet activities work better; you can find out more from NetPro North West, whose site is worth visiting anyway. I've heard good things about TweakDUN, and it certainly does no harm. While I haven't yet tried to test how much good it does, I have the impression that it has helped a lot.

Incidentally, I managed to buy two copies of TweakDUN at $12.95 each. Naturally, a story goes with it.

Buying the first copy was a pain. There is a free shareware copy, but I generally forget to pay for shareware, so it's simpler to pay when I get it. Trying to pay for TweakDUN led me to the BuyDirect.com page; that one didn't want to accept my American Express card. It never said why. I checked the number and the expiration date, and got the same message: "There's something wrong." Eventually, I figured out that my card has no period after my middle initial, erased the one I had inserted, and downloaded my copy.

I did all this on Princess, which runs NT. Then I transferred the resulting td_12r.exe self-extracting installation file to Cyrus and ran it, getting the error message that "This application uses CTL3D32.DLL, which is not the correct version. This version of CTL3D32.DLL is designed only for Windows NT." I had no idea what program generated that message, except to note that whoever wrote it wasn't very clear on pronoun references.

Mistakenly—although I think understandably—I concluded that since I had downloaded the file on an NT system, I had somehow got an NT version of it. That was when I fired up Communicator on Cyrus (which runs Windows 95) and bought the second copy of td_12r.exe.

Of course it gave the same error message. Ignoring that message produced the information that I didn't have any Visual Basic 5 run-time programs, but I could get them from http://www.simtel.net/pub/simtelnet/win95/dll/vb5run97.zip.

There's no way to cut and paste from that error message, so out came the logbook so I could hand-copy all that. The first time I fed that URL to Communicator, it did not work. I chopped it back to http://www.simtel.net/, which got me to a place worth going to: a collection of updates and freeware. Drilling down through its index got me nowhere, but eventually I found a search-engine form, entered vb5run97.zip, and voilà!

That gave me a chance to test a newly installed update of WinZip. I copied vb5run97.zip into a work directory with Symantec's Commander 95, double-clicked on the filename, and up came both EXE and readme files. The readme file warned that installation would be tedious, requiring an installation, reboot, and another installation, but stay with it.

Double-clicking on the EXE file in Commander started the process, which went exactly as described. After this, double-clicking on td_12r.exe, ignoring the message about the wrong version of CTL3D32.DLL, and doggedly proceeding, I installed TweakDUN. WinZip and Commander make a good combination, and both are recommended.

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Chaos Manor

To Cure a Failing Memory

Various Registry entries, while making it easy to restore the defaults. As I mentioned, I haven't actually measured how much good making those changes has done, but a number of people I respect say it's worth doing; and certainly it has done no harm.

Incidentally, this machine is also running DUN I 2, and that hasn't done any harm either; but be careful.

I've been thinking about the big flap over Microsoft's requiring resellers to install Microsoft Internet Explorer (MSIE) 4 as a condition for getting Windows 95, and I think it's a tempest in a teapot.

If you want to be concerned over a Microsoft business practice, get angry over the Sun lawsuit about Microsoft "improvements" in Java that result in Java applications that work in MSIE 4 but not in Navigator. The big attraction of Java is its universality, and Microsoft is doing its best to undermine that. I may be on Sun's side on this one.

The computer book of the month is Using Netscape Communicator 4 by Mark R. Brown with Tom Fronckowiak et al. (Que, ISBN 0-7897-0980-5). This book will tell you things about Communicator you didn't suspect you needed to know. It's complete, well organized, and well written. Incidentally, I use Communicator rather than MSIE mostly out of habit. Eric Pobirs, our intern, switched to MSIE 4, which he claims has some outstanding features. So far, though, I haven't found as good a book about MSIE as this is about Communicator.

The book of the month is by Tim Powers, Earthquake Weather (Tor Books, ISBN 0-312-86163-X). Powers writes modern fantasy: imagine that the Fisher King of the West has been slain in modern-day Southern California, and Dionysius must be invoked to restore the king. This is a sequel to Tim's Expiration Date.

