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Raising the Java Standard

We need many flavors, but one standard.

The recent call by Microsoft, Intel, Digital Equipment, and Compaq for a standardized Java deserves both qualified support and skeptical appraisal.

Let's take the skepticism first. Can you think of four companies with less inclination to openness? Windows and VMS have never been within a city block of a standards body. Intel used to be relatively open, for a chip company, but its latest moves with the Pentium II (see page 73) represent a classic closed door to competition. And while Compaq has developed more original technology than most PC companies, it hasn't developed a single open one that I can think of.

Nonetheless, even a broken clock is right twice a day. Mindful of this group's motives, let's look at the realities.

Why is the Internet bigger than Unix? Because you can depend on the Internet to be the same everywhere and you can't with Unix. Which way should Java evolve—like Unix or the Internet?

I vote for the Internet. For Java to spread beyond a dedicated core, both the software industry and corporate IS will have to believe it has a stable future. Right now, Java has not realized its dream of "write once, run everywhere." Plenty of small differences in virtual-machine implementations prevent that. 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?

In a standards body, Sun will not get everything it hopes for, and neither will Microsoft.

Microsoft will hijack Java. Sure, it'll try. For over a year, the rap from Redmond has been "Java is a language, not a platform." Sounds a lot like "The Internet is a network, not a platform," a rap Microsoft was forced to retreat from. However, should Microsoft not come to its senses, there's nothing about a standardized Java that prevents Sun or anyone else from putting out its version of correctness and letting customers decide. If this technology is capable of standing up to the rigors of mission-critical computing, it's capable of surviving a standards body.

Standards slow the development process. Sure they do, in the same way that reading a map slows down the process of getting somewhere. It also prevents us from getting lost, a very likely outcome for Java if its advocates don't plan the route carefully. And what's the rush? Java is three years from being a mainstream application development platform. I'd like to think it'll be right, not just available, by then.

Java's too young to strangle in a standards body. Hmm, standards are too slow to achieve results, but too fast to allow growth.

Standards mute competition. Really? Tell that to IBM, loser of the 1980s network standards race between Ethernet and Token Ring. Submitting its Token Ring technology to the IEEE 802 committee did not prevent the other main 802-governed technology—Ethernet—from whopping IBM in the market. But it did allow customers committed to Token Ring to know where the technology was headed.

No other operating system vendor has ever submitted its product to a standards body, so why should Sun? No one else—at least since UCSD's p-code implementation—has claimed its product as a universal platform. Such a goal requires more than business as usual.

In a standards body, Sun will get everything it hopes for, and neither will Microsoft.

Right now Sun and Microsoft are mirroring each other, trying to establish de facto standards. I support the Java Lobby's call to Microsoft and Intel to cease fractious activities. But I also think Java needs an independent standards body—perhaps a combination of the Java Lobby and vendors—dedicated to advancing the technology. If serious users are going to commit to Java, they're going to have to see maturity, stability, and reliability from the vendors as well as from the products.

Mark Schlack, Editor in Chief
mschlack@bix.com

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Overcome one of the Internet’s most annoying problems

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ActiveX Files

The otherwise very good ActiveX cover story (September) includes some disinformation in David Linthicum’s sidebar on security. Simply put, ActiveX has no security model. The infamous Exploder control that powers down a Windows PC was signed with a Verisign certified signature (http://www.halcyon.com/mclain/ActiveX). Microsoft claims that Authenticode, its code-signing framework, is a security model. It is not. It’s an authentication framework.

“If a control destroys your system,” you say, “at least you’ll know whom to beat up.” This is silly. What if the government passed a regulation that thieves must wear name tags if they break into a house when the owners are not present, and then the FBI rationalizes it by saying, “If a thief steals you blind when you’re not home, at least you’ll know whom to jail”? I don’t think so.

Any hostile ActiveX control worth its salt will erase all traces of itself before proceeding with the rest of the dirty work. Since ActiveX is Win32-omnipotent, it can do anything. ActiveX may have its place in the developer’s toolbox, but it’s not a suitable model for executable content.

Gary McGraw
Research scientist
Reliable Software Technologies
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My intention was to explain the ActiveX security model, not promote it. As with any security subsystem, there are always methods to defeat it. We’ve seen this with Java, with the Internet, and I’m sure ActiveX is no exception. — David Linthicum

I want to thank the folks at BYTE for writing that excellent article, “ActiveX Demystified.” There is, however, something that came to mind after reading it. Does ActiveX open Microsoft to a new era of unrelenting competition? Think about it. By dividing applications into objects that follow the Component Object Model (COM) spec, Microsoft has created many more targets subject to competition. It is difficult to unseat an entire suite of applications (as Corel has found out), but now, small and hungry software firms can target spelling checkers, TCP/IP handlers, peripheral drivers, and many other objects. Are we going the way of software widgets? Is Microsoft going the way of GM, where, in order to keep costs down, it will have to subcontract? The future that ActiveX will bring will be interesting indeed.

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P&S’ing for Dollars

We appreciate BYTE’s recognition of the growth of publish and subscribe technology (“Publish or Perish,” by Richard Hackathorn, September). However, we would like to clarify several points made in the article.

The statement that “no examples of monetary exchange with P&S have occurred” (page 66) dismisses the origin of publish/subscribe technology on Wall Street, where this model provides the infrastructure for billions of dollars in transactions. In fact, Open Horizon’s Ambrosia product opens the door for electronic commerce beyond the trusted computer base of a LAN to the often unreliable environment of the Internet. Ambrosia offers guaranteed message delivery, transaction support, and comprehensive security around the core publish/subscribe messaging engine.

Contrary to the article’s characterization of Ambrosia as based on CORBA, it is a pure publish/subscribe product implemented in Java. Ambrosia provides three levels of CORBA compliance to increase the flexibility of customer implementations, but it is not tied to CORBA. Finally, while you quoted our CEO, you left out our contact information: 650-869-2200; http://www.openhorizon.com.

Audrey Kalman
Director of marketing
Open Horizon, Inc.
South San Francisco, CA

While there are certainly billions of dollars being exchanged daily, these exchanges are done in systems carefully designed with limited sets of parties involved. There are no standards to allow economic exchange between independent consumers and producers. The subscribing process needs to be opened, as the Webcasting folks are doing.

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Economic exchange is critical to that openness. While the article might have implied that Open Horizon works only as a CORBA-based product, this was certainly not the intent. That said, CORBA and Java are not mutually exclusive. —Richard Hackathorn

Web Groupware

Jon Udell's "HTML + NNTP = Groupware" (September Web Project) hit on several important points but didn't mention that the Web was originally designed to do what he's describing: collaborative authoring. When Tim Berners-Lee invented this stuff, he was trying to provide a way for people to collaborate on document authoring so that dispersed groups could write scientific papers. That's why the little-known and even less-used CHECKIN and CHECKOUT methods are part of the HTTP standard. POST was meant to allow people to post articles and papers to newsgroups; it wasn't meant to receive results from a form as it is now used.

The only advantage of using NNTP/INND over the Web is that replication is better supported (this is where Lotus Notes scores). How about doing all this stuff using a Web browser and a Java applet that would add as Java applets that get downloaded and updated when required, plus some server-side scripting for sorting, outlining, and thread displaying.

Hubert Matthews
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Very true about the Web's origins. And yet oddly, the Web has emerged into popular consciousness as primarily a read-only medium. Meanwhile, the Usenet has become a read-write medium for the masses. My strategy is to go with the flow.

The biggest advantage of using NNTP/INND is: no server-side programming required at all to deal with a basic document database, with discussions, binary entities and, now even with HTML. It wasn't planned this way, but the combo of NNTP servers and clients has become in a way more useful than the combo of HTTP servers and clients, that is, for the particular class of application to which I'm trying to draw attention. This is a very large, important class of application.

A Web server script can do those things you mention. I've written lots of things like that. But I'm trying to focus on what can be done with out-of-the-box tools and no programming. —Jon Udell

Other Interfaces

Your article on network user interfaces ("Good-Bye, GUI—Hello, NUI," August) left out one important NUI. Silicon Graphics' Indigo Magic has had for about a year now many of the features other vendors will be implementing in the "near future," such as URLs directly on the desktop, a network clipboard, and a file manager that can show FTP sites or other URLs directly and lets you drag and drop a page to a local file.

Kristoffer Lawson
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Here's another interface you might want to check out: the KDE (as in Kool Desktop Environment) project for X Window—but mostly Linux—systems. Based on the Qt widget set by Troll Tech, KDE is a free GUI/NUI undergoing development by a team of programmers around the world. At the heart of KDE is Kfm, the file manager. It's network-oriented and can view any file tree that can be described in URL format. It can already render most HTML, and the next major version, Kfm II, will also function as a Web browser (it will even support frames). There are other applications in KDE, too, including simple editors, a font browser, and a sound player. At the moment, the software is still in alpha phase, but it's remarkably stable, and I use it virtually full-time now. If you want to read more, go to http://www.kde.org/.

John McNulty
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Improbable Products, or if We Had a Million

Man, I am sitting on an S.F.-to-Boston flight and cannot stop laughing. September's Improbable item about Stochastic Cleaner—the program that "cleans your hard disk of all the clutter that you probably don't need"—is just great. Keep up the good work.

Steve Butcher
stevebcollectivetech.com

Glad you enjoyed it. Many readers have written us to find out how they can actually buy the products covered in Improbable; for example, we received virtually millions of letters about Cyber Babewatch (August), including one from a clinic that dangled before us the possibility of real cash expenditure. But until those fussy, ROI-obsessed venture capitalists start returning our calls, the items mentioned on the end page will have to remain on the drawing board in Marc Abraham's mind.

—Editors

Hot Plug Today

While you did a solid job of describing how Hot Plug PCI technology works, and the role it can play in reducing server downtime, you left out information regarding the current availability of compliant products ("Hot Plug Will Deliver Higher Availability," July Bits). NetFrame Systems has been shipping Hot Plug PCI systems, boards, and device drivers since 1996, when the company introduced its ClusterSystem 9016 server. Last June we introduced the ClusterSystem 9008, which offers eight individually hot-

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pluggable PCI card slots.

NetFrame has tested its systems with the proposed Hot Plug PCI standard you wrote about and recently announced that both the 9016 and the 9008 are fully compliant with the most recent draft of the specification. NetFrame is committed to ensuring that its servers will be compliant with the finalized specification, due later this year.

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FIXES

We used Visual C++ version 4.2, not 4.3, as part of our benchmark tests of Pentium II PCs (September Hardware Lab Report).

Zyxei's omninet.net (October Hardware Lab Report) is 17.9 (W) x 13.1 (L) x 3.8 (H) centimeters, not inches.

Wright Strategies' FormLogic 3.0 development kit (September What's New, page 145) costs $250 per user for 75 users. The per-user price goes down incrementally as the number of seats goes up.
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Circle 112 on Inquiry Card
A Chip off the Old Block

Digital has reestablished Alpha’s CPU performance lead over Intel at the high end.
Its next move: Another stab at the desktop PC space.

ow that the new 600-MHz 21164 delivers a considerable advantage in raw performance over Intel’s Pentium II, Digital will try again to penetrate a market that has so far eluded its Alpha processor: the desktop PC.

Like other RISC CPU vendors, Digital was embarrassed in late 1995 when Intel’s Pentium Pro caught up to the Alpha, at least in integer performance. However, Digital has reestablished its performance lead at the high end: A new 600-MHz 21164 Alpha-based system from Polywell, which BYTE recently tested, trounced 300-MHz Pentium II–based systems in our CPU-/FPU-intensive BYTEmark tests. The 350-MHz 604e also does quite well on this test.

Now Digital is readying a new CPU, the 21164PC (see “Alpha Arrives at the Desktop,” May BYTE), which costs less than the 21164 but delivers almost as much performance. The 21164PC targets desktop PCs costing $2500 to $3000, a price that’s still at the high end of the mainstream PC market but much less than the $10,000 or so that systems using the 600-MHz 21164 now cost.
The first 21164PC–based systems were expected to start shipping this fall, according to officials at Digital.

With the 21164PC, Digital retained the 21164’s basic core but did several things to reduce costs, including moving the 21164’s modest (96-KB) Level 2 cache off-chip and reducing the pin count by eliminating support for multiple processors and limiting the size of the L2 cache to a maximum of 4 MB (down from 64 MB).
The 21164PC processor costs $495 in OEM quantities for the 533-MHz model and just $295 for the 400-MHz version. At those prices, the chip competes with both the Pentium and the Pentium II, although the 21164PC’s chip set, the 21174, costs about $60 more than Intel’s 440LX Accelerated Graphics Port (AGP) set. The 21164PC’s motion-video instruction set enables it to perform streaming video compression (e.g., full-frame and full-motion digital videodisc [DVD] acceleration) that can’t be done on the x86 architecture without additional hardware, such as a graphics accelerator with DVD support, Digital officials say.
The 21164PC isn’t Digital’s first attempt to enter the RISC PC market. The company’s 21066, a less expensive version of the 21064 Alpha CPU, fared poorly and illustrates the many reasons why penetrating the mainstream PC market is such an uphill battle for a RISC vendor. At the time, Digital officials blamed the 21066’s tepid reception on a lack of native Alpha NT applications and other market factors. But analysts say the main reason the 21066 sank was due to poor price/performance. Results from running our BYTEmark tests on a reference system based on the 21164PC indicate that the new CPU will deliver plenty of performance for the dollar: It beats the 300-MHz Pentium II in both integer and floating-point performance.

Alpha chips are still dogged by nagging questions about the number of native applications available for the platform, although Digital and its partners have done much to improve this situation since the days of the 21064. Today, Digital claims 2000 to 2500 native applications are available for the platform, and it’s pushing the creation of more by offering hardware discounts for software vendors and by helping vendors port their applications to Alpha. “We have been driving the porting of applications to Alpha for all OSes—with the focus on NT, and Unix a close second,” says Aaron Bauch, manager of technical marketing for Digital’s Alpha Microprocessor. Another technology, Digital’s FX!32 emulation/translation software, improves the performance of native x86 programs when executing on Alpha NT hardware.

Nevertheless, there are some holes. For example, Microsoft currently has native Alpha versions of Excel 97 and Word 97, but none of any other applications in its Office family. Getting more Alphas onto more desktops will make the platform a more
attractive one for software developers to target.

Many Alpha-powered systems are still geared toward high-end applications, such as animation, graphics production, and databases, and most smaller companies apparently don’t need all that power at the prices Alpha systems command (see the Survey on page 24). Bauch believes that this will change with the continued evolution of Windows NT. “Our advantage in the NT marketplace is performance and the longevity of a system,” he explains.

By the first half of 1998, Digital will be ready to release a new CPU, the 21264. This is to be the company’s flagship processor; it will target high-performance servers and workstations and offer both uniprocessor and multiprocessor configurations.

In the past, Digital has simplified the CPU core while gunning for the highest speed. The new 21264, which features a complex, out-of-order CPU core, will process up to 80 instructions at once. It has a bandwidth several times higher than that of previous chips, channelling up to 5.3 GBps of cache data and 2.6 GBps of main memory into the demanding new processor core. The new 21264 will start life at 500 MHz, still far ahead of any competitors in terms of speed. And you can expect Digital to release a PC version of the 21264, according to Pippa Jollie, product manager for the 21164PC.

Digital is trying to emulate the success of x86 manufacturers in building a base of OEM customers by making the technology more readily available. During the past few years, for example, Mitsubishi and Samsung have begun producing Alpha chips, VLSI Technology has begun producing third-party core logic (and it might release a less expensive alternative to the 21174 chip set), hundreds of options from third-party hardware vendors’ add-in cards now exist, and 2000-plus independent software vendors now support the platform.

What’s missing—and what Digital covets—is a design win for the 21164PC with a top-tier PC vendor, such as Compaq or Dell. “It’s always been a primary goal to get a tier-1 company,” says Digital’s Jollie. Tier 1 vendors are interested, she says, but they’re currently in wait-and-see mode. “With the 21164PC, we are providing vendors a product that we hope they will adopt. I would be thrilled if they did.”

—Jason K. Krause

x86 Vendors Unite Against Intel

Foiled by Intel’s rigid patents on Slot 1, rival vendors of x86 chips are working on a new CPU interface to succeed the widely used Socket 7. The higher-bandwidth interface would be an open alternative to Intel’s proprietary sockets and slots, but it could split the PC system architecture into incompatible standards.

Cirix officials confirm they’ve held discussions with AMD and other companies about a successor to Socket 7. Socket 7 is the 296-pin CPU socket used by all P5-class x86 chips, including Intel’s Pentium processors, the AMD K5 and K6, the Cirix 6x86 and 6x86MX, and the Centaur IDT-C6. Intel’s competitors need an alternative because they can’t license the patented bus protocols for Intel’s P6-class processors.

All of Intel’s Pentium Pro, the Pentium II, and the forthcoming Deschutes) require the same basic bus protocols, although the physical interfaces vary. The Pentium Pro uses Socket 8, the Pentium II uses Slot 1, and some future Pentium II processors will use Slot 2. Mobile versions of the Pentium II use still another proprietary interface that’s a miniaturized variation on Slot 1. Motherboard makers can put Intel’s CPU interfaces on their boards, but Intel won’t share the technology with rival vendors of x86 processors, although it has licensed it to some core-logic chip-set vendors.

“If we adopt a proprietary solution, it will only help Intel win,” says Stan Swearingen, product management director at Cirix. “We believe the industry wants that to be an open socket. We’re already talking to chip-set vendors, AMD, and other companies to define a new interface,” he adds.

The interface would probably debut in 1999. Cirix, AMD, and Centaur agree that Socket 7 will remain popular at least through 1998, and possibly beyond. Although it has less bandwidth than Intel’s interfaces, it’s fast enough for mainstream desktops and servers.

Vendors are currently working to ex-
Desktops for the MIS director who'd rather
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tend the life of Socket 7 in several ways. This fall, AMD will likely announce a new K6 processor with a larger Level 1 (L1) cache. Centaur plans to ship next year a new version of the IDT-C6 that will integrate the Level 2 (L2) cache. Other possible stopgaps include CPU daughter-cards that plug into Socket 7 (see "Socket to Me" on page 73).

Meanwhile, Intel isn’t standing still. In August, it announced a new Pentium Pro processor with 1 MB of L2 cache—twice the maximum cache size of earlier Pentium Pro chips. Intel plans to introduce the Deschutes version of the Pentium II in mid-1998. Deschutes will be the first Pentium II chip fabricated on a 0.25-micron process, and it will eventually replace today’s 0.35-micron Pentium II chips (for more information, see “Future Watch,” below).

Slot 2 is a higher-performance version of Slot 1 that will run at a bus frequency of at least 100 MHz and support larger single-edge contact (SEC) cartridges. These cartridges have room for bigger L2 caches. Intel is aiming Slot 2 at higher-end desktops and servers, leaving Slot 1 for mainstream systems.

Even if Intel’s competitors can rally around an alternative interface, it will put many companies and users in a quandary. Today it’s possible to make a Socket 7 motherboard that works with anybody’s P5-class processor. But manufacturers say it costs too much to construct a motherboard with two different CPU interfaces because they’re electrically incompatible. Vendors would have to either create two versions of every product or choose sides.

The result could be two competing PC architectures: Intel and non-Intel. And since Intel is the industry’s leading supplier of CPUs, motherboards, and chip sets, the non-Intel faction faces an uphill battle to establish an open standard.

—Tom R. Halfhill

### Power Mac Prevails (with an Asterisk)

Thanks to its 350-MHz PowerPC 604e CPU, faster cache, and other improvements, Apple’s new Power Macintosh 9600/350 delivers excellent performance. But its status as the “fastest Mac” comes with an asterisk. Thanks to turmoil surrounding Mac OS licensing and Apple’s acquisition of Power Computing, the competition for the 9600/350 is now a lot thinner. With Motorola pulling out of the Mac clone market and the Power Computing buy-out, Apple doesn’t have to worry as much about clone vendors further eroding its market share by introducing

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**Future Watch**

**Coming in 1998:** 400-MHz PII PCs

By this time next year, Pentium II chips should be available at speeds of 400 MHz or higher, along with Pentium II versions for systems that have more than two processors and for notebooks.

Intel says the Deschutes version of the Pentium II will debut at 333 MHz early next year. It will be built on a 0.25-micron process and will reach speeds of 450 MHz by the end of next year. Sometime during the first half of 1998, Intel will release a 350- or 400-MHz version of the Pentium II that will support a 100-MHz system bus. This chip, which will sit in a Slot 1 cartridge, will target desktops, entry-level servers, and workstations.

Around midyear, the company will introduce Pentium II processors that plug into Slot 2, which is intended for servers and accommodates a larger Level 2 cache that runs at the core clock speed of the processor. Slot 2 configurations will support a 100-MHz system bus next year, and servers based on it will scale to a minimum of four processors, company officials said.

Intel will introduce Pentium II processors for portables during the first half of 1998. These chips will be available in either a modified cartridge design (similar to slots but significantly smaller) or the Mobile Module.
new, powerful Macs based on the upcoming G3 series (e.g., the PowerPC 750).

Another chip, Exponential's 533-MHz X704 CPU, is also no longer an option: After falling short of its target clock speeds and delivery schedule, Exponential killed the X704 and is suing Apple for breach of contract, interference, and other actions. At press time, the only Mac-clone vendor that had licensed Apple's Mac OS System 8 was Umax Computer.

For now, Apple's top high-end system is based on the 604e; G3-based systems from the company will probably ship this fall. But the 9600/350 offers plenty of performance for power users. In addition to its 350-MHz CPU, the system has a 1-MB secondary (L2) cache and a new cache controller that enables the CPU to talk to the L2 cache at 100 MHz. Due to the cache design, known as an in-line cache, the PowerPC doesn't have to wait as long for data as it would if the CPU accessed the L2 at the same speed as the 50-MHz system bus (CPU to main memory). The 604e's increase in megahertz is due to the new 0.25-micron process.

The 9600/350 delivered the highest integer performance of any desktop system BYTE has tested using our CPU/FPU BYTEmark tests. You can see how it rates against other systems on page 18. The BYTEmarks measure raw CPU performance and do not test other system components, such as hard drive and video adapter. In our suite of cross-platform Photoshop tests, the Power Mac beats a 300-MHz Pentium II decisively in the arbitrary rotate test, but the other scores are closer.

The PowerPC 750 (code-named Arthur), the first processor slated to come from the new G3 PowerPC family, will initially run slower (275 MHz) than the fastest 604e. But thanks to a separate L2 cache bus and a small die size, the G3 series promises better performance at a lower price: A system from Power Computing with a 275-MHz G3 scored 9.4 and 6.1 in the BYTEmark integer and FPU tests, respectively. That system won't ship now, although Apple might sell it in the future.

But although Apple's decided that competition from clones wasn't such a good idea, it still must compete against Wintel, and, compared to some Pentium II PCs, the 9600/350 is pricey: with 64 MB of RAM, a 4-GB hard drive, a 24X CD-ROM, a Zip drive, and a video card with 8 MB, it's about $3400. AST's similarly configured Bravo MS 6300 is $2950.

Dave Andrews

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**Bug of the Month**

**The Man With No Domain Name**

Dennis Gaughan must have looked forlorn, standing in the pouring rain, pounding on Network Solutions' door and pleading with security to put him in touch with tech support. But what else was there to do? His domain name was gone.

Sometime Saturday afternoon, August 2, WebCom, a Web and e-mail service that hosts Gaughan's intranet site, had its domain name removed from the root servers of Network Solutions, which manages the domain-registration system for the Internet. The source of the problem was a bug in a script that Network Solutions was running over the weekend while cleaning its databases, erroneously deactivating WebCom's domain. In the aftermath of the crash, WebCom, which is based in California, was unable to contact Herndon, Virginia–based Network Solutions to find out what had happened. Many analysts say the WebCom incident is yet another in a string of snafus that highlight the Internet's immaturity for hosting bet-your-business applications.

"Network Solutions is a single point of failure for the Internet, yet there's no 24-hour hot line to contact them if something goes down," says Thomas Leavitt, executive vice president of WebCom. Network Solutions claims to have a direct line for contacting system administrators at any time, but it's not a general hot line, and company officials asked BYTE not to publish the number for the general public. Leavitt was unaware of this number at the time that his Web site went down.

In the wake of the domain-name crisis, WebCom officials were able to find a WebCom user, Gaughan, who lived in the same area as Network Solutions' facilities. "I went to Network Solutions' facility in Herndon," says Gaughan. "I knew it wasn't the InterNIC engineering center, just an administrative office, but I wanted to get their security to put me in touch with someone who could help."

Gaughan's confrontation with security happened to coincide with the first thunderstorm in the area in 3½ months, and he got soaked for his efforts, but Network Solutions called in some staff members and ran an emergency regeneration of the root server Zone file to restore accessibility of WebCom's domain.

-J. K. K.

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**Send yours to jason_krause@mgh.com!**

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**DVD RAM Splits, But Products Still Coming**

Just when it looked as if DVD RAM was sailing along smoothly as the next standard for writable storage, a rift in the group of key vendors backing the standard has created serious questions for end users. A trio of companies—Hewlett-Packard, Philips, and Sony—have decided to come up with an alternative format to DVD RAM, the recordable version of DVD video.

The new format, which will be called DVD+RW, is incompatible with the one approved by the DVD Consortium and differs largely in its higher recording capacity, as well as in its recording technology. Nevertheless, major companies, such as Toshiba, say they're on track to release products based on the original standard by the end of this year.

DVD+RW will handle 3 GB on a single-sided disk, and twice that on a double-sided disk, versus 2.6 GB per side for the Consortium DVD RAM standard. At press time, Mitsubishi, Ricoh, and Yamaha had all signed on to the renegade standard, providing momentum for this proposal.

Could the split in the DVD RAM standard be a replay of the infamous Beta-versus-VHS battle? Possibly, but it almost certainly portends unsettled times for buyers of DVD RAM products. Several other major players, such as NEC and Toshiba, have not announced any intent to support this new standard. "Toshiba is pretty much in line with the original schedule to commercialize this technol-
What's Next for Java Office Apps

Amid a sea of changing strategy and concerns over Java's direction, software vendors say they will continue to bring Java business applications to market. Software developers working in the Java space must juggle the evolving Java platform with the realities of bandwidth availability and end users' expectations.

Java Office Apps Road Map

**Applix:** Will release this year an NT server version of Anyware Office (which delivers a word processor, a graphics-capable spreadsheet, an e-mail client, and HTML authoring to Java-enabled clients) to complement current Unix servers. Also planned: a new presentation module and a Java client for the TM1 OLAP program. (508-870-0300; http://www.applix.com)

**Corel:** Will release in mid-1998 "Remagen" (which lets Java-enabled clients access existing Corel WordPerfect Suite 8 or other office suites running on a server) and "Alta" (a universal in-box, calendar/scheduler, ad hoc work-flow, task-management, and data access/analysis package), plus technology for dynamic UI and application assembly to make programs run better over networks. (613-728-0826; http://www.corel.com)

**Lotus:** Will release this year the "Kona" family (which includes a GUI, data-access, spreadsheet, word processor, charting, project-scheduling, presentation-graphics, calendar, to-do, and e-mail applets). (617-577-8500; http://www.kona.lotus.com)

But vendors such as Applix, which already sells Java-based business applications, continue to forge ahead with new versions. Corel, after rethinking its strategy, says it will release a new Java suite next year, and Lotus plans to release Java productivity applets in the fourth quarter of this year.

Corel originally announced plans for a Java version of its full-function Office suite of applications, but the company has since scrapped that approach. "The problem was that we would demonstrate our applications, and the response from users, even at pro-Java sites, was 'This is great, but can you add just this one feature?'" says Chris Biber, Corel's director of strategic alliances. "Before you know it, users were asking us to add more and more features. Adding all those would have resulted in a chubbby—not a thin—client." Corel will satisfy demands for a fully functional, Java-enabled office suite with its Remagen technology (see the table above), while a new product line, currently code-named Alta, will combine elements of CorelCentral and the evolved Corel Office for Java.

While Corel and Lotus work on their projects, Applix says it will continue to improve its existing Anyware Office and Enterprise Anyware (which consists of sales, service, and help-desk modules). "We've already released our first suite, so we know that you can use this kind of technology to create complex applications for the power-user community," says Barry Burke, vice president of product marketing at Applix.

However, as vendors go forward, they will have to master the art of broken field running as the Java platform evolves. The latest donnybrook between Microsoft and Sun, over which foundation class to support—Sun's JFC or Microsoft's AFC—in addition to questions over who should control the Java standard may only serve to impede Java's growth.

—Jon Pepper

Survey

Small Companies Snub Alpha

Most companies select x86-based hardware to run their Windows NT applications over Digital's Alpha CPU, especially companies that have less than 500 employees. According to a recent survey of companies that now run Windows NT, which was conducted by BYTE's research department, almost 97 percent of those smaller companies don't have any systems powered by Alpha CPUs.

Source: BYTE magazine research dept. Total number of respondents: 140.

<table>
<thead>
<tr>
<th>Percentage of Systems Powered by Alpha</th>
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</thead>
<tbody>
<tr>
<td>Under 500 employees</td>
</tr>
<tr>
<td>One or More Alphas</td>
</tr>
<tr>
<td>96.5%</td>
</tr>
<tr>
<td>3.5%</td>
</tr>
<tr>
<td>500 or more employees</td>
</tr>
<tr>
<td>No Alphas</td>
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<td>73%</td>
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</tbody>
</table>

—D. A.
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Server Wars: Sun and Compaq Take Shots at Each Other

Sun Microsystems' recently announced Ultra Enterprise 450 Work Group server is a stiff competitor for Compaq's ProLiant servers. The Enterprise 450 levered the cost-of-ownership issue against Windows NT/Intel (Wintel) servers, offers better performance, supports PC-client environments, and offers the resiliency of Solaris and scalability across Sun's Enterprise server product line (which supports up to 64 processors in a symmetric multiprocessor/server configuration). Compaq's ProLiant 7000 (see article, next page) is strategically positioned against the 450, but Sun's 450 announcement is a bold strike against Wintel.

The Enterprise 450 is a robust midrange server. It supports up to four UltraSparc II processors, which use Sun's UPA system bus; it has a peak speed of 1.78 Gbps. This compares with 540 MBps for Intel's Pentium Pro. A fast system bus lets multiple processors access memory faster, providing more efficient symmetrical multiprocessing.

The Enterprise 450's I/O architecture is based on the PCI bus: It has six PCI buses, including three 66-MHz PCI busses, resulting in a peak I/O bandwidth of just over 1 Gbps. This is more than three times the I/O bandwidth of the Pentium Pro Intel servers, which support two 33-MHz PCI busses.

The Enterprise 450 is actually priced less than Compaq's ProLiant 6000 and 7000 servers (see the table below). And Sun has taken care of third-party application software costs, which were a huge differentiator between midrange Unix servers and Wintel servers. Sun has negotiated a new workgroup-server pricing level for one- to four-way Sun Enterprise servers that levels the pricing differentiation for applications such as Oracle and Sybase. Third-party applications for Sun's Enterprise 450 are priced the same as identical applications for Wintel servers.

Sun's Enterprise 450 server provides more performance than the fastest Intel servers currently available for Windows NT 4.0 (see the table). Compaq has yet to publish a TPC-C result for the ProLiant 7000 for NT, but it claims 10.547 tpm for the ProLiant 7000 with four 200-MHz Pentium Pros running SCO UnixWare. Its price/performance result ($71/tpm) was not as good as Sun's. Compaq is expected to publish a TPC-C result for the ProLiant 7000 running NT, which should have better price/performance--and maybe even better performance.

PC users can access their files transparently from any Sun server with Sun's Solaris for Intranets, which ships with every Sun Enterprise server. Solaris for Intranets is also available for $1290 for Solaris Intel platforms. Introduced recently, SunLink, a module of Solaris for Intranets, supports file systems for Windows 3.11, 95, and NT; Mac; NetWare; and MS LAN Manager. Print-sharing and file-sharing services for these clients are supported by SunLink. PC users can access their Microsoft Office files from Sun's 450 without changing anything. SunLink is included with the Enterprise 450 server, but no additional client software is needed.

Sun has completely disguised Solaris from PC users, who can install the Enterprise 450 (or any Sun Enterprise Server) using any browser. Sun's WebStart is an easy one-button installation that has options for customized configurations. Installation is not harder than it is for Compaq's SmartStart.

The Enterprise 450 has many, but not all, of the Reliability, Availability, and Serviceability (RAS) features found in the Enterprise 3000, 4000, 5000, and 6000 servers. It comes standard with two (and an optional third) 560-W power supplies, which are hot-swappable. Sun's 450 also supports hot-pluggable disk drives, thermal sensing, and four levels of system diagnostics.

Sun's SyMON provides a complete set of on-line diagnostics. If a CPU or memory module fails, the 450 detects the failure automatically, takes the failed module off-line, and continues to process. But the system does not support on-line reconfiguration (as other Sun servers do), where a failed processor or memory module can be replaced, or a new module added, and the system can reconfigure itself without being taken down.

Short of supporting NT, Sun has done almost everything it can do to take on Wintel workgroup servers: It has eliminated price as a barrier and brings most of its enterprise capabilities to the workgroup server. The Enterprise 450 should gain market share against Sun's major Unix competition (HP and IBM), whose Unix midrange servers lag far behind. For mixed Unix and NT environments, Datapro recommends that customers evaluate both Sun and Compaq (and other Wintel platforms) for workgroup computing.

Peter Lowber is a principal analyst for Datapro, a division of the Gartner Group. For more information on Datapro reports, call 609-764-0100; fax 609-764-2814; or see http://www.datapro.com.

Sun Strike on NT

<table>
<thead>
<tr>
<th>Processor/ MHz</th>
<th>Sun Enterprise 450</th>
<th>Compaq ProLiant 6000</th>
<th>Compaq ProLiant 7000</th>
</tr>
</thead>
<tbody>
<tr>
<td>L2 cache</td>
<td>1 and 2 MB</td>
<td>512 KB and 1 MB</td>
<td>512 KB and 1 MB</td>
</tr>
<tr>
<td>TPC-C tpm results</td>
<td>11,560 (four 300-MHz CPUs, Solaris 2.6, Sybase 11.5)</td>
<td>9029 (four CPUs with 512-KB cache, UnixWare, Sybase)</td>
<td>10,547 (four CPUs with 1-MB cache, UnixWare, Sybase)</td>
</tr>
<tr>
<td>$/tpm</td>
<td>$56.6</td>
<td>$79</td>
<td>$71</td>
</tr>
<tr>
<td>Entry street price (128 MB of memory, 4-GB disk)</td>
<td>$14,650 (250 MHz)</td>
<td>$15,196 (512-KB L2 cache with NT Server 4.0)</td>
<td>$23,016 (1-MB L2 cache with NT Server 4.0)</td>
</tr>
</tbody>
</table>
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ProLiant 7000 Takes on Sun 450

With the excellent reputation Solaris has for supporting enterprise-class, mission-critical environments, and the scalability of Sun's Enterprise Server line, Sun's 450 is attractive for workgroup server and enterprise environments. But with its ProLiant (PL) 7000, Compaq has developed a server that's strategically positioned against Sun's 450.

The PL 7000 provides many of the same Reliability, Availability, and Serviceability (RAS) features as Sun's Enterprise 450 (see Datapro Report, previous page). In addition, the PL 7000 supports up to four of Intel's Pentium Pro 200-MHz, 1-MB, L2 cache processors.

But Compaq is positioning the PL 7000 with the future capability to support up to eight Intel processors. As eight-way servers for NT become a reality with NT 5.0 and Deschutes, the next-generation Intel server processor, the pressure will be back on Sun. The 450 is only a four-way server; for more scalability, Sun users are forced into a much-higher price bracket. Also, Compaq is strategically positioning the PL 7000 as a standards-based server for hot-plug PCI and ILO.

Now that Sun is supporting the PCI bus, Compaq is upping the ante. This is not an issue yet, but it may become one as these new standards materialize during 1998.

P. L.

Compaq's ProLiant 7000 is expandable to eight CPUs.
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Blasts from the Past

Years ago in BYTE

What goes around, comes around. Five years ago, the hot topic was penny-pinching PCs. Dell's Dimension 386SX/25 system offered an 80-MB hard drive, two floppy drives, Windows 3.1, and a mouse for just $1359. Inexpensive PCs made lots of news this summer, too—not only traditional Pentium-type PCs that sell for under $1000, but NetPCs and network PCs (and cost of ownership), too.

Years ago in BYTE

Bill Gates was drumming up support at users-group meetings for OS/2, but developers (and BYTE columnist Jerry Pournelle) complained that OS/2 didn't take advantage of the 386 and that it was a crippled OS on the 286. Compaq's 20-MHz Portable 386 weighed 20 pounds, had 1 MB of RAM, and 40 MB of hard drive space for a mere $7999.

Years ago in BYTE

Remember the movie Tron, about a programmer who finds himself trapped inside the electronic world of computers? Today its special effects seem tame, but at the time people were wowed. We wrote about how it was made and how Tron presaged a new era in computer-generated imagery.

Years ago in BYTE

Steve Ciarcia's well-known Circuit Cellar column, one that attracted a loyal following over the years, debuted. And Apple co-founder Steve Wozniak wrote an article about how to extend the 6502 processor using software.

Jakob Nielsen, Sun Microsystems
Distinguished Engineer, discusses the hows and whys of product usability.

Nielsen's Top 10 List

PROVIDE STATUS FEEDBACK. The system should tell users what's going on. "This is particularly true for the Web, which is not yet robust and reliable."

MATCH BETWEEN SYSTEM AND REAL WORLD. The system should communicate in words, phrases, and concepts that are familiar to the user.

GIVE USERS CONTROL AND FREEDOM. "Don't trap people in a state where they cannot escape. Always have a cancel button available."

BE CONSISTENT. "If a button for your home page is always in the same location, users don't have to figure out where it is."

PREVENT ERRORS. This may sound obvious, but if something is likely to lead to an error, make it difficult to do and ask confirmation questions such as, "Do you really want to do this?" But don't overdo the confirmation, or the user may get impatient and click "YES" to everything.

MAKE OBJECTS, ACTIONS, AND OPTIONS INTUITIVE. "Remember, where you have to remember what something does, is much more difficult than recognition, where you immediately know what something does."

PROVIDE FLEXIBILITY. "Give experienced users shortcuts and give novice users Wizards. There should be more than one way to accomplish a task."

PRACTICE AESTHETIC AND MINIMALIST DESIGN. "Every piece of information on the screen competes with all the other information there. If something isn't necessary, remove it."

HELP USERS RECOGNIZE, DIAGNOSE, AND RECOVER FROM ERRORS. "In an error message situation, the user is motivated to overcome a problem. Errors are a primary opportunity to teach users through informative error messages."

PROVIDE ON-LINE HELP that provides quick answers to specific questions.

BYTE: You've studied usability and user-interface design issues since 1983. Is the number of people who design products with which others interact increasing?

Nielsen: Oh, yes, more people are already designing their own user interfaces, in the sense that a Web page is a user interface. The scope of user-interface design has expanded dramatically because of the Web. It used to be a small set of professionals doing it. But now, it's essentially everybody, because everybody seems to be designing a Web site.

My analogy is that designing a Web page is quite similar to designing a dialog box. In either situation, you're designing a set of options for users. These options include what users can click on, what they can do, and what the stream of their attention is when looking over the layout.

Designing a Web site is similar to designing an application. You have to worry about not just those detailed issues, but also about the navigational flow. How users move between all those different options is one example of what comes into site design as opposed to page design.

We now have millions of people doing this, whereas, a few years ago, we had a few thousand people doing this. Many of the issues and problems that we see on the Web today, such as inconsistency, are the same ones we've had with other systems, such as mainframes, for a long time.

You can get more on this topic from http://www.useit.com/papers/heuristic.
Don't Blink
Your eyes might be the best way to control your PC screen. Page 32IS 3

Multilingual Net Searches
And Internet-based translation services. Page 32IS 4

Broadband Choices
ISDN or ADSL? The question just won't go away. Page 32IS 7

Bug Hunters
New testing tools help software developers control bugs and costs. Page 32IS 17

Greener Design
Software helps manufacturers build environment-friendly products. Page 32IS 23
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Don’t Blink

Forget Windows, icons, and your mouse. Your eyes may be the ultimate computer commander.