The runner-up game of the month is Interplay's Fallout, about the best "modern" role-playing game I've seen. It takes place in a dark and grim post-nuclear war society of survivors just barely hanging on. As a game it's pretty good, but I am very irritated by games that don't work well in Windows; you have to exit to DOS, and you may even need a boot disk to get this to run. I call that dark ages technology.

The game of the month is Microsoft's Close Combat: A Bridge Too Far. I've seen ads that imply that you can test your skill against Montgomery's in his worst campaign, but that isn't true. This game uses the Microsoft Close Combat engine, and the scale is minor tactics down to the infantry squad; there are no real strategic decisions to make. It's like a real-time Steel Panthers II. I once swore never to play another real-time game again, but in fact the timing on this one is just right, neither too fast nor too slow. It's quite realistic, a good simulation of company-level tactical control that's also fun to play. It installs and runs in Windows 95 or NT without problems. Recommended.

And now I'm taking off to the annual Hackers' Conference, where I'm sure I'll learn a lot.

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 high volume of letters, Jerry cannot guarantee a personal reply. You can also contact him on the Internet or BIX at jerry@bix.com. Visit Chaos Manor at http://home.earthlink.net/~jerry/.
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FEBRUARY 1998 BYTE 149
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<td>$1,880</td>
<td>$1,825</td>
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Hardware

This month, we check out Mitsubishi's new mini-notebook, Pentium II workstations, translation software, updated Linux software, and remote-access software.

PREVIEW

Mitsubishi Amity CN

$1995

Enter HotBYTES No. 976.

Little Problems Trip Up a Little Notebook

Since last year's announcement of the Toshiba Libretto sub-notebook, vendors including Hitachi, Nimantice, and Mitsubishi have raced to provide higher-powered micro-laptops. Powered by a 133-MHz Pentium processor, the $1995 Mitsubishi Amity CN fits between the 120-MHz Pentium MMX Libretto 70CT and Nimantice's 150-MHz Pentium MMX Persona T-150.

The Amity CN can accommodate from 16 to 48 MB of system RAM and a 1.2-GB hard drive. Weighing a little over 2½ pounds, the unit measures 9.3 inches wide by 6.7 inches deep by 1.34 inches tall. Its keyboard is well sized; each key is spaced 16 millimeters apart, making touch-typing bearable.

The system is not perfect, however. Take its pointing stick, which sits flush against the keyboard and is difficult to maneuver without hitting the keys next to it. I had to connect a standard PC/2 mouse to continue using the system, not a good situation for working on the road. I also found the 7.5-inch passive-matrix color display to be blotchy in areas.

I did like its external lithium-ion battery pack, which adds 7½ hours of life, weighs about 1½ pounds, and doubles as a carrying handle. It doesn't come standard, however; you'll have to shell out $383 for this feature and $300+ for a CD-ROM drive. An external floppy drive ships with the system.

This could be the perfect traveling companion, but problems with the pointing stick and screen are minuses for road warriors.

-Michelle Campanale

Laptops

The Joy of Portable Computing

Compaq's Presario 1680 Has All the Features of a High-End Laptop With New Enhancements to Make Portable Computing More Pleasant. A modification called 8-Hour Display plays audio CDs without starting the whole system, and with its built-in bass boost, the $4195 system doubles as a potent CD Walkman or boom box, if need be. Synaptics' enhanced touchpad lets you move on-screen windows with only a finger tap on the touchpad, no buttons are needed, and has an adjustable touch threshold. The Presario 1680 has a 200-MHz Pentium MMX (upgradable to 233 MHz), a 20x CD-ROM drive, 128-bit graphics with 2 MB of videomemory, a 56-Kbps modem, a USB port, and up to 96 MB of SDRAM. This gives the system power to go with its new usability features.

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The Velo 500, Philips' Latest Windows CE Machine, is Unchanged in Form Factor, Keyboard, and All Outward Physical Characteristics from the Velo 1. Internally, the device now supports Windows CE 2.0, and the on-board 19.2-Kbps modem has been upgraded to 28.8 Kbps. The CPU now runs at 75 MHz. The Velo 500 accepts a miniature add-in module for expanding RAM and sports a 240- by 640-pixel, 4-bit gray-scale screen. It has no PC Card slot but has expansion capabilities for RAM and ROM. It also has a V-
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Systems

A Workhorse of a Workstation

THE MEDALLION 300X-D WORKSTATION targets high-end graphics and data-intensive applications with support for the newest system technologies, which should stave off the early onset of obsolescence. It is ready for Windows 98 and NT 5.0. The system board has support for DVD and USB. The system comes with 64 MB to 1 GB of DRAM. Configurations include features such as dual 300-MHz Pentium II processors, dual-channel SCSI, AGP support, a RAID port, and an STB Velocity 128 AGP 3-D accelerator with 4 MB of SGRAM. Pricing starts at $3495.

Enter HotBYTES No. 983.

Scanners

Scanning Without Interference

MICROTEK'S SCANMAKER 5 ($3000) is a 36-bit 1000 by 1200 optical dpi (8000-dpi interpolated) color flatbed scanner with a built-in medium tray that eliminates distortion at http://www.byte.com/hotbytes/

### Networking

**Build a Smarter Network**

GADZOOKS' DENALI FIBRE CHANNEL LOOP (FCL) area switch, which is priced at $12,250, works with FCL hubs to build enterprise Storage Area Networks (SANs). A SAN consists of intelligent storage devices that are connected on their own distributed network, and Denali provides three gigabit-speed Fibre Channel Loops that give you increased bandwidth and network performance. Contact: Gadzooks Microsystems, San Jose, CA, 888-423-3222 or 408-360-4950; http://www.gadzooks.com. Enter HotBYTES No. 989.

**Back Up Your Backup System**

THE ARK SYSTEM ($8995) PROVIDES speedy disaster recovery and high availability of data on distributed, multivendor systems. It resides between your server and backup systems, including RAID subsystems, creating multiple copies of data to be maintained on storage arrays anywhere on a WAN or LAN. The unit routes data between servers and any SCSI devices accessible on the network and supports Fast Ethernet and T1 lines. Contact: Ark Research, San Jose, CA, 408-260-5900; info@arkres.com; http://www.arkres.com. Enter HotBYTES No. 988.

### Hard Drives

**Get More from Your Hard Drive**

IBM HARNESSES THE CAPACITY OF ITS denser Giant Magnetoresistive head technology to build the Deskstar 16GP, a 16.8-GB drive that's built for the desktop. The hard drive, which costs $849, makes multimedia and entertainment applications more feasible for PCs. IBM estimates that this drive, which has an areal density of 2.687 billion bits per square inch, is sufficient for when scanning slides, film, or transparencies. The medium is scanned inside the scanner, with no glass between an image and the scanner lens. Built for design professionals, it comes with ScanWizard TWAIN scanner controller software, OCR color calibration, and medium trays for 35-mm, 2¾-inch, or 4- by 6-inch film; slides; or 8- by 10-inch transparencies. Contact: MicroTek, Redondo Beach, CA, 800-634-4160 or 310-297-5000; http://www.microtekusa.com. Enter HotBYTES No. 985.

### Web and Database Integration

**Kiva's Enterprise Server 2.0 ($35,000 on Unix, $25,000 for Windows NT)** middleware resides between Web-server software and an enterprise database, helping developers create applications that work with existing enterprise systems. Developers can use Kiva's Java and C++ libraries to write applets or applications that talk back to the server via IIOP (using a third-party ORB from Iona or Visigenics) or Kiva's own communications protocol. The classes are transport-independent. Thus, developers can use a third-party bridge to DCOM. Contact: Kiva Software, Mountain View, CA, 650-526-3900; http://www.kivasoftware.com. Enter HotBYTES No. 993.

### Programming

**Help for HTML**

BLUE SKY SOFTWARE'S ROBOHTML 1.0 ($489) is an HTML help authoring tool that complements Blue Sky's RoboHelp 5.0 and Microsoft's HTML help format. This tool automates the process of working with HTML help extensions and provides support for HTML extensions and ActiveX controls that a general-purpose HTML editor might not have. Contact: Blue Sky Software, La Jolla, CA, 800-459-2356 or 619-459-6365; http://www.blue-sky.com. Enter HotBYTES No. 992.