Envision a PC that lets you trace a series of hyperlinked documents as you glance at the keywords or activate an incoming e-mail message by just looking at the subject line. Researchers at the Heinrich-Hertz research institute (HHI) in Berlin recently demonstrated a gaze-controlled 3-D user interface. It works without inputting traditional explicit commands. “Our current prototype reads users’ gazes and reacts before they can utter a command,” says Siegmund Pastoor, a project leader at HHI.

Called Blick (the German word for gaze), the system includes an autostereoscopic display that represents objects in 3-D without the user wearing either a head-mounted display or shutter glasses. Built-into-the-monitor head-tracking and eye-tracking cameras capture a user’s gaze.

“The advantage of our system is that users do not need to look at a fixed point on the screen or hold their head in a particular position,” says Pastoor. Blick projects the stereoscopic right- and left-eye views into the user’s visual field.

Blick’s autostereoscopic, free-viewing 3-D display uses direction multiplexing, a display technique that makes different perspective views visible only from specific positions. For each position, the system calculates on the fly both stereoscopic views and projects them together to create the illusion of a 3-D space. Images seem to jump out at you.

To avoid time lags between the head-tracking camera’s image capturing and the stereoscopic visualization on the monitor (a typical delay of about 120 milliseconds), the system runs an algorithm to predict the viewer’s head position. Thus, the graphics subsystem often works with anticipated head positions.

Additionally, an eye-tracking system constantly senses a user’s point of fixation (via a cornea-reflex method). The system then simulates the limited depth of focus of the human visual system and makes currently fixated objects on the screen stand out against the environment. Thus, the user can interact with 3-D objects by just looking at them. If you focus on an object for more than 0.1 second, the object may change its shape or pop up new objects. Of course, the system takes time to get used to.

HHI researchers also developed a virtual OS (VOS) that allows you to paste together objects, configure applications, and even “visually” program applications in 3-D space, controlled by your gaze. VOS runs on a Silicon Graphics Onyx machine and also allows for live videoconferencing in a virtual 3-D space.

–Rainer Mauth
Search the Net in Multiple Languages

Information retrieval on the Internet can be a laborious task, not just because search engines often give you links that are completely out of context, but also because you may stumble on sites that are in a language you don’t understand. The only way around this hassle is a multilingual search engine that automatically translates information into a language that you understand. Lernout&Hauspie, a leading speech and language technology developer, is planning to offer this service in mid-1998.

L&H acquired several translation companies, including Mendez Translations (Brussels, Belgium), Translingua (Bonn, Germany), and Lexitrans (Madrid, Spain), last year. L&H says it will be investing $35 million in the development of Internet-based translation services. “Internet-based services will employ both our speech technologies and our newly acquired translation capabilities,” says Bob Kutnick, L&H’s chief technology officer.

The L&H on-line translation services will include multilingual text retrieval based on machine translation, and automated submission and receipt of human translations via e-mail. The L&H search engine will, for example, translate a German-language search request into English, create an abstract of the retrieved documents, and translate the result back into German. According to Kutnick, the engine will also rank translated documents and build content clusters that make it easier for you to narrow down your interests. If you want an exact translation of your findings, you will be able to submit documents via e-mail.

The company plans to offer several levels of services (e.g., basic machine translation for a flat monthly fee, unlimited domain-specific machine translation for a higher fee, and combined machine and human translation on a per-page basis). At press time, L&H had not set fees for these services. First supported language pairs will be English/Spanish and English/German (bidirectional). Bidirectional translations from English to French, Italian, Mandarin Chinese, Korean, and Japanese will follow, though L&H declined to say when they would be available.

The services will initially be targeted at certain business domains such as law and medicine. A prototype service will be launched by the end of the year.

Better 3-D Sound Coming to PCs

Audio chip manufacturers such as Taiwan’s C-Media and Japan’s Yamaha earlier this year licensed Central Research Laboratories’ new Sensaura Digital Ear 3-D audio technology. Yamaha says it selected CRL’s algorithms because, for the first time, they provide spatially accurate sound perception using only two stereo speakers.

The Sensaura 3-D audio core digitally emulates human hearing. Music takes on a “bigger room sound,” including the spatially accurate acoustic perception of the recorded environment. The Sensaura-compatible chips manufactured by Yamaha and C-Media are meant for PC-related multimedia applications such as computer games and virtual-reality applications. They can make any monophonic or multichannel source sound like a spherical 3-D sound field by virtually positioning sound sources all around the listener, including above, below, and behind. Secondary processing provides sound effects, such as reverberation and Doppler shifting. The system also includes cross-talk cancellation that is critical for loudspeaker playback.

The chips will be compatible with Microsoft’s Direct3DSound and the Virtual Dolby standards. Expect to see the first PCs including the new 3-D audio technology early next year from Taiwanese PC manufacturers such as Mitac.

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New Driver Could Lead to Brighter, Cheaper LCDs

Prime View International Co., Ltd., of Taiwan has developed an LCD driving method that can crank sharp and crisp color images out of a thin-film transistor (TFT) LCD. Called the Integrated Driving Technology, this new driving method will give TFT LCDs higher resolution than other active-matrix LCDs, the company claims.

“We are the first in the world to offer such an advanced technology,” says Dyi-Chung Hu, senior director of R&D and the LCM manufacturing division at Prime View. The new driving technology has received patents in the U.S., Australia, and Taiwan, and is patent-pending in Japan and the EC.

The Integrated Driving Technology will lower the cost of the LCDs by drastically reducing the number of driver ICs. Hu explains that in conventional active-matrix TFT LCDs, higher resolution has to be addressed by more individual pixels, resulting in a greater number of driver ICs.

For a Japan-made 5.4-inch TFT LCD, it requires six ICs—two 120-pixel I/O scan-driver ICs and four 240-pixel I/O data-driver ICs—to drive pixels to create a full-color display. However, using Prime View’s Integrated Driving Technology circuitry design, you can achieve a full-color, video-rate display with only one 240-pixel I/O data-driver IC.

Prime View’s latest 1.8-inch TFT LCD module using the technology has a high resolution of 234 by 480 pixels, compared to standard 220- by 279-pixel resolution supported by the existing 1.8-inch models. It will let digital camera users obtain all the detailed images for back-panel review and replay.

The LCD module also applies an advanced chip on glass (COG) mainstream technology, which directly mounts the driver LSI onto the glass of the LCD and thus produces a thin LCD panel. Compared with the currently used tape-automated-bonding (TAB) technology, the COG process cost is lower and the process yield rate and reliability are higher.

“We are seeing more and more consumer and small industrial products incorporate specialized LCD panels. Almost all of the next generation of digital cameras will include LCDs,” Hu says.

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Rainer Mauth
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The battle over who gets to bring broadband to the home is heating up. While ISDN seemed to be the answer a few months ago, other—possibly more practical—solutions are beginning to emerge: 56-Kbps/112-Kbps modems, cable modems, and Asymmetric Digital Subscriber Lines (ADSLs).

To date, most Internet service providers (ISPs) still operate at 33.6 Kbps, with only a few of them offering 56-Kbps speed. Routing pathways often limit throughput even further. These bottlenecks are worse during times of heavy traffic. Throughput can fall well below what current analog modems can handle. Thus, the demand for speedy broadband technologies is on the rise.

**ISDN’s Wide Availability**

ISDN is the most widely available technology of the high-bandwidth options. Most competing high-speed offerings are currently in various stages of research, testing, and deployment. None of them are as mature or as widespread as ISDN.

Even in the U.S., where ISDN is seen as a not-so-attractive technology, an increasing number of ISPs are now capable of handling ISDN. Once it’s installed properly on the user end, this high-speed technology connects reliably at speeds of up to 128 Kbps and transfers data at speeds of up to 300 Kbps with compression.

There are two types of ISDN: Primary Rate Interface (PRI) and Basic Rate Interface (BRI). PRI ISDN is generally found in telephone switches, computer telephony, voice processing, and dial-up Internet access. Residential installations and small businesses chiefly use BRI ISDN. A BRI ISDN link provides two B channels for data and voice transmission, and a D channel for signaling functions, such as call setup. You can use either or both B channels for LAN-to-LAN access, Internet access, videoconferencing, or other applications that demand higher bandwidth than analog modems can provide.

To achieve an aggregate 128-Kbps throughput, all ISDN modems now support the multilink PPP channel-bonding technology, which lets two connecting units negotiate and combine two or multiple channels to serve as one larger pipe with expanded bandwidth. In addition, multilink PPP ensures interoperability with all carrier equipment. What’s more, by incorporating a new technology called Always On/Dynamic ISDN (AO/DI), the D channel will soon be available to carry e-mail, news headlines, or other data—without having to dial up an ISP or corporate network.

Therefore, ISDN users could speak on one voice channel, send files into a corporate office on another, and get low-bandwidth data such as e-mail on a third. And because the D channel is always live between the ISDN subscriber and the phone company’s central office, users save the cost of dialing up every time they want to get low-bandwidth data.

**ADead Technology?**

Contrary to many phone companies’ expectations, ISDN services did not take off as planned, especially in the U.S. Users complained that it was difficult to install, that the phone companies took forever to set up the lines, that technical support was inefficient, and that it was too expensive.

Also, ISDN’s 64- or even 128-Kbps rate hardly spurred the interest of the business community, which handles many bandwidth-hungry communications applications such as shared CD-ROM access, shared live video catalogs, interactive movies, and real-time, downloadable videos and music.

“| If such obstacles in getting ISDN service cannot be removed, |
users will turn to emerging new high-bandwidth technologies,” says Thomas Huang, president of VersaNet Communications, an affiliate of Taiwan modem maker CIS Technology.

In fact, a handful of ISDN vendors have already predicted that ISDN may eventually be replaced by faster technologies such as ADSL or cable modems. However, “these data-only solutions are not likely to replace ISDN, but to coexist,” according to Felix Jeng, R&D manager at Alpha Telecom, a professional customer premises equipment (CPE) manufacturer.

Jeng points out that cable modem services don’t cover switched voice traffic. Cable-modem service is based on a shared-network topology, which means that the amount of bandwidth that’s available to a customer depends on how high the traffic volumes are at any given time. In addition, he says that the shared networks operate at a speed as fast as 10 Mbps. This should give customers at least as much bandwidth as BR! ISDN under normal traffic loads.

“At least for the next two years, cable modems and ADSL devices will not pose any threats to ISDN,” says Jim Hsieh, ISDN project leader for the communications product business division at CIS. ISDN is the best solution because users are able to manage phone calls, e-mail, and videoconferencing with one technology, Hsieh adds.

Cost Is a Big Factor

In spite of its slow takeoff in the U.S., ISDN has long been a standard for high-speed remote access in regions where the infrastructure is complete and the service is easy to come by. Europe and Japan have seen the greatest success in terms of ISDN proliferation. In Japan, it has the strong backing of the government. There will be nearly 1 million ISDN lines installed there by the end of the year.

This is why most Taiwanese ISDN product makers target Japan as their largest sales outlet. However, because Japan’s NTT and NEC corporations dominate more than 80 percent of their home market, there is little room for market expansion in Japan.

Many modem and networking-product manufacturers in Taiwan are applying their mass-production strengths to volume ISDN service providers who need terminal adapters (TAs) and infrastructure equipment such as routers, bridges, and switches.

Most ISDN TAs that Taiwanese companies make are 16-bit ISA cards with Windows 95 Plug and Play support. These internal cards sport common features as they all use solutions provided by chip makers. Cutthroat competition among ISDN vendors has largely brought card prices down, resulting in decreasing profit margins.

Lately, vendors in Taiwan are moving more upscale by adding external ISDN TAs to their product lineup. While they earmark internal cards for the European market, stand-alone models are in large demand in Japan.

Finding ways to make ISDN TAs more suitable for use with portable computers, active, self-powered adapter cards that have their own processors, memory, and drivers are currently under development. E-tech will soon launch an active-type ISDN adapter that features a 32-bit CPU, at least 256 KB of static RAM (SRAM), and 8 KB of dual-port RAM for ISDN protocols and driver software. This will allow it to operate without host PC resources.

Full support for ISDN APIs such as Win- ISDN, Winsock with PPP, multilink PPP, Common API (CAPI) 2.0, and Telephony API (TAPI) is important to ensure a TA’s operability. It lets ISDN TAs run most existing communications software and all commercially available applications.

Standards Support

European users, especially those in Germany, require the use of CAPI 2.0, because it eliminates the need for COM-port emulation. Auto-detection for the 1TR6, 1TR7, 1TR12, E-DDS1, and NT-1 protocols, as well as the Network Driver Interface Specification (NDIS) interface for raw-HDLC (high-level data-link control), Cisco-HDLC, PPP, and MLPPP supports, are included in most Taiwanese products.

Additionally, these units conform to the ISDN-1, SESS, DMS-100, European Telecommunications Standards Institute (ETSI), and INS Net 64 standards for ISDN communications. Some of these models also come with bundled applications, such as Internet, videotex, file transfer, fax, voice, mail, and terminal-emulation software.

For the high-end corporate segment, Taiwanese manufacturers are making more routers that enable multiple users on a LAN to access the Internet at high speeds. ISDN routers, like other routers, let users build anything from complex switched-circuit networks to simple peer-to-peer dial-in connections. Users can also fine-tune their line usage, which can reduce ISDN fees.

Many ISDN routers are equipped with some combination of a standard Ethernet port, multiple plain old telephone service (POTS) ports, and a built-in fax modem. Some of the routers even have a built-in...
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Ethernet hub. This bundling obviates the need for extra analog lines for the user's office and additional equipment. The Prestige 28641, from Zyxel Communications, for instance, has an option of a five-port external Ethernet hub.

The standard for compression in ISDN routers is Stac L2S, which offers up to 4-to-1 and 5-to-1 data-compression ratios. However, though many router vendors implement Stac L2S and most implementations work together, some vendors support Microsoft's Stac compression, which may not work with other Stac-based compression. Many vendors support both types, but a few support only one.

Another unique feature that's supported by ISDN routers is IP-address sharing. With this feature, each remote workstation has its own local IP addresses, but all outbound packets from the remote workstations share a single IP address, which is attached at the router. Inbound packets destined for those machines are sorted by the router and readdressed to those specific remote workstations. Because dial-in ISPs typically charge by the IP address, this can save on operating costs and effort.

At the CeBIT show in Hannover, Germany, this year, Zyxel demonstrated its Prestige 100, which lets up to four users access the Internet at the same time, supporting IP routing. Another model, the Prestige 128, supports both IP and IPX routing, as well as bridging. A single-user account feature lets multiple users on a corporate LAN access the Internet simultaneously using a single IP address from an ISP.

ADSL on the Rise

ADSL links designed to give high-speed, inexpensive remote access to corporate LANs and the Internet over standard phone lines are the next big thing on the high-bandwidth horizon. The performance benefits are clear: The technology supports typical downstream rates of 1.5 to 8 Mbps and upstream links as fast as 640 Kbps. That makes it potentially more than 10 times speedier than ISDN without the requirement to install an expensive new medium.

But while a new infrastructure is not required, high equipment cost is keeping ADSL from significant growth in the consumer market for the time being. CIS's Hsieh speculates that wide-scale ADSL
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**Supports Three Channels**

The ADSL technology supports three channels: downstream (simplex), upstream plus control (full-duplex), and POTS. As always, POTS occupies the lowest end of the bottom 4 kHz and is split off from the digital data by a passive low-pass filter, ensuring uninterrupted voice service even if the ADSL connection fails. Both the downstream and full-duplex channels can carry more than one bearer channel. Moreover, the digital portion of the connection never reaches the service provider's switching system, thereby offsetting network overload on the central switch.

In Taiwan, CCL/ITRI is a government-sponsored R&D organization. Chen Yun, manager of its transmission system department, says ADSL's channel-splitting capability makes the technology appealing to phone companies in the U.S. and elsewhere in the hope that they will be able to fend off competition from high-bandwidth data services offered by cable modems.

To take advantage of the technology, you need a special ADSL modem, and telecommunications operators must install special switches and equipment to provide service. Because most of the necessary switch upgrades are not in place, it will take some time to bring ADSL within reach of everyone.

Foreseeing a rosy future for ADSL as the most widespread high-bandwidth solution for connecting home computers to the Internet, modem manufacturers are revving up product development for the new ADSL technology.

CCL/ITRI heads an ADSL alliance with more than 10 modem and telecom companies, including Askey, DBTEL, GVC, Hitron, Tainet, Taiwan Telecom, Tecom, UFOC, U-King, and ZyXel. The first product produced by the alliance is a remote-site product: ADSL Remote Bridge and
POTS splitter. The interface between each site is connected by an HDLC/ADSL interface. The service between each site uses a 10Base-T Ethernet interface. The frame-based media access control (MAC) encapsulation is implemented for ADSL router-based network access.

**DMT or CAP?**

For now, CCL/ITRI has yet to choose between two types of ADSL: discrete multi-tone (DMT) or carrierless amplitude and phase modulation (CAP). Both are designed to modulate bits that are sent through the line.

According to Chen, DMT is expected to become the industry standard in the future. The technology brings transmission speeds closer to the theoretical limits allowed by ADSL, because it is more robust against difficult line conditions and impulse noise. Another major benefit offered by DMT is support for interoperability between equipment from different vendors.

Another advantage of DMT is that line coding divides available transmission bandwidth into 256 independent sub-channels. Interference to the signal in one frequency range does not have as great an impact as it would with the unified channel structure of CAP.

CCL/ITRI is currently caught between the two standards. While DMT offers more performance benefits, CAP is more widely used than DMT. Besides, CCL/ITRI officials worry that the price for DMT’s chip set will remain too expensive and difficult to implement without the pressure of competition from CAP technology.

**Reduced Cost**

Recent developments that are aimed at reducing the cost of the ADSL technology are mainly directed toward increasing highly integrated, low-cost, high-performance chip sets. Leading suppliers for this market are Motorola, SGS-Thomson, Alcatel, Texas Instruments, and Analog Devices.

Originally, CCL/ITRI’s ADSL alliance agreed to use Motorola’s single-chip CopperGold ADSL transceiver, which guarantees the highest board reliability, according to Chen. CCL/ITRI is also Motorola’s alpha-site test-bed for the solution. Nevertheless, Motorola is finding it difficult to increase its yield, according to sources in the alliance, making the alliance turn to alternative solutions from Alcatel or SGS-Thomson.

IC vendors from Taiwan such as Winbond Electronics and Macronix International have also announced development projects for ADSL chip sets. The move will help hardware makers to substantially reduce their costs.

Furthermore, CCL/ITRI plans to develop ATM-based (asynchronous transfer mode) ADSL technology in hopes that the technology will be competitive with cable modems without requiring telephone companies to overhaul vast portions of their existing phone network.

In 1998, the ADSL alliance will introduce the HLA system, which includes remote- and central-site products, ADSL Remote Bridge and POTS splitter and DSL Access Mux (DSLAM) and Central POTS splitter. The interface between each site is connected by an ATM/ADSL interface. The service at the remote site uses a 10Base-T Ethernet interface, and the service interface at the central site uses an ATM interface to connect the ATM public data network.

Stella Kao is a BYTE contributing editor in Taipei. You can reach her at meou@e-mail.gcn.net.tw.
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Bug Bounty Hunters

As software complexity grows, new testing tools help developers control bugs and costs alike.

By Derek Jones

Software testing may be one of the least attractive of all software-development activities. Yet, simply put, it's one of the most important parts of the development process.

Typically, it costs 10 times more to fix a bug at any stage of the development cycle than it does to fix it during the previous stage. But the cost of formal, comprehensive testing procedures can be prohibitive and often delays the time to market unacceptably. Automated software-testing tools can be a cost-efficient solution for developers looking to enhance the quality of their products. In addition, as application development becomes more intricate—especially with the growing complexity created by the move to applets and components—tools that systematically check source code or detect unexpected behavior at run time are becoming increasingly important for developers.

Software testing involves more than just debugging code. It encompasses the validation and verification of software throughout the whole development process.

Static vs. Dynamic Testing

So-called static analysis tools analyze the source code of an application. Static checks deal with such details as unreachable code, the misuse of pointers, undeclared variables, and variables used before initialization. The information gathered by these techniques serves two main purposes: to help developers understand the source code (e.g., by displaying a graphical representation of the control flow) and to act as an automated proofreader, looking for constructs that are likely to cause problems.

Commercially available tools either support a variety of programming languages or are specifically designed for a certain language. Generally, tools that focus on a specific language can better handle that language's special cases. Generic tools that support multiple languages, on the other hand, are more appropriate for working with a variety of programming languages. Generic tools include IPL's (Bath, U.K.) Cantata; Verilog's (Toulouse, France) Logiscope; and Battlemap, from McCabe and Associates (High Wycombe, U.K.). Tools for specific languages include PC-Lint, from Gimpel Software (Collegeville, PA), and QA-C and QA-C++, both from Programming Research (Hersham, U.K.).

PC-Lint offers an entry-level method of quality assurance on PCs. It detects a large number of common programming errors in C and C++ and gives developers a possibility to customize. Programming Research's QA series of tools are geared to large corporate development groups. They offer comprehensive customization features and can also generate metric information as well as graphical representations of code. In addition, both PC-Lint and the QA series of tools support cross-module checks.

Find Bad Pointers

Dynamic testing tools help you test a program's individual units and modules and, gradually, as modules come together, complete applications. Their big strengths include checking for bad pointers and memory leakage. In addition, they allow you to test the concurrent operation and integration of modules, check operation after a bug has been fixed, and perform stress tests.

There are two approaches to dynamic testing. One class of tools includes a compiler and uses source-code information to flag problems as it compiles. Another type of dynamic-testing tool checks the run-time behavior of executables.

Of course, a tool that checks source code has access to more information and can therefore do checks that are more thor-
A case in point for testing executable is written in. Although it checks uninitializable variables down to the byte level, it's language the original application was pointer-checking capabilities don't go down to the level that the GNU C bounds-checking tools do. Instead, it treats contiguously allocated storage as a single memory item.

Is More Testing Needed?

How do you know how much testing has been done and how much more is still needed? There are a couple of techniques for measuring test coverage. Statement coverage counts how many of the total statements in the application are executed. Achieving 100 percent statement coverage shows that the tests are exercising every statement in the application, although it doesn't give you any measure of how much of the program structure was tested.

An interesting side effect of 100 percent statement coverage is that it helps programmers find statements that can never be executed. This is because defining test procedures to execute a given statement makes developers look at an application in a new light. It unavoidably leads to the question: Is this statement necessary? Some programmers say they remove almost 30 percent of the statements they find through this procedure.

Path coverage, on the other hand, calculates the number of paths through an application. Achieving 100 percent path coverage for any but the simplest code requires enormous resources. In practice, you can use path-coverage measures only to check the testing level of the critical portions of an application.

Some tools insert code to flag that a statement or path has been executed to obtain coverage information, a process called instrumentation. The big problem with instrumentation is that it involves memory and CPU overhead. Fully instrumented programs typically run up to three times slower than noninstrumented ones. A good decision for software testing is, therefore, to completely instrument only critical portions of a program.

A case in point is ATAC, a publicly available tool written at Bell Communications Research for instrumenting C code. ATAC (http://www.clark.net/pub/dickey/atac/atac_961112.tgz) gives developers comprehensive coverage information by counting various bits of code being executed at run time.

Large sources and complex applications are naturally harder to test than software with simple functionality. Software metrics is one way of measuring the volume and complexity of an application. This procedure looks at the structure and linkage between the larger software building blocks rather than at the level of statements and expressions.

The two most often used metrics are the Halstead software science counts, which calculates code volume based on
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abstract operator and operand counts, and McCabe's cyclomatic complexity measure, which measures the number of control-flow nodes and edges.

If you're new to testing and have a complicated application to test, then metrics might help you find the most likely trouble spots within your code. The most complex and hardest-to-test modules of a program typically have the highest metric values. Once you locate potential trouble spots, you can break these modules down or rewrite the parts of a program that exceed predefined metric limits.

However, don't overestimate the value of metrics to software testing. Interestingly, many metrics correlate very highly to the number of noncommented lines of code. When evaluating a new software metric, always ask how accurate its predictions have been on historical data and to what extent it correlates with simple lines of code measurements. (Why use a complicated formula that doesn't give significantly better results than you can get from simply counting lines of code?)

You can also use metrics to estimate such things as the number of bugs likely remaining in code, the ease of software portability, or future maintenance costs.
include waiting for specific events to appear. It's also possible to add synchronizing points to handle cases where an application runs at different speeds.

In the third stage, the modified script runs against the application. The extent to which the script can reliably handle unexpected behavior depends on the effort you put into manually programming the script. The more sophisticated programs can graphically display differences between what the script expects and what the application sends to the screen. It's also possible to single-step through a script and display the values of variables, as simple debuggers do.

GUI testing tools, such as Mercury Interactive's (Or Yehuda, Israel) WinRunner for Windows and XRunner for Unix, enable developers to visually create test scenarios and verifications using a point-and-click method of selecting objects on-screen. They handle application changes automatically and maintain object-specific data independently of individual scripts to ensure that the same scripts can be used even when an application changes during development.

**Internet Adds Complexity**

Current trends in software development challenge programmers as well as designers of testing tools. The Internet is dramatically increasing the pace of the software industry, and many developers believe that there is now even less time available for testing. Object-oriented design techniques, such as polymorphism, encapsulation, and inheritance, increase the complexity of testing through the extensive use of information hiding.

In addition, Java's "build once, run anywhere" paradigm complicates matters because it requires developers to test applications not only on all platforms but also on each virtual machine (VM) they might run on, including the VMs used in Web browsers. As Java testers say, "build once, test everywhere."

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OEM/ODM Distributor Welcome
As consumers demand more environment-friendly products, new software tools help manufacturers build greener machines.

By Eric Johnson and Christina Seeberg-Elverfeldt

The pressure on European manufacturers to produce cleaner and greener products never lets up. A steady stream of new regulations focuses not only on issues such as waste disposal and air and water emissions, but also increasingly on companies’ use of hazardous materials in their products.

Take, for example, the computer industry. Unlike the rules of the 1970-80s, the latest rules no longer apply only to manufacturing sites, where chips are made, circuit boards fabricated, or components assembled. As Walt Rosenberg, Compaq’s director of environmental affairs, points out, “Environmental rules of the 1990s focus on the products themselves.” Regulators want to see both greener PC manufacturing plants and greener PCs.

Additionally, users are demanding environmentally friendly PCs. Led by public authorities in northern Europe, green-minded computer buyers have plumped for bans on certain materials, green guidelines for public procurement, and eco- and energy-label programs.

The key to reducing environmental and financial costs of manufactured products is the design process. “About 80 percent of a product’s environmental costs are established in the conceptual design phase,” says Agis Veroutis of environmental consultant Roy F. Weston (West Chester, PA, U.S.). “The sooner in the design phase you start analyzing the environmental impact, the better the results.”

Measure Environmental Impact

What designers therefore need is a yardstick to measure the environmental performance of a product design. A new breed of tools, collectively called design-for-environment (DfE) software, lets product developers analyze the environmental impact of their concepts. These tools comprise several databases of environmental evaluation factors and aim at product designers rather than environmental experts.

The core functions of DfE programs are eco-impact reduction and disposal optimization. However, out of the 15 tools we considered, only two of them, Ecobalance’s DfE Tool and Boothroyd Dewhurst’s Design for Environment, can do both.

This is not surprising, because the two functions of DfE software are distinct and independent tasks. Eco-impact reduction compares the environmental effects of a product’s design options, using life-cycle assessment, or LCA. (See the text box “Life-Cycle Assessment” on page 3215-24.) The idea of LCA is to find the design option that scores best when considering all effects on, for example, global warming, marine pollution, or waste-disposal problems.

In disposal optimization, the idea is to model and experiment with the disposal options for a given product. Typically, there are many possibilities.

You can dismantle or shred products or components, or deliver them whole for reuse, recycling, incineration, landfill, or any mixture thereof. In theory, the final optimized design should cause the lowest environmental burden and include the optimal number of reusable parts, no hazardous material, and a high degree of recyclable material.

You must do disposal optimization before you build the product. “Sometimes, just a slight reconfiguration of a machine’s internals can make dismantling ever so much easier,” says Mark Curtis, a senior partner at Boothroyd Dewhurst. But he warns that disassembly is not just assembly in reverse order. “Fasteners can get rusty, glues can refuse to unstick, and things don’t always go out the way they came in.”

continued
Architecture of DfE Software

At the core of DfE software is a component-inventory database. It holds large amounts of environmentally relevant data such as emissions, energy consumption, dismantling times, and recyclability indexes for electronics parts such as batteries, capacitors, and ICs.

A design module represents components visually and shows how they link together to form the product. This module retrieves the environmental information from the inventory database and displays it on the screen.

In eco-impact reduction, the software then aggregates eco-impact information into a few categories or even a single-number index. Two common indexes are Eco-Indicator, created in the Netherlands, and EcoPoints, developed in Switzerland. These indicators compare the eco-impact of a design to a fixed reference such as human- or eco-toxicity, thereby generating a relative score per eco-impact (e.g., for global warming or acid rain). The design with the lowest sum of these relative scores is best in environmental terms.

In disposal analysis, the software runs a sophisticated optimization process before aggregation and reporting. Several vendors have developed proprietary algorithms that model the component structure and solve for an optimum level of disassembly. Defining the optimum can be intricate. As Otto Meedt, one of the developers of Regred/DisPlay software from FAPS, points out, “If two aluminum parts are held together by an aluminum rivet, it may be better to recycle all three parts together rather than separating them.”

It is on this optimization knowledge and expert judgment that DfE tools are competing. Many vendors supply proprietary component databases and optimization algorithms aimed at producers of electronics equipment. Vendors point out the paucity of public domain information in this area. “Environmental data on some components is costly to develop and commercially sensitive,” remarks Martin Wielemaker, a director at Turtle Bay.

Naturally, product designers want to swap component databases around under one DfE system. But because systems are incompatible, this is not yet possible.

Standardization Is Coming

Four competing initiatives are addressing the standardization of component databases, not only for electronics but other industries as well. They are the LCAD

Life-Cycle Assessment

Life-cycle assessment (LCA) aims at comparing the environmental performance of products. It is an environmental accounting method that tries to quantify the inputs and outputs throughout the life cycle of a product, assess the effects of environmental loadings, and reduce the associated environmental burden. LCA is also the foundation for the eco-impact analysis in DfE software.

The methodology behind software tools that support LCA is to calculate the outputs during a product's life cycle and translate them into environmental effects or damage. That's why these tools need detailed information on manufacturing processes, materials, and energy use held in a large database that describes generic manufacturing processes and their emissions (see the figure "Architecture of DfE Software" above).

Because the evaluation depends so much on the quality of the database, critics say LCA usually reveals that whatever design you choose is best. Proponents, however, argue that LCA brings a desperately needed quantitative, rational element to environmental decision-making. Despite these debates, industry and government are increasingly accepting LCA, especially in Europe.
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group in the U.S., led by Battelle (Columbus, OH); SPINE, a Swedish group run by Chalmers University (Göteborg); the DALCA team in the Netherlands, led by research institute TNO (Delft); and the industry consortium SPOLD in Brussels. All these groups concede that, at best, a more comprehensive database will take some more years and that the more specialized the data, the less likely it ever will become public.

However, in an attempt to open the component inventory, some manufacturers have published their data. For example, about a year ago, Delta Electronics Testing published detailed material balances on about 50 components common to electronics goods, plus details on the hazardous content and disposability of each material.

The reason for the industry's and software vendors' sensitivity in this field is that information about hazardous materials is not always public. An electronics device, for example, has a number of hazardous materials (e.g., brominated flame retardants and sometimes cadmium and mercury compounds) that are not labeled and tend to be a problem to dispose.

Low-Cost Tools

For now, say some vendors, the answer for manufacturers is to buy what they can afford and build the rest of the expert judgment internally. "Most companies will want to use their own expertise anyway," notes Remi Coulon of Ecobalance. "It all depends on how they view their environmental situation."

Vendors such as Conceptware, Decision Dynamics, Product Ecology Consultants, and Spinwest encourage users to start with their less-expert packages, which are considerably cheaper than the ones with built-in expert systems. This is especially helpful if a vendor's proprietary component inventory doesn't meet a manufacturer's environmental compatibility standards. In this case, companies can buy cheap software and build their own expert judgment and database.

Another competitive factor is integration with CAD systems. This is especially important if designers use DfE tools on a day-to-day basis. Says Stefan Utzinger, the managing director of Conceptware, "CAD integration is a way of building the environmental expert right into the designer's desktop."

Thus far, only Nortel/Cognition's Eco-Design Tool and Savantage's SavanSys have a direct link to Intergraph's CAD system Pro Engineer. However, Boothroyd Dewhurst, Ecobalance, and FAPS have all built their offerings with CAD linkage in mind.

DfE tools are proliferating. By the end of the year, there will be about 15 commercially available tools. While some industry experts expect a shakeout of DfE tools during 1998, the user base for DfE tools will be growing steadily. Says Weston's Verotitis, "At the end of this century, every electronic product manufacturer will have a DfE system in place."
RAID Controller Runs Intel 960RP Chip

The GDT RP is one of the first RAID controllers to run Intel's 960RP chip. It consists of a 30-MIPS RISC processor with local memory, a PCI-to-PCI bridge, and built-in support for interrupt handling and DMA transfers. The new chip makes the GDT RP compatible with the upcoming I2/9/O standard. But since OSes for I2/9/O are not ready for market yet, you'll have to wait several more months to capitalize on I2/9/O's performance and manageability benefits.

The GDT RP bridges I/O gaps between the CPU and disks via high-speed bus transactions and intelligent caching algorithms. This new PCI board can carry up to 64 MB of cache memory, implemented either as fast-page-mode or EDO SIMM modules. If 64 MB is not enough, an optional PCI module lets you extend cache memory to a piggyback board. In addition, the caching algorithm includes adaptive delayed-write and read-forward functions. You can now buy the board in Wide and Ultra SCSI versions; a Fibre Channel version will be available by the end of the year.

With ICP Vortex's RAIDXNE firmware installed, disk arrays with RAID levels 0, 1, 4, and 10 work independently of the host machine. You can plug in extra disks and change RAID levels during operation. It also enables you to assign a spare disk to a single RAID cluster or define a pool of extra disks that can be used by all clusters in case of failure.

Because the GDT RP comes in several variants with up to five independent SCSI channels, it's a scalable solution. It works in midsize file servers as well as in high-end database servers with a capacity of more than 25 GB.

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MindMan Helps Manage Creativity

The concept behind mind mapping is as simple as it is enticing: Instead of using traditional lists and other forms of note-taking during brainstorming sessions and general idea conception, use color, curved lines, and suggestive symbols to be more creative. This mirrors the way in which the mind works and lets you harness your creativity to the best advantage.

Whereas traditional mind mapping involves the use of paper and colored pens, MindMan 3.0 uses all the bells and whistles of the Windows 95 GUI to stimulate and visualize your ideas. With MindMan you can drag and drop branches to reorganize your ideas quickly, drag and drop objects from other applications, create hyperlinks to external documents and Web pages, link multiple mind maps, and define relationships between items or branches. The tool also lets you attach textual notes to items and branches and automatically assigns symbols to keywords.

Because creative processes are often more efficient when done with teams, MindMan has a conferencing system that allows for real-time editing and collaborating of shared mind maps via the Internet.

The beta version I tested didn't include any tutorials, which may be helpful if you're new to mind mapping. However, MindMan is impressively easy to use, and its concept of user interaction is consistent. The quality of the symbol library needs work, however. Most icons are just blunt and sober bit maps.

-Rainer Mauth
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Graphics Card

With raging video playback and your choice of either AGP or PCI, the Revolution 3D runs circles around the competition. By David Em

Number Nine’s New Spin: Revolution 3D

According to Moore’s Law, computing power doubles every 18 months. When it comes to computer graphics, however, it triples. As a result, graphics horsepower that was once available only on high-end workstations now exists at the consumer level.

One of the first of the new generation of graphics subsystems to include the Accelerated Graphics Port (AGP) is the Revolution 3D card from Number Nine Visual Technology. The Revolution 3D comes in single-slot AGP and PCI versions. It incorporates a third-generation 128-bit chip called Ticket to Ride.

The Revolution 3D comes in dual-ported Window RAM (WRAM) configurations ranging from 4 to 16 MB. I tested both the 8-MB PCI and AGP versions of the card, and ran both cards at 1280-by-1024-pixel resolution and 85 Hz.

The Revolution 3D’s 2-D performance is spectacular. Screen refreshes are as fast as any I’ve seen, and at 85 Hz, the display is rock-solid. Programs such as Adobe Photoshop and MetaCreations’ Painter 5 were very responsive.

Video playback was similarly impressive and included RGB MPEG decompression. I played both Audio Video Interleave (AVI) and MPEG clips scaled to full screen at 1280 by 1024 pixels in true color on Windows 95. At 30 frames per second, the motion was extremely fluid.

Serious 3-D users will want to consider the 16-MB card, which can support double-buffered color at 1280 by 1024 pixels, or up to 1920 by 1060 pixels at 65,000 colors. The Revolution 3D supports OpenGL, Heidi, and Direct3D drivers, although Windows NT does not yet have hardware support for Direct3D.

The floating-point setup engine reduces the performance hit experienced when multiple 3-D features are enabled. The combination of the 128-bit, 2-D drawing engine and the WideBus internal architecture allows the card to process graphics and video data at up to 1.56 GBps.

The PCI and AGP versions of the 4-MB Revolution 3D sell for $349. The 8-MB version costs $449. An 8-MB upgrade to 16 MB is an additional $249. The Revolution 3D can’t compete with the highest-end 3-D graphics cards from such companies as Intergraph and Dynamic Pictures, but it costs only about a quarter as much. Its performance is well suited for artists, graphic designers, and desktop publishers who need good 3-D and scorching 2-D and video.

David Em (Sierra Madre, CA) is a digital artist and writer. You can reach him at davidem@earthlink.net.

RATINGS

| TECHNOLOGY | *** | *** | *** | *** |
| IMPLEMENTATION | *** | *** | *** | *** |
| PERFORMANCE | *** | *** | *** | *** |

NOVEMBER 1997 BYTE 33
Using new CMOS sensor technology, the SVmini-209 delivers high-quality pictures at a low price. By Stan Miastkowski

Digital Camera

CMOS Gets the Picture

Until recently, digital still cameras were either inexpensive, low-resolution devices or high-end units for people who need professional-grade images. But a new camera from Sound Vision, the SVmini-209, delivers ultrahigh-quality digital images at a relatively bargain price. Sound Vision itself sells the SVmini and also OEMs it to Vivitar and others.

The key to this camera is its CMOS sensor, developed with VLSI Vision (Edinburgh, Scotland). The model I tested is Sound Vision's second-generation camera. The first, sold as the Vivitar Vivicam 3000 and Umax Sharpset 8000, was the first digital still camera on the market to use a CMOS sensor instead of a charge-coupled device (CCD) sensor. High-resolution CMOS sensors are less expensive than comparable CCDs, and they also require considerably less power and support circuitry, which means dramatically increased battery life.

The SVmini-209's four-color sensor produces a native resolution of 1000 by 800 pixels (10 bits per color). A Texas Instruments TMS-320C209 digital signal processor extrapolates the image to 2000 by 1600, a truly impressive 3.2-megapixel image. A noise-reduction algorithm in the camera software removes graininess from images taken in poor light. The camera holds 1 MB of DRAM and 1 MB of flash memory. System software takes 1.5 MB, leaving about 500 KB for image storage. The SVmini uses variable JPEG compression, which you adjust using either an on-camera LCD or a serial connection, to balance image quality against storage space: 80 percent compression (100 KB per image) gives optimal quality; 40 percent (50 KB) produces some artifacts. The 500-KB internal memory isn't much space for images, so the SVmini has a slot for flash memory cards holding 2 to 16 MB. An adapter will be available for SanDisk MiniPort cards, which use a DOS-compatible file format.

The SVmini-209 sports an f/4.0 fixed-focus glass lens, a built-in flash, and a self-timer. There's a built-in microphone for recording brief clips of WAV audio along with each image (although this eats into image-storage space). Windows 95 software included with the camera lets you download and view images through a serial port, set all the camera's parameters, and clear images from memory. Macintosh software is also available. An optional AC adapter extends the life of the six AA batteries.