### Firewalls

**Your Own Private Firewall**

PC SECURE IS A PERSONAL FIREWALL THAT protects individual PCs, workgroups, or small business networks from on-line attacks. Priced at $59.99 for individual users (multiuser licenses are available), PC Secure monitors e-mail, Web activity, FTP, and any TCP/IP links you make. It alerts you when unauthorized and unwanted applets, ActiveX controls, or outside hackers invade your system or network. Contact: Software Builders International, Atlanta, GA, 800-432-0025 or 770-541-1500; http://www.softwarebuilders.com. Enter HotBYTES No. 994.
Business

An Insider’s Outsourcing Tool

As companies increasingly depend on outsourcing to get work done, a product such as Glovia 4.0 can help you keep track of outsourced labor and integrate it into existing financial, manufacturing, and customer-service operations. Priced at $2500 to $5000 per concurrent user, Glovia runs on Unix or Windows NT platforms and provides tools for managing engineering, education, and consulting jobs, tracking all associated activities and scheduling billing, progress reports, and deliveries.


Enter HotBYTES No. 995.

Making Sense of Your Data

AnswerTree ($495) is an ODBC-compliant data-mining tool that builds profiles, predicts outcomes and trends, and uncovers patterns in data. It presents data in simple tree diagrams and color-coded charts and tables. It contains eight decision-tree methods for applications such as market research, direct mail, credit scoring, quality control, and institutional research.


Enter HotBYTES No. 998.

Telephony

A Universal Inbox

Communicate Pro ($179) has a single graphical interface for collecting and coordinating all your messaging services, including voice mail, pager, fax, e-mail, contact management, and Internet phone capabilities. It can automatically file voice, e-mail, and fax messages by name into the contact manager, and has auto-attendant voice-mail features, including the ability to give private messages to preselected incoming phone calls. It has a simple POP3 e-mail client and fax-on-demand. It supports text attachments and outgoing pager messages.

Contact: 01 Communicate Laboratory, Mississauga, Ontario, Canada, 905-795-2888; http://www.01com.com.

Enter HotBYTES No. 1002.

Operating Systems

Linux for the People

Linux is considered by some to be Unix-for-geeks-with-PCs, but Red Hat Linux 5.0 ($49.95) aims to make the popular OS accessible to the mass market. This multitasking OS runs on Intel, Digital Alpha, and Sun SPARC systems; provides simplified installation through a new disk-partitioning user interface; and offers automatic hardware probing and configuration, sound support, and an interface for system administrators. This latest release includes a new library called Glibc that offers better internationalization and supports for threads. Red Hat Linux 5.0 includes configuration for multiple managers, graphical user-level tools, Internet audio broadcaster Real Audio, backup utility BRU, and an X server.


Enter HotBYTES No. 998.

Dictation

Speak Naturally to Microsoft Word

Dragon has expanded its family of continuous speech programs for

at http://www.byte.com/hotbytes/
Software Update

EUDORA PRO 4.0 ($39) keeps abreast of the latest e-mail, Internet, and directory protocols, and provides an updated interface and an enhanced client called Eudora Pro CommCenter ($59). Eudora Pro 4.0 now supports IMAP, for accessing files from remote locations; LDAP, which supports directory services; and MIME/HTML, to compose HTML documents with tables, embedded sounds, images, and applets. The user interface has a movable icon-based menu bar, and a file browser simplifies importing files with a new drag-and-drop interface. Eudora Pro CommCenter 4.0 is an ad hoc groupware, with shared folders and document synchronization. It has a universal inbox for e-mail, voice, and fax communications; Internet paging; synchronization with the PalmPilot Address Book; and news and content delivery. You can run the application with voice control based on IBM's ViaVoice speech-recognition technology.


Enter HotBYTES No. 1004.

CORELDRAW 8 GRAPHICS AND IMAGE-EDITING SOFTWARE FOR WINDOWS has been upgraded to support more file formats while offering a customizable interface. Users can now simultaneously import multiple files and specify their placement on a page at any location in a CorelDraw document. In addition, there are new options to import an image at original size, scale the image proportionally, or scale without maintaining aspect ratio at import time. Personal preferences and custom toolbars can be saved for multiple users, and the program can handle animated GIFs, JPEG preview capabilities, HTML tables, cascading style sheets, and Netscape layers. It costs $695 for the full version and $248 for the upgraded version.


Enter HotBYTES No. 1005.

COSESSION REMOTE 32 VERSION 8 IS A 32-BIT IMPLEMENTATION OF ARTISOFT's REMOTE-ACCESS SOFTWARE FOR REMOTELY RUNNING APPLICATIONS AND DOCUMENT SHARING. IT NOW OFFERS CONTROL OVER INDIVIDUAL OR GROUP RIGHTS TO DATA, AS WELL AS PASSWORD PROTECTION, ENCRYPTION, AND KEYBOARD AND MOUSE LOCKING FOR SECURITY.


Enter HotBYTES No. 1006.

Remote Access

Remote Access for Administrators

NetOp for Windows ($149), from CrossTec, is remote-access software that can reach multiple PCs on multiple platforms simultaneously. You can remotely control PCs with dial-in or Internet access on Windows 3.x, NT, and 95; DOS, or OS/2. It can handle and route traffic via TCP/IP, NetBIOS, and IPX, automatically translating whichever protocol a situation demands. NetOp for Windows is designed for help-desk support, remote software loading, or remote configuration.

Contact: CrossTec, Boca Raton, FL, 800-673-0729 or 561-391-6560; http://www.4tc.com.

Enter HotBYTES No. 1000.

Cross-Platform

Standards-Based Interoperability

NFS is a UNIX FILE SYSTEM THAT, AMONG OTHER THINGS, ALLOWS NT APPLICATIONS TO RUN ON UNIX PLATFORMS. Attachmate's PathWay Server NFS for Windows NT uses this open standard to provide any NFS client with access to heterogeneous file and print services located on UNIX, NT, VMS, Hewlett-Packard, or IBM mainframe environments. The PathWay NFS Server costs $395, runs on Intel or Alpha platforms, and includes WebNFS for firewall and TCP support.


Enter HotBYTES No. 997.

More Scalable Videoconferencing

While videoconferencing breaks barriers between people, BoxTop Interactive's iVisit aims to break barriers in videoconferencing technology. The product is scalable because it doesn't need a reflector like other videoconferencing tools. BoxTop simply maintains a directory server that keeps a list of names and IP addresses of VisIt users. You can contact someone by querying this server. A black-and-white version is available for free downloading at http://www.boxtop.com, a color consumer version costs $49, and there is also a corporate version with a proxy server for operating within a firewall.

Contact: BoxTop Interactive, Los Angeles, CA, 310-235-3900; http://www.boxtop.com.

Enter HotBYTES No. 999.

Free control software DragonDictate 3.0 Classic (included), an active vocabulary of 55,000 words, and a noise-canceling headset. You'll need at least a 133-MHz Pentium processor.


Enter HotBYTES No. 1003.

Windows With NaturallySpeaking Preferred Edition ($229), you can dictate directly into Microsoft Word. The program also lets multiple people create their own voice files and use them on the same system, for better accuracy in a multi-user setup. It can record your voice for proofreading and editing. It also has a text-to-speech and mouse-grid voice controller for better control over the mouse cursor. The Deluxe version ($695) has all the above capabilities, plus a macro language, multiple topic support, integration with hands-free control software DragonDictate 3.0 Classic (included), an active vocabulary of 55,000 words, and a noise-canceling headset. You'll need at least a 133-MHz Pentium processor.


Enter HotBYTES No. 1003.
Letter End Zone  Last June, we mentioned this snippet of an Associated Press news item: “An oditorial in the Iraqi government newspaper Al-Jumhuriya says that the Internet...is ‘the end of civilizations, cultures, interests, and ethics.’” What else, we asked, is the Internet the end of? Some responses we received were philosophical: “It is the end of that age that was ruled by isolation and dogmatic doctrines, and the beginning of a new age that will be ruled by communication, reason, and the common good,” predicted P. DeMoss. Many other readers’ responses about what the Internet has doomed were more pragmatic: “Poor stock performance for modern companies,” wrote D. Johnson. “Stamps,” replied R. Browning. And, according to D. Fine, the Internet signals