The camera I tested, an early prototype, produced superb images in a variety of lighting conditions. While its CMOS sensor technology is new, the SVmini is obviously riding the wave of the future.

Don't It Make Your Brown Eyes Blue?

A digital camera tries to record colors the way the human eye sees them. Since the retina has three different color receptors (red, green, blue), you'd assume a camera also needs three receptors. Unfortunately, the dyes in a camera's sensors don't match the eyes' color response very well.

Sound Vision adds a fourth dye, teal. This extra measurement helps achieve a better color match. Interestingly, some women's eyes have four color receptors, a condition called tetrachromacy. Some geneticists speculate that such women can better assess their children's health by skin tone.

RATINGS

| TECHNOLOGY | ★ ★ ★ ★ |
| IMPLEMENTATION | ★ ★ ★ ★ |
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Stan Miastkowski is a BYTE consulting editor. You can reach him at stanm@bix.com.
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Authoring Software

This word/idea/document processor is something else, but we're just not sure what to call it. By Russell Kay

A Whatchamacallit for Words

Don Bricklin created the electronic spreadsheet as we now know it. His subsequent software products have all been distinct and different—category makers and breakers. So, too, is his latest brainchild, Trellix. There's no category label that clearly conveys what Trellix does. In brief, it lets you create hypertext documents that function like a Web browser, outline processor, and presentation-graphics package rolled into one, complete with instant links to other parts of a document or accessible URLs.

Paper documents are mostly read from beginning to end, while Web sites are clearly nonlinear: You branch back and forth, and when you find an interesting link, you click on it and bring it up. This navigation ability is the essence of Trellix, which is designed for on-screen viewing.

A Trellix document appears in two parts: a map that shows the document's structure, and the pages. Each page can have up to four borders (which are typically quite wide) that house navigation buttons, text elements, or graphics. There is also an optional outline view. The map shows each page as a small rectangle, highlighting the current page in yellow, indicating sequential links by connecting lines, and representing structure by a vertical hierarchy. When your cursor hovers over a page icon on the map, a label appears with that page's title. Put your cursor on an underlined link, and the corresponding map icon is also highlighted.

When creating a document, you can write pages in any order and rearrange them by dragging and dropping icons on the map. You can import content from existing documents in a variety of formats. Menu items make it easy to create links and sequences of pages. It's easy to present summary information without interrupting the flow of the document. And it's even easier to incorporate auxiliary information and footnote-like references that don't get in the way.

Trellix lets you program complex documents for the reader. You can create different viewing sequences (Trellix calls them tours) in the same document, for different purposes or audiences. You can print a Trellix document, but you would normally view it with Trellix itself, a free viewer, or as an exported HTML page that any browser can display.

Trellix isn't a normal word processor for writing letters, e-mail, or the Great American Novel, nor is it a PowerPoint replacement. But it offers a powerful new potential for presenting and viewing structured information, from research reports to textbooks to business plans.

RATINGS

TECHNOLOGY

IMPLEMENTATION

I drafted this Eval using the "sneak peek" version 0.8, which didn't implement all the package's promised features but was easy to use without a manual. If the final release lives up to this early promise, Trellix will be a useful tool that could revolutionize many kinds of writing and presentation.

Russell Kay is a BYTE technical editor in the reviews department. You can reach him by sending e-mail to russellk@bix.com.

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A new ATM service enables applications to compensate for network congestion. By William Stallings

Adjustable Cell Rates for ATM Networks

Nowadays, when you use an asynchronous transfer mode (ATM) network, you have a choice from four classes of service for carrying traffic. The first one is constant bit rate (CBR), which specifies a fixed data rate. The ATM provider's network must ensure that this capacity is available and polices the incoming traffic on the connection to ensure that the subscriber does not exceed its allocation.

The second service is the more flexible variable bit rate (VBR). A VBR connection defines a sustained rate for normal use and a faster burst rate for occasional use at peak periods.

The third one is unspecified bit rate (UBR). This is a best-effort service: No amount of capacity is guaranteed, and any cells may be discarded. Finally, a new ATM service has been defined: available bit rate (ABR). It provides a guaranteed minimum capacity. When additional network capacity is available, you can burst data above the minimum rate without risk of cell loss. Each service has its uses, as seen in "Four Types of ATM Service."

ABR and UBR are best suited for LAN internetworking and other types of data traffic. UBR is directed at delay-tolerant applications (e.g., file transfer and e-mail). It provides no feedback about network congestion to the user or application. Thus, UBR increases the risk of discarded cells, which in turn increases network traffic because of the lost cells that must be retransmitted. To improve service to bursty sources that would instead use UBR, ABR was defined.

ABR is useful for on-line sessions where the network response is critical.

ABR Rate Control

An application using ABR specifies a peak cell rate (PCR) that it will use and a minimum cell rate (MCR) that it requires. The ABR mechanism uses explicit feedback to the sources to assure that capacity is fairly allocated. Any capacity that ABR sources don't use remains available for UBR traffic. An example of an application using ABR is a LAN interconnection. In this case, the end systems attached to the ATM network are routers.

ABR can increase network use without affecting the quality of service of CBR/VBR connections. Second, the share of available capacity used by a single ABR connection is dynamic and varies between an agreed MCR and PCR.

Third, the network provides feedback to ABR sources so that ABR flows are limited to available capacity. The time delays inherent in providing feedback dictate the use of buffers along a connection's path. Because of the large data rate and a relatively large propagation.
delay through a network, these buffers may be substantial, leading to large delays. Accordingly, the ABR service is appropriate for applications that can tolerate adjustments to their transmission rates and unpredictable cell delays. Finally, for ABR sources that adapt their transmission rate to the provided feedback, a low cell-loss ratio is guaranteed.

**Feedback Mechanisms**

The transmission rate of cells from a source through an ABR connection is characterized by four parameters. The source initiates the bulk of the RM based on feedback from the network. Feedback appears periodically as a sequence of resource management (RM) cells. Each cell has three fields: a congestion indication (CI) bit, a no increase (NI) bit, and an explicit cell rate (ER) field. The source first checks the 2 feedback bits. If an increase is called for, it is increased by a fixed-size increment. If a decrease is called for, the rate is lowered by a fixed-size increment.

Finally, if the ER is smaller than the ACR, the source reduces the ACR to the ER. These adjustments are subject to the constraint that the ACR varies between the limits of the MCR and the PCR.

**Cell Flow**

The figure “Adjusting ATM Cell Flow” illustrates the way that the feedback works. It depicts a flow of data in one direction over an ATM connection; a similar flow occurs in the opposite sense for two-way data communication. Two types of ATM cells flow on an ABR connection: data cells and RM cells. A source receives a regular sequence of RM cells that enable it to adjust the rate of cell transmission.

The source initiates the bulk of the RM cells. It transmits one forward RM (FRM) cell for every \((N_{rm} - 1)\) data cells. \(N_{rm}\) is a preset parameter, usually equal to 32. As each FRM cell is received at the destination, it is turned around and transmitted back to the source as a backward RM (BRM) cell. Each FRM cell contains the CI, NI, and ER fields. The source typically sets CI = 0, NI = 0 or 1, and ER equal to a desired transmission rate in the range \(ICR \leq ER \leq PCR\). An ATM switch or the destination system may change any of these fields before the corresponding BRM cell returns to the source.

An ATM switch on the network has a number of ways to provide rate-control feedback to a source:

- **Explicit-rate marking**: The switch sets the Explicit Forward Congestion Indication (EFCI) condition in an ATM data cell header (using the payload type field) as it passes in the forward direction. This causes the destination end system to set the CI bit in a BRM cell.

- **Relative-rate marking**: The switch directly sets the CI or NI bit of a passing RM cell. If the bit is set in an FRM cell, that bit will remain set in the corresponding BRM cell. More rapid results are achieved by setting one of these bits in a passing BRM cell. To achieve the most rapid result, a switch may generate a BRM cell with the CI bit set if an EFCI signal has been received on the previous data cell.

However, if the destination is experiencing congestion, it may set the CI or NI bit, or reduce the ER value when converting an FRM cell to a BRM cell. The first ATM switches to support ABR use the EFCI, NI, and CI bits, providing a simple relative-rate control mechanism. The more complex controls associated with the use of explicit rate constitute a second generation of ABR service.

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Autoconf Makes for Portable Software

Since the birth of Unix in 1969, there have been at least 70 distinct versions of Unix and Unix-like systems. With thousands of programmers enhancing Unix over the years for various system vendors and educational facilities, Unix's genealogy looks as tangled as a royal family tree.

Due to the many versions of Unix that exist, popular opinion is that portability among them is poor. To avoid a Tower of Babel situation, many vendors, users groups, and standards organizations have made efforts to define common components and APIs for Unix. The end result is that while all versions differ to some degree, in modern-day Unix systems the variance between the APIs for any two versions is small.

Still, if porting software is so difficult, why is there so much free software available for so many versions of Unix? During the first 20 years of Unix's history, software porting was something that often required overnight stints or even weeks of effort. Today, a utility called Autoconf neatly eliminates this work.

To understand how Autoconf does this magic, we must first understand the changes that have occurred to Unix over the years. In the early 1990s, two events made porting much easier: the use of feature-based portability and the invention of the configure script.

Feature-Based Portability

Back when there were only a few Unix variants to contend with, it was common to base portability on preprocessor define statements that specified a particular version of Unix. Such statements as XENIX, BSD, SUN, USG, and SYSV were common. This is known as OS-based portability.

Unfortunately, as Unix continued to evolve, define statements that had previously made sense became incorrect. For example, when Sun went from using a BSD-based kernel to using an SVR4 kernel, software that made decisions based on the vendor's being Sun did not compile or work correctly on SVR4 implementations. By the mid-1980s, these problems became critical due to the ever-expanding pool of Unix variants and the growing amount of software that had to be maintained.

Feature-based portability then stepped in to the rescue. Rather than presuming certain characteristics based on an OS vendor, feature-based portability identifies the OS features (i.e., the APIs) that the software uses and compiles code conditionally based on those features. For example, the define statement HAVE_..._MADVISE is a feature-based definition rather than an OS-based one, since it identifies a capability found in any OS. Porting existing code to a new version of Unix entails identifying the features that the OS provides, providing equivalent defi-

The Configure Script

Configure scripts (usually written in the Bourne shell, /bin/sh) are designed to root...
All around in the OS and look for clues that tell it what features it has. The end result is a tailored make file, and possibly an include file or two.

The first significant configure script that I know of was written by Larry Wall and designed to configure Perl. This script was named Configure and became part of the Metaconfig package. Metaconfig Configure scripts are interactive and typically require the user to affirm guesses that it makes about the OS. The initial thrill of watching this script run is soon lost after the process continues for half an hour or longer.

However, David MacKenzie of the Free Software Foundation (FSF) wanted more. He wanted a configure script that didn’t require any attention at all. This way it could be run simultaneously on many kinds of machines to aid in the FSF’s porting and testing efforts. There was also the desire to automate the end user’s software-installation process.

MacKenzie wrote the original versions of his configure script by hand, which made it difficult to reuse. He learned of similar efforts elsewhere at the FSF and at a company named Cygnus Support. Experience had shown that it was valuable to be able to build a configure script based on the needs of a specific program, rather than a monolithic one that supports all programs. The Autoconf package grew from a combination of all these ideas, and it became a common ground for configure-script efforts.

How Autoconf Works

Autoconf is based on a shell script wrapper around a macro language known as m4. This obscure macro language is similar in operation to the C preprocessor (cpp) but is much more powerful. Autoconf provides m4 macros that an application (or package) developer can use to

- determine installation paths
- locate tools and utilities
- determine compiler flags
- determine header-file availability
- determine available libraries
- test compilation of code fragments
- execute arbitrary shell-script fragments
- write make files
- write configuration-header files

The package developer informs Autoconf about features that the package requires by providing a file named configure.in as input. This file is an m4 script that invokes m4 macros provided by the Autoconf package. This creates a configure shell script that tests for OS features. When the generated configure script is executed, it takes template versions of files with the extension .in (e.g., Makefile.in) and edits them to generate a version tailored to the environment. (See the figure on page 45 for more on the files the developer makes and how they are deployed by an end user.)

The power of Autoconf is its ability to take advantage of the collective knowledge and experience of hundreds of software developers porting to the many variants of Unix. Each Autoconf m4 macro encapsulates this knowledge in a shellscript fragment that knows how to test for a particular feature. As Autoconf matures, developers using it automatically pick up portability improvements by simply upgrading to a newer version.

What You See

When you obtain a package that uses Autoconf, it will include (at a minimum) files named configure, Makefile.in, and, often, config.h.in. The configure script processes Makefile.in and config.h.in into Makefile and config.h, respectively. To configure and install the package in the /opt/tools directory tree, the end user executes these simple configure commands:

```
'configure --prefix=/opt/tools' 'make install'
```

This supports options that allow tailoring where files are installed. It also determines which features should be included in the package and where special-purpose libraries and files reside. See the listing above for a script example of this capability. If you ever happen to forget what these options are, just type configure -help.

Autoconf’s Future

Most public-domain software packages now use Autoconf. With its ground swell of support, the future of Autoconf looks bright. Commercial software developers should note that Autoconf decreases the cost of, and increases the reliability of, supporting more OS versions. Software vendors can increase their profit margins and market share by using Autoconf.

As Autoconf continues to be refined, the winners will be the users of Autoconf; the losers will be those who don’t realize the value of this free software.

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The Quest to Standardize Metadata

Metadata is popularly defined as “data about data.” For the IT manager, this is more concisely stated as “information about the enterprise.” In the context of data warehousing, the term refers to anything that defines a data-warehouse object, such as a table, query, report, business rule, or transformation algorithm. Metadata management gives users greater control of corporate data by providing a map of the locations where that data is stored. It also supplies a blueprint that shows how one type of information is derived from another.

The current crop of data manipulation and management tools has resulted in IT products that all process metadata differently, with little consideration for sharing the information. This situation highlights the need for a metadata standard.


Initial Steps

MDIS consists of components that represent the minimum common set of metadata elements and the minimum integration points that must be incorporated into database tools for compliance. MDIS also provides standards for optional and extension components that are relevant only to a particular class of tool.

A common language must be developed before a standard can be constructed. This involves setting up well-understood and well-communicated processes for naming metadata elements, standardizing data types and lengths, and maintaining descriptive glossaries.

This development of a common definition and terminology involves two entirely different information models. First, there’s the application metamodel. This model is application-specific and describes the tables and objects that contain the metadata for schemata particular to a given application. Second is the metadata metamodel, which is the set of objects that MDIS describes. These objects reflect information common to one or more classes of tools, such as database servers and data-discovery and data-extraction tools. For MDIS to succeed, the metadata metamodel must be indepen...
To establish a bidirectional data flow, the standard uses three types of information. First, the metadata files include a header with version information. Second, a Tool Profile file contains character-based information that describes the type of metadata elements that the tool manipulates. Finally, a character-based Configuration Profile file describes the mapping of data to specific metadata objects. It also describes what flows of the metadata are legitimate: A tool might be prohibited from using a later version of a metadata object because of major changes to source-to-target mappings of the metadata.

MDIS uses a text-based tag language that resembles HTML. The mechanism that implements extensibility to the MDIS is similar to Lisp’s properties object, a character field of arbitrary length that’s composed of identifiers and a value. The tool’s import function uses the identifier to recognize the metadata type and to locate the data within it. The value is the metadata itself.

**In Search of a Standard**

The Metadata Council examined several ways to implement the standardized MDIS model, as shown in the figure at right. The **ASCII batch approach** relies on an ASCII file format. The file contains descriptions of the common metadata components and standardized access requirements that make up the MDIS model. The file loads whenever a tool accesses metadata via the common API.

This approach does not require updating the tool when the metadata model changes; modifications to the standard are made to the file instead. However, since using an object requires loading the entire MDIS framework, this approach is processor-intensive.

The **procedural approach** requires that the intelligence to communicate with the MDIS standard be built into the tool. This approach only needs a modification to the API to accommodate changes and additions to the metamodel schema and/or access parameters. But it also requires a great deal of up-front effort on the part of tool vendors to retrofit this logic to achieve MDIS compliance.

The **hybrid approach** combines the ASCII-batch and procedural approaches. It follows a data-driven model. A tool loads a set of tables that define the MDIS API. The tool interacts with the API through the MDIS framework and retrieves just the needed object. This eliminates the need for reading the entire schema.

Changes to the standard are reflected in the table data so that the tools don’t have to be modified to maintain compliance with the MDIS specification. But loading the tables can be time-consuming, which is unacceptable in information-intensive applications.

A fourth approach is to develop the MDIS standard within the Electronics Industries Association’s CASE (Computer Aided Software and Systems Engineering) Data Interchange Format (CDIF). The CDIF standards support multiple semantic layers and transfer formats for CASE tools. Adopting this approach carries two obligations: the Metadata Coalition must appoint people to track the CDIF standards, and every vendor supporting the MDIS must subscribe to the CDIF publications to avoid violating the EIA’s copyright on the standard.

For version 1.0 of the MDIS, the Council recommends the ASCII batch approach because vendors can implement support for the specification with minimum overhead and a shorter time to market.

**Into the Future**

There will continue to be a lack of integration among metadata tools for the next several years. Integrated metadata won’t be readily available until at least the 1998/1999 time frame, when repository-based solutions should begin to emerge.

Furthermore, integrating new objects that consist of video, audio, and spatial data types will offer some additional challenges to the Metadata Council — as well as anyone who’s looking for integration of metadata tools. 

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Plus, the new UltraDaytona RAIDarray is twice as fast as previous versions, and supports up to 128 MB of SIMM-based data cache for even higher performance. It’s available in several configurations, and features an optional expansion chassis for up to seven additional disks.

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Building the Virtual PC

Development of Virtual PC—Connectix Corporation’s Macintosh application that emulates a PC and its peripherals—began almost two years ago, in October 1995. The goal from the beginning was to create a fully Intel-compatible PC in software. The effort centered around a core Pentium instruction-set emulator, complete with MMX instructions. True PC emulation also required the reverse-engineering and development of a dozen other PC motherboard devices, including modern peripherals such as an accelerated SVGA card, an Ethernet controller, a Sound Blaster Pro sound card, an IDE/ATAPI controller, and PCI bridge interface. This strategy of hardware-level emulation resulted in an application that allows Macintosh users to run not only Windows programs and DOS games but several x86-based OSes, including Windows 95, NT, and NeXT OpenStep.

Pentium Emulation

The heart of Virtual PC is the Pentium recompiling emulator, a sophisticated piece of software written entirely in hand-coded PowerPC assembly language. Its job is to translate Pentium instruction sequences into a set of optimized PowerPC instructions that perform the same operation. Translation occurs on a “basic-block” basis, where a basic block consists of a sequence of decoded x86 instructions. Basic blocks end on an instruction that abruptly changes the flow of execution (typically a jump, call, or return-from-subroutine instruction). As the recompiler decodes x86 instructions, it analyzes them for “condition code” usage. Finally, it generates a block of PowerPC code that accomplishes the same task. For more details on this process, see “Virtual PC Operation” at right.

For purposes of speeding things up, the emulator employs the following tricks.

Translation cache: Even though written in PowerPC assembly language, the translator still requires substantial time to generate optimized instruction translations. To reduce this overhead, the emulator caches blocks of translated code. Interinstruction optimization: Because the Pentium is a CISC processor, most instructions perform more than one operation. For example, the ADD instruction not only adds two values together, it also produces a number of condition-code flags that tell programs whether the addition produced a zero or negative result. Such codes are used, for example, to determine if a program performs a conditional jump. Most of the time these codes are ignored. The translator analyzes blocks of x86 instructions to determine which flags the program uses (if any). It then generates PowerPC code for those flags actually used. The first two listings in “Translated Code” (next page) show how one Pentium instruction translates into three PowerPC instructions,
while three Pentium instructions can be optimized from nine into five PowerPC instructions.

**Address translation:** One of the most difficult Pentium features to emulate is its built-in memory management unit (MMU). This hardware translates linear (or logical) addresses into physical memory addresses. Operating systems use the MMU to implement virtual memory and memory protection. Because of the Pentium's small register file, about three in four Pentium instructions reference memory in one way or another. Each memory address potentially needs to be translated before the emulator loads from, or stores to, the referenced address. An MMU implemented in software would impose a high overhead, which would degrade performance. Luckily, this overhead can be avoided: The Connectix engineers were able to program the PowerPC's MMU to mimic the Pentium MMU's behavior, thus managing the address translations in hardware. The Pentium's memory page attributes can also be mirrored in the PowerPC's MMU. For example, if Virtual PC's emulated OS marks a memory page as write-protected, the page mappings are modified so the corresponding PowerPC page is write-protected.

**Segment bounds checking:** The Pentium architecture includes the archaic notion of memory segments. Every memory reference, such as instruction fetches, stack operations, loads, and stores, has an associated memory segment. When a segment's bounds are exceeded, the Pentium's MMU generates a general protection fault (GPF). The OS uses GPFs for more than detecting bugs in applications: They enable a program to "thunk" down into privileged driver-level code not accessible at the application level. Therefore, the Pentium emulator must detect segment bound faults where appropriate. Although the PowerPC does not contain segmentation hardware akin to the Pentium, Connectix used Power-PC trap instructions to perform segment bounds checks with little or no overhead.

**Hardware Emulation**

Besides the Pentium processor, a typical PC motherboard contains a dozen or so chips that work together concurrently. All these chips need to be emulated faithfully for compatibility. The Intel architecture provides an I/O address space that's used to access hardware outside of the CPU. You work with this "I/O space" through two instructions—IN and OUT. When using these instructions, software must specify an I/O port (or address). Virtual PC routes I/O accesses to code modules that emulate each chip. For example, if Virtual PC encounters an IN instruction referencing port 0x21, it calls a routine in the interrupt-controller emulation module that returns the current interrupt mask. Similar module calls occur for every I/O space access, as the third listing in "Translated Code" shows.

Many of the extra chips on a PC motherboard control I/O devices such as the hard drive, CD-ROM, keyboard, and mouse. For compatibility with the Mac OS and all Macintosh hardware, Virtual PC performs all I/O through the standard Mac OS drivers. So, a request sent to the emulated PC's IDE controller to read a sector from the hard drive gets translated into a read operation that's sent to the Mac OS SCSI driver.

The most difficult hardware components to emulate involve precise timing. For example, sound is a real-time operation, and any timing perturbation results in clicks or pops as digitally sampled data fails to arrive on time. Because Virtual PC is hosted on the Mac OS (which gives time to other Mac programs running concurrently, as well as Virtual PC), and it needs to emulate several dozen PC chips in parallel, precise timing isn't always possible. Virtual PC compensates by placing the highest priority on tasks that directly affect the user, such as sound and video.

**Performance**

Emulated systems are naturally going to be slower than real hardware. But Connectix engineers concentrated on tuning aspects of the emulated hardware required to run popular PC games and productivity applications at a usable performance level. This was especially challenging given that the PowerPC processor emulates not only the Pentium but all the other chips on a PC motherboard.

Performance of Virtual PC is also greatly affected by the host hardware system. The latest PowerPC processors with high clock rates and large on-chip caches will run it best. The speed and size of the system's L2 cache is also critical because of the code expansion that occurs during the translation process. While users will take a performance hit because this is an emulator, Virtual PC successfully emulates the entire PC at a very low level. PC programs—applications, device drivers, and operating systems alike—cannot tell they are not running on actual PC hardware.

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**Translated Code**

<table>
<thead>
<tr>
<th>Pentium Instruction</th>
<th>PowerPC Instructions</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADD EAX, 20</td>
<td>li rTemp1, 120</td>
</tr>
<tr>
<td>add doc</td>
<td>pf rTemp1, rEAX</td>
</tr>
<tr>
<td>mr</td>
<td>rEAX, rPF</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Pentium Instructions</th>
<th>PowerPC Instructions</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADD EAX, 20</td>
<td>li rTemp1, 120</td>
</tr>
<tr>
<td>ADD EBX, 30</td>
<td>li rTemp1, 140</td>
</tr>
<tr>
<td>ADD ECX, 40</td>
<td>li rTemp1, 160</td>
</tr>
<tr>
<td>add doc</td>
<td>pf rTemp1, rEAX</td>
</tr>
<tr>
<td>mr</td>
<td>rEAX, rPF</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Pentium Instructions</th>
<th>PowerPC Instructions</th>
</tr>
</thead>
<tbody>
<tr>
<td>MOV AL, 8</td>
<td>li rAL, 8</td>
</tr>
<tr>
<td>MOV DX, 0x1FO</td>
<td>li rDX, 0x1FO</td>
</tr>
<tr>
<td>OUT DX, AL</td>
<td>bl DispatchToNextBlock</td>
</tr>
<tr>
<td>ADD DX, 7</td>
<td>li rDX, rDX, 7</td>
</tr>
<tr>
<td>IN AL, DX</td>
<td>bl DispatchToNextBlock</td>
</tr>
<tr>
<td>RET</td>
<td>b DispatchToNextBlock</td>
</tr>
</tbody>
</table>

---

**Address Translation:** Examples of translated code for Pentium instructions and PowerPC instructions.
Dynamic HTML Explained, Part I

Dynamic HTML (DHTML) is like HTML on steroids. It uses an object-based model that builds on HTML tags, yet it permits dynamic styles, content, and positioning as well as data binding to a browser. For the site visitor, DHTML Web pages deliver a richer, faster browsing experience through the magic of client-side processing.

This is the first in a three-part series on DHTML. A review of Cascading Style Sheets (CSS), a core DHTML enabling technology, leads into a discussion of HTML tags as objects. This DHTML primer closes with an introduction to the event object and bubbling—a new concept for scripting that simplifies and streamlines code.

Not surprisingly, Netscape and Microsoft offer different DHTML implementations. Both companies promise that these versions will converge after the World Wide Web Consortium (W3C) issues final recommendations. This article uses Microsoft's version because it offers more capabilities (for more information, see "Dynamic HTML Comparisons," September BYTE, page 23). It offers more than 90 HTML elements with properties, methods, and events. For detailed documentation, visit http://www.microsoft.com/msdn/sdk/inetstdk/help/. The site also includes many code samples that can jump-start you on your way to learning this new technology.

Tags and Scripting Objects

DHTML relies on CSS. This technology appeared initially with Microsoft Internet Explorer 3 and is approved by the W3C. CSS allows developers unprecedented control over the appearance and positioning of content on Web pages. It generally helps Web content authors separate style from content. (Look, Ma, positioning without resorting to tables!)

CSS offers four ways for site builders to incorporate style components into a document. First, you can reference an external style sheet. Second, you can physically import an external style sheet. Third, your code can create and modify style rules with a pair of style tags located inside the current document. Fourth, you can place in-line style attributes within the tags on a document. There are over 60 style attributes for fine-tuning the appearance of your Web pages.

All the traditional HTML tags become DHTML objects. Developers must write short VBScript or JavaScript programs that enable end-user interactivity by manipulating object methods and properties. A rich array of events offers a broad selection of options for triggering code that responds to user and Web actions.

Each DHTML tag has a corresponding scripting element. The `P` tag, for example, matches a `P` element (or scripting object). The `P` tag's read-only `parentElement` property returns the next object up the document hierarchy—the `Body` element, which is owned by the `HTML BODY` tag. The `P` tag's `read/write` `innerText` property lets developers dynamically read and replace the text within a `P` scripting object.

Two `P` methods specifically support dynamic content operations. First, the `InsertAdjacentHTML` method lets you insert new HTML into a `P` tag. Second, the `InsertAdjacentText` method helps to update a paragraph's content, but not its HTML code.

Dynamic Styles

Many developers will be attracted to DHTML by its ability to change style in response to user and system events. One easy way to achieve this is with the `className` property. This property applies to block elements, such as `P` and it corresponds to the `CLASS` attribute. To change styles, simply set the `className` property to a new style rule.

To revise a property, your code must first reference the underlying object. The `all` collection often makes this easy. Use the `all` collection's `tag` property to...
flag all similar elements in a document. Then, use the tag's item method to reference specific instances of an element in a document. Then, you set the instance's className property equal to the new style rule.

The Classy Style Change listing in "Code Gallery" (on the previous page) illustrates these principles. The HTML document contains two style rules and two paragraph blocks. The block containing Welcome! has its CLASS attribute set to the littlegreen style rule. The other paragraph uses the default style.

Clicking anywhere in the document fires the Body's on click event. This event launches the JavaScript changeStyle function. It uses the index numbers of 0 and 1 to reference the document's first and second paragraphs. The JavaScript sets the className properties of the first and second paragraphs to the bigred and littlegreen style rules, respectively.

The Stylistic Style Change segment in "Code Gallery" illustrates a more granular technique for achieving the same result. This version of changeStyle sets specific properties of the style object for paragraph blocks. When you need finer-grained control than the className property permits, or when you want to make ad hoc changes, consider using style object properties.

Events and Bubbling

DHTML introduces a new event object that tracks the firing of events. Its properties permit identifying the element where the event occurred, the current state of the keyboard keys, the location of the mouse, and the state of the mouse buttons. For example, the onclick and onmouseover events capture end-user mouse behavior relative to HTML tags, and the Body's onload event fires immediately after the browser loads a document. You write the handlers that respond to these events. Event handlers can be written in EcmaScript or Microsoft VBScript.

DHTML events can bubble up from lower to higher document hierarchy levels. This permits events for lower-level objects to bubble up and trigger event handlers for unrelated upper-level objects. Because of this potential, you must consider whether your code should explicitly turn off bubbling.

The "Bubbling Up" code segment (above) illustrates how to use the event object, and it reinforces basic scripting techniques. The document in this code segment includes a couple of H1 blocks and a P block. Within the P block is a B block. The P block has an event handler, setParaStyle, that captures the onclick event.

Clicking anywhere in the P block launches its onclick event handler. It starts by setting a variable, el, equal to the source element for the event. This will be either P or its embedded B block. If the tag's name is not B then the code sets el equal to the tag's parent, thereby forcing el to P. Notice that the function uses the tagName property of the srcElement property of the event object to determine where in the paragraph a user clicked. The code uses the textDecoration property of el's style object to underline the whole paragraph, no matter where the user clicks on the line.

The final line in setParaStyle turns off event bubbling if the user clicks in the B block. This line selectively controls event bubbling, depending on where in the line a user clicks. Clicks anywhere on the line—except in the B block—permit the event object to bubble up the document hierarchy to the Body level and beyond. Body's event handler, setBodyStyle, then changes the color of the document's two H1 blocks.

The setBodyStyle function also demonstrates some interesting scripting techniques. First, it uses the innerText property of the srcElement object to echo back which document object caused the function to run. Second, it uses a for loop to iterate through the item indices for the H1 tag objects.

Hard Choices

DHTML offers Web developers the potential of improved speed and interactivity; it offers Web users a richer browsing experience. The technical challenge of moving to DHTML calls out to HTML and Visual Basic developers because it builds directly on HTML but offers an object-oriented model that is familiar to VB programmers.

The operational challenge of moving to DHTML might be more problematic. Will folks be able to view the effects? The answer is "Yes" only if they have the Internet Explorer 4 browser. There are two solutions to this predicament. First, target DHTML for environments where you can mandate the browser (an intranet or extranet). Second, make your Net applications so compelling that folks voluntarily upgrade to the free Microsoft Internet Explorer browser.

Rick Dobson, Ph.D., is president of CAB, Inc., a database and Internet development consultancy. You can reach him by sending e-mail to Rick_Dobson@msn.com.
NEW! On Screen Management
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Multiple Users
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Alpha processors are made by these leading technology companies.
Broadband satellite systems stand ready to bring multimegabit data rates worldwide. Sounds great. What's the catch?

By John Montgomery

Something special is in the air: your data. Or, at least, it's about to be. The technological and regulatory hurdles to create true high-speed satellite networks have fallen. We've seen low- and mid-bandwidth systems such as Motorola's Iridium and Hughes' DirecPC. But those were almost a parlor trick compared to the promise of 2 Mbps, 20 Mbps, and even 155 Mbps streaming down from the sky. And all you need is a small antenna, a satellite-to-computer gateway (a small black box), and the service itself. In all, you'll probably buy satellite service pretty much the way you buy Internet service from an Internet service provider (ISP) today.

So, it's time to ditch your T1 lines and asynchronous transfer mode (ATM) hardware, right? Not quite yet. Just as Iridium's universal telephone didn't kill the cellular phone, broadband satellite systems won't kill terrestrial lines. Every broadband satellite system creator I talked to was clear that broadband satellite systems will complement terrestrial networks. They will provide high-speed service where terrestrial infrastructure does not exist, and they will enable easy multipoint distribution of video. But high-speed, low-cost landlines are here to stay.

So where will these emerging data networks fit in? Better yet, how will they fit in? What makes them different from each other? Simple questions, it seems. The answers are also simple—at least until you start to dig. By examining some of the main systems in development, I was able to determine that these systems, while touting much the same capabilities, are vastly different. Some of the most visible ones may prove the most difficult to implement. Some of the most staid-looking

The Air Up There

The two primary considerations with any satellite system are how far from the earth it is (its orbit), which affects latency, and the spectrum it uses, which affects how powerful the signal needs to be and how much data it can carry.

L-band
Frequency range: 1.53–2.7 GHz
Pros: Long wavelengths can penetrate many structures; requires less powerful transmitters.
Cons: Largely allocated.

Geosynchronous earth orbit (GEO)
Orbit: fixed at 22,300 miles
Pros: Requires only very few satellites to cover all of the earth; well-known technology.
Cons: High latency (0.24-second round trip); satellites are often more expensive than other systems; limited number of orbital slots above each country.
Ka-band
Frequency range: 18–31 GHz
Pros: Lots of available spectrum; short wavelengths carry lots of data.
Cons: Requires powerful transmitters; short wavelengths subject to rain fade.

Medium earth orbit (MEO)
Orbit: 6250 to 13,000 miles
Pros: Relatively low latency (0.06–0.14-second round trip); requires a handful of satellites to cover all of the earth.
Cons: Balance between latency and number of satellites considered by some suboptimal; satellites spend time covering empty space (e.g., oceans).

Ku-band
Frequency range: 11.7–12.7 GHz downlink, 14–17.8 GHz uplink.
Pros: Medium wavelengths penetrate many obstacles and carry lots of data.
Cons: Mostly allocated.

Low earth orbit (LEO)
Orbit: 500–1500 miles
Pros: Very low latency (sub 0.03-second round trip).
Cons: Requires many satellites (dozens or hundreds) to cover all of the earth; satellites spend time covering empty space (e.g., oceans).
systems may beat every other system to the punch.

Playing with the Bands

Satellite communications is nothing new. For years, you could hook up a very small aperture terminal (VSAT) system and buy a terminal that's good for predictable communications, but not so good for the ad hoc networking that most of us are used to.

For "anytime, anywhere" networking, you need new technologies. Primary among them are more tightly focused beams and digital signal technology, which together can increase frequency reuse (and thereby increase bandwidth) and reduce dish size from meters to centimeters. According to some, you also need a large and unused chunk of the electromagnetic spectrum.

All these technical requirements began to come together in 1993, when NASA launched its Advanced Communication Technology Satellite, or ACTS (see the text box "NASA Gets into the ACTS" on page 61). ACTS pioneered the testing of an all-digital, Ka-band (20–30 GHz), spot-beam, geosynchronous earth orbit (GEO) satellite system—for definitions of these terms, see the text boxes "The Air Up There," "NASA Gets into the ACTS," and "I'm with the Band"—capable of delivering hundreds of megabits per second of bandwidth. With NASA showing that such a system could work (and offering time on the system to interested institutions), it was not long before others were interested. Very interested.

Earlier this year, the FCC granted orbital locations and Ka-band licenses to 13 companies. Some are names you may recognize: EchoStar, Hughes, Loral, and Motorola. Others may be more obscure: Ka-Star, NetSat 28, PanAmSat, and Teledesic. Regardless of name recognition, they all aim to bring information into your home and office at incredible speeds—up to 155 Mbps. These broadband systems are not going on-line before 2000 (although Loral's Cyberstar will start offering 400-Kbps rates next year), and most will not be fully operational until 2002.

What are they going to use it for? According to the FCC, just about everything you would use a terrestrial line for: desktop-to-desktop videoconferencing, Internet access, electronic messaging, faxing, telemedicine, direct-to-home video, electronic transaction processing, distance learning, and even news gathering.

Is This Trip Necessary?

Who needs this stuff, anyway? Most of the market that needs data services seems to be well served by landlines. "These systems will be important globally. In the U.S.? We're well served, although things are changing quickly," says Erwin Edelman of NASA's Lewis Research Center.

A first guess at an obvious market is in places that have underdeveloped communications infrastructures. In some countries, stringing copper or fiber is out of the question—the empty distances to cover are too great and available money is too little. (There are places where people will rip down any copper wire to resell it.) Still, a wireless, solar-powered telephone has some appeal. Of course, you don't need a broadband satellite to make phone calls, though. Systems such as Iridium will likely serve that market. Marco Caceres, of the Teal Group, says, "For most of the people in the world, the services Ka-band supplies aren't interesting."

So who does need this new class of broadband satellite communications? The first answer I heard from virtually every broadband vendor is the same: multinational corporations. "For some applications, landlines will always be superior. But when your reach is diverse and you have last-and first-mile problems, then satellite will be the better choice," says Edward Fitzpatrick, Hughes Communications'
Broadband Satellites, Broadly

<table>
<thead>
<tr>
<th>Backers</th>
<th>Cyberstar</th>
<th>Celestri</th>
<th>Astrolink</th>
<th>Teledesic</th>
<th>Spaceway</th>
<th>Skybridge</th>
</tr>
</thead>
<tbody>
<tr>
<td>Use</td>
<td>Data, video</td>
<td>Voice, data, video-conferencing</td>
<td>Data, video, rural telephony</td>
<td>Voice, data, video-conferencing</td>
<td>Data, multimedia</td>
<td>Voice, data, video-conferencing</td>
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<td>Altitude (miles)</td>
<td>22,300</td>
<td>875 and 22,300</td>
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<td>435</td>
<td>22,300</td>
<td>911</td>
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<tr>
<td>Spectrum</td>
<td>Ku (initial and Ka)</td>
<td>Ka and also 40–50 GHz</td>
<td>Ka</td>
<td>Ka</td>
<td>Ka</td>
<td>Ku</td>
</tr>
<tr>
<td>Antenna size (est.)</td>
<td>16 inches (initial Ku)</td>
<td>24 inches</td>
<td>33–47 inches</td>
<td>10 inches</td>
<td>As small as 26 inches</td>
<td>TBD</td>
</tr>
<tr>
<td>Data throughput</td>
<td>400 Kbps (initial Ku); up to 30 Mbps (Ka)</td>
<td>Up to 155 Mbps transmit and receive</td>
<td>Up to 9.6 Mbps</td>
<td>16 Kbps–64 Mbps (up to 2.048 Mbps on symmetrical links)</td>
<td>Up to 6 Mbps</td>
<td>16 Kbps–2 Mbps to satellite; 16 Kbps–60 Mbps to user; any multiple of this for business users</td>
</tr>
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<td>User terminal cost (est.)</td>
<td>$800 (initial Ku); $1000 (Ka)</td>
<td>Starts at $750</td>
<td>Under $1000 to $2500</td>
<td>N/A</td>
<td>Under $1000</td>
<td>$500 (consumer)</td>
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<td>System cost (billions)</td>
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<td>$4</td>
<td>$9</td>
<td>$3.5</td>
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<td>Number of satellites</td>
<td>TBD for Ku; 63 LEOs, 3 likely for Ka 9 GEOs</td>
<td>9</td>
<td>288</td>
<td>8 initially</td>
<td>64</td>
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<tr>
<td>Access method</td>
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<td>FDMA, TDMA</td>
<td>FDMA, TDMA</td>
<td>MF-TDMA, ATDM</td>
<td>FDMA, TDMA</td>
<td>FDMA, TDMA, FDMA, WDMA</td>
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<td>Intersatellite communication</td>
<td>Undecided</td>
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<td>Yes</td>
<td>Yes</td>
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</table>

**NASA Gets into the ACTS**

The whole Ka-band craze can be traced to NASA. When it launched its Advanced Communication Technology Satellite (ACTS) in September 1993, it began a research-and-testing project to determine what it needed to do to make Ka-band satellite communication work. "All the current Ka-band filings (to the ITU) are direct tributes to ACTS technology," says Erwin Edelman, demonstrations coordinator at NASA's Lewis Research Center.

ACTS proved that it was possible to create an all-digital Ka-band system that could overcome rain fade, a signal-degradation problem resulting from short wavelengths passing through rain. ACTS is a TDMA-based system that uses many of the things you'll find in commercial Ka-band satellite systems, including spot-beam (or multibeam) technology, on-board storage and processing, and all-digital transmission.

**Spot-beam.** This technology enables an antenna system to subdivide a single large footprint (area of coverage) into many subfootprints. It can then focus these subfootprints (or spot beams) on particular areas. Subdivision enables a high degree of frequency reuse. Rather than spreading the entire frequency over the entire footprint, it creates subsets of the frequency over smaller footprints. And, most important, it reuses these subsets in nonadjacent footprints.

**On-board storage and processing.** Most satellites are "bent pipes"—a signal goes up and then goes back down immediately. On-board storage and processing enables the caching of information until a spot beam is aimed; it also enables intersatellite switching.

**All-digital transmission.** To overcome rain fade, signals need to be digital so that they can incorporate error codes. According to Edelman, ACTS uses the same TDMA system that you'll find in terrestrial cellular systems.

Together, these technologies enable nearly unheard-of data rates. "The ACTS is theoretically capable of communicating over three 622-Mbps channels," says Edelman. In case you're wondering, that's about 400 T1 lines.

Of course, there are even places in the U.S. that won't get broadband data service for a long time. For example, until recently, BYTE's office in Peterborough, New Hampshire, would have had serious problems getting anything more than a T1. But imagine if one of these satellite services had been in place—we could have tapped it no matter where we were. That is the second market that most of the broadband vendors cited—low-population areas.

The main problem satellite systems solve is getting high-bandwidth access to places without a high-bandwidth infrastructure. It's unlikely that a satellite system could compete with Digital Subscriber Line (DSL) to the home or fiber to the office—if you can get those services. Still, if you're in a rural area of the U.S.—or in a low-population area in any country—you may not be able to get such services. Satellites will deliver them, enabling not only high-speed Internet browsing (a technology that some industry pundits focus on relentlessly), but all forms of high-speed networking, including such things
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Is the telephone dead? Says Teledesic president Russell Daggatt, "It's not going to replace the current phone network—the capacity isn't there." Put simply, terrestrial networks and satellite networks will complement each other. "Nobody's going to put up a satellite dish and take out their telephone," agrees Ron Maehl, president of Cyberstar. "We don't believe satellite should compete with fiber or Asymmetric Digital Subscriber Line (ADSL)—it should complement them, especially for bursty service. Use the technologies for what they're best suited."

**LEO vs. GEO**

But bandwidth is only half the story. The other half is latency—the amount of time for your data to get from point A to point B. Here is where the rubber starts to meet the road. It's all well and good to talk about high-bandwidth satellite systems—that technology has existed in VSATs for years. But to deliver on the promise of highly interactive satellite networks is a different matter altogether. "There are some applications not suitable to satellite," says Karl Savatiel, president of Astrolink and vice president for broadband systems at Lockheed. "Bond transactions, for example, are too latency-sensitive."

That is true—at least for a GEO system such as Astrolink. GEO satellites park some 22,300 miles above the equator: 0.24 second—an eon to computers—of round trip away. With that kind of latency built into the system (not counting whatever latency is added by the various gateways and trans- the data must go through), a telephone conversation is an annoying, awkward mess. And any kind of interactive application has to be nonlatency-sensitive. So Bank of America can probably forget putting its on-line transaction processing (OLTP) system through a geostationary satellite. Such systems include not only Astrolink, but Loral's Cyberstar and Hughes' Spaceway projects.

So here’s a simple solution: Move the satellites closer to earth. That's just what systems such as Teledesic, Alcatel's Skybridge, and Motorola's Celestri will do. With low earth orbits (LEOs) under 1000 miles, these systems offer latency that's barely apparent: hundredths of a second. Of course, it's not that simple. While GEOs are a well-known technology (TV broadcasts, for example, have been using them for decades), LEOs are new and face new challenges. Perhaps the biggest one is that you need a lot of them to get total global coverage. At one point, Teledesic planned a constellation of more than 800 satellites, for example (that number recently dropped to 288 when it signed an agreement to work with Boeing). Until recently, the concept of launching dozens or hundreds of multimillion-dollar satellites was a pipe dream.

Each of Teledesic's 288 satellites will cost in the realm of $20 million, according to Daggatt. That's $5.76 billion just in satellites. That does not include launch fees or insurance—which, in the case of some satellite systems, is the price of the satellite again.

Price is only one issue. Who is going to launch all these satellites? Teledesic has set an 18-month to two-year launch window to get its 288 satellites airborne. All told, the LEO system creators are talking about putting more satellites into orbit in the next five years than the world has put into orbit since the Soviets launched Sputnik 40 years ago. To make it happen, a huge
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Once the LEO satellites are in orbit, there’s an entirely new set of problems. First, there’s the matter of space junk: leftovers from past space missions of all sizes, speeds, and lethality. “With all these satellites in orbit, it’s possible that debris will start running into them,” says the Tea Group’s Caceres. “They aren’t these satellites in orbit, it’s possible that there’s an entirely new set of problems. Junk, they still will fall into the atmosphere eventually. Unlike GEOs, when their operational life is over, move into a parking orbit a few miles higher than normal, LEO systems will burn up in the atmosphere, like Skylab. Although satellite life may be 10 or 12 years, “with LEOs, you must have a plan for satellite replacement,” says Myron Wagner, vice president and director of engineering for Motorola’s Celestri system (a hybrid LEO/GEO system). It’s possible, however, and Wagner cites Iridium as a pioneer in this field.

Let’s say you solve these challenges. There are more. For example, there’s the matter of acquiring and tracking these fast-moving satellites. A LEO satellite may be visible for only 20-30 minutes before it passes over the horizon. This poses no small feat for aiming the antenna and keeping the link active.

A technology called a phased-array antenna solves the antenna problem. Unlike a satellite dish, which mechanically tracks satellite locations, phased-array antennas are self-aiming boxes consisting of many smaller antennas. They can track several satellites using the slightly different signals received by the array of antennas—without physically moving, reducing wear and tear among other advantages.

The problem of keeping a link active when your satellite disappears every half hour is solved by keeping at least two satellites in view at all times (many LEOs will keep three or more in view). The antenna array is aware of all the satellites’ positions and starts a new link before the one to the setting satellite. This is “make before break” in satellite parlance.

All LEOs have to solve these challenges. Some of them have others, too. For example, there is the matter of whether a LEO constellation uses intersatellite routing. The problem is, how do you get a signal from the footprint of one satellite to the footprint of another? In other words, if a LEO user in New York wants to communicate with one in Moscow, the LEO system needs to figure out how to route the signal.

If the system is a bent pipe, such as Alcatel’s Skybridge, the satellites don’t have to be very smart. The LEO satellite over New York will beam the signal down to a ground station, which will route the signal over landlines to a ground station near Moscow. That station will feed the signal up to the LEO satellite over Moscow, which will in turn bounce it down to the user there.

According to Motorola’s Wagner, however, “Bent pipes are not good. There are too many hops from sky to earth.” And that means dreaded latency—defeating the whole reason LEOs are supposed to be better than GEOs. Instead, some systems, including Teledesic and Celestri, use satellite-to-satellite routing. The Teledesic constellation communicates in the 40-50-GHz band. Celestri uses lasers for its links.

The downside is, of course, that each satellite has to have more communications and tracking hardware—more intelligence—and therefore a higher price than a bent-pipe system. Also, the performance gain over a bent pipe is not tremendous—a few hundredths of a second.

Alcatel’s Skybridge faces yet another set of challenges, because it selected the Ku-band instead of the Ka-band. According to Mark MacGann, director of public affairs for Skybridge, this lower frequency lets Skybridge be “the cheapest system in low earth orbit.” That’s because Skybridge can use less powerful transmitters. The Ku-band is pretty crowded, though, with many GEOs working there, and that spells interference when Skybridge satellites are over the equator. “We took the GEO arc,” says MacGann, “and defined a nonoperating zone of a minimum of plus or minus 10 degrees. Once a Skybridge satellite comes
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within that arc, it shuts off its offending beams, and the ground terminal switches to another satellite.” A simple solution.

**Niches in the GEO Sphere**

In spite of the concerns of latency, GEOs and LEOs will likely coexist. Guy Christensen, of Leslie Taylor and Associates, sums up the markets based on whether the system is a GEO, with its inherent 0.24-second delay, or a low-latency LEO. LEOs will be good for high-speed networking, teleconferencing, and telemedicine—interactive applications. GEOs will be better for information downloading and video distribution—broadcasting and multicasting.

Some GEO vendors disagree. Hughes’ Conti says, “Today, we’re able to use GEO satellites to transport at least 24 Mbps of broadcast IP data and over 2 Mbps of point-to-point TCP/IP data. The latter uses technologies such as TCP spoofing. HNS has been using this technique for over three years to deliver Internet/intranet content at high speed to both consumers and enterprises.” If necessary, ground terminals using the SpaceWay system will use similar TCP spoofing technologies.

But there’s still the 0.24-second delay that you just can’t get around. Daggart says that any lossless protocol is going to have problems with this latency. Even if TCP spoofing works (and he is skeptical about that, given TCP’s 64-Kb buffers), there’s the matter of other protocols. “It’s reasonable to think that future network protocols will be designed for terrestrial networks,” he says. “You need systems that offer low error rates and low delay. People talk about voice and data as though there were two types of data. They aren’t. And if the network doesn’t work for voice, it won’t work for other applications.”

**LEO Meets GEO**

One of the systems I looked at is considering offering the best of both worlds: a hybrid solution. Motorola’s Celestri plans a LEO constellation of 63 satellites (initially) coupled with one GEO satellite over the U.S. Motorola has the rights to eight more GEO orbital slots if it needs them. The LEO constellation and the GEO satellites will be able to communicate directly through a satellite-to-satellite network.

“We want users to be unaware of the kind of system they’re using. The only way we know to do that is with a LEO configuration,” says Wagner. The hybrid configuration will enable Celestri to take advantage of LEO’s shorter delays for interactive uses and GEO’s power in the broadcast arena.

Alcatel and Lockheed have had similar thoughts. They are looking at a partnership that will enable Skybridge and Cyberstar to work together through land-based gateways. It’s not going to be quite as transparent as Celestri’s system, because it will need to route traffic through terrestrial gateways, but it does hint at the power of a hybrid configuration.

**Space Security Unit**

Once you get beyond the latency and bandwidth issues (which is what the satellite creators spend a lot of time arguing over), there is another challenge: security. If your data is being packaged up and broadcast into space, can’t anybody with a scanner just tune in? In theory, the answer is yes. But the access technologies that these systems use—combinations of code division multiple access (CDMA), time division multiple access (TDMA), frequency division multiple access (FDMA), and a bunch of other xDMA protocols—make that at least as difficult as it will be to intercept a digital cellular signal. On top of that, many of the networks will offer some kind of internal security systems. But exactly what kind? Well, that gets a bit murky.

All the vendors I spoke with told me that they were aware of the potential security
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concerns that customers would have. Few, however, had concrete solutions. Sig Dekany of Astrolink, for example, says, "I can say only that it does involve encryption. Additionally, second-tier security at the user level will come by way of public-key encryption." Representatives at Spaceway and Cyberstar were even less forthcoming, saying only that they were working on the problem and had not yet decided on a solution. Teledesic said that there is encryption within its network, and, if users want, they can add more. That seems to be the general consensus: If you want security, you're going to have to add it yourself.

But is that so different from running private business over any public network? Would you, for example, engage in trusted transactions over the Internet? Of course not. You would purchase some kind of encryption software, a virtual private network (VPN) system, for example. And because all the satellite systems claim that they will be completely transparent to your network, it's likely that the VPN system you purchase for the Internet will work just as well—and just as transparently—over a satellite system.

**Down-to-Earth Price Tags**

What will be the price for this magical universal service? Surprisingly, on a per-bit basis, every company I talked to said it will be probably not much more than what you're paying for your landline services. That may seem like a pretty amazing statement, considering the investment required to get some of these systems running—Teledesic, for example, is forecasting a $9 billion start-up charge (which some critics say is low); Motorola's Celestri is at $13 billion. But Teledesic president Daggatt thinks it's reasonable. "It's a very high-capacity system. And

unlike a wire-line network, where all the capacity of the infrastructure is rigidly dedicated to locations and users regardless of whether they are actually using it at any particular moment, Teledesic offers 'bandwidth on demand,' where the system capacity used is limited to that required by a particular user and a particular application at a particular time.
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Satellite System Overview

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Source: Leslie Taylor and Associates

moment. That allows the high system capacity of the Teledesic network to extend to a very large user base.

Other system operators agree. Savatiel says, "The price can compete with under-utilized T1s, like 25 percent utilized T1s." Astrolink will be in the range of 20 to 25 cents per minute for 64 Kbps, but remember that you will pay only for time that you use. "If you provide a good value to end users, you'll be rewarded," says Savatiel. Astrolink will word reseller agreements to try to avoid price gouging—a practice more common in countries where telecommunications is a monopoly. Cyberstar's Maehl puts it a different way: "We're trying to wait to see what the market wants." He sees Cyberstar's service coming in at about $20 per month for basic service on its Ku-band system (which has a lower bandwidth than the planned Ka-band system) and a similar price on its eventual Ka-band system.

The price you see as a customer, however, is likely to be set by your service provider. Satellite system creators are wholesale service providers. None of the satellite systems will be selling bandwidth to end users. They'll sell to gateway providers such as telephone companies, who will probably resell the satellite bandwidth to service providers (like ISPs), who will sell to customers.

The goal is to make the satellite systems transparent to end users—you buy the service, and somebody else worries about the plumbing. This transparency is incredibly important. Cyberstar, for example, is working on deals with router vendors to facilitate intelligent routing of hybrid networks. "Satellite guys can't just do satellites—we have to know about the network architecture as well," says Maehl.

Shooting for the Stars

According to analysts conducting research for Motorola, the total telecommunications market is about $650 billion, and that's going to double in 10 years, chiefly due to data communications. In other words, there are a whole lot of people out there needing a whole lot of bandwidth. And we'll need every hose we have to put out that fire: fiber, ATM, Synchronous Optical Network (SONET), xDSL, Gigabit Ethernet, cable modems, satellites, and probably a few that haven't even been thought of yet.

"I don't think the fact that it's a satellite system is going to make a difference," says Guy Christensen. He sees all telecommunications systems competing on their availability, price, and speed. That means there are going to be two big winners: whoever gets its broadband service to consumers first, and whoever can offer the most bandwidth with at least not-unreasonable latency.

At this point, the race could fall to any of the companies putting together a broadband satellite system. Or even to someone we've never heard of. The profile of the broadband satellite race has changed a great deal since last spring. AT&T has dropped out. Teledesic changed its configuration. And Motorola is collapsing two of its systems (M-Star and Millennium) into Celestri.

Gentleman, to your launch pads.
Socket to Me

The Pentium II’s proprietary slots could extend Intel’s control over the PC architecture. That’s bad for Intel’s competitors. But what does it mean for users?
By Tom R. Halfhill

You can’t fit a square peg in a round hole. And lately, Intel has much of the PC industry feeling like a square peg. The round holes are the new CPU interfaces Intel has been introducing for its P6-class processors. They are making it more difficult for rival chipmakers to compete with Intel, and they’re dividing the industry into camps that are fighting over the future of the PC system architecture. Caught in the crossfire are users. Will the PC standard they’ve always thought was open soon become proprietary?

It all started in 1995 when Intel introduced the first P6-class microprocessor, the Pentium Pro. At the same time, Intel rolled out a new interface—called Socket 8—that connects the Pentium Pro CPU to the motherboard. The 387-pin Socket 8 was incompatible with Socket 7, which is the standard 296-pin ZIF socket used by all P5-class processors, including Intel’s own Pentiums, Advanced Micro Devices’ K5 and K6, Cyrix’s 6x86 and 6x86MX, and Centaur Technology’s new IDT-C6.

Last May, Intel introduced another P6-class processor, the Pentium II, and another new CPU interface, Slot 1. Electrically, Slot 1 is identical to Socket 8. But physically, the Pentium II and Slot 1 represent major departures from past standards.

Instead of selling the CPU in a small ceramic or plastic package studded with pins—the flat, black square commonly referred to as a chip—Intel encloses the Pentium II in a much larger carrier known as a Single Edge Contact (SEC) cartridge. It’s really a daughtercard sealed inside a protective housing, and it’s the only way anyone can buy a Pentium II. The SEC cartridge requires a 242-contact Slot 1 on the motherboard.

Intel isn’t stopping there. In mid-1998, the company will introduce another Pentium II processor (code-named Deschutes) and another interface for desktop systems, Slot 2. For notebook computers, Intel will introduce a miniaturized version of the SEC cartridge and a miniaturized version of Slot 1, which will also work with Deschutes-series processors.

It’s the biggest barrage of CPU interfaces in industry history, but that’s not the problem. The problem—from the viewpoint of Intel’s competitors—is that all these new sockets and slots are Intel’s proprietary technology. And Intel doesn’t want to share them with just anybody. The chip giant is guarding the new interfaces with strong patents that make reverse-engineering a much greater legal challenge than a technical challenge. Although Intel allows motherboard manufacturers to use the new interfaces, it won’t license them to rivals who produce x86-compatible processors. And that puts many companies in a difficult position.

AMD, Cyrix, and Centaur can’t make processors that fit motherboards with SEC slots. Vendors of core-logic system chip sets can support the slots, but only if they can license proprietary technology from Intel. Motherboard companies can’t make motherboards that accept P6-class processors from any x86 vendor, as they can today with Socket 7 and P5-class processors. They also can’t make Socket 7 motherboards with Intel’s latest system chip sets (because the chip sets aren’t compatible with Socket 7), and they face a more limited choice of chip-set suppliers for SEC motherboards because some would-be suppliers don’t have an Intel license.

These are unexpected obstacles for an industry that has been comfortably making PC clones for more than a decade. Motherboard makers have to choose sides because it costs too much to build motherboards with both a Socket 7 and a SEC slot. Users will have to make a choice, too.

One solution, of course, is to stick with Intel, whose processors offer the best all-around x86 performance (integer, FP, MMX). But Intel CPUs cost about 25 percent more than CPUs
Socket to Me

from other x86 vendors, and SEC motherboards cost $30 to $100 more than Socket 7 motherboards.

The PC market has always thrived on competition. But now it's almost as if PCs are following the lead of the Macintosh—a historically proprietary architecture that's going proprietary again after a brief fling with cloning.

What's Open?

It's easy to portray Intel as the bad guy. "Intel is trying to do exactly what IBM tried to do in 1987 by driving the industry toward a proprietary bus, in that case Micro Channel," says Glenn Henry, president of Centaur Technology and a former IBM fellow. "In fact, that's one reason why I left IBM. I thought they were stupid."

Henry is referring to IBM's Micro Channel architecture, an internal peripheral bus that IBM pushed as the successor to ISA. Micro Channel was a proprietary bus that other companies had to license from IBM. If successful, Micro Channel might have forced some clone companies out of business and restored IBM's control over the PC architecture it invented in 1981. But the bus failed to catch on.

"Customers voted Micro Channel out of existence," says Henry. "Now it's in the Computer Hall of Shame."

Without question, Intel is gradually establishing control over the PC architecture. The critical components of a PC are the CPU, the system chip set, the graphics controller, the memory chips, and the motherboard. Intel makes about 90 percent of the CPUs and 80 to 85 percent of the system chip sets. Intel is also the leading motherboard manufacturer.

Intel recently announced its intention to acquire Chips & Technologies, which makes key components for notebook computers and is working with Intel and Hughes to develop a 3-D graphics controller chip (code-named Auburn); this controller is a threat to companies such as S3. Intel also owns part of Rambus, which stands a good chance of setting the future standard for memory chips. Intel and Rambus are promoting Rambus DRAM (RDRA M) as the successor to synchronous DRAM (SDRAM), which would mark the first time since 1974 that a single company controls the DRAM standard.

Not since IBM's heyday in the early 1980s has a company enjoyed so much dominance over the PC architecture. And Intel has done it without selling a single PC under its own name. It seems the only thing beyond Intel's reach is the OS, which is still firmly in the grip of Microsoft.

Does that make Intel the Evil Empire? Before indulging too deeply in conspiracy theories, keep four points in mind:

• Like any company, Intel has a right to invent technologies and protect them with patents. "As an Intel stockholder, I would get very upset if Intel gave away its most valuable secrets without getting anything for them," says Manny Vara, Intel's public relations manager for desktop CPUs.

• Intel had solid technical reasons for inventing a new CPU interface. Socket 7 doesn't have enough bus bandwidth for high-end systems and servers, especially multiprocessor (MP) configurations. All bus traffic on Socket 7 moves across a single 64-bit-wide bus. At the typical bus frequency of 66.6 MHz, that's about 533 MBps of peak bandwidth. Even when the bus frequency increases to 100 MHz next year, it still won't be enough for high-end systems. (See the figure "Comparing Peak Bus Bandwidth," page 75.) So Intel added a second 64-bit-wide bus to the Pentium Pro and Pentium II. This backside bus talks independently to the Level 2 (L2) cache and runs faster than the frontside bus. It needs at least 72 more pins than were available on Socket 7.

• Not everyone is frozen out; Intel does share some of its P6 technology with others. For example, it helps companies such as Corollary, NCR, and Hyundai develop P6-compatible chip sets for MP systems with more than four CPUs. Intel says those

**Sorting Out the Slots**

All of Intel's P6-class processors use a similar electrical interface—only the physical interfaces are markedly different. Is this a ploy to make the interfaces more difficult to clone? No, because the physical connections are available from independent suppliers, and anyone can use them. Intel's patents protect the bus protocols, not the sockets and slots themselves.

Instead, Intel is trying to match each interface to the processor package and to different markets. Here's how they break down:

**Socket 8**

is a 387-pin ZIF socket for the Pentium Pro. It requires a multichip module—a special package that includes a CPU die and one or two SRAM dies for the Level 2 cache (256 KB to 1 MB).

The L2 cache can run at the full core frequency of the CPU (currently up to 200 MHz). The Pentium Pro supports an L2 cacheable address space of 64 GB and is found in high-performance desktops and servers.

**Slot 1**

is a 242-contact daughtercard slot that accepts a Pentium II processor packaged as a Single Edge Contact (SEC) cartridge.

Inside the cartridge are the CPU die and enough SRAM chips for an L2 cache of up to 512 KB. The current Pentium II supports 512 MB of cacheable address space, much less than a Pentium Pro.

Motherboards can have one or two of these slots. The frontside bus usually runs at 66.6 MHz and will increase to 100 MHz when Intel introduces the 440BX system chip set in the first half of 1998. The L2 cache can run at 1:1:1:2 or 1:3 ratio of the core frequency. However, it typically runs at 1:2 because higher frequencies would require expensive SRAMs, and Intel aims Slot 1 at mainstream desktops and servers.

**Slot 2**

is a new daughtercard slot that will accept Pentium II processors packaged in a slightly larger SEC cartridge. Slot 2 will not replace Slot 1. Instead, it will aim Slot 2 at higher-end desktops and servers.

**Slot 3**

is a new daughtercard slot that will accept Pentium II processors packaged in a slightly larger SEC cartridge. Slot 2 will not replace Slot 1. Instead, it will aim Slot 2 at higher-end desktops and servers.

**Slot 4**

is a new daughtercard slot that will accept Pentium II processors packaged in a slightly larger SEC cartridge. Slot 2 will not replace Slot 1. Instead, it will aim Slot 2 at higher-end desktops and servers.

**Slot 5**

is a new daughtercard slot that will accept Pentium II processors packaged in a slightly larger SEC cartridge. Slot 2 will not replace Slot 1. Instead, it will aim Slot 2 at higher-end desktops and servers.

**Slot 6**

is a new daughtercard slot that will accept Pentium II processors packaged in a slightly larger SEC cartridge. Slot 2 will not replace Slot 1. Instead, it will aim Slot 2 at higher-end desktops and servers.

**Slot 7**

is a new daughtercard slot that will accept Pentium II processors packaged in a slightly larger SEC cartridge. Slot 2 will not replace Slot 1. Instead, it will aim Slot 2 at higher-end desktops and servers.

There's room inside the larger cartridge for more SRAM chips—enough for L2 caches well beyond 512 KB. Slot 2 processors will support much more cacheable memory than Slot 1 processors (probably 64 GB). By using expensive burst SRAMs, the L2 cache can run at the full core frequency. The frontside bus won't run slower than 100 MHz.

Intel's mobile slot (as yet unnamed) is a physically smaller version of Slot 1 for notebook computers. Otherwise, it's the same as Slot 1. Intel also sells mobile processor packages on a small card known as a mobile module.

Contrary to some reports, future P6 chips aren't necessarily tied to specific slots. For example, the Deschutes processor—slated for mid-1998—is simply a Pentium II fabricated on a 0.25-micron process. (Current Pentium II chips are 0.35-micron.) Deschutes will arrive at clock speeds of 333 MHz and higher, and it will gradually replace today's Pentium II. There will be versions for Slot 1, Slot 2, the mobile slot, and the mobile module.
companies “advance the PC architecture,” while rivals such as AMD and Cyrix merely undercut Intel’s market share.

- Intel can’t make the PC architecture proprietary because it was never truly open to begin with. This runs contrary to common wisdom, which holds that PCs are more popular than Macs because they’re an open standard that anyone can clone. But in fact both the IBM PC and the Mac were proprietary from the start. The PC was cloned only because it was easier to clone. By inventing a bus protocol that’s difficult to duplicate, Intel is proving that PCs aren’t as open as many people think.

Preserving Socket 7

All this might seem to doom Socket 7 and Intel’s competitors to the endangered species list. Not necessarily. Although Socket 7 lacks the bandwidth needed for high-end systems, it’s still good enough for low- to mid-range systems—the kind most people buy. That also happens to be the mainstream market coveted by AMD, Cyrix, and Centaur.

“We are not limited by Socket 7. That’s the clear message I want to get across,” says Lance Smith, AMD’s technical marketing director. “We’re limited by time, more than anything else—the time we need to get new products out the door.”

Early next year, new CPUs, system chip sets, motherboards, and SDRAMs will boost Socket 7’s bus frequency to 100 MHz. That will boost the bandwidth to 800 MBps—50 percent more than today’s 533 MBps at 66.6 MHz.

Meanwhile, engineers are striving to reduce bus traffic. Enlarging the Level 1 (L1) cache increases the possibility that a CPU will find the instructions and data it needs without venturing out on the bus. All CPUs have bigger L1 caches these days; AMD, Cyrix, and Centaur include 64 KB in their latest chips. That’s twice as much cache as Intel’s Pentium, Pentium Pro, and Pentium II chips.

It’s likely that AMD will add even more cache when the K6 moves from its current 0.35-micron fabrication process to 0.25-micron in the next few months. The smaller process will shrink the die from its current size of 162 square millimeters to a miniscule 68 mm². That leaves plenty of room to add cache while still holding down the cost.

Centaur is taking a similar approach.

Seven Ways to Boost Socket 7

<p>| 1. Speed up the CPU bus | Faster overall performance for L2 cache and main memory | More expensive motherboards; probably fewer motherboard suppliers | Everyone |
| 2. Enlarge the L1 cache | Higher rate of cache hits | Consumes more silicon area on the microprocessor | AMD |
| 3. Enlarge the L2 cache | Higher rate of cache hits | Requires more SRAM chips | Unknown |
| 4. Add an L2 backside bus | Separates cache traffic from frontside bus traffic | Adds expense to microprocessor and requires a daughter card that plugs into Socket 7 | Centaur, AMD |
| 5. Integrate the L2 cache | Greatly speeds up access to L2 cache; eliminates need for external L2 cache or allows optional L3 cache | Consumes more silicon area on the microprocessor | AMD, AMD |
| 6. Use an in-line L2 cache | Speeds up access to L2 cache; doesn’t consume any silicon area on microprocessor | Complicated design with multiple bus speeds; requires a daughter card that plugs into Socket 7 | System chip-set suppliers |
| 7. Integrate the L2 cache in a multichip module (MCM) | Speeds up access to L2 cache over dedicated backside bus; doesn’t require a daughter card | Prohibitively expensive unless manufactured with IBM’s C4 process technology | AMD, Cyrix |</p>
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Late next year, the company plans to ship an improved version of the IDT-C6 processor that integrates the L2 cache with the CPU—already a feature in some RISC chips but a first for the x86.

Glenn Henry estimates that an eight-way set-associative 256-KB L2 cache in the CPU could yield the same hit rate as the direct-mapped 512-KB L2 cache found in most of today’s PCs. Yet the integrated cache would be significantly faster than an external cache because it’s synchronized to the CPU’s core frequency, not to the slower bus frequency. And the integrated cache would reduce bus traffic.

“Even if you didn’t know anything about the PC industry, an economist from Mars could look at it and recognize there’s plenty of room for many companies to compete,” says Henry.

**Future Alternatives**

Bigger on-chip caches aren’t the only options available to the Socket 7 preservation society. There are some more short-term solutions as well as some new alternatives beyond Socket 7.

One option is to design new CPUs with a backside bus for the L2 cache, just as Intel has done. But instead of inventing a new socket to accommodate the extra pins, the dual-bus CPU and L2 cache would sit on a daughtercard that plugs into Socket 7. The backside bus could run as fast as the CPU core, or at some fractional speed—probably half the core frequency, to reduce SRAM costs. The frontside bus would still run at 66.6 or 100 MHz for backward compatibility. (See “Adding a Backside Bus to Socket 7,” at right.)

The same thing could be done even better by integrating both the CPU die and the L2 cache in a single package called a multichip module (MCM), much like the Pentium Pro. The core and the cache would communicate over a fast backside bus, and the MCM would fit Socket 7. (See the figure “Multichip Modules for Socket 7,” page 80.) MCMs are costly to manufacture, but AMD uses an IBM fabrication technology called C4 that would make it more economical. This technology distributes the pads (the contacts to which the pins are wired) all over the chip’s surface instead of only around the edges of the die, which is the more common pad-bonding technique. Among other benefits, C4 makes it less expensive to bond another die on the same substrate. NexGen, which was acquired by AMD, did something similar two years ago: One version of the Nxis86 processor had a separate FPU in an MCM. This option is also possible (but less likely) for Cyrix, whose manufacturing partner is IBM.

Another option is to add an in-line or look-through L2 cache to a daughtercard that plugs into Socket 7. In this scheme, the CPU wouldn’t need a backside bus. Instead, an external oscillator overclocks the CPU bus to drive it at a higher-than-normal frequency. The CPU talks to the L2 cache at this higher speed, but the cache controller steps down to 66.6 or 100 MHz when communicating over the daughtercard’s interface to Socket 7. This option saves the trouble of designing new CPUs. Some of the latest Macs and Mac clones are using in-line caches to overcome their slow 40- and 50-MHz buses. (See the figure “Adding an In-Line Cache to Socket 7,” above.)

“Any one of those alternatives could extend the life of Socket 7 and match the performance of Slot 1,” says Mark Bluhm, vice president of strategic planning at Cyrix. “This socket has at least another year or two of life ahead of it.”
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Beyond that, however, even the Socket 7 advocates admit they’ll need a longer-term solution. If they can’t get around Intel’s patents by then, they’ve got two more alternatives: Agree on a universal motherboard slot that accepts daughter cards with any kind of CPU, or invent a new socket or slot that competes directly with Intel’s slots.

The first alternative already exists, though it’s not universal. At the Computex show in Taipei last June, Asus won a BYTE Best of Computex award for a motherboard (the P/1-P65UP8) with a special slot for CPU daughter cards. The daughter cards may contain a Socket 7, Socket 8, or Slot 1 processor, along with the appropriate system chip set. In this way, Asus needs to make only one motherboard that works with anyone’s CPU. The daughter card slot is proprietary for now, but if enough companies agreed on a standard, any company could build universal motherboards.

One drawback is that this design needs an additional edge connector (the universal daughter card slot) between the CPU and the motherboard. If the CPU is a Pentium II, there are two edge connectors between the CPU and the motherboard—Intel’s slot and the universal daughter card slot. Edge connectors can be troublesome sources of noise and signal delays at higher bus frequencies.

The second alternative is for the rebel faction of the industry to agree on a new CPU interface to supersede Socket 7 without stepping on Intel’s patents. “We believe the industry wants that to be an open socket,” says Stan Swearingen, product management director at Cyrix. “We’re already talking to chip-set vendors, AMD, and other companies to define a new interface.”

None of those companies wants to reveal much about their negotiations at this point. But even if they can agree on a new socket, they still face a formidable obstacle: Intel. Whatever new interface the contras come up with, it won’t be supported by the industry’s leading CPU maker (Intel), the industry’s leading motherboard maker (Intel), and the industry’s leading system chip-set maker (Intel). The fallout could be two PC architectures: one controlled by Intel and the other supported by a majority of the industry that nevertheless controls only a minority of the market share.

Users Will Choose

Users could tip the scales either way. Will they be comfortable with a PC architecture largely controlled by Intel, or will they rebel? When BYTE put this question to users in our on-line conferences (http://www.byte.com), the answers were interesting. Some people denounced what they perceived as Intel’s attempt to hijack the PC standard. But when they considered the alternatives—basically either boycott Intel or buy a Mac—they weren’t so adamant. It’s not easy to go cold turkey on Intel. The Pentium is popular because it’s a good product, not because it has the best TV commercials.

For users who prefer to buy Intel-based PCs anyway, it’s not a dilemma. Nor is it likely to matter to the growing number of users who don’t know a motherboard from a surfboard. Performance-minded users who buy MP systems and high-end servers will have to choose Intel in any case because AMD, Cyrix, and Centaur say they’re not competing in that space.

Comparisons to the Micro Channel architecture go only so far. Micro Channel was a peripheral bus, so it affected users more directly than a CPU bus does. And IBM had to persuade other companies to make compatible cards, while the whole point of Intel’s new slots is that nobody else can make compatible cards.

Motherboard makers’ support is seen as a determining factor to the continued success of Socket 7. A sampling of Taiwan motherboard makers said they were going both ways, designing boards to accommodate standard Socket 7 processors as well as Intel’s new vertical-insert design. Motherboard makers also say that Intel’s actions could encourage them to use more non-Intel processors. An official at one company (who asked BYTE to withhold his firm’s name) said the industry wants alternatives to Intel because nobody wants their future to be determined by a single vendor. When there are CPU shortages, it’s common for smaller companies to suffer from short allocations.

Intel is taking the PC into unexplored territory. Chances are, most PC users will follow. ☞

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

WHERE TO FIND

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Déjà Vu All Over Again

Windows NT security is under fire. It’s not just that there are holes, but that they are holes that other OSes patched years ago.
By Peter Mudge and Yobie Benjamin

Do you have a strange feeling? The feeling that you’ve been somewhere or done something before? It’s déjà vu, and we’re developing a serious case of it as we hunt down bugs in Windows NT. It’s not strange that there are bugs in it. We certainly have not come across any OS or piece of software that is bug-free.

The peculiar feeling comes from the fact that the bugs we’re seeing are the same security holes that were fixed many years ago in older OSes.

Why hasn’t anybody noticed until recently? The Internet is largely a network of Unix computers, so hackers aimed their sights on the thousands of Sun, Hewlett-Packard, and IBM servers on it. NT was largely ignored. Microsoft’s marketing juggernaut changed that. The hacker community targeted NT security starting in the fall of 1996, and the rash of security breaches has been relentless ever since.

The shame of it is that none of these threats are new to the security world. Why does an OS only five years old (compared to Unix’s 25-year history) have these problems? NT may be another example of the veracity of Santayana’s statement that “those who cannot remember the past are condemned to repeat it.”

Let’s look at NT’s security by highlighting some of the breaches, how they work, and what you can do about them.

Denial of Service Attacks

Denial of Service attacks, commonly referred to as DoS, make a machine unusable. They range from shutting services off to blue screen of death (BSOD) attacks to devoting resources to one process and thus depriving other tasks of any sort of sizable time slice. In general, DoS attacks do not require user names or passwords. Instead, they work by combining the inherent weaknesses of TCP/IP and the OS. Let’s take a look at four examples: WinNuke, Domain Name System (DNS), Internet Information Server (IIS) 1.0, and Microsoft remote procedure call (RPC).

WinNuke is particularly troublesome. Most of the NT boxes out on the Internet are still vulnerable to this attack. We don’t know just who came up with the first example of WinNuke or found the initial problem. Our apologies for not being able to give credit where it is due. The scenario goes something like this.

A cracker makes a TCP connection to a machine running Windows 95 or NT. As soon as the connection is made, and before any regular data is sent, the cracker transfers a message over the connection with the Out of Band (OOB) flag set. This flag normally signals an application that some information needs to get through right away and cannot wait in the regular data stream to be processed. The paradox here is that there is no data in the regular stream.

In an unpatched or underpatched NT machine, your screen turns a nice shade of blue. You must reboot to clear this problem.

The moral of this example? TCP stacks are not the easiest things in the world to write. Users continue to find bugs in most vendors’ implementations. The one stack that is probably closest to being bulletproof is BSD Unix. What’s more, the source code for this more robust and quicker stack is free. The only catch is that the license states you must mention that parts of your product were derived from Berkeley code if you use it.

NT also had problems with DNS. DNS is responsible for mapping numbers such as 10.23.143.12 to names such as foo.bar.com.
It is in much need of an overhaul, but it's entrenched in how the Internet works.

The Canadian company Secure Networks found a problem in Microsoft's implementation of DNS. The standard operation for a DNS server is to field queries and send responses or send queries and field their associated responses. What happens when you send a response to a nonexistent query? The DNS server dies, most likely as a result of trying to reference a fictitious ID number in the DNS packet.

IIS 1.0 had a similar problem. All someone with malicious intent or sloppy fingers had to do was request a URL in the form of http://www.someiismachine.com/./././..., and the Web server would stop running. An easier way of doing this was simply to telnet to port 80 of the target machine and type “GET ...” Why did the server die? Probably, this is a case of requesting a file handle, getting a NULL pointer in response, and trying to dereference the NULL pointer.

Finally, and not because we are running out of DoS attacks on NT, but because we don't want to write exclusively on ways to make your NT network unusable, we have the problem of how a program should respond to unexpected or erroneous input. There are three possible responses to this question: Ignore the input, report the error and terminate gracefully, or act in an undefined manner (the program dies from a segmentation fault or a bus error, munges its stack frame, or sits there spinning its wheels in an endless loop).

We believe most people would prefer either of the first two responses to the third. Unfortunately, however, the last one is what happened to most Microsoft services that listened on the network.

Windows NT 4.0 Service Pack 3 fixed the port 80 OOB attack, but crackers struck again. By connecting to port 135 of an NT machine and letting your 2-year-old bang away at the keyboard for a second, you would leave the program previously listening on that port spinning its wheels and pegging the CPU use at 99 percent. Microsoft plugged the port 135 hole in one of the 14 patches to Service Pack 3, but there are probably more TCP/IP bugs remaining than we'd care to think about.

Noncaptive Environments

In many situations, it is necessary to give someone or something limited access to your system. It is not necessary for everyone who connects to your FTP or Web server to have access to your main C or D drives. In the case of HTTP servers, all that people will usually need is the document root.

For example, if your Web tree lives in c:\users\web\html and your main page is c:\users\web\html\index.htm, users should be able to request http://your.site.com/index.htm. Thus, users\web\html looks like to the foreign entity. The same holds true for FTP servers, file sharing, and the like.

In the Unix world, administrators found that you had to double-check to be sure that restricted environments were really restricted. Administrators found this out the hard way and fixed it over time. Now it's Microsoft's turn to learn for itself. It's also possible that Unix vendors had an easier time of it, because the
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find people to sign their ActiveX controls.

In the ActiveX/Authentication code model, once a source is trusted, it is always trusted. For example, users who go to Microsoft's Web site are sent a flood of ActiveX controls without warning, because the controls came from a trusted source—Microsoft.