Fighting Words  Our report about Ebonics and the C++ dialect brought a deluge of mail. Most of it was from native C++ speakers. Some urged us to interpret their thoughts for the general public; others wanted their words compiled and stored for later use. A few letters came from people who were outraged at the reference to Ebonics. Nearly all the 10 angry correspondents used the word professional in describing themselves. Quality time with my peacock Anticipating them, Mary Benton, a self-described “country programmer from Missouri” wrote: “I’ll bet you get angry when stupid academic jargon escapes into the public. Academics, politicians, and ing something up in an encyclopedia; of needing friends, a life, any form of social contact; reporters get to show us how pompous they can be. Let’s not forget paradigm, critical thinking, new math, excellence, and, centric. Quite a few trumpeted the Internet as “the end of research in libraries.” Readers my all-time favorite, quality. I just love to hear self-inflated people spout these words.” Dale Roberts sent in this report about named ESTW0d2170 predicted “The end of ignorance—the beginning of understanding.”

Marc Abrahams is the editor of the Annals of Improbable Research. You can contact him by sending e-mail to marca@improb.com.

Marc Abrahams is the editor of the Annals of Improbable Research. You can contact him by sending e-mail to marca@improb.com.
THANKS TO THE DELL INSPIRON 3000 NOTEBOOK WITH A 200MHz PROCESSOR AND 64MB SDRAM, HIGH PERFORMANCE IS VERY AFFORDABLE.

If you think high-performance notebooks only come at a high price, relax. This sleek new Dell Inspiron 3000 notebook has got it all — a 200MHz Pentium processor with MMX technology, 64MB SDRAM, and a 2.1GB hard drive. It also features a bright 12.1" SVGA Active Matrix Display that’s easy on the eyes. Not to mention a 128-bit graphics accelerator and stereo speakers with 3D Surround Sound and Yamaha Software Wavetable to further enhance your multimedia experience. You’ll be pleasantly surprised at the way it feels as well, weighing in at a lean 6.4 pounds.* So if you’re looking for a supreme package at an inviting price, call Dell. Or visit our website, for an equally painless way to get all the satisfaction you need.

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* Zoom Video and USB Ports
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Common features: • Mini-Tower Model • 512KB Integrated L2 Cache • 3.5" Floppy Disk Drive • Two USB Ports • Microsoft Office 97 Small Business Edition plus Bookshelf 98 • McAfee VirusScan • Microsoft Works 95 • Microsoft Internet Explorer 4.0 • MS IntelliMouse • Dell Quiet Key Keyboard • 3 Year Limited Warranty with 1 Year On-site Service • Upgrades: • 3Com 3CS55 Fast EtherLink XL 10/100 PCI Card, add $79 + Iomega Zip 100MB Internal Drive, add $99

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300MHz PENTIUM II Processor featuring MMX Technology

Common features listed above plus:
• 128MB SDRAM Memory
• NEW 9.1GB Ultra ATA Hard Drive (9.5ms)
• 1200MHz 17" Monitor (15.9" v.s., 260s)
• Sound Blaster AWE64 Performance Sound Card
• Altic Lansing ACS-95 Full Dotby Surround Sound Speakers with Subwoofer • NEW Dell Comfort Key Keyboard

Common features listed above plus:
• 64MB SDRAM Memory
• 8.4GB Ultra ATA Hard Drive (9.5ms)
• 1000X1 17" Trinitron Monitor (15.9" v.s., 260s)
• Sound Blaster AWE64 Performance Sound Card

Common features listed above plus:
• 64MB SDRAM Memory
• 4.3GB Ultra ATA Hard Drive (9.5ms)
• 1000LS 17" Trinitron Monitor (15.9" v.s., 260s)
• Sound Blaster AWE64 Performance Sound Card

Common features listed above plus:
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• 4.3GB Ultra ATA Hard Drive (9.5ms)
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Dell Workstation

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- 128-bit Graphics Accelerator with 16 Million Colors at 1024x768
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PC COMPUTING DECLARES THE DELL DIMENSION XPS D300 SERIES PRODUCT OF THE YEAR

After months of reviewing the PC industry's hottest products available, the experts at PC Computing have reached their decision. The Product of the Year is the blazing fast Dell Dimension XPS D300 PC line. After checking out a 300MHz Pentium II processor based system, PC Computing claimed, "It's just about the fastest PC on the planet," and "Dell has become the clear technology leader." But their praises didn’t stop there. Our service and support were loaded with compliments too. "Dell also gets the nod here for unparalleled service and support..." and, "Dell has become the customer loyalty model for the entire industry."