What if a rogue Microsoft employee decided to modify registry settings, plant backdoors for later use, or deposit logic bombs? An example of a rogue ActiveX control, called Internet_Expose, can be found at http://www.network-security.com/nt/internet-exposure.

In addition to the Trojan horse examples, a slick program entitled getadmin was recently released by Konstantin Sobolev, who wrote it in Russia, according to one security expert. This program found functions the NT kernel was providing that would let nonprivileged processes attach to memory areas that they should not be allowed to touch and modify the contents.

The result? A tool that would let an ordinary account convince the system it was just debugging something and place the account in the Administrator group of an NT domain. The next time you logged in, you had full rights to the system. This avenue seems ripe for exploitation as Microsoft pulls more and more of the services that used to live in user space into kernel space. Any bug or lack of validity checking in userland gets much worse if it continues to exist in kernel space. As expected, getadmin has been ported into an ActiveX control and an application that a Trojan horse can deliver.

At press time, Microsoft has issued two patches for getadmin, the second of which was headed for NT 4.0 Service Pack 4, but each works only in certain cases. Neither will work if you have any software developers on your system, because they need to be given permission to attach to processes for debugging purposes.

Weak Passwords/Authentication

A while back, a white paper on insecurities and potential flaws in Microsoft's CIFS specification (its replacement for NFS and how all systems will share files across networks in the future) was posted on the Internet. The paper, which was by
One interesting note in the paper was that logging of attempts to connect to file shares was done via the NetBIOS name, not the IP address. Thus, it was trivial to explicitly tell the machine what to log by handing in the NetBIOS information. Walking into work and seeing your logs filled with connection attempts from "HAHAHAHAH" might tell you that you were under attack, but it gives you little information to work with other than a daunting ramble.

In addition to logging, NT provides account lockout "slowdown" solutions to programmatic dictionary or sequential password attacks over the network. In account lockout, the administrator specifies how many invalid attempts it takes before an account is locked out and how long the lockout period lasts. Great, except you can't lock out the Administrator account. If someone renames the Administrator account to try to hide it and leaves a dummy account in its place, you can tell as soon as your automated attack scripts start failing in rapid succession as opposed to slowly and programmatically.

The slowdown solution makes NT introduce a delay between each attempt to authenticate. Ostensibly, this would make it unfeasible for an attacker to launch an

Anatomy of a Windows NT Server Break-In

Cracker builds Web site to harvest NT security information posted on mailing lists and via Internet Relay Chat. Cracker gathers ActiveX controls, and then builds attack DLLs and applications to be hosted on a Web site.

NT workstation user goes to Web page on cracker's Web server, which returns "trusted" ActiveX control.

Cracker's Web server changes Internet Explorer security level to none, drops a payload of getadmin, ActiveX control version.

Altered NT workstation client becomes a member of Administrators' group; masks with registry of NT workstation and server, cracker installs numerous backdoors and dummy accounts.

Exploiting holes in NT security, hackers can even cause mischief behind many firewalls.
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MD4 message digest function. The resulting 16-byte value is the NT hash. The only time hackers should be able to retrieve a LAN Manager password and not the NT MD4 version is if the MD4 version is originally longer than 14 characters. But ironically enough, NT’s User Manager application won’t let you type in a password greater than 14 characters.

Caught Unaware?

Microsoft officials we spoke to downplay these problems and characterize NT as “a very solid and secure OS.” According to Enzo Schiano, group product manager for NT Server, “if you compare NT to Unix, we probably have a very, very comprehensive security infrastructure.”

But much of Microsoft’s advice on its Web site smacks of the obvious: Precautions include reminding users not to pick easily guessable passwords. The Syskey patch to NT 4.0 prevents anyone from reading hash values out of the NT registry. The hacker community is now calling Microsoft’s bluff by exposing more holes every day.

Unfortunately, the cracker community is exploiting the revealed vulnerabilities for criminal purposes, and patches such as Syskey hamper administrators, not the crackers. To help administrators test the strength of their encryption, a future version of L0phtrail will include an NT-based sniffer kit, for reading hash values over the NT server’s network.

You can’t just blame users who don’t adopt or enforce security policies rigorously. DoS attacks, noncaptive environment attacks, and privilege escalation attacks will continue, even through the implementation of Kerberos security in NT 5.0. Eventually, users will complain enough that Microsoft will turn its full attention to the problem. The seriousness of the situation may even cause Microsoft to turn to Unix methods and technologies developed over the years to patch the holes. NT is a robust OS, but only compared to other Microsoft OSes. It can prosper only if it becomes something more.

Peter Mudge is the chief security architect of LHI Technologies, and Yobie Benjamin is the chief knowledge officer of Cambridge Management Labs, a division of Cambridge Technology Partners, Inc. They spend much research time in the areas of Java, ActiveX, Unix, Windows NT, security, cryptography, and the Internet. You can reach them c/o editors@bix.com.
Components Battling Components

Everybody's doing components on the desktop these days, but what are the components doing to the desktop?

By Robert Richardson

When it comes to software components, simplicity is everything. It's not that these items—such as DLLs for Windows and extensions in the Mac world—can't do fiendishly complex things. These mix-and-match software plug-ins can range from simple buttons on Web pages to full-blown chart packages that you can toss into your enterprise database. However, the environment that these parts and pieces inhabit has to be homey if a thriving marketplace for them is to emerge: It should be obvious how to add these components to an existing system. After all, what's the point of having components if it takes an advanced degree and as much as a year of coding to get a few of them to communicate with each other?

The computer industry came to realize the value of no-frills practicality after the hothouse growth in third-party controls (known as VBXES) for Microsoft's Visual Basic. Since then, Microsoft has jettisoned righteous abstractions, such as inheritance and polymorphism, which are sacred to the serious object-oriented-programming crowd. The result has been a shower of derision from the gallery—and a ground swell of support from the vendors and users in the trenches.

DLLs Aren't Dull

Today, the locus of Windows component development is the shared DLL. This isn't surprising; developers want to be able to share functions without having to share code. This basic functionality is something that DLLs have provided within Windows since the get-go.

There is a problem, though: The wide variance in the structure and syntax of procedure calls within DLLs inhibits the broad use of disparate DLLs. So, increasingly, the Component Object Model (COM)—Microsoft's framework for encapsulating the variations within components behind rigidly defined binary interface entry points—has become a popular way of packaging the components stored within DLLs. COM makes component use easier through two technologies: OLE provides the standard approach to binary interfaces, and the COM "bus" hides the complexity of finding and loading components (even when those components are to be loaded on remote machines).

Much of the success of components on Windows desktops has been due to the success of DLLs. At the same time that DLL use has grown swiftly, however, a troubling pathology of system instability has emerged. In the pursuit of simplicity, Microsoft has overlooked management mechanisms needed to prevent component chaos. The flood of DLLs in a Windows system directory (several hundred on an average Windows installation) is impossible to manage properly. Microsoft seems to be only barely aware of what action it will take to keep components safe for end-user consumption.

Extension Tension

Most component screwups today are on Windows desktops, but that's not because other systems are any cleaner. Rather, the popularity of Windows and the frenzy of shared DLL development have combined to make Windows the de facto test-bed for the desktop componentware concept.

Apple's Mac OS has a limited concept of shared components: Mac OS extensions. These extensions load extra functions into the general OS environment rather than loading and unloading them on a per-application basis. But they do not lend themselves to easy reuse by other applications and, as a result, have not been an active development area. As John Landwehr, product mar-
The marketing manager for Apple's forthcoming Rhapsody OS, puts it: "There aren't many components in the Mac OS, and I would not say that they're the easiest to use."

Landwehr adds that extensions are mostly for situations requiring device-driver software, and that applications generally use only the extensions in the application package. Yet Mac extensions often conflict with each other. This has spawned a market for third-party extension managers, such as Conflict Catcher (Casady & Greene, Salinas, CA), and the Extension Manager in more recent versions of the Mac OS. These utilities give users much finer control over when and in what order extensions load. If Mac applications shared extensions more often, as Windows applications do, Mac users would encounter the same array of disasters that Windows users face daily.

Jeff Foster, president of Mac software developer Vicious Fishes Software (Brea, CA; http://www.viciousfishes.com), says that, as a way to add functionality to serial ports and other hardware, the extension mechanism is "worth the aggravation of most of the conflicts." But there are conflicts aplenty. "Since we're a development shop here, we are continually having conflicts of one sort or another," he adds. "You either find a workaround or let the machine keep crashing."

The original Apple strategy was to leave extensions as just that—extensions to the low-level OS—and then embrace OpenDoc, a multivendor component-software initiative, as a way to deliver componentware on the Mac. But OpenDoc never gained widespread user support, and Apple abandoned it earlier this year.

For now, extensions are the only mainstream component mechanism that the Mac OS has and offers. Since most vendors don't use extensions from third parties, relying on some other developer's extension—the Achilles' heel of DLLs—is not the problem. However, extensions share a common memory space, and one extension's bug is often another extension's corrupted data.

Apple's Technical Information Library is full of helpful tidbits like this: "You can attempt to remedy a conflict by changing the loading order of a given extension or Control Panel by locating the file in the System Folder and adding a space or spaces to the front of the file's name." In other words, you can use the alphabetical ordering of the extension filenames to shuffle around the order in which extensions load. The goal is to mix things up enough so that whatever memory sins being committed are happening in some location where no one gets hurt.

Aspirations for a higher level of rocket science have spawned a market for the aforementioned third-party extension managers. They give users much finer control over when and in what order extensions load, generally by copying extensions in and out of the folder from which the Mac OS loads them.

This system might be OK for genuine OS extensions. But as a basis for components similar to DLLs (which is what Mac extensions have gradually become), it's a ludicrous approach, and Apple has done next to nothing to make the arrangement better. As of the 7.6 version of the Mac OS, you don't have to load all your extensions at the same time, but you do have to reboot every time you want to change extension sets. This is not one of those situations where Mac loyalists can gloat over how long it took the Windows camp to figure out how to do it right.

Apple's use of components will change radically with the introduction of its new Rhapsody OS, a heavily object-oriented, high-end, "next-generation" product scheduled to be in a developer release by the time this article sees print. Rhapsody, built from the foundations of the Next-Step OS, has a highly developed object framework and at least the beginnings of a system for managing it (see the screen on page 94). It remains to be seen whether Rhapsody will have the same component confusion that Windows now has, but it seems possible. Since the simpler Mac OS has extension-conflict problems, Rhapsody may well have even more.

**DLL Dilemmas**

DLL discomfort has several causes. For example:

Older DLL versions copy over the "correct" versions. This "back-revving" happens because vendors never know whether a customer's system is going to have the necessary shared DLLs. So, DOESGOOD DLL version 2 goes into the Windows system directory, obliterating version 3 of the same name. To be sure, vendors distribute the DLLs they've tested during development. However, newer drivers may already have superseded these by the time users load them.

In theory, a vendor's installation routine should double-check to see if a newer version of a shared DLL is already on the target system. Yet vendors have been sloppy or cautious about this, depending on how you look at it. On the sloppy side of the equation, some installation routines simply don't check for existing DLLs. In the interest of caution, though, some vendors intend to copy the specific DLL that they've tested, which gives them some cause for confidence (in particular because they're worried about the next DLL...
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discomfort I’ll discuss). Copying older DLL versions means the newly installed application will work, but applications that rely on later versions of the DLL are now more likely to encounter problems.

Users can also get in on the fun by, for example, restoring files from backup tapes without regard for newer versions installed in the meantime.

**Newer DLL versions copy over older versions.** The heartening, if perverse, optimism of the software industry makes us believe that an updated version of a component will be better than older versions. But new versions introduce new bugs or don’t speak the same interface language as older versions. So when a vendor follows the rules and does not load an older DLL, it can get into trouble for adhering to Microsoft guidelines.

If you load a new copy of Microsoft’s Publisher 97, for instance, the installed program may fail immediately after it starts. The Microsoft Technical Support KnowledgeBase boldly states that “this error occurs if a newer version of the MSVCRT40.DLL file is already installed on your computer when you run Publisher Setup.” This is your reward for keeping up with Redmond’s product line.

**The system deletes shared DLLs during uninstalls.** When an application installs itself according to Microsoft guidelines, it increments registry-based usage counters for all the shared DLLs it calls. When Microsoft’s uninstall feature removes programs, it consults the counters to see how many other programs expect the shared DLL to be there.

If no other applications need the DLL, the system will assume it’s OK to remove the DLL. But nothing forces applications to increment the counters. If one program shirks its duties, the counter is off, the DLL may well vanish prematurely, and thereafter any programs that need the DLL are bound to fail.

**Windows keeps hidden copies of special DLLs that you cannot delete.** Windows keeps copies of some particularly sensitive DLLs in the SysBckup directory within the Windows directory. At startup, it compares the copies to the originals in the System directory and, if they don’t match, the backups copy over whatever’s in the System directory. Copying a new version of WINSOCK.DLL into the System directory, for example, will be magically undone at the next system start-up.

**DLLs can conflict with each other.**

Some DLLs are just plain badly coded, a simple fact of programming life. While we’re all resigned to a certain amount of buggy code, it would be desirable to be able to separate contentious DLLs so that they never load at the same time.

This is an instance where the Mac has created advantage from adversity. Unlike DLLs, which load as needed, Mac extensions load into memory and stay there throughout a session. In earlier versions of the Mac OS, all the needed extensions had to load, meaning that they all used memory all the time. When conflicts occurred, the only remedy was to juggle the order in which the extensions loaded.

Version 7.6’s Extension Manager could create different groups of extensions so that some would load together while others would not.

**The DLL namespace readily allows collisions.** Vendors currently tend to throw all their DLLs into the System directory, although Microsoft suggests that only shared DLLs belong there. Further, even though Microsoft’s 32-bit O/Ses allow DLLs to have long filenames, most vendors stick to the 8.3 convention; they must if their DLLs are also for 16-bit environments. Plus, their files may someday reside on a shared network drive that supports only short names.

There are only so many eight-character names—fewer when you use meaningful abbreviations and short words. When two developers use a name like DISPLAY.DLL, somebody’s going to get hurt.

**DLLs may not load the way Microsoft says they do.** Dan Plastina, group program manager for Windows administration, says Microsoft’s 32-bit platforms load DLLs “by path name, not by filename.” He says there is not a problem if they call two DLLs with the same name if they have unique full path names.

Not so, say programmers, including John McMillan, lead programmer for new product development at Great Lakes Business Solutions (Canton, MI; http://www.glbs.com), which makes the installation product Microsoft now uses for its System Management System product.

“One a DLL is in memory, the system will never pull in another version of that DLL again,” he adds. Other programmers cite cases in which Windows has mistakenly used a same-name DLL.

The issue seems to arise because there are two ways in which a DLL can load. In a normal case, it uses a link library of stub functions (i.e., the same process compiles the actual DLL) and calls the DLL by its short name. Windows checks memory for currently loaded DLLs of the same name before looking elsewhere. It’s possible to load a DLL by path name, but only
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**DLLs with the same version number may be different.** Each DLL has a version resource that includes several stock fields, including a binary version number and a string for the manufacturer. You can see the version number for a DLL by right-clicking your mouse on the file within File Explorer and then selecting Properties. But there's no standard rule for updating these numbers. It's common practice at Microsoft, for instance, to release several different builds of a DLL with the same version number.

This last problem—different DLLs with the same version number—has some independent software vendors (ISVs) hopping mad. Bob Denny, creator of O'Reilly and Associate's WebSite, says the root cause of "DLL hell" is what happens when you have "a component where the behavior hasn't been changed but that's been bug-fixed. Microsoft itself has in some cases released dozens of versions of a DLL that are functionally identical but that have different levels of bug fixes."

Moreover, end users are often unaware that underlying system-level components have changed. Loading something like an Internet Explorer browser update can update low-level OS components—the lowest-level TCP/IP protocol stack DLLs, for example. There may be no direct relation; Microsoft may have used the update to slipstream a number of OS patches.

The result is that it becomes harder for vendors to support their products because it's difficult to tell exactly what set of system DLLs any given user has. "As a developer," Denny says, "I really hate working in the Microsoft environment right now, because it's just a snake pit from a support standpoint. You never know what your customers have."

**How Active Can One Desktop Be?**

Developers are making two separate realizations about desktop components.

The first is that haste makes GPFs. Microsoft's rush to get activated has resulted in too many versions of system components that beg for stability. Vendors have been sloppy, too, with shared components in the System directory.

The second realization, though, has consequences that require more than tightening and good manners: Applications badly need a way to protect themselves when forward compatibility with new versions of trusted components does not work out. There's a new realization that better tools are necessary for assessing component conflicts. It's sometimes more stable if developers reuse components in their products but don't try to share them with other applications on users' systems. Much more stability is necessary in widely shared components, such as the 3-D controls in Office, FrontPage, and Internet Explorer (all now shipped with slightly different versions).

**The Microsoft Way**

Microsoft realizes there's a problem, says Russ Madlener, product manager for desktop OSes. However, don't look for any real fixes to come with Windows 98 (aka Memphis). Help will come in the form of somewhat-better safeguards for DLL installation and a tool for post-mortem forensics on failed systems.

First, Microsoft intends to get tougher about granting "Designed for Windows" logos to software vendors. Madlener says there will be "enhanced restrictions" on the "whole approach of installing and uninstalling an application." To date, he says, Microsoft has offered only guidelines, which are often not well understood or followed.

Under the new program, vendors will be in "violation of logo" if they copy anything other than Microsoft-shared DLLs to the System directory (see the figure "How to Stay Clear of the Long Arm of the Logo Police" above). Components intended to be shared by others will be copied into the Common Files directory. Every other DLL that an application uses must be in the application's own directory. Assuming vendor compliance, this will at least reduce the risks of name collisions.

Coming with Windows 98 is the System File Checker, which performs such an obvious function that one wonders why it wasn't available before. This utility checks system-level files—and any other files that the user wants to monitor—to make sure they haven't been modified or corrupted since the last time the utility recorded a profile of the system (see the screen on page 90).

**NT Promises**

It's with the release of Windows NT 5.0 that component-management enhancements really get interesting, according to Madlener. For one thing, vendors will no longer control their own destiny when installing a new application. Instead, installation will pass to a system-level installation utility. Currently code-named Darwin, this setup utility will run on all 32-bit platforms.

With NT, says Microsoft's Plastina, "when you go to install an application, you ask Darwin to do the work for you. You give Darwin an instruction file." Dar-
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Rhhapsody manages objects in three folder tiers: for user and system on each system and, here, for the system object folder on the server.

win carries out the instructions, following the rules of DLL reference counts and replacing DLLs.

Another change in DLLs has to do with packaging system components. Says Plasentina: "Today when you install an application, it puts down a good number of megabytes of data that comes with the system. Those are really OS components, though. With NT 5.0, we'll have quarterly releases of shared component service packs." These will contain "the latest versions of the DLLs that the OS group has blessed, and applications won't ship those DLLs anymore." DLLs in service packs will contain updated version numbers.

Darwin is just one part of the Zero Administration Windows (ZAW) initiative that Microsoft announced a year ago. Network administrators will also be able to lock down the Windows directory so that a user can't change it (see the figure "Windows NT Corrals Components" on page 88). In addition, administrators will have complete control over which programs go on a user's system.

Future Perfect?

To some degree, mismatches among components are an inevitable result of the current pace of software development and the modular approach to software that's necessary for updates in short time frames. But there's now concern among some developers that Microsoft's game plan of migrating most components from plain DLLs into the COM framework might only make matters less manageable. If the problem of DLLs is a lack of control over versioning, the problem with COM is that the whole notion of versioning is absent.

In COM, the functionality of each interface is specified and permanently fixed. Every interface is assigned a Globally Unique ID (GUID), which virtually eliminates name collisions. But individual implementations of the interface associated with any given GUID are indistinguishable within COM.

For now, Microsoft has implemented most of the widely used COM interfaces. Furthermore, until now, fixing Microsoft's COM interface bugs has entailed adding functionality; each revised interface has received new function calls and new GUIDs.

Despite prior insistence that the interface is all that matters, Microsoft's Madlener says that there are "plans to add finer-grained versioning to COM." The details of versioning in the next generation of COM (called Common Object Runtime [COR]) should be out by the time you read this.

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In our October issue, we talked briefly with Microsoft vice president Jim Allchin about some of the elements of Windows he would like to change. Recently, we spoke with him again about his vision of operating systems, components, directory services, and Microsoft's technology strategy.

BYTE: What is your view of OS evolution?

Allchin: WE HAVE A BROAD VISION THAT TIES together a few dimensions. One dimension is the basics: quality, robustness, reliability, scalability, and security. We will continue to improve on those basics.

A second dimension is communications. I'm wiring communications into every nook and cranny of the system so it becomes a great citizen in transient networks. If the connection drops or if you move between cells, the system should still work with the network. The system needs to figure out what protocols are on the network automatically. It needs to understand whether it is going over a low-latency or high-latency network. It needs to understand how to take advantage of the quality of service that may exist if you are doing video streaming. If it has an error on a network, it needs to automatically reconfigure. The programming model I'm promoting is that the network is broken all the time. People design their software so that if you communicate at all, it's a miracle.

The last dimension is ease of use and simplicity. Systems are too difficult to use. I would feel much prouder of the computer industry if there were not so many arcane things hidden in software. We present error messages that somebody can't do anything with. The system could recover from more errors if we worked harder on it. And the system could be much more intuitive. We clutter the screen with many options, and the system isn't adaptive to what the users are doing.

Whether it's consumer or business makes no difference: Everybody wants simplicity. We want an environment that is much more helpful and much more intuitive. Intuitiveness is more than intelligence. The system should be able to follow what's going on and make proposals. You've seen some work in that area in some of our applications and the answer wizard, but we're just starting to scratch the surface.

If I tile these three dimensions together, the result is being maintenance free. There is no reason machines can't just do much more cleanup. I mean, I hate utilities that run after the fact that have to clean up temp files and other things. It's unnecessary. The system could be much, much smarter. It should be able to automatically manage space,
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and if it does run out of space, it should be graceful. You want your system to basically be foolproof.

**BYTE:** The average system has thousands of DLLs and device drivers on it. When you talk about achieving simplicity, are you saying you can create a layer that manages that complexity?

**Allchin:** No. Layers are nothing but more overhead: You can put lipstick on a chicken, but it's still a chicken. We don't think apps should have to go through an install process—it should be seamless. As far as having lots of DLLs, I think about it like this: The fact that you can see any of this stuff is like looking through a transparent TV where you see all the transistors and chips and ICs. The end user shouldn't see that. TV manufacturers don't encourage you to open the case, stick your finger in, and try to pull out a transistor. Well, that's what happens if you try to delete a DLL. We've created an environment that can get into trouble, and we can change some of that. There are still going to be device drivers, but we'll apply some here-and-now technology like Authenticode to sign them so customers are assured of a certain quality level.

**BYTE:** Some of what you said reminds me of the best years of the Mac, where you put stuff in and it would install itself and it actually worked.

**Allchin:** First, the Mac is super-primitive. I hope that nothing we are doing will be compared with that. The Mac was a joke architecturally. Come on—virtual memory? We have to have a rich, solid infrastructure for how apps deal with the system. The problem with the Mac is that it was too closed. It wasn't an open environment that people could innovate in. And if you didn't use a particular tool set from Apple, who knows whether it would work properly? It wasn't an industry: It was a closed world.

**BYTE:** At one time, you were talking about an object file system as part of Cairo; now, you're silent on the matter. Has that idea gone away?

**Allchin:** It hasn't. In NT 5 we will deliver basically all the functionality we talked about in OFS. Just think if we renamed OFS as NTFS [NT File System], which is basically what happened. So NTFS 5.0 will have quotas. It will be attributed, meaning you can have properties tied to streams in the system, and arbitrary properties tied to files. And it will be automatically indexed on properties and content. It will have distributed link tracking, so if you point to a link or if you have a link embedded in a document, we will automatically track down that document.

We are pushing three dimensions in terms of storage. The first is location independence. We are doing some in Dfs [Distributed File System] now. We want to be able to migrate data between the client and the server transparently. The last thing we're focused on—and we have a team definitely cranking on this—is merging database technology with the file system to get a more unified storage system. It will not replace the super-high-end OLTP environment, but our goal is to be able to offer programmers a rich storage system that is available everywhere.

**BYTE:** Are you going to create an object file system? If so, what sets an object file system apart from a regular file system with these extensions?

**Allchin:** I think it's all semantics. When I talk about an object, it's got a data type and you can automatically bind to the code that is associated with it. Make links fundamental to the architecture and you can do things like link management automatically. You can surface this storage environment up into a programming language, so you can deal with the object in a seamless way in a programming language. So it's just a question of binding the programming language to this environment.

People are doing that today, and it becomes a question of the granular size of the data. Some types of data—integers, for instance—may be small, and the storage system may not be good at storing them. NTFS certainly is not good at storing integers; it needs reasonably sized pages.

When we did OFS, we thought the object sizes were going to be fairly small and spent a great deal of time packing the
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node items densely. It turns out that was a mistake: Most things people deal with—take an HTML page—are fairly large.

But when you ask will we ever build one, I think NTFS is in part an object file system. It doesn’t have the surfacing binding into a language, but we have some people looking at that. I think there are many other things that can be done to the storage system. We want to reduce the number of stores that we have on the system.

NT 5.0 offers a step in the right direction. Now we have a very large team between the SQL group and the file system group that is working on continuing that movement for the future.

BYTE: How are you going to handle information that’s stored in different formats—or even executables that are stored within documents like Active Server Pages?

Allchin: [FOR THE first one] you will end up with a common interface that will enable you to access the directory, address books, SQL, the file system, and Exchange. And in terms of being able to handle the dependencies and to understand the code, we’re scratching the surface in NT 5. There is a class store as part of the directory. You use the directory to find snippets of code and how to automatically download those and how they should be run. But we have a broader vision—which is still early—where we are looking to do a repository.

BYTE: How does a security system have to adapt for today’s sometimes-anonymous/sometimes intranet style of computing?

Allchin: WE ONCE ENVISIONED THAT EVENTUALLY there would be a community of kiosks, and we thought that public key would be the answer there. We thought people would have smartcards and walk up to the kiosks [and use them], so we would have to do some sort of authentication to be able to customize the environment we would show. This big-directory-in-the-sky idea did exist.

What have we done? As you probably know, in NT 5 we will have a mapping of public key-to-private key IDs. We think it’s a pretty efficient and smart thing to do. You’re going to want to know who’s coming into your site. You’re going to want to be able to tailor the information for them. That implies there’s a directory. So when we’re testing the directory that will be in NT 5, [we’re testing with millions of entries,] not a thousand. I believe that you will see more and more authenticated users because the Internet is going to turn into a good transfer environment—something that people count on even if it’s not good.

BYTE: What’s the direction the directory has to go in now?

Allchin: IT GOES BACK to the dimensions I talked about, [especially greater intelligence]. Instead of having the user or administrator try to figure out where a replicant should be, why doesn’t the system just figure it out? We’ll be working on performance, and we’ll be working on tools to make schema changes even simpler than we are going to make it in the first release. I can also think of integration with the storage system being even tighter. We’re definitely banking on it. Hopefully we’ve learned by watching others and having our own experience with the current NT directory. Some of us have a little background in that area, so we think we’re going to come out okay.

BYTE: Are the improvements we’ve talked about a five-year project? A three-year project?

Allchin: I DON’T THINK THAT ANYTHING I’VE talked about is five years out. It’s just a question of how capable we can make it. In other words, it can come out in intermediate milestones; it’ll be in NT 6, and from a technology perspective it may be used in several different products. But certainly it is going to happen. We’ll continue to move ahead. NT 5 will have quality-of-service support in it, but we’ll move that ahead further in NT 6.0. It’s just one step at a time. You know, NT 5 is a big release, and we think we have a fairly reasonable number of people working on things beyond NT 5. Things like this repository, things like the storage that we’ve been talking about, things like the end-user simplicity—those things are now being thought about.
Cascading Style Sheets

HTML purists say that the mark-up language, like SGML, expresses only the structure of documents. The browser—not the author—controls presentation, because only the browser knows best how to adapt content to exploit the capabilities and workaround constraints of its host system.

The reality of HTML is quite different, of course. There’s intense pressure on publishers and software developers alike to control the look of their Web pages. We do this with bastard HTML tags, such as <FONT> and <CENTER>; with nested tables; and with nonbreaking spaces and invisible GIFs. By resorting to these hacks we achieve the necessary effects, but we also trade away universal access and easy maintenance.

CSS purists say that style sheets influence, but do not absolutely control, the presentation of documents. Author and reader can share influence, and the rendered page is a negotiated compromise. Non-CSS browsers can fall back to vanilla HTML, which remains the skeleton of any CSS-enhanced page.

The reality of CSS will likely diverge from the ideal, just as HTML has, for the same reasons, involving the same tradeoffs. With HTML, I’m always looking for the sweet spot—the right balance of purity and pragmatism. Because that’s a moving target, I continually adjust my pages and applications to track it. So with CSS.

What’s the sweet spot for CSS right now, with immature support for style sheets in the 4.0 browsers from Netscape and Microsoft? What’s it likely to be in eight months when CSS implementations are more complete, widespread, and reliable? Here are some answers, and some educated guesses.

**HTML + CSS + JavaScript = Dynamic HTML**

Here’s a lightweight approach to active content. In this demo, every list’s title (i.e., one, two, three) is wired to a JavaScript function that toggles the CSS display property of the corresponding list. When you set the display property to “none,” the browser hides the list and reflows the document to reclaim its space.

**CASE I:**

An HTML/JavaScript/CSS Slide Show

When I give presentations nowadays, I use Web pages for slides. Modifying style across a set of slides always used to be a problem. If you used embedded HTML tags, such as <FONT>, you had to do a global search-and-replace across multiple files to change the look of a presentation consistently.

CSS neatly solves this problem. Now when I create a slide show, I clone pages from a template that includes a reference to a style sheet. The style sheet contains a series of directives, like this:

```css
body { font-family: arial; }
h1 { font-size: 24pt; }
font-weight: bold; }
```

In this example, CSS defines the default font, and the size of <H1> headers, for every slide. Technically, CSS merely influences these matters, subject to the counter-influence of the user’s style preferences. In practice, that won’t happen much until browsers support user style sheets and users learn to apply them.

There’s a lot to say about these rules. The font-family, for example, might better be requested like this: Verdana, Arial, Helvetica, MS Sans Serif. Proceeding from specific to generic, this list equips the browser to use the author’s preferred fonts when available (in order of preference) and authorizes the browser to fall back on a generic sans serif font if necessary.
Likewise, the font-size might better be expressed in one of these ways:

```html
h1 { font-size: larger;  
h1 { font-size: 200%;  
h1 { font-size: x-large;  
```

Almost everything in CSS can be expressed using abstract terminology that's relative (larger, 200%) or absolute (x-large). Relative mode makes an element independent of others. Why x-large rather than 24pt? Because 0.33 inch (24 points divided by 72 points per inch) might be too small to say “extra large” on a high-res workstation, but overwhelmingly large on a PDA. x-large requests an absolute size, but one that can still be interpreted in a device-appropriate way.

The h1 headers use the body's font-family, although the h1 rule says nothing about font-family. Why? h1 inherits from body. If you're familiar with style sheets in conventional word processors, it may take a while for you to get the hang of this. CSS inheritance is a powerful mechanism. To exploit it requires a mind-set that owes more to object-oriented programming than to desktop publishing. The challenges—and and the rewards—are similar.

### A Dose of Practicality

When I added a table to one of my slides, I ran into a snag. The table didn't inherit my font-family request. Why not? Navigator 4.0's CSS support is very shaky; inheritance across table boundaries is one of many things that just don't work. Microsoft Internet Explorer (MSIE) 4.0 (currently in beta 2) works properly in this regard, and in general it's far better than Navigator 4.0. It's a second-generation effort for Microsoft, which committed early to CSS with support in MSIE 3.0. Netscape resisted for too long, and it now finds itself in catch-up mode.

What to do? Because I'm the only one giving my presentations, I could use MSIE 4.0 and just ignore Communicator's CSS flaws. But I don't want to just show my presentation; I want to put it on the Web so that others can view it. Requiring MSIE 4.0 won't do. I'd rather build something that works with both browsers. It's frustrating to look for workarounds, but that's the lot of the Web author. Better my frustration than the reader's. In this regard, CSS is going to be a déjà vu experience. CSS is enormously flexible, so there are lots of different ways to work around problems. To switch my table cells to an alternate font-family, I first tried this:

```html
td { font-family: monospace  
```

But the preamble that my JavaScript code inserts into every slide builds another table containing navigational icons and a title. The rule shown above sets every table cell in monospace type; I want only certain tables to be handled that way. CSS offers a variety of solutions. Here's one: You can make a new class out of any element by adding a class attribute to its HTML tag, like this: `<td class=BodyTableCell>`, then you can address the set of elements so tagged, as follows:

```html
td.BodyTableCell { font-family: monospace  
```

This works. But it's stupid to add a class attribute to every cell. You might as well just say `<td font-family=times>`, just the sort of brute-force redundancy that CSS is supposed to abolish. Here's another idea:

```html
<dt class=BodyTable>
<table>...
  ```
HMMMM...

ArtMedia's 20" Monitor Earns a Spot on 1997 WinList.

Our canine friend won't be the only one surprised by what they see on an ArtMedia monitor. CAD operators and graphic designers will appreciate our sharper resolution, better focus, lower distortion and higher brightness. Basically a great picture. Which might explain why the editors of Windows Magazine placed our 20" GT-960T monitor on their prestigious 1997 WinList. It also might have helped that the GT-960T comes with advanced Trinitron® technology, a flatter screen and superfine pitch. So if you want the best professional monitors around, take a look at who the experts are picking.
In CSS you can use two new HTML elements—DIV and SPAN—as metatags that group and classify other elements. DIV defines a block element (anything bounded by line breaks); SPAN marks an in-line element. In this case, the class attribute on DIV defines a class called BodyTable. Now a single wild-card rule, like this:

```
.BodyTable { font-family: monospace }
```

can influence all the tds contained within instances of that class.

Was this the solution? Nope. It requires inheritance, which, as you'll remember, doesn't work properly with tables in Navigator 4.0. Fortunately, CSS has another trick up its sleeve. You can select sets of elements not only with attributes (td, BodyTable) but also with contextual patterns of attributes. Here is what finally worked:

```
div th, div td { font-family: courier; }
```

This says: "Apply courier to TH and TD elements, but only those contained within a DIV." I wrapped the tables that I wanted to match this rule in a `<div class='BodyTable'> ... </div>` tag.

Note that it would have been enough simply to say `<div>`—the new class BodyTable isn't contributing anything to this solution. I left BodyTable in, though. It won't cause problems with CSS or non-CSS browsers. And it's extra information that might come in handy. Someday I may want to select only the elements that match BodyTable, rather than a more general set that matches div th, div td. Or, in a non-CSS context, I might want to use a Perl script to extract and catalog or rearrange all the tables of that type.

Even if you have no immediate need to influence presentation with style sheets, there are compelling reasons to adopt the CSS method of classifying content. Class attributes do more than lay the foundation for stylistic control of your pages. They can also provide new hooks for managing your content. Document collections are text databases. Class attributes are selectors that operate on these databases. CSS uses these selectors, but other applications can, too. The value of your text databases grows in proportion to the number and specificity of the selectors you can apply to it.

CASE 2: BYTE Home-Page Redesign

A recent redesign of our home page gave me the chance to try out the design and layout capabilities of CSS-enhanced HTML. Our requirements included a variety of static and dynamic elements of various shapes and sizes, all with fixed locations. There's only one way to do this in straight HTML. You wrap everything in tables. CSS offers two other approaches: floating elements and absolute positioning.

Because I'd have to deploy to non-CSS browsers, I started with a table-based approach. Even in this context, CSS can be useful. If you classify elements, you can rapidly evaluate a series of alternate treatments. The family, size, weight, and color of fonts; the alignment, indentation, line spacing, and margins of text; and a host of other stylistic variables are easily twiddled.

Depending on your inheritance scheme, you can adjust these things for the whole document tree or for selected branches. Once you settle on a design, you can translate your CSS rules down to the per-element tags required by straight HTML.

The next thing to try was floating elements. HTML authors use the FLOAT attribute of the IMG tag to force images left or right and to flow text around them. CSS generalizes the float property. Any block element—image, list, DIV—can float. In theory, you can use this technique to build a page that has a 2-D look but that adapts gracefully to narrow displays. In practice, CSS can do this effectively only in simple cases (see the screen on page 97).

The inventors of CSS are talking about extensions that will make it a full-blown layout system, but in its current form it isn't one, nor does it pretend to be. Still, the float property is powerful. You can, for example, apply it to a group of elements wrapped in a DIV tag. The effect varies according to the other properties of the DIV (e.g., absolute or relative width, left or right alignment), the properties of the other elements in line with the DIV, and the properties of the DIV's container. It's worth spending some time to sort out all these interactions.

Finally, I tried a version of the home page that uses absolute positioning. With this CSS extension, which is supported in both 4.0 browsers, you can place any element at a precise pixel offset from the topleft origin of the page. It's an all-or-none method because elements positioned in this way will never flow; any other elements that are allowed to flow are liable to overlap the fixed ones. However, normal flow still occurs inside fixed elements.

Using this technique, I tiled the surface of the page with my major elements. The result was pleasing because, unlike a conventional table treatment, the CSS version didn't have to align elements on a grid. This freedom costs something, of course. Tables can stretch if you express their widths in percentages. A page whose elements stand in fixed relation to the origin cannot stretch.

I like this last version best, and I plan to translate it into straight HTML for deployment. Here's hoping that widespread adoption of CSS will make that ugly procedure unnecessary when our next site redesign rolls around. 0

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www.byte.com
Metrowerks' Discover Programming provides a decent introduction to Java code, but it has some annoying inconsistencies.

The CodeWarrior Discover Programming Edition (DPE), from Metrowerks, provides a decent multilingual gateway into the world of programming. But if your goal is to become fluent in Java, you may want to look for additional help: Anyone purchasing this set of learning tools should be aware that it's not Java-specific enough to serve as a solid introduction to Java programming.

DPE, which is available for the Macintosh and Windows 95 and NT (I used the Windows version), supports C, C++, Pascal, and Java. The supplied CD-ROM includes version 2.0 of the distinguished CodeWarrior integrated development environment (IDE), plus tutorials, sample code, untold piles of documentation, and seven on-line books.

The entire documentation system is constructed as a Web site. In fact, to enter the documentation system, you have to double-click on an icon named “CodeWarrior Reference WebSite.” All the documentation is in either HTML or PDF form. You probably won't need anything else to get going. The CD-ROM includes installable versions of Microsoft's Internet Explorer and Adobe Acrobat reader.

DPE's documentation appears to be spread evenly among all its supported languages, although only one of the seven books (The Java Programming Language Handbook, from Coriolis Press) is Java specific. The language and compiler documentation includes both the Java language and Java virtual machine (VM) specifications. More specific to the CodeWarrior IDE is the included Targeting Java manual. Finally, the complete Java API and Java Generic Library documents are supplied.

I have two complaints about The Java Programming Language Handbook. First, it's in Adobe Acrobat, and navigating through a book in this format can be an annoying pain. The Acrobat reader counts certain elements in a book, such as the cover, table of contents, and prefaces, as separate pages. But the Handbook's table of contents does not. Thus, there's no easy correlation between pages as Acrobat understands them and pages as the book's table of contents understands them.

This is exacerbated by the fact that the book is carved into multiple PDF files—which leads to my second complaint. As a result, the table of contents becomes nearly unusable. For instance, if you're looking for a particular section, you have to guess which PDF file that section is in (and, since Acrobat pages don't match table-of-contents pages, your guess is usually off). The index is equally unusable, having been placed at the end of part 1. (I discovered that by accident.)

Unfortunately, none of DPE's supplied tutorials is Java-specific. A mini-tutorial guides you through the CodeWarrior IDE, but the examples provided are for the Macintosh version. This can be distracting for someone working with the Windows version.

On a more positive note, examples for the Handbook are provided as separate, accessible projects that you can easily pull into the IDE. Even though much of the text in the Handbook is in 1.0-era Java, the examples provided are updates to the 1.1-level Java Development Kit (JDK). At the bottom of the HTML link page for the book, you'll find links to each of
Multiple Java Dimensions

In August, JavaSoft announced the new media and communications Java APIs, of which there are a passel. They include the following:

- Java 2D and Java 3D (which is what I’ll focus on here).
- Java sound, including mixing and MIDI synthesis.
- The Java media framework, which deals with (among other things) audio/video playback and videoconferencing.
- Java animation, which deals with 2-D animation.
- Java telephony, which is self-explanatory.
- Java speech, which includes speech recognition and synthesis.
- Java collaboration, which deals with data sharing.

I could spend much of the rest of this magazine’s pages trying to cover all the APIs, but obviously I don’t have enough space for that. Instead, I’ll continue my coverage from previous columns, in which I discussed 2-D graphics and VRML, and concentrate on the Java 2D and Java 3D APIs. (You can find and download further information about the other APIs from http://www.javasoft.com.)

Java 2D is actually an extension to the Java Abstract Window Toolkit (AWT). Plans are that it will be included as part of the JDK. The additional classes of Java 2D provide such features as arbitrary fills, tiling, Bézier paths, extended font characteristics (which let you define such font features as kerning, glyph substitution, and ligatures), and a variety of transformation operations.

More elaborate elements of Java 2D provide for image-processing operations. For example, Java 2D defines the classes and interfaces necessary for constructing convolution kernels, as well as source and destination image buffers. With the added help of the ConvolveOp class, you can easily implement 2-D filter operations, such as blurring, sharpening, edge detection, and so on.

In addition, Java 2D provides greater control over colors. For example, its color-conversion classes provide for converting among RGB, CMYK, gray scale, HSL, HSB, and a half dozen more color spaces (some of whose acronyms I’m not familiar with).

Java 3D (unlike Java 2D) is a “premium” extension to the standard JDK. What that means in terms of availability and distributability is currently unclear. At the time this article was written, JavaSoft representatives were unable to discuss the details of the business model.

Java 3D runs atop standard 3-D rendering engines, such as OpenGL, Direct3D, and QuickDraw 3D. But since it simply depends on the rendering capabilities of such graphics engines, it can run atop “raw” graphics hardware.

Java 3D is a “scene graphics” API. The virtual universe modeled by Java 3D is stored in a complex tree-like structure that’s known as a “scene graph” and is composed of connected objects. Some objects in the scene graph define shapes that are ultimately rendered into the things seen in the virtual world. Other objects define textures, color, reflectivity, and so forth.

One particular object, called the view object, carries the information needed to render the scene. The view object is itself a composite of other objects. For instance, one of its components is the PhysicalBody object, which contains information describing the characteristics of the viewer (i.e., the end user). The information is frighteningly detailed, and it’s obviously designed to model the characteristics of a human viewer immersed in a 3-D world.

Data in the PhysicalBody object defines the location of the viewer’s eyes—even the interpupillary distance. The idea, of course, is to provide the developer with a framework that has enough richness to capture the widest range of viewing devices.

A unique component of Java 3D is the 3-D sound component. Given that a scene graph includes a view object, the system has all it needs to deduce the location of the viewer and the viewer’s relation (in 3-D space) to other objects in the scene. (In addition, the system has information about the geometry of the viewer himself/herself.) This information is used by the sound engine to provide realistic, spatialized 3-D sound with little programmer intervention. If the viewer is close to an object that’s emitting a sound, the sound is louder; farther away, the sound is softer.

Finally, even if you’re uninterested in 3-D graphics, you should be aware that Java 3D defines a vector-and-matrix math library suitable for general-purpose mathematics programming. These libraries are not part of the Java 2D API per se, although Java 3D depends on them as storage and manipulation classes for data such as coordinates, color information, vector normals, and so on. JavaSoft expects that the members of this library will be removed into a separate java.vecmath package in the future.

WHERE TO FIND

Metrowerks, Inc.
Austin, TX
800-377-5416
http://www.metrowerks.com

Metrowerks says that the books provided on the CD-ROM are “previews,” and the company recommends that if you find one of the on-line books useful, you should purchase a “real” copy of that book in deference to the author. I agree, but I would add that you should do so primarily to keep your sanity. Dealing with a book in Acrobat form is the antipode of fun.

The DPE is more useful as an introduction to basic Windows programming than Java programming (and, admittedly, this is how Metrowerks advertises it). The DPE is sold as a learning environment; an upgrade for commercial development costs an extra $449. Still, for only $79 you get that great CodeWarrior IDE. Go buy a couple of newer Java books, and you’ve got a great starter development system.

Rick Grehan is a senior editor at Computer Design magazine and coauthor of The Client/Server Toolkit (NobleNet, 1996). You can contact him at rickg@pennwell.com.

the projects. If you click on a link, CodeWarrior copies the project file into the directory of your choice. (It works just as though you had selected a file for an FTP-style download from the Web.) Once the project file is on your system, double-clicking on that file opens the IDE.

Another positive aspect is the included Metrowerks IDE. But be warned: This is a classic editor/compiler/debugger environment. And as good as the compiler and debugger are, there are no facilities for visual applet construction or drag-and-drop frame population.

The system requirements for the Windows version of DPE are remarkably modest. All you need is a 486-based system with at least 16 MB of RAM, Win 95 (or NT 4.0), and a CD-ROM drive. It ran comfortably on my 50-MHz 486. (The Mac version requires a 68020 or PowerPC 601, 16 MB of RAM, and System 7.1 or higher.)

I understand that the rapid evolution of Java standards makes it difficult to keep pace, and I applaud Metrowerks’ updating of the examples from the Handbook. But updating the examples puts them out of sync with some of the material in the book, and that can be a little confusing.

Metrowerks says that the books provided on the CD-ROM are “previews,” and the company recommends that if you find one of the on-line books useful, you should purchase a “real” copy of that book in deference to the author. I agree, but I would add that you should do so primarily to keep your sanity. Dealing with a book in Acrobat form is the antipode of fun.

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You’d probably be more than a little surprised if you walked into a car dealership and the salesperson steered you away from an expensive Jaguar or Lexus: “What you really want is this Honda. It does most of what the Jag does, and in a year or two, you will be able to add on the other features.” But that’s just what many resellers are doing these days.

Two years ago, resellers used Unix in 70 percent of their projects, with NetWare and Windows NT taking up the slack. Today, these same resellers report a 180-degree turn: NT accounts for Unix percentages of old, Unix projects run just under 30 percent, and NetWare is all but gone. Some resellers, such as Willow Technologies in Campbell, California, report changes that are even more dramatic. “Eighty percent of our business was Unix, with a bit of NetWare. Last year, our business was predominantly NT. Our Unix work was mostly for mainframe connectivity,” says Gary Clueit, Willow’s CEO. “As BackOffice expands, it will grab an even larger share of the market from OS/2, NetWare, and Unix,” predicts James Venturi, president of Creative Technologies, a New York City reseller. “The market is ripe for NT because of its price and performance. SQL Server, for example, is a great value.”

The surprising news is that resellers who report surges in NT say in the same breath that the BackOffice family, for all its advantages, remains glaringly immature in some areas. The platform’s security measures are still “hokey,” according to Mohnish Pabrai, director of BackOffice implementation practice for Transtech in Naperville, Illinois. In particular, he dislikes the need to install third-party firewalls onto a platform that’s touted for its tight integration. And resellers still question the platform’s large-enterprise capabilities, despite Microsoft’s lavishly staged Scalability Days conferences. Some resellers shy away from BackOffice and NT for critical applications, such as real-time reservation systems and terabyte-size data-warehousing projects.

But Microsoft sees these limitations and is promising changes. Even skeptical resellers believe Microsoft will correct shortcomings in BackOffice, though it may take a couple of development cycles. “We’ve seen [nondisclosure] specs for
BackOffice, and we're confident that in 18 months, problems like scalability will be moot," says Pabrai.

So how well does the current release of BackOffice serve the needs of resellers and systems integrators? BYTE spoke with resellers across the country and found them upbeat about BackOffice's business potential, if not completely enamored with the product line from a technological standpoint.

What's in It For You
For anything but the largest client/server projects, resellers see the Windows NT/BackOffice package as an attractive one-stop shopping alternative to buying different applications from different vendors and coping with integration hassles.

The complete BackOffice bundle consists of NT Server, which includes Internet Information Server (IIS); Exchange Server, for e-mail and groupware applications; SQL Server; Systems Management Server (SMS), for network administration and troubleshooting; Systems Network Architecture (SNA) Server, for IBM host connectivity; and Proxy Server, for secure Internet access for desktops. New additions are Merchant Server, for Internet/intranet electronic commerce, and Transaction Server, for managing distributed transactions. Resellers can license the full bundle or choose individual components, depending on the project.

Resellers like the tight integration among NT and the BackOffice applications, as well as with mainframe hosts. Integration makes BackOffice more than a bundle of separate applications, says Pabrai. “Because the development staffs of NT and SQL Server are in bed with each other, the SQL Server people are privy to the inner workings of NT, which isn't the case for developers for Oracle and the other databases,” he notes.

This integration pays off, especially in economics. Clueit says that a full-blown client/server implementation on Unix typically costs two to three times more than on BackOffice, primarily because RISC-based workstations and servers are so much more expensive than PCs. He also adds that while RISC-based Unix systems offer superior performance on paper, x86 power is adequate for many real-world needs. “Intel hardware is growing at a faster rate than [our customers] need,” he says.

This price difference sometimes makes up for Unix's power and scalability advantages. Clueit says his company inherited a large client/server project that was begun by another reseller, whose specification called for several hundred RISC workstations running Unix. The cost was $60,000 to $70,000 for each workstation, Clueit recalls. “We switched to NT, and now we estimate that the hardware costs will be between $15,000 and $20,000 [for each Pentium machine]. When we got down to the numbers, the customer said [the Unix proposal] was a hell of a premium to pay for features they weren't sure they needed.”

He adds that many of his customers are familiar enough with the Windows environment that training or additional staff for systems administration usually isn't necessary with BackOffice, which isn't always the case with Unix.

Clueit cautions that he's seen prices rising as the BackOffice platform matures, and while there are still significant price advantages, the gap between BackOffice and Unix is narrowing. Also, experienced resellers know when to look beyond BackOffice to give customers the right match of power and integration. For example, Clueit says SCO/Open Server and UnixWare support thousands of third-party applications, including turnkey financial and accounting programs, which are as tightly integrated as the BackOffice family and provide essentially plug-and-play convenience.

Tackling Scalability
A catalyst for the growing popularity of BackOffice applications is the growing need for scalability and NT's answer to it. "We're looking at Mips, Hewlett-Packard, Sequent systems, and they all have hardware designed for scalability," says Pabrai. "Clustered [NT] servers address the scalability issue. Several people outside of Microsoft are working on this. NT today can't run airline reservation systems, but it will in three years," Pabrai believes. Wolfpack uses a distributed lock manager and a shared-nothing approach to clustering—somewhat basic implementation that keeps servers from sharing resources unless a failover occurs.

He adds that in the projects his company has worked on, the limits of NT scalability haven't been a negative factor. "Most of our work centers around departmental servers, Web servers, print servers. The fun starts when you get beyond departmental servers. Scalability is more of a SQL Server issue than a BackOffice issue. You need to get to terabyte-size databases before you have problems." SQL Server may have some problems there.

Many resellers credit SQL Server developers with improving the relational DBMS (RDBMS) since its early days as a direct descendant of Sybase SQL Server. Because the BackOffice bundle gives end users run-time licenses for SQL Server, it becomes convenient for resellers to use that RDBMS in custom applications. But
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the price/performance advantage of SQL Server is, as Pabrai quips, "where Billy wins hands down, thanks to volume."

Pabrai estimates that a 10-client Sun/Oracle implementation with one server costs about $250,000. An NT/SQL Server project with the same number of clients comes in at only $35,000. "That's why in three years, the database wars will be over. The winners will be SQL Server [for small to midrange projects] with Oracle keeping its lock on enterprises."

Nevertheless, resellers say that Microsoft must look to what Oracle and other DBMS vendors are doing to find ways of changing SQL Server into a more powerful product. Clueit reports that the developers in his company "are less than enthralled" with SQL Server, compared to competing products from Oracle and Sybase. "Microsoft put a lot of effort into the user interface and the administrative capabilities, but some of the functional aspects of the server are not up to snuff," Clueit says.

SQL Server was slow to move beyond accommodating only page-level locking. It wasn't until its current incarnation that SQL Server supported row-level locking. As interest in data warehousing and data marts heats up, more SQL Server short-comings become obvious. Tools for creating and managing metadata have yet to blossom, and there are no native on-line analytical processing (OLAP) programs.

**Exchanging Notes**

Thanks to recent upgrades that have boosted the reliability of e-mail services, Microsoft Exchange is a "powerhouse," according to Venturi. He gives Exchange high marks for its electronic messaging, discussion, scheduling, and group-calingendar capabilities.

True, hardware requirements can be daunting in the BackOffice environment. "Exchange clients are fairly weighty," Venturi observes. "But with the Citrix technology [which Microsoft acquired last spring], we'll be able to deploy clients across an enterprise without upgrading to Pentiums. It will also be excellent for remote access."

But its integration with other systems is superb. For example, according to Venturi, Novell's GroupWise and Lotus's cc:Mail require resellers to manually import and export directories. Exchange, on the other hand, handles this task automatically. Venturi says he's currently working on a project that melds Exchange with Quickmail and is finding that he can easily import directories into Exchange. "There are a lot of legacy mail systems out there, and a lot of our work centers around integrating Exchange with the old systems," Venturi says.

**Management and Middleware**

Integration is also the key when it comes to management and connections to other types of systems.

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it's "simply more logical" than working with, say, Novell products. With support for SNMP, BackOffice provides a central display for setting up the network, adding servers and workstations, and configuring equipment. However, the platform's capabilities won't cause large-scale network administrators to turn in their HP OpenView or CA Unicenter licenses just yet. Clueit says SMS "could do with a lot of improvement. It's a pig in terms of resources."

The BackOffice platform is getting two new pieces of middleware to boost the environment's stature for large enterprises. Transaction Server essentially marries the capabilities of a transaction-processing monitor and an object request broker (ORB). Message Queue Server (MQS), code-named Falcon, is Microsoft's reworking of IBM's MQSeries, a store-and-forward message-queuing technology for getting BackOffice to operate with other platforms, such as IBM's Customer Information Control System (CICS).

The design objective of Falcon is to link network applications through a queuing system. According to Microsoft, applications send and receive information as messages that are stored and routed through a series of queues that are designed to survive system and network failure.

However, some resellers aren't convinced the technology is ready for prime time. One reseller that has beta-tested Falcon has come to the conclusion that the product "will be behind the eight ball," because it doesn't offer as many features as MQSeries.

Development Advantages

So how do you string all these pieces together? For development, especially when mixed clients are present, "only two environments are worth anything: Microsoft's and Metrowerks'," says Clueit, adding one caveat: "Microsoft started to get its tools act together only recently.... We do a lot of multiplatform development. We write MFC [Microsoft Foundation Classes] applications and run them on the Mac, and have had some problems. That was on [Visual C++] 4.0. When 5.0 came out, Microsoft decommissioned [Mac support]. That was a real disappointment, because we're actually doing more Mac development than ever before."

Although he says Visual C++ is solid, Clueit notes that developers at his company are using Metrowerks increasingly often, primarily because of its capabilities for both NT and the Mac.

Ronnie McNeill Consulting Service's namesake president says Visual Basic "is progressing along quite well" as a development environment. "But it wasn't until the third version that you could take it seriously." The company develops client/server systems for such companies as HP and Coldwell Banker using Visual Basic for client applications and BackOffice applications on the server.

He adds that the BackOffice platform hints at object orientation, but "it's not fully there." For example, McNeill says an application can inherit the interface of an object but not the object itself. NT isn't truly multithreaded in McNeill's view.

Seller's Market

Does tight integration of applications mean end users pay less for reseller and systems-integration services? No, say resellers who are working overtime to install BackOffice systems. Some savings are derived if fewer hours are needed to launch the project, but the cost of integration services is at a premium because the market is now so bullish. "We see a strong need on the services end for BackOffice, particularly for SQL Server," Pabrai says. Because of demand, resellers are finding a profitable supply-and-demand situation. "There's a shortage of people to handle demand. It's fundamental capitalism."

Alan Joch is a freelance writer and former BYTE senior editor who covers emerging technologies. You can reach him at ajoch@monad.net.
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During the 1992 election campaign, George Bush made headlines for being out of touch when he expressed astonishment at the technology used at a modern supermarket checkout counter. If he hasn’t taken advantage of retirement to do a little shopping, returning to his local grocery store might give him a heart attack. Retail technology is undergoing a startling transformation—from staffed cash-register stations to new-generation self-service checkout machines, RF price changing, and multipurpose clients. The catalyst is the widespread adoption of PC-based point-of-sale (POS) packages, long advocated by resellers and industry consultants and only recently embraced by resistant POS vendors.

This is a marked change from just one year ago, when the norm was a proprietary POS system. Even vendors that claimed to provide open systems included proprietary pieces requiring unique middleware wraps, points out Carol Simmons, a senior analyst in the Retail Automation Division of Datapro Information Service Group (Delran, NJ). The reasons for this include a cyclical wave of industry investment in technology, the booming national economy, and the growing acknowledgment of the labor-saving benefits associated with improved PC-based POS systems. Labor is near the top of the expense column in most retailers’ balance books.

The new POS systems offer increased integration as well as new capabilities, such as sales-figure consolidation and the automatic organization of disparate data. POS clients at a register record everything from individual consumer-buying patterns to the effectiveness of shelf-space allocation.

But retailers want systems that go beyond simply capturing point-of-purchase information—they want integration with back-end client/server systems (e.g., SAP’s R/3 suite and Vantive’s customer-service automation software) as well as support for their existing investment in PCs running Windows and servers running Unix or NT. They also want to increase communication between their sales force and management by providing capabilities such as e-mail at POS stations. In short, resellers are being asked to provide PC-based POS service that fits into a company’s existing IS architecture.

Four important technologies are ushering in the PC POS rev-

“POS should be just one of the functions of the corporate LAN. We have them running HR systems, payroll, and benefit enrollment in addition to POS.”

—Dave Sabre
olution: new GUIs, RF labels, adherence to client/server application APIs, and easy integration with back-office systems. In addition, a single technology, Java, currently stands poised to make the biggest difference of all by connecting a POS station to a Web-based infrastructure (and leveraging such new technologies as Web-based data warehousing), although it’s not there yet.

**The New Interface**

Most proprietary POS systems don’t share a common user interface (UI). This means that, even if a company hires a person who has experience working at a checkout, for example, it’s going to have to train that person to use a new system. But PC-based POS systems with standard UIs are changing all that. They’re enabling companies to cut training costs and even create self-shopping systems.

The leading example of a no-training-required system is the ATM machine. NCR’s DynaKey (see the photo at right) is an ATM-style POS interface that many vendors are currently using precisely because it’s so easy to learn. Says Dan Bogan, vice president of retail marketing for the NCR Retail Services Group, “We’ve combined our ATM technology and PC-based technology and then connected that to our high-performance scanners. Together it provides consumers with an interface that they’re very comfortable working with.”

DynaKey is the main competitor to Microsoft Windows, the other easy-to-learn POS interface. Both offer an intuitive, graphical interface that accommodates complex promotions and pricing structures and allows for the near-elimination of POS training.

Looking to the future, the model of an open-system ATM will be extended by even-newer technology emphasizing self-service capabilities. The vision, which is expected to be delivered sometime in late 1998, is entirely self-service check-out lanes. NCR intends to execute such a system by combining biotic scanners and self-checkout software with a video-based security system.

**Supermarket Frequencies**

Another technology that is more easily integrated into the PC architecture than it is into legacy systems is RF pricing labels. This market is shared mainly by four vendors: ERS (Wilton, CT), NCR, Sweden-based Pricer, and TelePanel (Toronto, Ontario, Canada).

Retailers use RF to electronically update shelf labels, replacing the familiar paper shelf tags and eliminating the need for store employees to walk through the store aisles with infrared readers to note price changes. Instead, new prices are transmitted from antennas located at the ceiling of the store. To avoid confusion, several neighboring stores all implement RF, each store gets its own signal. The systems are surprisingly simple because they often are available as prepackaged products.

RF is credited with increasing price-tag accuracy while accelerating the response time for stores that are eager to react to their competitors’ sudden promotions or price hikes. RF is a proven technology that has actually been available for some time, but demand remained sluggish at first as a result of the dominance of proprietary systems and regulatory prohibitions that relegated RF to stores in only a few states.

During the past year, CB Consultants, a company that specializes in RF technologies, has seen the use of RF expand in tandem with the rise of PC-based POS. “Stores are seeing RF as a way to change prices whenever they want, either from the PC in the back room or from the warehouse,” explains George Gilfoil, president of CB Consultants.

Likewise, the rise in popularity of back-office client/server applications, such as supply-chain software from Manugistics, has led resellers and system integrators to use PC-based POS systems that offer more seamless integration between RF and PC-based POS. Resellers might develop software to transmit data retrieved from single-use POS devices into distributed databases, but it’s a strictly one-way exchange, according to Dave Sabre, regional partner of the western region for consumer markets at KPMG Peat Marwick. Non-PC POS devices are designed to send data to the back-end database, where the information is crunched by online analytical processing (OLAP) systems, such as Arbor Software’s Essbase, into useful, compacted sales figures.

**Connecting the Back Office**

But in the new PC-based POS systems, information is like a two-way street; it runs both to and from the executive suite. By returning processed information back to the store manager, employees at the cash register are empowered to make use of sales and pricing data on their own.

“POS should be just one of the functions of the corporate LAN,” explains Sabre. “We have them running HR systems, payroll, and benefit enrollment in addition to POS. The expansion of the features of POS on the PC is what gives
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The hypercompetitive restaurant industry is one of the first businesses that has embraced advanced POS; Restaurant Consulting Services (RCS) is at the forefront of this advance. RCS looks for features that enable it to add to client functionality, integrate with client/server systems, and incorporate the latest in data-retrieval and data-disbursement technologies.

RCS emphasized all these qualities during its system-implementation projects for Unique Casual Restaurant, the company behind the Fuddruckers and Champs Americana chains of restaurants. The 150-restaurant Fuddruckers chain was looking for a system that gave company managers timely access to POS information so that they could change guesstwork into informed decision-making.

RCS offered two systems for review. One was based on IberTech software running on IBM equipment with infrared touchscreens. The other ran on an NCR system with 7440 POS terminals and MicroTouch capacitive touchscreens; it had POS, cash management, navigation, and labor software modules from Compris Technologies. From these pilots, RCS and Unique Casual Restaurant selected the NCR/Compris combination because it offered a significantly better level of detail, especially in the area of inventory management, and a clearer graphical presentation. "We take the POS information and use it to populate the Oracle Financials applications that we have in the back office," explains Ted Mountzuris, CEO of RCS.

"When I can use PC standards, I can control costs much better." —Ted Mountzuris

"There's a lot of interest right now in the thin client and its impact on point of sales," says Tracy Flynn, vice president for the food-industry-marketing group at NCR Retail Services Group. He points to several expensive qualities of the PC that aren't required for traditional POS, such as access to a disk drive, and then points resellers to the future potential of the network computer or NetPC as excellent alternatives.

"Initially, we won't see these kinds of standards applied to POS; it's still 12 to 18 months out," he predicts. "However, in some markets, such as the hospitality industry, you'll see it sooner because they have fewer peripherals with which to contend."

By turning to PC-based systems for POS solutions, resellers are betting they will find gold in industry-standard PC development environments, such as Visual Basic and Java. Even though some POS vendors are currently working on designing Java interfaces for devices, the technology isn't yet available.

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Unified messaging systems bring together voice, fax, e-mail, and paging for less than ever. By Ilan Greenberg

The Universal Inbox

Unified messaging systems, which provide an interconnected system for everything from e-mail and voice mail to faxes, have obvious benefits for end users—especially for workers who prefer a single inbox.

A slew of new, increasingly sophisticated unified messaging packages has recently become available, each offering a slightly different road toward a universal communication destination. While certain trends are emerging, such as a predominance of support for Windows NT as a server OS platform, other requirements, such as type of mail system supported or telephony standard employed, are more varied. Choosing a unified messaging system calls for considering whether the software package is compatible with the network architecture an office environment already has in place (different solutions support a wide variety of file formats, for example). Cost is another factor, with prices ranging from a low monthly subscription to turnkey solutions running upwards of $40,000.

Look for technologies that combine the best of integrated inbox and real-time communication capabilities, such as a pop-up screen that provides relevant information when your phone rings, advises Brian Curran, product manager at Coresoft (Orem, UT). “In the whole unified messaging field we need to focus more on messaging and less on the concept of inbox. We still live in a real-time world, and messaging should be secondary. Products generally do one or the other, but there are a lot of benefits to doing both,” he says.

There’s no shortage of providers in the unified messaging system market (as the product listing on the following pages shows). Industry observers say this is bound to change as vendors consolidate. This is already proving true at the high end of the market, as exemplified by the recent acquisition of the leading voice application maker, Octel, by Lucent Technologies.

Standardization will probably become the biggest issue for unified messaging systems. Many products are not yet compliant with the Windows telephony API standard, TAPI, but TAPI is going to become more and more prevalent. Another criterion, says Michael Stanford, chairman of Algo Communications, is network integration. Also keep in mind the potential of a messaging system to scale up to new technologies. continued
# Messaging Products

<table>
<thead>
<tr>
<th>Product</th>
<th>Basic Features</th>
<th>Server OS</th>
<th>Access Method</th>
<th>Text-to-Speech</th>
<th>Pager Interface</th>
<th>Price</th>
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<tbody>
<tr>
<td><strong>Axxess</strong></td>
<td>Voice mail, e-mail, fax server, automated attendant</td>
<td></td>
<td>PC</td>
<td></td>
<td>✓</td>
<td>$75–$150/user</td>
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<td>800-669-6858</td>
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<td><strong>CallWare family</strong></td>
<td>Voice mail, e-mail integration, fax, automated attendant</td>
<td>NetWare</td>
<td>PC, telephone, Web browser</td>
<td>✓</td>
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<td>$4895 (10 users)</td>
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<td><strong>David</strong></td>
<td>Voice mail, e-mail, fax, Web server, interactive voice response, instant Web publishing</td>
<td>Windows NT, NetWare</td>
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<td>✓</td>
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<td><strong>GroupWise</strong></td>
<td>Voice mail, e-mail, Web server, contact manager, document management</td>
<td>NetWare, Windows NT, Unix, IntranetWare</td>
<td>PC, telephone, Web browser</td>
<td>✓</td>
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<td><strong>Hello!NT</strong></td>
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<td>PC, telephone, fax, Web browser</td>
<td>✓</td>
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<tr>
<td><strong>Intuity Audix Multimedia Messaging System</strong></td>
<td>Voice, e-mail, fax server (adding Web server in 1998), automated attendant, contact manager</td>
<td>SCO UnixWare</td>
<td>PC, telephone, Web browser</td>
<td>✓</td>
<td>✓</td>
<td>$15,000+</td>
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<td>908-959-2716</td>
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<td><a href="http://www.lucent.com">http://www.lucent.com</a></td>
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*Note: N/A = not applicable*
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<th>Pager Interface</th>
<th>Price</th>
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<tr>
<td>IPost Universal Box/ Courier</td>
<td>Voice mail, e-mail, fax server, Web browser</td>
<td>Windows NT</td>
<td>PC, telephone, Web browser</td>
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<td>IRDG, Inc.</td>
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<td>888-476-7893</td>
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<td>MediaMail</td>
<td>Voice mail, e-mail, fax, Web browser</td>
<td>Windows NT</td>
<td>PC, telephone, fax, Web browser, POP 3 e-mail client</td>
<td>✔️ ✔️</td>
<td>$6900+</td>
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<td>Telinet Technologies LLC</td>
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<td>MVX-2000 S</td>
<td>Voice, e-mail, fax, automated attendant, Web browser</td>
<td>Windows NT, Windows 95</td>
<td>PC, telephone</td>
<td>✔️</td>
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<td>Macrovoice Corp.</td>
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<td>800-622-7689</td>
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<td><a href="http://www.macrovoice.com">http://www.macrovoice.com</a></td>
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<td>NeTrueLink</td>
<td>Voice mail, e-mail, fax server, Web server</td>
<td>Windows NT</td>
<td>PC, telephone, Web browser, fax</td>
<td>✔️</td>
<td>$7800 (4-port unit)</td>
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<td>NeTrue Communications</td>
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<td>714-870-0861</td>
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<td>PremisMail</td>
<td>Voice mail, fax, Web browser</td>
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<td>Unified Messaging</td>
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<td>Repartee</td>
<td>Voice mail, e-mail, fax server, automated attendant, contact manager</td>
<td>OS/2</td>
<td>PC, telephone, Web browser</td>
<td>✔️</td>
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<td>Active Voice Corp.</td>
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<td>Telephony OneStop</td>
<td>Voice mail, e-mail, fax</td>
<td>Windows NT, OS/2, Notes</td>
<td>PC, telephone, Web browser</td>
<td>✔️</td>
<td>$50/user</td>
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<td>Lotus Development Corp.</td>
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<td>Unified MailCall for Lotus Notes</td>
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<td>PC, telephone, fax, Web browser</td>
<td>✔️</td>
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<td>Work Group Attendant</td>
<td>Voice mail, e-mail integration, fax server, automated attendant</td>
<td>Windows NT</td>
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<td>✔️</td>
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- EDO SO DIMM memory up to 128 MB
- PCI Bus with 3D graphic engine and 4MB video RAM
- Built-in 20X CD-ROM or DVD option

The Most Popular "Maestro T"
- Pentium 130/166/200 with MMX technology
- 12.1" SVGA TFT or 12.1" SVGA DSTN color
- Built-in 20X(Max.) CD-ROM module, 2.1 / 3.2 GB HDD and internal FDD
- 16 bit audio system with two stereo speakers and microphone
- Two PCMCIA type II slots with Zoomed Video and Card Bus support
- Internal 56Kbps data / voice / fax modem
- Fast IrDA infrared port and USB support

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26 No-Compromise Power Portables

Picture this: You're 33,000 feet above sea level, packed in your seat tighter than the stuffing in a Thanksgiving turkey. On either side of you are irritable passengers who fight you for the arm rest. Indeed, traveling thousands of miles cross-country is no easy trek. A turbulence-free flight makes it bearable. A high-powered laptop souped up with a 13.3-inch screen, Pentium MMX processor, 20x CD-ROM drive, and 6-hour battery life can make the trip a delight.

Road Rules
True road mavens won't leave home without their trusty laptop. What's more, many people are replacing their aging desktop computers with portable versions with as many bells and whistles. Now, the newest-generation notebooks, powered by Pentium 166-MHz and 200- or 233-MHz "Tillamook" processors, are more capable than their predecessors of becoming true desktop replacements.

We judged 26 portables that hit both ends of the price spectrum, ranging from $2600 to $5700. All employ 166-, 200-, or 233-MHz CPUs. We tested a good sampling of what's currently shipping and chose to focus on 166-MHz nonbeta models with stable drivers. For this roundup, we sought systems that have 166-MHz processors or better, 1 MB or more of video RAM, 32 MB of memory, 2.1-GB hard disk minimum, a maximum of 512 KB of L2 cache, and two batteries. (Reference manuals and user guides were also judged, and they contributed to each system's usability score.) You'll notice a few systems reviewed here don't exactly match that feature list; we wanted to make sure that the most useful configurations were tested, and we note variations where necessary.

Unfortunately, some vendors introduced systems too late for testing, and others fell out for various reasons. We had already reviewed a beta version of the new ThinkPad 770 from IBM (see "The Best ThinkPad Gets Better," October BYTE) . The first PC notebook (called the PowerTrip) from former Macintosh clone maker Power Computing was not ready for review in time to meet our deadline. Fujitsu, Nimantics, and Samsung also missed our testing deadline.

What's Hot, What's Not
Evolving trends in laptop design aren't hard to spot. Support for Zoomed Video and CardBus are common. We also saw some support for MPEG hardware acceleration for playing full-screen video smoothly at 30 frames per second. And designers continue to improve placement of device bays.

Integrated modems are becoming a standard for high-end notebooks. Additionally, integrated Universal Serial Bus (USB) ports showed up on nearly all the machines we tested. A few systems, like Micron's, include both trackpoint and touchpad pointing devices. Function keys provide access to configuration tools for each pointing device.

A handful of computers we tested had 13.3-inch screens. These could display full-screen, full-motion video. Many of the remaining laptops sported 12.1-inch screens. More than half the laptops in our tests have a maximum internal resolution of 800 by 600. But vendors like Gateway, Micron, Hewlett-Packard, Hitachi, Sony, Sharp, and a few others provided screens that support 1024 by 768 pixels. The Gateway 9100XL supports 1280 by 1024 maximum internal resolution.

In addition to better screen resolutions, other breakthroughs are apparent. A few vendors, like Dell, Micron, Gateway, AMS Tech, Sceptre, WinBook, Eurocom, and Micro International, include huge hard disks with 3 GB of space. On the CD-ROM front, Micron broke new ground by sending in a system with a 20x CD-ROM drive.

233 MHz: Built for Speed
Mobile MMX CPUs running at 200 and 233 MHz, in addition to the existing 166-MHz CPUs, are available in a variety of configurations. The mobile module,
DISPLAY
Screen size: 12.1-inch SVGA or XGA TFT is common. Look for 13.3-inch XGA TFT screens, just now beginning to appear on the market; 14-inch active matrix displays will arrive in the near future.

AUDIO SPEAKER/MICROPHONE
Every multimedia notebook should have integrated stereo speakers that support 16-bit stereo sound. Add a 3-D spatializer and support for surround-sound and wave-table sound are viable. A microphone and stereo line in/out jacks are also a must for today’s multimedia laptops.

INTERNAL BATTERY
Lithium ion batteries are the most widely used in high-performance laptops; they work well for units with lots of components. You should ideally purchase a second battery for cross-country travel. Nickel metal hydride batteries are common among low-end laptops. In the near future, look for lithium polymer batteries, which contain lithium instead of cobalt in the cathode.

PROCESSOR
Many systems are powered by a 166-MHz Pentium with MMX processor. Look for 233-MHz processors in Tillamook-powered systems.

CHIP SET
Intel’s PCI Mobile 430TX is common for 166-MHz MMX systems and Tillamook systems.

STORAGE
You’ll want the largest-capacity hard disk available. Some models have 3-GB removable hard drives, though some systems still come with 2-GB and 1.6-GB drives. Drives that can hold a massive 5 GB are just around the corner.

POINTING DEVICE
Both touchpads and pointing sticks are common among laptops, with trackballs nearly obsolete. Most laptops have one or the other; a few (like the Micron shown in the illustration) have both.

BACK VIEW
USB, high-speed infrared (one on front, one on back), parallel, serial, VGA, PS/2 (one for external keyboard, one for mouse), game/MIDI port, cellular port, modem port, NTSC and S-video ports.

INTEGRATED PORTS
These accommodate increasingly powerful components, such as high-resolution color displays, 20x CD-ROM drives, 56K modems, and high-capacity disk drives.

As components become increasingly more powerful, the need for longer battery life continues. The 166-MHz systems currently operate at 2.45 volts. Tillamook laptops operate at a core voltage of 1.8. Yet the next generation of laptop components, including 24x CD-ROM drives and 14-inch displays, may negate any reduction of power and heat.

Six of the 26 systems have 200-MHz (or faster) processors. Because these were early prototype or beta units, we chose not to declare one a winner. There are three 200-MHz MMX CPUs in this roundup, from Chem USA, AMS Tech, and MicroExpress. Sceptre, Micro International, and Eurocom were able to send us 233-MHz systems for evaluation.

Contributors
Steve Platt and Andy Froning, Managing Editors/NSTL
Dorothy Hudson, Project Manager/NSTL
Jeff Hudson, Tester/NSTL
Maryanne Eves, Acquisitions Editor/NSTL
Linda Higgins, Editorial Associate/BYTE
Michelle Campanale, Technical Editor/BYTE

Illustration based on the Micron TransPort XKE.

which integrates the Pentium CPU with MMX technology, a portion of Intel’s 430TX chip set, and the pipeline burst static RAM L2 cache, powers many of the machines tested. Systems based on Intel’s P55C processor can reach speeds of up to 166-MHz only. With Tillamook processors, laptops now reach 200 and 233 MHz.

The first to utilize a 0.25-micron manufacturing process, Intel’s Tillamook processors are expected to enhance chip performance 20 percent over their 166-MHz counterparts. In addition, they are expected to consume 40 percent less power than previous high-end mobile processors. Lower battery consumption can
We chose the Micron TransPort XKE as the overall winner. It was the performance leader among all the 166-MHz systems we tested. Though it is pricey (it is the third most expensive among the 166-MHz crop), the Micron's superior usability and excellent collection of features more than compensate.

Micron does not skimp on components. The unit includes a 13.3-inch XGA-compatible active matrix display and modular bays for holding either a CD-ROM drive or a floppy drive. The conveniently placed device bay is in the front of the system, beneath the keyboard. Additionally, it has Zoomed Video and CardBus support, a built-in 33.6-Kbps modem, and 20x CD-ROM drive. The TransPort has excellent battery life and two pointing devices (touchpad and stick). It's heavy, however, weighing 7.2 pounds with battery and floppy drive.

Best Value

First place for Best Value notebook goes to the 166-MHz Gateway Solo 2300SE. It has the best price of all systems reviewed. The Gateway's strong performance score bested that of all the 166-MHz systems tested except for the higher-end Micron TransPort XKE and the Gateway 2000 Solo 9100XL. In addition, its usability is better than average.

The unit has a 12.1-inch screen that supports 800 by 600 resolution. Its PC Card connection supports Zoomed Video. And it can house up to 192 MB of memory in three SO-DIMM sockets.

Battery Rundown

WinBook EX p166 MMX
Howlett-Packard OmniBook 6700 Ctx
Eurocom 7200
Dell Latitude Xplod CD M166ST
MlcroExpress NP 7200 MMX
Acer/TI TravelMate 7060
NEC Versa 6000
Sharp PC-9800 C1
CTX ExBook EZT64MT
Toshiba Satellite Pro 460 CDT
Sceptre Soundx 5500
Compaq Armada 7730 MT
Mlcron TransPort XKE
Gateway 2000 Solo 2300SE
Gateway Solo 9100XL

Not all batteries are born to run. Many of the laptops in our tests averaged around 3 hours of juice, but there were exceptions. Tillamook processors, though expected to score well on battery life, actually scored significantly lower. However, this is likely due to power-eating features like 4-MB graphics cards, 24x CD-ROM drives, and other hungry components.

A Scattered Mix

Eight vendors sent us speedy machines in either 200-MHz Pentium MMX or 233-MHz Tillamook configurations. Those vendors who sent in 233-MHz machines were Sceptre, Micro International, Eurocom, Toshiba, and NEC. The 200-MHz systems were sent in by MicroExpress, Chem USA, and AMS. The performance results were a scattered mix, to say the least. Some of these 200- and 233-MHz systems even scored lower than many of the 166-MHz systems tested. As a result, we did not pick a winner for this category.

The Sceptre Soundx 5500's performance score led the way; note, though, that it beat the top-performing 166-MHz by a mere 3 percent. However, new drivers will surely improve these higher-speed PCs in the months to come.
# Best Overall

**Micron TransPort XKE**

Micron’s TransPort XKE bested all rivals in the 166-MHz crop. Though it’s pricey (the third most expensive, behind the Gateway 9100 and the HP OmniBook), its extremely strong features and usability deliver the goods. Its 13.3-inch XGA screen supports 1024 by 768 resolution. On the high end of the battery life spectrum (4:72), it will accommodate a typical cross-country plane ride.

<table>
<thead>
<tr>
<th>Machine</th>
<th>Price</th>
<th>Technology</th>
<th>Price</th>
<th>Performance</th>
<th>Features</th>
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# Best Value

**Gateway 2000 Solo 2300SE**

Hands-down, the Gateway Solo 2300SE is our low-cost winner. It scored exceptionally well in our performance tests, and its good usability and nice price make it the top choice for price/performance value. Additionally, its battery life spans 3:21 hours.