Our customers also have reasons to be passionate about this Dell Dimension XPS D300 system, with impressive features like 64MB of high-speed SDRAM, an 8GB Ultra ATA hard drive, an S1B nVidia 4MB AGP Video Card, and premium Altec Lansing speakers. Starting around $2499, so give us a call or visit our website. Because this big win for Dell is an incredible win for you.

### Dell Dimension XPS D300

300MHz Pentium II Processor

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- 64MB SDRAM Memory
- 512KB Integrated L2 Cache
- 8.4GB Ultra ATA Hard Drive (9.5ms)
- 100LS 17" Monitor (15.9" v.s. 1)
- STB nVidia 4MB AGP Video Card
- 32X Max* Variable CD-ROM Drive
- Integrated Yamaha WaveTable Sound
- Altec Lansing ACS-90 Speakers
- Microsoft Office 97 Small Business Edition plus Bookshelf 98; McAfee VirusScan
- Microsoft Windows 95/Internet Explorer 4.0
- Microsoft IntelliMouse
- 3 Year Limited Warranty* with 1 Year On-site Service
- Upgrade to a 9.1GB Ultra ATA Hard Drive (9.5ms), add $99
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**PC COMPUTING PRODUCT OF THE YEAR**

[Image of Dell Dimension XPS D300]

Dell Dimension XPS D300 system, with impressive features like 64MB of high-speed SDRAM, an 8GB Ultra ATA hard drive, an S1B nVidia 4MB AGP Video Card, and premium Altec Lansing speakers. Starting around $2499, so give us a call or visit our website. Because this big win for Dell is an incredible win for you.
It begins with a slight glazing-over of the eyes and ends with complete immobilization of all body parts. Brain waves fall stagnant. EKGs go idle. Some might call it an endless loop. But we know what it is: BYTE content overload.

Luckily, most of our readers are acutely aware of the hazards of mixing BYTE and brie at an intimate gathering. They’re not exactly fools. Over 40% of them have earned their post-graduate degrees. A whopping 91% qualify as expert or advanced IT professionals. Which is why, on a regular basis, at least 20 people turn to the BYTE reader for his opinion on technology. And, on average, BYTE readers call the technology shots for 853 people within their organizations. These are well-informed people who make smart, safe decisions. And luckily most don’t risk rendering some chip-dipping small-talker as still as a statue with too much BYTE.

A good host knows: Not all guests can hold their BYTE.

The prospect of a whole new month’s worth of BYTE reviews and articles sends shivers of joy up the spines of the Technology Elite. It is no wonder, then, that they feel compelled to read aloud the rich, meaty content BYTE offers.

So it will be a cold day in you-know-where before we compromise what we put into our magazine for fear that some innocent party goer might accidentally seize up. It’s a chance we’re willing to take. The average reader spends 4.2 hours with his nose in our book – and keeps it around for over 14 months for reference. So we’re not going to fill our pages with a bunch of fluff or pointless drivel. This is solid technology coverage. And a bit of gray matter shut-down isn’t going to stop us from printing more of it next month.

We may not be getting into the best parties in town,
but we’re getting inside the heads of the Technology Elite.

When it comes to top-of-the-line IT professionals, no other magazine gets in there and shakes them up quite like we do. We give them information that makes them think even more than usual – and the supercomputers in their noggins are already processing overtime. That’s why, month after month, BYTE is in the hands and on the minds of the people you want to reach. The kings of cryptography. The fathers of daughterboards. The emcees of NT. The Technology Elite. Buy BYTE and you’re buying some intense brainpower.

As for the potentially catatonic among us, remember, a frozen brain is not a pretty brain. Cover your ears. Cover your eyes. Because BYTE covers too much for you to handle.

BYTE magazine.
It’s not for everyone.
Our readers can handle more technology than can fit in the average frontal, temporal and parietal lobes.

You are cordially invited to give us a call for more information.

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