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Size Matters

Sony steers clear of shoulder-straining hell with its first laptop on the market, the thin and light PCG-705C. Skinny but not weak, it weighs 5.3 pounds and measures 1.5 inches thick. It sports a 166-MHz MMX processor, a 2.1-GB hard drive, and a removable 14x CD-ROM drive that can be replaced with a floppy disk drive or a second battery.

Nice Touches

Compaq's Armada MT is the Martha Stewart of laptop computers. None of the fine details have been overlooked in its design, including programmable function keys and an indicator light right on the battery.

Tests Yield Few Surprises

Battery Life Blues
Battery life and power consumption are a hot issue concerning today's laptops. Though the 166-MHz systems led the way in terms of battery life, the 200- and 233-MHz laptops fell short of expectations. Keep in mind that factors such as screen lighting, hard disk, and memory strongly affect battery life. For example, something as simple as taking out half of your RAM can add 20 percent or more battery life. Sacrificing powerful components for longer battery life, however, may not be an option for those who need a laptop that can double as a desktop.

The Performance Predicament
Performance among the 166-, 200-, and 233-MHz machines varied widely in our tests. However, some general trends did surface from the benchmark results:

- Stable drivers play an important factor in a system's overall performance.
- Systems with faster processors tend to be faster, but in some cases, the difference is a very small margin.
- Systems with write-back cache tend to be faster.
- Systems with 512-KB cache tend to be faster.
- Unsurprisingly, 233-MHz machines are typically faster than 200-MHz machines.

"Tend to be" means "in general"; there are lots of counterexamples. Some systems are better designed than others. If we factor out the lower-performing Eurocom 7200 and Micro International 7200/mint from our tests, the 200-MHz and 233-MHz machines score fairly well.

MMX Performance

Average MMX scores (scaled 1-10) compared by CPU speed.

Graphics Diva

Less eyestrain is a good thing. Gateway kept this in mind when designing the Solo 9100XL, which has 4 MB of video memory and a 13.3-inch screen capable of 1024 by 768 resolution. Like a few others we tested, it uses a high-performing 128-bit graphics accelerator.
We picked the best portables based on their usability, features, performance, technology, and price, all on a scale of five stars. We rated the MMX notebooks by testing performance with a suite of application-based benchmarks (including Word, Excel and Access) and Intermark video-component benchmarks. We tested these elements separately and then formulated an overall score by assigning a weight to each element. The Overall category score is weighted 60 percent for performance, 20 percent for features, 10 percent for usability, and 10 percent for price.

We derived the performance rating by averaging the results from our performance tests. First, we measured the system's performance during a series of MMX tests. The second test consisted of a software-based battery test, a Windows application that records the power status of a system once every minute.

Features

To determine features scores, we measured each unit's capabilities in a few key areas. Each vendor completes a lengthy questionnaire providing a detailed description of its system's features and support options. NSTL then weighs certain features and calculates an overall score. The features chart lists the speed of the processor and availability of secondary cache, the display technology used, and maximum internal resolution. Other features items we weigh for the overall score include I/O ports, graphics and sound systems, fax/modem communications, and power supplies.

Warranty and support policies are what frequently separate major system manufacturers from second- and third-tier vendors. The length of the standard warranty is one of a system's most important features. We also look for the availability of on-site service, on-line support, and a toll-free help line.

Usability

For usability, we focus on two key areas: system design and documentation. We paid close attention to the quality of each keyboard, concentrating on keyboard placement. If a system offers a comfortable typing position, we award it extra points. Additionally, we rate the ease of use and placement of pointing devices. Top honors were given to systems with recognizable status indicators for low battery and hard disk access. We rate the manuals for their organization, diagrams, and index. Finally, we determine how easy it is to install batteries and upgrade system RAM.

Performance

For our performance tests, we use NSTL's applications-based suite, which consists of Microsoft Word, Excel, and Access. These tests portray real-world situations by running macros that execute common functions. For example, the Excel test measures the time it takes to delete a variety of cell ranges and calculate various addition, financial, and statistical functions. The Word benchmark includes subtests that measure search-and-replace functions, changing fonts, scrolling by page and line, checking spelling, print-previewing, and printing to a file. In addition, NSTL's Intermark subsystem-level Windows tests exercise the video/graphics subsystems.

Since these systems use MMX processors, our tests measure multimedia performance. An MMX test, provided by Intel, puts the systems through a gauntlet of multimedia tasks. The automated test suite includes some photo editing with Adobe Photo Deluxe, an Intel multimedia video clip, an MPEG-1 video file, a Direct 3D game, and business photo manipulation with Adobe Photoshop. These are all common tasks that MMX technology is designed to enhance.

Our battery check consists of power consumption and battery-drain tests that are executed by Power Monitor, a simple Windows application that records the power status of a fully charged battery. Status is recorded until the system suspends itself due to low battery power.
<table>
<thead>
<tr>
<th>Vendor</th>
<th>Model</th>
<th>Price (MSRP)</th>
<th>Overall Rating</th>
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<th>Fax/Modem</th>
<th>CD-ROM Drive</th>
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**BYTE Best**

- ✔ = yes;
- N/A = not applicable.

**Warranty:** P = parts; L = labor;
- F = freight to repair center; R = return to customer.

- **** Outstanding
- **** Very Good
- *** Good
- ** Fair
- * Poor
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<th>DISPLAY</th>
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Have you ever tried to have a private conversation in a public place? It's not easy. Have you ever listened in, inadvertently or intentionally, to someone else's private conversation? If so, you'll understand the increasing popularity of virtual private networks (VPNs).

The Internet offers a great way to communicate, but it's not very good for transmitting secrets. You never know who's listening, and a well-placed packet sniffer can compromise your confidential communications.

VPNs eliminate the hazards of conducting private conversations in public networks by making your communications intelligible only to the person with whom you want to communicate. VPNS encrypt IP datagrams, use strong authentication before allowing communication, and check data integrity to assure packets arrive at their destination unchanged.

Organizations implementing VPNS leverage their relatively inexpensive Internet connections to build virtual WANs with secured access for off-site employees, remote offices and business partners. VPNS reduce the costs of building and maintaining internal dial-up infrastructures or more expensive point-to-point WAN links.

The VPN Puzzle
VPNS enabled devices typically fit in at the network perimeter. These devices might link the network to individuals in a client-to-LAN configuration, effectively extending the internal network out to the remote user, or they might connect to another VPNS enabled device, thereby creating a virtual, encrypted point-to-point link between two separate networks.

LAN-to-LAN VPNS hide functions like data encryption from end users. The devices on the LAN at the remote end of the VPN link appear to be part of the corporate network. The VPN operates entirely transparently to the user. Client-to-client VPNS, on the other hand, employ software (on a workstation) that intercepts all network traffic destined for a VPN-linked host and adds the necessary encryption elements. End users communicate securely with hosts running compatible VPNS software without affecting access to non-VPN hosts.

A VPNS requires three functions: encryption, authentication, and data integrity. Typically each VPNS node uses a secret session key and an agreed upon encryption algorithm to encode and decode session data, exchanging session keys at the start of each link using public key encryption. VPNS nodes also must confirm that the entity at the other end of the connection is who they say they are. Most VPNS use public key authentication methods to validate each end of the connection; some may additionally require the end user to supply an account name and password. Finally, both endpoints of a VPN link check data integrity, usually using a cryptographic hash or digest function such as Message Digest 5 (MD5) or Secure Hash Algorithm 1 (SHA-1). MD5 is a public-domain standard for generating 128-bit cryptographic checksums. SHA-1 is a hashing function for generating 160-bit cryptographic checksums. Developed as part of the Digital Signature Standard (DSS) by the U.S. Department of Commerce and the National Institute of Standards and Technology, SHA-1 performs an advanced form of a checksum on all data received.

Testing
For this report, we selected 10 VPN products. They reflect three different approaches to VPN implementation. In addition to four stand-alone VPN products, we tested four firewall servers with VPNS features and two packages that integrate VPNS functions into network and operating system-level products.

Most of the products combine a variety of encryption methods, algorithms, and key lengths, so developing a consistent testing methodology that could produce meaningful results was impossible. I tested for overall security, ease of use, manageability, and interoperability, with particular attention to individual security elements, such as supported encryption schemes, key length, authentication methods, and data integrity support.

Aventail currently offers the best combination of supported standards, management features, and ease of use. Impressively versatile, it makes creative use of the SOCKS protocol (frequently...
You can view tunnel definitions and activity through AltaVista's Tunnel Manager administration utility.

The Aventail Administration Tool provides modular support for a wide variety of authentication and encryption options.

A Java-capable Web browser is all you need to configure a VPN with Secure Computing's BorderWare firewall server.

Check Point's FireWall-1 can encrypt on a protocol-by-protocol basis and supports multiple encryption methods.

Data Fellows' F-Secure Virtual Private Network includes a handy graphical VPN creation utility.

To configure a VPN connection with FTP Software's Secure Client, just add the IP address of the remote host along with basic encryption information.

Trusted Information Systems' Gauntlet 4.0 supports trusted, private, and pass-through VPN services through its Java-based administration tool.

While their operation is mostly transparent, VPNs all need configuration and administration interfaces.

used by proxy firewalls) as its primary VPN mechanism. Two other products rank highly: Check Point's FireWall-1 and Raptor Systems' Eagle NT. Both add an extra level of security by integrating VPN features with firewall functionality, so you can provide varying levels of controlled access to VPN users once they've been authenticated.

Vendors define the term "VPN" very broadly; each product reviewed here offers some kind of VPN functionality, but each implementation is also unique. Almost every product solves at least one problem better than the others. For example, Data Fellows' F-Secure Virtual Private Network 1.1 works for multinational organizations looking for the highest encryption options available to connect multiple networks, while products like FTP Software's Secure Client and Sun Microsystems' SunScreen SKIP shine at client-to-client communications. Firewall-based products, like FireWall-1, Eagle NT, and BorderWare, help corporations that must combine VPN versatility with the security of a firewall.

The VPN product category is still in its early stages. Only five of the products would interoperate for me: the firewalls, FireWall-1, BorderWare, and Eagle NT, and two clients, FTP Secure Client and SunScreen SKIP. Properly configuring them to work together is not for the faint of heart. As protocols such as the IPSec family become officially standardized, and as VPN vendors implement them, expect true interoperability to become a core feature of all VPN software. For now, plan to stick with a single vendor to ensure VPN compatibility—organizations planning to establish VPNs with business partners must choose carefully.

AltaVista Tunnel 97

AltaVista Tunnel 97, a dedicated VPN, supports tunneled LAN-to-LAN (available through the Workgroup edition) or client-to-LAN (with the Personal Edition) connections. Managing keys with the included Tunnel Manager application is more...
## VPN Architecture Features

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<th>Feature</th>
<th>AltaVista Tunnel 97</th>
<th>Avontail VNP 2.5</th>
<th>Check Point FireWall-1 3.0a</th>
<th>Data Fellows F-Secure Virtual Private Network 1.1</th>
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<td>Diffie-Hellman</td>
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<td>✔</td>
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<td>MD4</td>
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<td>SHA-1</td>
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<tr>
<td>Full strength available for unlimited export</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td></td>
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</tr>
<tr>
<td>Supports automatic key exchange during session</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
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<tr>
<td>Does it support encryption on a service-by-service basis?</td>
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<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Management and Administration</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Manage access levels by group</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
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<tr>
<td>SNMP-manageable</td>
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<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td></td>
<td></td>
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<tr>
<td>Remote manage via HTTP</td>
<td></td>
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<tr>
<td>Remote manage via Java</td>
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<td>✔</td>
<td>✔</td>
<td>✔</td>
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<tr>
<td>Remote manage via other</td>
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<td>Directory support for LDAP</td>
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<td>Directory support for NDS</td>
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<tr>
<td>Other directory support</td>
<td>A</td>
<td>B</td>
<td>A</td>
<td>A</td>
<td>B</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Includes client software</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td></td>
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<td>Client/server support:</td>
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<td>Windows 3.x</td>
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<tr>
<td>Authentication Features</td>
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<tr>
<td>CHAP/PAP</td>
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<td>✔</td>
<td>✔</td>
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<tr>
<td>RSA</td>
<td>✔</td>
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<td>✔</td>
<td>✔</td>
<td></td>
<td></td>
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<tr>
<td>RADIUS</td>
<td>✔</td>
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<td>✔</td>
<td>✔</td>
<td>✔</td>
<td></td>
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<tr>
<td>S/Key</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
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<td>SecurID</td>
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<td>✔</td>
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<tr>
<td>SSL</td>
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<td>✔</td>
<td>✔</td>
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<td></td>
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<tr>
<td>Does it support filters?</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Is user authenticated by IP address?</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td></td>
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</tbody>
</table>

A = NT Domain directory support  B = directory file import support  C = client support  S = server support

**BYTE Best** ✔ = Yes
intuitive than with many of the other products reviewed, and the ability to control how much of the internal network to make available to VPN users is a very useful feature. A setup wizard and well-organized administrator’s guide simplify installation, but compared to the other products reviewed, Tunnel’s narrower encryption support and less flexible implementation reduce its appeal. Tunnel 97 is a good product hobbled by relatively limited capabilities and feature set.

**Aventail VPN 2.5**

Aventail has taken a different approach to creating a VPN product, and the results seem unusual at first. Aventail impressed me with its flexibility, extensive support for encryption methods, and array of authentication options. Unlike other VPN products that tunnel encrypted packets, Aventail implemented a reverse SOCKS proxy gateway to provide VPN capabilities and encryption functions at the session layer. Encryption and authentication can be controlled on a service-by-service level, and additional filters can be employed to limit user access or protect them from potentially hostile Java code or ActiveX components.

Authentication and encryption methods are implemented as software modules, so adding new standards as they evolve should be as easy as installing a new module. Administrators can exercise as much (or as little) control as they want over their VPN users. With its multiple authentication and subauthentication options, and multiple platform support for both servers and clients, Aventail is extremely versatile.

**Check Point FireWall-1 3.0a**

Check Point extends FireWall-1, one of the most popular firewall servers on the market, to include support for both LAN-to-LAN and client-to-LAN VPNs. Similar to Eagle NT, FireWall-1 lets administrators create VPN connections with unrestricted network protocol access, or they can create VPNs with an extra level of security by enabling the firewall to restrict or permit certain types of traffic. Adding traffic restrictions on VPN links, limiting the type of application that can be run, makes sense when connecting to business partners.

Configuring a FireWall-1 VPN is complicated, but it is also much more flexible than most and supports a wider variety of encryption and authentication options. For organizations that already use FireWall-1 as their firewall server, adding VPN functionality is a no-brainer.

**Data Fellows F-Secure Virtual Private Network 1.1**

Developed in Finland, F-Secure VPN boasts freedom from any export restrictions, which means that international organizations are free to implement a full-strength version at all their locations. Its graphical VPN configuration design utility let me create our VPN definition with drag-and-drop simplicity. However, F-Secure supports only LAN-to-LAN VPNs, and each endpoint network requires a dedicated VPN server, based on a stripped-down NetBSD kernel with limited hardware support. Undocumented configuration parameters that were needed to get the software to work with our 3Com network cards hampered installation.

**FTP Software Secure Client 3.0**

FTP’s Secure Client offers VPN functionality as a component of a full-featured Windows 95 TCP/IP client implementation, unlike the other VPNs. Secure Client replaces Microsoft’s IP stack and supports both IPSec and SOCKS security. Its ability to interoperate with other VPN products is impressive, as is its client-to-client communication encryption function. However, with security features limited to client communications, Secure Client scores poorly compared to products offering both client and LAN VPN capabilities. As a stand-alone product, Secure Client might not meet all your VPN needs, but it could fit in nicely if used with other products.

**Trusted Information Systems Gauntlet 4.0**

Gauntlet 4.0, from Trusted Information Systems, also incorporates VPN functions into an existing firewall framework, supporting three types of VPN configurations: private, trusted, and pass-through. Private links provide secure communications, with the added safeguard of forcing all communications to be evaluated by the firewall rules. Trusted links provide full, unlimited access between VPN sites. Pass-through mode lets you implement a third-party VPN product in addition to Gauntlet. You configure Gauntlet at the server console or through a Java-based management applet.

Gauntlet 4.0’s extensive support for different authentication modes provides a
Aventail's extensive VPN features give it an edge over some close competition.

### BEST OVERALL

**Aventail VPN 2.5**

Aventail's extensive VPN features give it an edge over some close competition.

### TECHNOLOGY VPN FEATURES IMPLEMENTATION EASE OF USE OVERALL RATING

<table>
<thead>
<tr>
<th>Software</th>
<th>VRAPTE MODEL</th>
<th>VRAPTE FEATURES</th>
<th>IMPLEMENTATION</th>
<th>EASE OF USE</th>
<th>OVERALL RATING</th>
</tr>
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<tbody>
<tr>
<td>Aventail VPN 2.5</td>
<td>****</td>
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<td>****</td>
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<tr>
<td>Check Point FireWall-1 3.0a</td>
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<td>****</td>
<td>****</td>
<td>****</td>
</tr>
<tr>
<td>Microsoft Routing and Remote Access Service</td>
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<td>****</td>
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<tr>
<td>Raptor Systems Eagle NT 4.0</td>
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<td>****</td>
<td>****</td>
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<tr>
<td>AltaVista Tunnel 97</td>
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</table>

**Raptor Eagle NT 4.0**

Raptor's Eagle NT firewall/VPN combo scored well thanks to its support for multiple encryption and authentication schemes, as well as its ability to selectively control access to internal resources through the firewall access rules. I was also secondary level of security. In a private VPN scenario, users can first authenticate to the VPN server, then use an authentication token such as SecurID to access individual servers or services. VPN support is currently available only in the Unix version of Gauntlet; the NT version is slated to have VPN support soon.

### Microsoft Routing and Remote Access Service

Routing and Remote Access Service (see “Software-Only Routing for NT,” September BYTE) offers VPN functionality through Microsoft’s Point-to-Point Tunneling Protocol (PPTP). RRAS can do 128-bit encryption. It can authenticate only through NT’s directory service or through Remote Authentication Dial-In User Service (RADIUS). Overall security would benefit from the addition of some form of certification authentication on the client end. However, RRAS’s availability as a free download makes it an attractive option for budget-conscious organizations with modest security requirements. In addition, RRAS offers enhanced multiregion routing and dial-up support for remote users, and it’s easy to set up.

### Grab Your SOCKS

Most software VPN products use one of two methods for providing data security. Either they encrypt entire IP packets and "tunnel" them within plain packets, or they encrypt only the data portion of the packet and include clues for how to decrypt the data. Aventail VPN, however, takes a totally different approach: using SOCKS to provide both encryption and access control.

SOCKS, a security technology, uses circuit-level proxies to relay information between networks. All traffic destined for a remote network must be transmitted to a SOCKS server via the SOCKS protocol. The server then establishes a proxy connection to the requested resource and returns the data to the original requester. No traffic ever passes directly between the two networks.

One of the traditional disadvantages of SOCKS has been that every client that wanted to access the SOCKS server had to use specially modified applications (the term for modifying an application is known as "socksifying"). Companies like Aventail avoid the socksification requirement by creating a specialized Winsock as part of their AutoSOCKS client. The AutoSOCKS Winsock.dll works with any Winsock-compliant application, so software such as Web browsers or FTP clients can work without modification.

The latest version of SOCKS, version 5, includes a number of enhancements over previous renditions, such as support for multiple authentication, encryption, and message integrity functions, as well as support for UDP packets.
The Harder Side of VPNs

All the VPN products reviewed here are software-based, but hardware-based VPN solutions are also increasingly popular. Many router companies, such as Cisco and Bay Networks, are offering VPN functionality within their routers and dial-up access products. Cisco introduced Layer 2 Forwarding (L2F), a tunneling protocol similar to Microsoft's Point-to-Point Tunneling Protocol (PPTP), while Bay offers its BayStream IP Virtual Circuit technology.

With either of these product lines, users connect to the dial-up or LAN-based router using standard utilities, such as Windows 95 dial-up networking. All encryption functions are handled by the router, which establishes the virtual connection with the router at the destination network. Once end users have been authenticated, they may be totally unaware that they are connecting to their resources through an encrypted channel.

impressed with its monitoring and logging capabilities, though Eagle NT suffered from some minor glitches during testing. For example, it allowed only dial-up VPN sessions from a LAN workstation running Windows 95 version OSR2; other versions of Windows worked fine.

BorderWare Firewall Server 4.1

Configuring the BorderWare Firewall server for VPN sessions is extremely easy thanks to its Java-based remote administration utility and simplified setup menu. Configuring the server hardware itself, however, is not so easy. Like F-Secure, BorderWare is based on a stripped-down Unix kernel, so hardware support is more limited than for the other products. Once we got all the right pieces together, installing the software was not a problem. BorderWare's combination of firewall and VPN functionality is a plus because it gives you the ability to define varying levels of access for VPN clients.

SunScreen SKIP

Like FTP's Secure Client, SunScreen SKIP is a client-based package. It works on Windows 95 or Solaris 2.5.x computers and installs as a virtual network interface, so it can be managed through the Control Panel in the Win 95 version. SunScreen SKIP supports the SKIP key management scheme, so you'll be able to establish secure connections without the hassle associated with manually exchanging encryption keys. One of the more attractive features of SKIP—not found in some of the tunnel-based products—lets you define secure and insecure hosts, and all traffic between your workstation and those hosts will be encrypted accordingly. Overall, SunScreen is easy to work with; however, it does lack the full feature set of server-based products.

Digging Your Own Holes

Choosing the right VPN product for your organization requires careful thought about your requirements. Client-to-client encryption products, like those from FTP Software and Sun, might be best for decentralized organizations or those with many mobile users. International corporations might prefer Data Fellows' F-Secure VPN because of its full-strength cryptography and no export controls.

The products that scored best in our testing—Aventail VPN, Check Point Firewall-1, and Eagle Raptor NT—did well because each offers a good combination of encryption and authentication options, along with support for both LAN-to-LAN and client-to-LAN VPN connections. They proved to be the most versatile and easy to use of all the products in this roundup.

However, VPN software is a rapidly growing product category, and many of the technical obstacles I encountered, such as lack of product interoperability, will fade as open standards for security evolve. Look for big changes in the next revisions of all of these products.

Morgan Stern (morganst@world.std.com) is a network consultant and coauthor of NT Enterprise Network Design (Sybex, 1997).
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Cryptography Gets Personal

With Internet security issues in the headlines, software vendors are answering the call with a variety of personal encryption products. Some, like Symantec's Norton Your Eyes Only (YEO) for Windows 95 and RSA's SecurPC 2.0, secure files and directories with proprietary architectures on your desktop. Others, such as the offerings from Netscape and Microsoft, bundle S/MIME secure e-mail functions into Internet clients for e-mail encryption and digital signatures. In between, Entrust/Solo from Entrust Technologies offers a minimalist point of entry for individuals into Entrust's open security architecture, while Pretty Good Privacy's PGP for Personal Privacy 5.0 combines e-mail and desktop security with a "web of trust" certificate model (see "Who Goes There?", June BYTE).

In my tests of ease of use, functionality, and interoperability, PGP led the pack with its comprehensive personal security solution. No one package aced the interoperability test: While PGP hews to its own de facto standard, the S/MIME clients fared unevenly when dealing with standard key and certificate formats. Entrust/Solo accepted only Entrust certificates. YEO does public-key encryption, but with a proprietary architecture, so only YEO keys will work. SecurPC does only symmetric encryption and cannot yet handle X.509 certificates. SecurPC, YEO, and Entrust/Solo do secure e-mail only as attached encrypted files, while Netscape's Communicator Suite and Microsoft's Internet Explorer (IE) 4.0/Outlook combination can exchange encrypted or signed e-mail—but it can't encrypt files.

Entrust/Solo
A spin-off of Nortel, Entrust has a Canadian location that permits it to export cryptography with minimal limits. Entrust sells enterprise security tools for building certification authorities (CAs) and clients for using the certificates. Solo encrypts or decrypts and signs or verifies signed files using Entrust-format public keys and file formats only. You can compress encrypted files and drag directory hierarchies into encrypted archive files, do a secure delete, or administer your own or others' Entrust-formattted keys. Solo uses the RSA public-key-encryption algorithm, although other (higher-priced)
Entertrust clients can add Directory Server Agent (DSA) support. Support for stream ciphers, used to encrypt the actual files, includes DES, TripleDES, and three strengths (64-, 80-, and 128-bit keys) of CAST, a patented encryption algorithm that's owned by Entertrust (but with a free version available for both commercial and noncommercial use).

Solo offers an easy entry point for secure communications with Entertrust organizations. Solo runs on Windows 95 only; other Entertrust clients work on the Mac, Unix, and Windows 3.x.

Microsoft Outlook/IE 4.0
Microsoft's IE 4.0 (see "Microsoft's Free Lunch Browser," June BYTE), Outlook, and Outlook Express are all more-than-adequate clients for most uses. To catch up with Netscape's S/MIME-based secure e-mail function, Microsoft added S/MIME support for digital signatures and public-key encryption of e-mail sent and received among Outlook clients.

Unlike stand-alone solutions, the Microsoft and Netscape products both need a CA, such as Verisign or Thawte, to issue you an X.509 certificate that lives in the client software. Once you get the certificate, you must load it into your Outlook e-mail account properties before you can do any cryptography. Microsoft's S/MIME implementation may not win prizes or solve all security needs, but it makes the IE 4.0/Outlook combination competitive with Netscape's Communicator.

Netscape Communicator
Netscape created Internet client cryptography, building Secure Sockets Layer (SSL) into Navigator 1.0. This year, S/MIME e-mail made its way into Navigator and Messenger in the Communicator suite.

Communicator makes it look easy: You just click on the Security menu-bar option for easy access to all security (including S/MIME) functions. You manage certificates and toggle the defaults for encryption and digital signatures on your e-mail and news postings, although you can modify the default for some messages by clicking on the Message Sending Options in Communicator's Composition application. Netscape did a better job of implementing S/MIME than Microsoft did, while supporting the same features. As tested, neither solves all your crypto needs, but both can do what they claim: S/MIME e-mail encryption and digital signatures.

I thought it wasn’t working. When you log on to YEO, you get access to all files encrypted in place, as well as to any files stored in auto-encrypt directories, but access is seamless throughout. I had to copy an encrypted file to disk and open it on another PC to be sure it was encrypted.

If you don’t log onto YEO on boot-up, you can access unencrypted data on the system, but you must reboot to get to encrypted data. YEO does clever things with its desktop integration, including figuring out which file a shortcut icon points to and encrypting it instead of the shortcut.

Like Entertrust/Solo, YEO can encrypt and digitally sign e-mail—but only as a file attachment. YEO will not interoperate with any other encryption program and can’t import standard certificates or keys (although a companion product, Norton Your Eyes Only Administrator, offers central key distribution and master access to YEO-protected desktops or data).

YEO uses the RSA public-key algorithm and offers a choice of data-encryption algorithms, including RC4, RC5, and DES. YEO can protect your desktop data, but lack of interoperability keeps it out of the running as an all-around crypto tool.

PGP for Personal Privacy 5.0
I enjoyed using PGP with the same sense of unease with which I enjoy sushi: There’s...
We have won the industry’s technology awards, now let’s have fun making money!

Suggestions for ScanOffix:
The comprehensive solution for office and home, ScanOffix is the ideal complement to your scanner and offers intuitively user-friendly capabilities for processing images and text. Now you can simplify routine jobs, organize data, use the Internet to the fullest, expedite procedures, streamline your workspace, and much more. ScanOffix takes advantage of the latest image manipulation technology to let you explore your creativity and perfect aesthetics in any presentation with capabilities for “Photocopying” in color, morphing, seamlessly fusing images, and creating virtual photo albums. Take charge of your computer with the newest generation of intuitive imaging technology - ScanOffix.

Suggestions for FunScan:
FunScan consists of six user friendly imaging applications in one awesome value-added package. With FunScan you can make your own greeting cards, and T-Shirts, play puzzle games and design your own screensaver and Internet homepages. Using our state-of-the-art technology, your scanner is now intuitive and easy.

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Circle 155 on Inquiry Card (RESELLERS: 156).
always a nagging sense that it's bad for me in the long run. With plug-ins for Qual­comm's Eudora and Microsoft's Outlook e-mail clients (and Netscape Messenger and Lotus cc:Mail plug-ins are coming soon), PGP is a click away at all times. With a key-management tool, you can go look for some­one's PGP key or just grab it out of e-mail with the plug-in. PGP's desktop integration enables you to encrypt and/or sign any file or decrypt and/or verify any PGP-encrypted file; the clipboard integration does the same for cut chunks of files.

So what makes me uneasy? It's the stand­ards. Even though PGP has millions of users, because S/MIME is bundled increas­ingly visible in Microsoft Internet clients and in Netscape's WebPass ID (rolled out with CA Verisign), PGP's installed base looks mighty small. However, with stan­dards decisions still up in the air, PGP's comprehensive and easy-to-use implement­ation puts it ahead and shoulders over the other products, and its availability out­side the U.S. makes it an ideal choice for those who prefer stronger international protection but don't feel comfortable going for one of Entrust's heavier clients.

**RSA SecurPC 2.0**

The oddest thing about SecurPC, from RSA, is its relative lack of public-key cryp­tography. Other than public-key encyrption of user keys, SecurPC does nothing but symmetric encryption: no signing of files, and no encrypting a file with some­one else's public key. SecurPC recently won approval for export of its full-strength encryption, making it attractive for inter­national use. Otherwise, it functions like YEO, with encrypt files and directories, boot protection, screen lockout, and secure deletes.

SecurPC is activated only when you right-click on a file. One big feature is a self-extracting encrypted file, which can be decrypted by anyone with the secret key you select, making it possible to at least e-mail encrypted attachments to recipients who don't have SecurPC. Like YEO, SecurPC should suffice for simple desktop protection, but its lack of support for digital signatures and interoperability limits its usefulness as a stand-alone solution.

Pete Loshin is a BYTE technical editor for soft­ware reviews and author of the forthcoming book Personal Encryption Clearly Explained (AP Professional, 1998). You can reach him at ploshin@mcgraw-hill.com.
Web Servers

Although there's plenty of cheaper competition, these two Web servers are more capable and dependable than ever. By Barry Nance

Battle of the Network Superservers

Netscape and Microsoft are lusting for your Web-server business in a dense marketplace crammed with over 200 other competitors. Moreover, the current market leader, Apache, doesn't cost a dime. Should you plunk down cold hard cash for Netscape's SuiteSpot or Microsoft's Internet Information Server (IIS)? If so, which one?

A year ago, comparing Netscape's and Microsoft's Web server suites was easy—Netscape's product was feature-rich, ran on multiple platforms, and was almost as fast as IIS 3.0. But IIS 4.0, which was in final beta form during this review, has pulled even with SuiteSpot 3.0 in many areas—and surpassed it in others.

I evaluated IIS 4.0 and SuiteSpot 3.0 on an intranet consisting of Pentium Pro-based NT Server 4.0 machines, an Ethernet LAN running TCP/IP, and a variety of clients (Windows NT, Windows 95, OS/2 Warp, and Macintosh System 7). I compared features, performance, ease of administration, reliability, and suitability for running (or developing) transaction-oriented business applications.

SuiteSpot proved to have a better messaging server, streaming audio server, and groupware server. However, IIS showed a slightly better search engine, a better transaction-oriented business application environment, and more-effective administrative tools. A forthcoming Microsoft proxy server also proved to be superior to Netscape's.

IIS is a part of Windows NT Server, while SuiteSpot is a separate product. Each contains a different mix of software components. To compare similar functions across both, I arbitrarily added Microsoft's NetShow (freeware) and Proxy Server (beta version) to the evaluation. As this article went to press, Microsoft wasn't sure whether it would bundle Proxy Server with NT Server.

Microsoft's IIS 4.0 is a significant upgrade over its predecessor. Version 4.0 makes Active Server Page (ASP)–based applications even easier to create and manage. IIS's debugger for testing ASP pages, the Microsoft Management Console (MMC) interface, and Transaction Server all simplify the management of ASP-based applications. Web pages produced from ASP scripts can now be part of a transactional system, which helps ensure data integrity.

One item often overlooked in evaluating IIS is that, in contrast to Netscape's Internet-oriented servers, NT Server can be both a file server and a Web server at the same time. Referring to a remote drive letter and printing to a shared printer haven't yet gone out of style.

IIS 4.0, which complies with HTTP 1.1, has a certificate server for creating and

---

RATINGS

TECHNOLOGY  ★★★★
IMPLEMENTATION  ★★★
managing digital certificates. It also comes with a search engine, a news server, Microsoft Transaction Server, and SiteServer Express (stripped-down log- and site-analysis tools for Web-site managers).

The new certificate server made it easy to create and distribute small numbers of digital certificates. It’s appropriate for small companies or departments but needs more sophisticated management tools to maintain large numbers of certificates.

Microsoft’s new Web server has a number of new features that should make it a more stable application server. I could run programs as processes in address spaces separate from those of the Web server. This means a badly behaved application is less likely to crash the Web server.

Proxy Server 2.0, despite its bias toward Windows clients, bested Netscape’s. The new fault-tolerance and reverse-proxy features impressed me. I was able to chain multiple Proxy Servers together for redundancy and load balancing, a feature Netscape’s Proxy Server 2.5 also supports.

However, Microsoft surpassed Netscape’s distributed caching by introducing the concept of arrays, which enables multiple Proxy Servers with the same name to run as mirrors of one another. I configured Proxy Server both to republish Web pages from protected Web servers and to publish multiple Web sites on a single server using multithreading support for multiple URLs and IP addresses.

I liked the way Microsoft has integrated Proxy Server with Remote Access Service (RAS) to allow access to the Internet for dial-up connections. An entire network can share a single ISP dial-up connection. Wizards helped me configure Proxy Server as a router that would dial the ISP each time a client accessed a remote site.

The Index Server component of IIS tested slightly better than Netscape’s Compass Server. While neither is as well endowed as, say, Infoseek’s Ultraserve Server search engine, both provided basic, useful search tools for locating information on the test intranet.

I especially liked IIS’s ability to handle different document types, its programmability, and its ease of administration. Index Server successfully indexed Office 97 (Excel and Word for Windows) files and Adobe PDF documents in real time. It allowed full-text and HTML field searching by word or phrase and integrated closely with NT Server. But Index Server has no natural-language interface and doesn’t support proximity searching. It does, however, support seven national languages.

Microsoft’s NetShow (which is freely downloadable) integrates closely with IIS to serve up streaming audio, video, and Web-enhanced presentations. While NetShow’s authoring tool gave me a time line that helped me insert audio, graphics, and URLs accurately, I couldn’t insert video clips directly. In fact, NetShow is rather rudimentary, with no tools for capturing audio or video. To convert audio or video files into Microsoft’s.asf format, you must first use a separate tool to make your source material conform to the frame and bit rate you select. I preferred Netscape’s Media Server to NetShow.


SuiteSpot remains a work in progress; only the Enterprise, Collabra, Compass, and Messaging servers (which make up the critical core) represent updated software. It also lacks a single administrative interface. From Communicator 4.0, I could use Netscape’s new administrative tool to manage only the updated servers. The tool centralizes common tasks, such as maintaining user accounts, via the Directory Server component. When I added a user or group, the change propagated automatically to the other version 3.0 servers. However, I had to use the version 2.0 administrative tool to update the down-level servers, making changes one server at a time.

The Collabra and Messaging servers carry new version numbers but haven’t changed greatly. Only Enterprise Server and Compass Server offer significant improvements, such as Web Publisher, a Java applet for remotely managing content on a Web server. The new Enterprise Server also offers server-based agents. I configured the agents to monitor intranet pages and perform daily searches. Because the agents are server based, I could access them from multiple systems.

 Compass Server (formerly CatalogServer) is a customized version of the Verity search engine. I liked Compass Server’s support for more than just HTML and plain text, its personalization options, and its easy administration. However, as with IIS, Compass Server lacked proximity searching and a natural-language interface.

In my tests, Compass Server accurately indexed Microsoft Office (Excel and Word), PDF, and WordPerfect files. Net-
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scape claims that Compass Server can also catalog Rich Text Format (RTF), PowerPoint, Interleaf, Lotus Word Pro, and FrameMaker files.

Compass Server allowed me to specify words and phrases with Boolean operators, and it performed phonetic lookups and synonym matching. I could locate documents based on metadata entries I had placed inside the HTML, and Compass Server let me categorize my documents into topics (taxonomies in Netscape parlance). The categorization made search responses immensely more relevant.

Compass Server let me painlessly create what Netscape calls a personal interest profile subscription. Thereafter, each time I updated Web pages or documents, Compass Server’s indexer automatically used my URL classification rules and taxonomy designations to prepare and send me, via e-mail, a My Compass newsletter, containing the updated Web content I’d expressed an interest in.

The Messaging Server adds tools such as receipt acknowledgement and encrypted messaging via Secure Multipurpose Internet Mail Extensions (S/MIME). I would have liked Messaging Server more if it incorporated some Exchange and Notes features, such as server-based rules for filtering messages.

SuiteSpot’s mail server has an Internet e-mail underpinning, supporting SMTP, Post Office Protocol Version 3 (POP3), and MIME. Exchange and Notes have only recently embraced these standards.

Calendar Server, which Netscape has licensed from Corporate Software and Technologies International, adds long-awaited group scheduling to SuiteSpot, along with yet a third administrative interface. Calendar Server lets you schedule people and resources so that you can manage time, events, and to-do lists. Collabra is a groupware product that supports ad hoc discussions, searching across forums, and virtual forms. Netscape plans to integrate Collabara to run as an LDAP process. Currently it, too, requires separate administration.

Netscape Directory Server is an LDAP-compliant server supplying a universal directory service for enterprise-wide management of user, access-control, and server configuration. (LDAP is a subset of X.500, a directory-services standard.) Netscape has a lot of work to do to improve Directory Server and integrate it with the other SuiteSpot components. When I set up a group list, I had to enter the cryptic LDAP query syntax. Netscape needs to provide a better interface.

While Netscape wants developers to use JavaScript, Microsoft touts VBScript and JScript, its own take on JavaScript. Microsoft’s Java version, J++, also contains proprietary extensions (if you discount the fact that Microsoft has handed ActiveX over to a standards body). From a developer’s perspective, viewing Microsoft tools for cross-platform applications is like walking a very thin tightrope. Active Server Pages is a more compelling technology than Netscape’s servlets, making platform selection for developers even more difficult.

Perhaps the answer to this dilemma lies in Netscape’s announced Open Network Environment (ONE), a cross-platform architecture that employs an object model (Netscape Internet Foundation Classes) and offers support for distributed objects through the CORBA-compliant IDL protocol. Although ONE competes directly with Microsoft’s OLE/ActiveX/DCOM architecture, Netscape says that ONE will include ActiveX technology and will be compatible with Oracle’s NC Architecture.

Media Server consists of server software, a set of conversion and audio-editing tools, and client-side software. It also includes the Netscape Media Converter, the ToolVox voice encoder and client, Navigator, and the Media Player client. Media Server did an excellent job, compressing and distributing audio almost as well as RealAudio. Like RealVideo, MediaServer can deliver different files for users with different bandwidths. I also found that MediaServer can serve on-demand or live audio feeds, either multicast or unicast.

While IIS is only for use with NT machines, SuiteSpot comes in versions for NT, Sun Solaris, IBM AIX, HP-UX, SGI’s Irix, and Digital’s Unix.

In short, SuiteSpot provides remote Web content management with version control, and its centralized directory holds great promise. However, Netscape needs to better integrate the disparate server modules, especially the administrative tools.

**TON**

For many Webmasters, server software comes down to a choice between Microsoft and Netscape. The decision is an easy one to make if you already have NSAPI-aware (Netscape) or ISAPI-aware (Microsoft) applications. If you’re developing a Web-based system, I believe that IIS’s ASP technology is the way to go. And IIS is much easier to administer.

On the other hand, if all you’re looking for is a server for distributing static Web pages, then either one, or almost any of the other 200 competing products, will do.

Barry Nance (Wethersfield, CT) is a computer analyst and consultant. You can contact him by sending e-mail to barryn@bix.com.
I'm exhausted, and I've got a meeting with Eanh Lin's services, and it's a lot easier to maintain my own services than trying to maintain my own site as soon as we get that set up. You can see my latest efforts at http://home.earthlink.net/~jerryp, not the easiest thing in the world to remember, but it works. I've been quite happy with Earthlink's services, and it's a lot easier than trying to maintain my own servers for a Web site. It's also a lot cheaper, since my page comes free with the Earthlink basic services.

It's not a fancy site. I've been offered help by some of the best people in this business—for that matter, BYTE has some of them on its staff—but the point of this exercise is to see what I can do more or less unaided. I did have David Em help me get started, but it's pretty much mine now. It will always be a text-oriented site—I'm a wordsmith, not an artist.

For that matter, other pictures. Olympus has steadily improved the software that comes with the camera. It's now easy enough to use that I can recommend it to nearly anyone able to use a computer, especially if they have a BYTE reader helping the first time they download pictures and play with them.

The D-300L comes with Adobe PhotoDeluxe, a sort of poor man's Photoshop. PhotoDeluxe is all right, but if you really want to touch up photographs—both digital photos from a camera like the D-300L or scanned images of regular photos—look at Kai's Photo Soap from MetaCreations. I find that Paint Shop Pro from Jasc is about the best all-purpose photo-tinker program I have. Photoshop is said to be better—and perhaps it is—but I find Paint Shop Pro a great deal easier to understand, and it's what I've been using for most Web photo work.

Photo Soap is amazing: it can do automatically what the other programs can accomplish only if you know what you're doing. If you have old photographs or you're a lousy photographer, try Photo Soap. Then when you get the picture the way you want it, use Paint Shop Pro to put it into JPEG format with the "progressive" option. That saves the picture in interlaced layers, so that when it is first downloaded, it appears as a blurry outline with progressively sharper detail.

PhotoDeluxe saves JPEG files in linear fashion; you see the top stripe of the picture and then the next, etc. It's possible that PhotoDeluxe will save in interlaced or progressive mode, and Photoshop will,

It will always be a text-oriented site—I'm a wordsmith, not an artist.
and it will find every graphics file and make a thumbnail.

We had one problem with ThumbsPlus. Graphics files tend to be big, and with the D-300L, I can make a lot of them. In 1024-by-768-pixel resolution, the D-300L holds 30 pictures; but in VGA (640 by 480 pixels), it will hold over a hundred, each one 50 KB and more in full-image JPEG (i.e., the images are compressed, but no detail is lost; as opposed to partial-quality JPEG, which blurs out some details as it compresses the file).

It seemed natural to combine the D-300L with the Olympus MO drive. The Olympus MO and Fujitsu MO drives use the same medium and format, so discs are interchangeable between them. MO discs hold 128 to 230 MB (there are larger ones, but I never find them at Fry's) and cost under $20; a lot of storage for the money. They're a natural accessory to a digital camera, so I brought one. If I download my photographs from the D-300L, they go onto an MO disc.

Then I found that ThumbsPlus would look at the MO drive, pretend to make thumbnails—and do nothing. This was frustrating, and the help file had nothing, so I called the programmer. “Do you have a volume label on the MO disc?” he asked. “We use that in making the database.”

A quick check showed I didn’t, so I added one. After this, ThumbsPlus worked perfectly with the MO discs. This program has quickly become essential: if you do any graphics work, get ThumbsPlus and pay the registration fee. You’ll be glad you did. Highly recommended.

Another utility worth having is Quick View Plus for Windows 95 (Win95) and NT. This will plug into Norton Commander for Windows 95 and NT, and view nearly any file, including graphics files. It doesn’t seem to view JPEG files saved by Paint Shop Pro in progressive format, although it has no problem with the same file saved linearly. Otherwise, I haven’t found much that it won’t show. Of course, Quick View Plus will work by itself or in conjunction with other file management software (including Explorer), but I particularly like it with Commander 95.

Commander has always been my favorite file manager, but the Windows version lacks the wonderful viewers that the last DOS versions had. With Quick View Plus, you can look at nearly anything, including individual components of ZIP files, DLLs, uncoded files, and all kinds of stuff. I prefer to use it with Commander, because when I use Explorer and double-click on a file, I am never sure what will happen; with Commander, F3 brings in Quick View Plus and nothing else. Together, Commander and Quick View Plus are a killer combination. Recommended.

Finally, there’s PhotoRecall from G&A Imaging. While this does limited special effects, mostly it’s useful for organizing photographs into albums. It does that reasonably well, but it doesn’t seem to have...
a batch capability. That is, to make a new album, I have to select and load pictures one at a time. Once that’s done, it’s easy to move them around in the album.

The presentation is quite good: a small, medium, or large picture in an album layout. Click on it to get the full-size picture. There’s also a way to search the Web for pictures, although most pictures I have found on the Web are not ones I would want to download and keep. As a presentation system, PhotoRecall is neat, but as a management system for lots of photographs, I greatly prefer ThumbsPlus.

In the course of playing with the Web, we upgraded our software, and that generates this month’s tales of hope, horror, and glory.

Begin with CyberMedia’s Oil Change. If you regularly cruise the Internet, you need this program, which finds and downloads updates to your software. In our case, it found an update to Dial-Up network and one to Win 95 Winsock. We downloaded and installed them on Cyrus, the Cyrix P-166 that is my current main Win 95 machine. My real main machine is now Prima, a Compaq Professional Workstation 5000 running NT 4.0, but for the moment, I do a lot of work on Cyrus as well. Both updates installed painlessly, although there were a few oddities. For instance, I had to go find the passwords to my Dial-Up network accounts, because the update lost the ones I’d saved.

The result is a real improvement. Internet access is much faster, and multiple Internet operations really work. We were able to simultaneously do two downloads, answer mail, and go look at another Web site without any slowdowns. That’s quite an improvement from a free download.

This worked so well that Alex thought he’d apply them to Pentafluge, the rater-dated Pentium 60 machine with an Intel Pentium OverDrive processor that Larry Niven uses when he works here. The result was a disaster: whatever effect these upgrades had on Internet browsing, the Dial-Up network update 1.2 (TweakDUN) collapsed the internal network. Pentafluge could no longer connect to any of our other machines.

Alex uninstalled the upgrades. After about an hour, he was able to get the network restored. It wasn’t easy. Among other things, TweakDUN set the network properties so that NetBEUI was no longer the default protocol. There were other problems, but eventually we had Pentafluge back on the network.

We defragged the disk drives and did some more tweaking. Then we tried the upgrades again. Big mistake. Once again, Pentafluge vanished from the network; and this time, possibly because we tried to do some adjusting without uninstalling TweakDUN, things got progressively worse. By the time we did the uninstallation, it was too late. Bottom line: I worked a day trying to get Pentafluge back on the network, to no avail. It would not work.

I decided that drastic action was required: it was time to boot up in DOS, nuke the Windows directory, and reinstall Win 95 from scratch. We’ve used Pentafluge as a test machine for a year, and there were remnants of programs that couldn’t be uninstalled. Tons of DLLs in the system directory. Garbage files everywhere. That sort of thing. Cleaning house was indicated anyway, and it also seemed to be the only way to restore the network. There was only one problem: in order to reinstall Win 95, I would need the CD-ROM drive, and that CD-ROM drive wasn’t visible unless I was running Win 95.

That shouldn’t have happened. In the

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Upgrading our software generates this month’s tales of hope, horror, and glory.

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Alex uninstalled the upgrades. After
command-line parameters for Microsoft CD Extension (MSCDEX). They’re in most
DOS books, but I don’t have many left.
Once I was sure the CD-ROM drive worked in DOS, I saved the entire Win­
dows directory onto the Maxoptix glass
drive and then deleted it on Pentafluge.
Boot up in DOS and run Golden Bow Sys­
tems’ Vopt, still the best disk defrag pro­
gram I know of. Reboot in DOS. Then I
installed Win 95 from a CD-ROM. Since I
had an upgrade Win 95, I had to find the
setup disk for Windows 3.11 and put it in
the floppy drive before Win 95 would in­
stall. After that, it all went swimmingly.

Moments later, I had the network re­
stored. I had a pleasant surprise: Penta­
fluge runs about five times faster than be­
fore. Programs load faster, and the system
doesn’t thrash about as much. Everything
is crisper. I didn’t do any benchmarks, so I
have no objective measures, but it’s more
than noticeably faster, so much so that I
am thinking of doing the same thing to
Cyrus.

The moral of this story is that if you
change hardware, don’t wait for a crisis to
update your panic disk. A second moral is,
clean your Windows once in a while. It
sure can make a difference.

**Clean your Windows once in a while.**
It sure can make a difference.

There are classes from raw beginner to
very advanced techniques, chances to use
a supercomputer for an hour or so, and
technical exhibitions.

Alas, the floor show is becoming indis­
tinguishable from the Electronic Enter­
tainment Exposition: lots of hype, flash­
ing lights, and a general heat-and-noise
level sufficient to drive me out of the room,
much larger machines, but you could cre­
ate a show, render in TV-video quality, and
have it to present to financial people with
equipment and software costing no more
than $25,000. This is astonishing.

Hewlett-Packard and Digital Equip­
ment, and even Dell and Gateway 2000,
are also getting into the high-end graphics­
machine game. I fully expect that my esti­
imated $25,000 for a professional system
will be cut in half in no more than a year.
Ain’t competition wonderful?

Second, it’s no longer a Silicon Graph­
ics/Unix world. At least half the profes­
sional-level displays we saw on the floor at SIGGRAPH were run on NT platforms.
A few years ago, there were essentially
none. As David Em, our graphics associ­
ate who attended the show with me, puts
it, “The era of SIGGRAPH as the Silicon­
Graphics-and-everything-that-goes-with­
it show is over.”

Third, while most of the very high-end
professionals are still using Softimage—a
program developed for Silicon Graphics
systems but now acquired by Microsoft
and running on NT platforms—3D Studio
Max, from Kinetix (a division of Auto­
desk), is catching up fast. Moreover, the
current version of 3D Studio Max was
designed to be an NT program and uses an
interface that will already be familiar to
AutoCAD users. This leads me to believe
that design students are more likely to
learn 3D Studio Max than Softimage.

Also, while the final cost of Softimage
and 3D Studio Max with all the enhance­
ments needed to bring it up to Softimage’s
power will be about the same, you can
buy 3D Studio Max and enough plug-ins
to get started for about half what you’ll pay
for Softimage. This is another big plus for
students and beginners.
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It's an exciting world out there.
As I said, David Em, who knows much more about graphics than I do, attended SIGGRAPH with me. Look for more of David's observations in the Web Exclusive part of the column on the BYTE Web site. Incidentally, if you are interested in computer-generated art, you can see some of David's work at http://businesstech.com/art/emgallery.html.

While we're on the subject of graphics, CAD, and Web sites, if you don't know about Visio, you ought to.

Visio is a stand-alone application for making technical drawings and other artwork. It has its own development environment or can extend Microsoft's Visual Basic for Applications environment. It also knows about Microsoft Office, and you can use it in conjunction with any of its components, including Word.

Mostly, Visio has a number of smart templates, and if the set you need didn't come with the package you bought, it's probably available. Templates include architect, chemical, electrical, electronic, process plants, pumps, pipes, heating and ventilation—well, you get the idea. There are also abstract shapes suitable for making flowcharts and diagrams. If you work with computers and don’t know about Visio, I bet you wish you did. Not only recommended, it’s close to essential.

If you're looking for some unusual clip art on a Western theme, the classy RT Computer Graphics collections are now available on CD-ROM. Cowboys and Indians, traditional Navajo and other Santa Fe art, petroglyphs (genuine and humorous), plains Indian art, borders and images, it’s all pretty neat. Look them up at http://www.rcomputer.com. Next time I do a pass through my Web site, I’ll probably include a few of these.

The old game of the month is Conquest of the New World, from Interplay. One tip: the Deluxe Edition has a feature known as the ancient temple of war. Find it and get control of it; it’s worth almost any cost. Even if you can’t control it, try to get the ownership in dispute, because it gives an enormous advantage to the side that possesses it.

The new game of the month isImperialism, from Strategic Simulations. It’s somewhat like Civilization II, but it takes place in the 1800s, which was the classic

A Message to Our Subscribers

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era of colonial imperialism, with great powers scrabbling for control of smaller countries. You do exploration and prospecting, and invest in both research and industry. It's not too bad as solitary, but it's great as a multiple-player game: all the

The book of the month is my own, but you don't have to pay to read it.

fun of Calhammer's Diplomacy, but with far more realistic economics and military actions. Make alliances and then stab your partner; but when you do, not only do the other human players take notice, but so do the nonplayer nations. Great fun.

The book of the month is my own, but you don't have to pay to read it. The Strategy of Technology was written in 1968 by Stefan T. Possony, Francis X. Kane, and Jerry Pournelle, and published by the University Press of Cambridge, Massachusetts. It was used as a textbook in all three service academies at one time or another and numerous times over the years in the Air War College at Maxwell AFB. It has been out of print for years, although photocopies circulated with my permission.

Recently, some young officers asked me to make it available. A professional Web designer, Arnold Bailey (abailey@bix.com), volunteered to turn it into good HTML, and so he did. You can find it, complete with partial revisions and notes, on my Web site at http://home.earthlink.net/~jerryp as well as a couple of other places. Fair warning, this is a cold war book, and while the principles haven't changed at all, nearly all the examples are from the Seventy Years War between the U.S.S.R. and Western civilization. It's an interesting example of how a book might be published on the Web; not fancy, but I think well done.

The computer book of the month is by Michael J. Hernandez, Database Design for Mere Mortals (Addison-Wesley Developer's Press, ISBN 0-201-69471-9). This is just what the title implies; if you keep lots of files and notes and wonder if there's a better way, you need a relational database, even if you don't know what one is. This book will help you understand the subject whether you work with Visual Basic, Access, FoxPro, Delphi, or whatever. It includes rules, views, and a good bibliography.

With luck, next month we'll have our new Pentium II system built. I've got all the parts, and we're getting a new ViewSonic monitor to go with it. Now to do my space council reports.

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 jerryp@bix.com. Visit Chaos Manor at http://home.earthlink.net/~jerryp/.
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A 600-MHz Alpha workstation, Unix notebooks, Java development tools, and remote network management software.

Digital Equipment's Alpha chip is not just for servers anymore, though it still is your typical desktop processor. The latest 21164 processor can run at 600 MHz, roughly twice the speed of most competitors' chips. The typical user won't need this kind of speed to run Microsoft Office or read e-mail, but this level of processing power promises to push high-end graphics or database applications to new heights.

I looked at a Polywell PolyAlpha PC running the new 600-MHz chip with a 2-MB L3 cache, 128 MB of RAM, a 4.5-GB Ultra-Wide SCSI hard drive, and a 4-MB Matrox Millennium PCI graphics card. This configuration costs $10,661, though most users will probably opt for a more powerful graphics card, should they use this system for animation, 3-D rendering, and such graphics applications.

The system runs either Unix or Windows NT. Unix systems have been shipping since July, but the system I saw is among the first running NT. I ran the native Alpha BYTEmark benchmark on this system (see "A Chip Off the Old Block" on page 18), which tests the raw processing power of the CPU, and got the highest numbers from any NT desktop system we've tested to date.

If over $10,000 is excessive for this kind of processing power, a 533-MHz system will cost $4300 less, and the 500-MHz Alpha system will cost $5200 less. The price of the 21164 chip will eventually come down, and the price of the system with it, but for now, this is likely the most screaming processor on the market.

- Jason K. Krause

Digital Technology

Video Graphics

TV Kit for PCs

MATROX'S NEW GRAPHICS, VIDEO AND TV Kit combines the Matrox Mystique 220 3-D and video accelerator with 4 MB of SGRAM and video-capture and TV-tuner options to let you capture and edit video. Or, you can simply watch TV on your PC. The system, which includes video-editing software, games, and other titles, sells for $379.

Contact: Matrox Graphics, Dorval, Quebec, Canada, 800-361-1408 or 514-969-6300; http://www.matrox.com.

Enter 979 on Inquiry Card.

Digitize Images Faster

THE HP SCANJET 6100C ($799) SPEEDS THE scanning process, capturing images with a single exposure, and

The Faster Box on the Block

PolyAlpha PC

Polywell Computers

South San Francisco, CA

800-999-1278

415-583-7222

http://www.polywell.com

$10,661

Enter 976 on Inquiry Card.


Enter 982 on Inquiry Card.

Bigger, Bolder Scanning

THE EPSON EXPRESSION 836XL IS A SCANNER for graphic designers and engineers. It can scan images the size of a tabloid newspaper, such as posters, blueprints, or large-format prints, or can batch-process multiple smaller images. It has 800- by 360-dpi with Canon's Drop Modulation Technology that allows the print head to control the size of dots as it prints. It is rated for 4-page-per-minute printing in black ink and 2 pages per minute in color.


Enter 979 on Inquiry Card.

Add-ins

Video Graphics

TV Kit for PCs

Add-ons

Video Graphics

TV Kit for PCs

Contact: Matrox Graphics, Dorval, Quebec, Canada, 800-361-1408 or 514-969-6300; http://www.matrox.com.

Enter 979 on Inquiry Card.

Printers

Desktop Printing in a Small Package

CANON'S BJC-80 OFFERS COLOR PRINTING in a package that's not just affordable, but portable, too. The Canon BJC-80 ($299) is a 3-pound, four-color ink-jet printer that is 11.8 inches wide, 6.2 inches deep, and 2.2 inches high. It is capable of printing on paper up to 8 inches wide. The BJC-80 achieves 720 by 360 dpi with Canon's Drop Modulation Technology that allows the print head to control the size of dots as it prints. It is rated for 4-page-


Enter 982 on Inquiry Card.

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Add-ons

Video Graphics

TV Kit for PCs

Contact: Matrox Graphics, Dorval, Quebec, Canada, 800-361-1408 or 514-969-6300; http://www.matrox.com.

Enter 979 on Inquiry Card.
Get the Picture

The Toshiba IK-MM1 brings high-resolution imaging to the portable-computer environment for $139. It features a CCD image sensor with a fixed-focus lens, automatic white balance, 512 x 492-pixel resolution, and a video-capture rate of 30 frames per second. The IK-MM1 has analog NTSC video output and works with most video-capture cards. It has no audio capabilities, which means you need a separate microphone to conduct an audio/video conference.

Get the Whole Picture

A 19-inch monitor from KDS USA, the Visual Sensations VS-19, presents 18.8 inches of screen space priced at $999. It has a horizontal scanning frequency of up to 95 kHz with a picture resolution of up to 1600 by 1200 pixels at 75 Hz. It needs an adapter for use with a Mac and supports Plug and Play on Windows 95 machines.

Monitors

Get the Picture

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**Thin Is In**

The AutoNet ($995), from Mylex, is a platform-independent, embedded Plug and Play network server engine, otherwise known as a "thin" server. Based on the NetEngine architecture, which uses open RISC, ASIC, I/O, and LAN architectures, the AutoNet will support the addition of high-performance SCSI peripherals to a LAN architecture. The AutoNet has the form factor of a 3½-inch disk drive. You can use it as a file server or to add storage products to a network. You can use the AutoNet to perform functions that were previously performed by more expensive file servers, but without requiring NICs, large amounts of RAM, or NOS licenses, as do other file servers.

*Contact: Mylex, Fremont, CA, 510-608-2222; [http://www.mylex.com](http://www.mylex.com).*

Enter 987 on Inquiry Card.

**Storage**

**Highly Scalable RAID Solutions**

The LynxStak Series 2000 RAID system scales from simple 4-GB RAID protection up to backup protection for workgroup environments with terabytes of backup disk space. Each LynxStak controller supports as many as 14 Artecon Lynx drive subsystems, for up to 118 GB of usable capacity. Ultra Wide SCSI channels provide up to 40-Mbps burst and 33-Mbps sustained data transfer rates. Hot-swap removable RAID controllers, disk drives, fans, and power supplies help eliminate downtime, and the RAID controller achieves 4600 I/Os per second. Prices start at $9710 for a 12-GB configuration.

*Contact: Artecon, Carlsbad, CA, 619-931-5500; [http://www.artecon.com](http://www.artecon.com).*

Enter 990 on Inquiry Card.

**Digitize Real-World Objects**

PhotoModeler Pro 3.0 ($795) generates 3-D models of real-world objects and scenes for architecture, accident-reconstruction, forensics, archaeology, engineering, and 3-D-animation applications. To construct 3-D models of real-world objects, shoot two or more photographs of an object or scene from different angles and mark points on one photograph that correspond to points in another picture. Scan or digitize the photographs, and let PhotoModeler process the data. You can export the resulting 3-D models into CAD, animation, or graphics software. A few new features include support for new file export formats, enhanced photo-texturing, cylinder and curve modeling, and multimedia tutorials.

*Contact: Eos Systems, Vancouver, British Columbia, Canada, 800-782-5974 or 604-732-6638; [http://www.photomodeler.com](http://www.photomodeler.com).*

Enter 998 on Inquiry Card.

**PC Camera and Software**

InTELS CREATE AND SHARE LET YOU TAKE snapshots from your PC, create short videos, or make video phone calls over the Web and regular phone lines. The program comes in three versions—USB, PCI, and PCI with built-in modem—ranging in price from $199 to $349. Applications include photo-enhancement software, NetCard (for creating e-mail messages with images and sound), Kai's Power Goo for shrinking and morphing images, and video phone. It also includes an imaging camera that sits on top of a 90-MHz Pentium (or better) PC.

*Contact: Intel, Santa Clara, CA, 800-538-3373 or 916-377-7000; [http://www.intel.com](http://www.intel.com).*

Enter 994 on Inquiry Card.

**Postproduction for Home Movies**

Feed video into your computer and edit and add special effects with Iomega's Buzz multimedia production software for under $200. The Buzz kit includes in and out connector cables for S-video, composite video, and stereo audio systems, and can output finished product to videotape. Buzz consists of a video-capture card, an UltraSCSI controller, and software. It is compatible with PCs and Macs, and can accept not only video input, but also data from any SCSI device.

*Contact: Iomega, Roy, UT, 801-778-1000; [http://www.iomega.com](http://www.iomega.com).*

Enter 995 on Inquiry Card.

**Java Development Tools**

BORLAND'S JBuilder Family of VISUAL DEVELOPMENT tools for Java, JBuilder Standard, JBuilder Professional, and JBuilder Client/Server Suite feature a JavaBean creation component, a scalable database architecture, and visual development tools. These Java development environments offer support for JavaSoft's JDK 1.1, JDBC, and the JavaBeans component model for producing Java applications, applets, and JavaBeans. JBuilder's open environment also supports 100 percent Pure Java, JFC, AFC, RMI, CORBA, JDBC, ODBC, and most major corporate database servers. JBuilder Standard has an
**What's New**

*Software*

estimated street price of $99.95. Owners of other Borland tools can purchase JBuilder Professional for $249.95, and owners of competitive tools can purchase JBuilder Professional for $299.95.


---

**Build a More Helpful Application**

**AnswerWorks ($795)** is a natural-language interface for building help files in an application. The program can interpret queries you type in and matches keywords from the question to the most relevant topics stored in the application's help file. For developers, the AnswerWorks project wizard guides them through the process of creating help topics. The program automatically generates end-user project files (NUP, LIM, and NMP files) and has intelligence built in for extracting keywords from a sentence keyed into a help program. AnswerWorks runs on Windows 3.1, 95, and NT; supports six languages; and can be given a custom interface.


---

**Compression**

**File-Compression Technology**

Rush Technologies has developed Rush, an encoding technology that, RMX claims, can shrink some files by up to 95 percent of the original size. RMX has kits available, starting at $5000, for developers who want to use this technology. Rush is able to encode parts of a file's data structure without mathematical compression, though you can use standard math-based compression on Rush-encoded files to further reduce file size. Rush is tailored to shrink graphics files. You can view the files with most Web browsers or through plug-ins.


---

**Development**

**Better Beta Testing**

**Aqueduct Profiler ($20,000)** answers the questions on every beta tester's mind: How are people using an application, who is using it, how long they are using it, and when does it crash? Written for SunOS, HP-UX, and Windows NT and 95 applications, it is integrated into an application by adding library calls to the source code. It automatically e-mails user activity information from the application to the developer as ASCII text, and a reporting tool puts the data into simple graphs, pie charts, or tables quantifying the ways beta users deployed the application.

Software Update

Intel has introduced a unified Windows NT and Novell NetWare client/server virus-protection version—5.0—of LANDesk Virus Protect ($1495). This release provides protection with real-time background scanning of incoming data and an integrity shield that detects executable files with write protection. Integrity verification scans modified files to limit virus propagation. Centralized management works across all Windows platforms as well as NetWare Server and DOS platforms, and you can activate a virus sweep of all servers and clients in a domain with one mouse-click.


Built-in HTTP and CGI functionality ends FileMaker Pro’s reliance on other software products for Web-related tasks. You can search, edit, and update records with a Web browser, and HTML templates facilitate the creation of custom intranet or Internet pages. FileMaker Pro 4.0 ($199 or $99 upgrade) supports storage of GIF and JPEG files in the database, and can send records in large, bulk e-mails. For general use, you can create FileMaker Pro files directly from Excel spreadsheets, and you can sort information in the main database according to various relationships and not just displayed by the dates files were created. This latest release also has new calculation functions and improved search features. It supports http, ftp, mail to, and file protocols for viewing on-line data.


First Aid 98 ($39.95), the third-generation version of the PC repair software, has a newly refined interface, an Emergency Recovery System, and on-line help services. It lists any problems with a system in plain English, listed in order of severity. It can fix a problem automatically. If you don’t trust the software to fix a bug on its own, you can fix stuff yourself, and the software will walk you through the steps, explaining them as it goes. It links to support sites to get answers it doesn’t know, and with HTML support and FAQs, on-line data can be presented without needing to launch a Web browser. First Aid 98 traps error messages to make it easier to identify the source of a crash. If the program is unable to find the source of a glitch, it will contact the vendor by e-mail, sending a detailed message outlining the nature of the bug. The Emergency Recovery System checks the OS for signs of failure. First Aid 98 runs on Windows 95.


Mapping

Travel Assistant Speaks for Itself

TRAVROUTE SOFTWARE’S IN-CAR NAVIGATION assistant (12-channel GPS receiver included) not only guides you in your trip from door to door, it will talk to you as you drive. If you miss a turn or need to detour for traffic, CoPilot ($499) automatically provides a new route to your destination, while continuing to provide verbal directions. CoPilot gives you detailed directions; all you do is input the addresses of the starting and destination points. In addition to CoPilot talking to you, you can talk back to it. You can speak to the program, commanding it to tell you where you have to make the next turn, for example.


Networking

Pragmatic Virtual Networks

REMOTE NET-ACCELERATOR ($1999), from Traveling Software, lessens the burden of remote- and Internet-access clients on a network. File compression, disk caching, and buffering increase an application’s response time over a virtual private network or RAS remote-node connection. During file transfer, only the parts of files that have changed are uploaded. Remote Net-Accelerator groups file requests and transfers files in blocks of information to control the network’s burden.


LAN, WAN, and VLAN Management

DIGITAL EQUIPMENT’S CLEARVISN 2.0 network management suite meets the demands of remote network administration. It features a new wizard for virtual LAN configurations, support for emulated LANs, and WAN services management. It supports a common database for storing device information. The suite consists of the Fault Policy Manager ($1495); the Intranet Manager, including WAN Services Management ($10,995); and the RMON Manager ($3,495).


Stock Quotes on Demand

DATALINK, A PROVIDER OF FINANCIAL AND personal information services that are delivered using alphanumeric paging and other wireless networks, enhances its QuoteXPress stock market service by adding Quote-On-Demand capabilities. QuoteXPress delivers stock quotes to your digital cellular phone or pager based on criteria you specify. With Quote-On-Demand, you can query a real-time stock quote feed and receive quotes over a wired or wireless phone. You can also get updates on market indexes (e.g., Dow Jones) and currency exchange rates.

Contact: DataLink Systems Corp., San Jose, CA, 888-603-5465 or 408-558-0800; http://www.datalink.net. Enter 992 on Inquiry Card.

Financials

www.byte.com
Something to STARE At

Forget 3-D because 4-D is here, literally here on this page. As you can see, it is stunning. Promises about 3-D stretch back more than a generation, but the reality was always disappointing, requiring that you wear colored lenses or that you buy very expensive and hokey viewing equipment. Some of the 3-D images also had the drawback of making you nauseous while you looked at them.

Arvin Papadopoulous, Inc., a tiny outfit from the high-tech wilderness of Boise, Idaho, has rendered all these 3-D efforts obsolete. The company is about to market a new kind of ink-jet printer that produces 4-D images on glossy paper. With this printing breakthrough, you can view all sides (including the inside) of every object in a picture. And you can also see the “fourth dimension,” which is time. You can see the images move! And you don’t even have to wear goggles!

This new printer allows you to vary the printing process so that the images appear to move in real time, accelerated time, or even slow motion. Ironically (and this example really demonstrates that life is a series of technological trade-offs), with this process, it is difficult to print an image that appears to be “still.” Admittedly, it takes a while to accustom your eyes to the Papadopoulous system. But once you “get it,” you will be able to instantly see the full glory of any other picture of this kind.

The image shown above (it appears to be three images, but really isn’t) was prepared using a beta version of the 4-D printer. To view it, position your eyes about 30 centimeters from the paper and hold the page at a slight angle. Do not blink (that’s important). If this is the first Papadopoulous image you have seen, it will likely take approximately 4000-4500 seconds before you see the picture for what it is.

Continuous Bombardment

Our recent story about e-junkmail generated numerous letters from readers who want to join the fight against e-spam. But e-junkmail perpetrators often disguise their true addresses by forging the message headers. Even if you find them, e-junkmailers are elusive. They move quickly (and often) from one Internet service provider (ISP) to another. What’s needed is a way to find and track them as you lay down a stream of deadly fire to wipe them out. We speak metaphorically, of course.

An elegant program called Firehose (see the text box) does exactly that. Like e-junkmailers themselves, Firehose is relentless and inhuman. Some of you may ask whether this approach is overkill, in that the mail Firehose generates does itself soak up enormous bandwidth. Perhaps. But in this war to eliminate e-junkmail, it may be necessary to destroy the global village in order to save it.

Marc Abrahams is the editor of the Annals of Improbable Research. You can contact him by sending e-mail to marca@improb.com.
INTRODUCING
A WHOLE NEW CATEGORY OF HIGH-PERFORMANCE NOTEBOOKS.
(THE UNDER $4,000 CATEGORY.)

Okay, we admit it. We think our new line of Inspiron® notebooks is pretty impressive. And it offers a feature set for under $4,000 that’s even more exceptional. It comes loaded with a 233MHz Pentium® processor with MMX™ technology, the fastest mobile Pentium processor you can find in any notebook. A 13.3” XGA TFT screen, adding up to a 21% larger viewing area than a 12.1” screen and, thanks to XGA resolution, fitting 63% more information on the screen. 3D Surround Sound and high-performance video. Pretty amazing considering that even loaded with all these features, the new Dell® Inspiron 3000 M233XT weighs in at just 6.9 pounds. So you see a whole new category of notebooks has arrived. Dell Inspiron. The notebook for people who are looking for more. If you’re looking for more, give us a call or visit us on our website.

NEW DELL® INSPIRON™ 3000 M233XT
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- 2.1GB ATA Hard Drive
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INTRODUCING THE DELL INSPIRON 3000 M233XT—13.3” XGA SCREEN, 233MHz, SDRAM. FINALLY, HIGH-END FEATURES WITHOUT THE HIGH-END PRICE.

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Keycode #01260
## DELL DIMENSION® DESKTOPS FOR BUSINESS

### NEW DELL® D560 D266
333MHz Pentium III® Processor featuring MMX™ Technology

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<td>Upgrades</td>
<td>• 3Com® 3C905 Fast EtherLink® XL 10/100 PCI Card, add $99  • 4/8/16/24 PCI EIDE Tru Tru, add $199  • APC Back-UPS Pro 650, add $299  • 3 Years On-site Service</td>
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### NEW DELL® XPS D266
266MHz Pentium III® Processor featuring MMX™ Technology

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<td>• 64MB SDRAM Memory  • NEW 8.4GB Ultra ATA Hard Drive with 512KB Cache (9.5ms)  • NEW 1200HS Monitor (17.9&quot; v. i., 26dp)  • NEW Matrox Millennium II 8MB WRAM AGP Video Card  • NEW Creative Labs AWE64 Value Sound Card  • Altex Lansing ACS-90 Speakers  • Iomega Zip 100MB Internal Drive with One Cartridge</td>
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### NEW DELL® XPS D223
233MHz Pentium III® Processor featuring MMX™ Technology

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<td>Common features</td>
<td>• 32MB SDRAM Memory  • NEW 8.4GB Ultra ATA Hard Drive with 512KB Cache (9.5ms)  • NEW 1000TX Trinitron® Monitor  • NEW STB Velocity 4MB AGP Video Card  • NEW Creative Labs AWE64 Value Sound Card  • Altex Lansing ACS-90 Speakers  • Iomega Zip 100MB Internal Drive  • 3Com® 3C905 Fast EtherLink® XL 10/100 PCI Card</td>
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### DELL® D560s D233s
233MHz Pentium III® Processor with MMX™ Technology

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<td>• 32MB SDRAM Memory  • 4.4GB Hard Drive (9.5ms)  • 1000LS Monitor (15.9&quot; v. i.)  • Matrox Millennium II 4MB WRAM PCI Video Card  • Sound Blaster 16 Wavesynth WAVetable Sound  • Altex Lansing ACS-90 Speakers  • Upgrade to an 8.4GB Hard Drive with 512KB Cache, add $99</td>
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</tbody>
</table>

## DELL DIMENSION DESKTOPS FOR HOME

### NEW DELL® D560 D266
333MHz Pentium III® Processor featuring MMX™ Technology

<table>
<thead>
<tr>
<th>Feature</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Common features</td>
<td>• 64MB SDRAM Memory  • NEW 8.4GB Ultra ATA Hard Drive with 512KB Cache (9.5ms)  • NEW 1200HS Monitor (17.9&quot; v. i., 26dp)  • NEW Matrox Millennium II 8MB WRAM AGP Video Card</td>
</tr>
<tr>
<td>Order Code</td>
<td>#560100</td>
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</tbody>
</table>

### NEW DELL® XPS D266
266MHz Pentium III® Processor featuring MMX™ Technology

<table>
<thead>
<tr>
<th>Feature</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Common features</td>
<td>• 64MB SDRAM Memory  • NEW 8.4GB Ultra ATA Hard Drive with 512KB Cache (9.5ms)  • NEW 1000TX Trinitron® Monitor  • NEW STB Velocity 4MB AGP Video Card  • NEW Creative Labs AWE64 Value Sound Card  • Altex Lansing ACS-90 Speakers  • Iomega Zip 100MB Internal Drive</td>
</tr>
<tr>
<td>Price</td>
<td>$2999 Personal Lease: $134/Mo., 24 Mos.</td>
</tr>
<tr>
<td>Order Code</td>
<td>#560100</td>
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</tbody>
</table>

### NEW DELL® XPS D223
233MHz Pentium III® Processor featuring MMX™ Technology

<table>
<thead>
<tr>
<th>Feature</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Common features</td>
<td>• 32MB SDRAM Memory  • NEW 8.4GB Ultra ATA Hard Drive with 512KB Cache (9.5ms)  • NEW 1000TX Trinitron® Monitor (15.9&quot; v. i., 26dp)  • NEW STB Velocity 4MB AGP Video Card</td>
</tr>
<tr>
<td>Price</td>
<td>$2499 Personal Lease: $111/Mo., 24 Mos.</td>
</tr>
<tr>
<td>Order Code</td>
<td>#560100</td>
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</table>

### DELL® D560s D233s
233MHz Pentium III® Processor with MMX™ Technology

<table>
<thead>
<tr>
<th>Feature</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Common features</td>
<td>• 32MB SDRAM Memory  • 4.4GB Hard Drive (9.5ms)  • 1000LS Monitor (15.9&quot; v. i.)  • Matrox Millennium II 4MB WRAM PCI Video Card  • Sound Blaster 16 Wavesynth WAVetable Sound  • Altex Lansing ACS-90 Speakers  • Upgrade to an 8.4GB Hard Drive with 512KB Cache, add $99</td>
</tr>
<tr>
<td>Order Code</td>
<td>#560100</td>
</tr>
</tbody>
</table>

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**NOTICE:** Price is not negotiable. For a complete copy of our Guarantee as Limited Warranty, please write Dell USA L.P., Attn: Warranty, One Dell Way, Round Rock, TX 78682. Terms and conditions of guarantee are subject to change without notice. Dell, the Dell logo, PowerEdge, PowerConnect, Dell OpenManage, DellConnect, and DellNet are trademarks of Dell Inc. Microsoft, Windows, Windows NT, Windows 95, Windows 98, Microsoft Word, Internet Explorer, Microsoft Mouse, and IntelliMouse are registered trademarks and/or trademarks of Microsoft Corporation in the United States and other countries. Other marks and names mentioned may be trademarks of their respective companies. Dell Direct is a service mark of Dell Computer Corporation ©1997 Dell Computer Corporation All rights reserved.
Common features listed above plus:
- 1.33" XGA Active Matrix TFT Display
- 32MB SDRAM (144MB Max)
- 512KB L2 Pipeline Burst Cache
- 128-bit Graphics Accelerator with 64K Colors at 1024x768
- 2.1GB ATA Hard Drive
- Zoom Video and USB Ports
- Stereo Speakers with 3D Surround Sound and Yamaha SW Wavetable
- Cardbus ready/ Fast IR1.1
- 6.4 Pounds*
- Upgrade to 64MB SDRAM, add $399.

$3999
Business Lease: $142/Mo., 36 Mos.
Order Code #800016

NEW DELL INSPIRON™ 3000 M200ST
200MHz PENTIUM PROCESSOR w/MMX

Common features listed above plus:
- 12.1" SVGA Active Matrix TFT Display
- 32MB SDRAM (144MB Max)
- 512KB L2 Pipeline Burst Cache
- 128-bit Graphics Accelerator with 16 Million Colors at 800x600
- 2.1GB ATA Hard Drive
- Zoom Video and USB Ports
- Stereo Speakers with 3D Surround Sound and Yamaha SW Wavetable
- Cardbus ready/ Fast IR1.1
- 6.4 Pounds*
- Upgrade to a 4GB Hard Drive, add $349.

$3399
Business Lease: $120/Mo., 36 Mos.
Order Code #800017

NEW DELL INSPIRON™ 3000 M166ST
166MHz PENTIUM PROCESSOR w/MMX

Common features listed above plus:
- 12.1" SVGA Active Matrix TFT Display
- 16MB SDRAM (144MB Max)
- 256KB L2 Pipeline Burst Cache
- 128-bit Graphics Accelerator with 16 Million Colors at 800x600
- 2.1GB ATA Hard Drive
- Zoom Video and USB Ports
- Stereo Speakers with 3D Surround Sound and Yamaha SW Wavetable
- Cardbus ready/ Fast IR1.1
- 6.4 Pounds*
- Upgrade to 32MB SDRAM, add $199.

$2999
Order Code #800613

NEW DELL INSPIRON™ 3000 M233XT
233MHz PENTIUM PROCESSOR w/MMX

Common features listed above plus:
- 14.1" SVGA Active Matrix TFT Display
- 32MB SDRAM (144MB Max)
- 512KB L2 Pipeline Burst Cache
- 128-bit Graphics Accelerator with 64K Colors at 1024x768
- 2.1GB ATA Hard Drive
- Zoom Video and USB Ports
- Stereo Speakers with 3D Surround Sound and Yamaha SW Wavetable
- Cardbus ready/ Fast IR1.1
- 6.4 Pounds*
- Upgrade to 64MB SDRAM, add $399.

$3999
Business Lease: $142/Mo., 36 Mos.
Order Code #800016

DELL POWEREDGE SERVERS

Common features listed above plus:
- 128MB ECC EDO Memory (512MB Max)
- 4GB Ultra-Wide SCSI-3 Hard Drive (27GB Max)
- 24X Max* Variable SCSI CD-ROM
- APC SmartUPS 700W Power Supply
- 3Com Office Connect Hub 8-Port/TPC
- 6 Drive Bays: 3 Hard Drive, 3 Removable Media
- 6 Expansion Slots: 3 PCI, 3 EISA
- Microsoft Windows 97 NT Server 4.0 (10 Client Access Licenses), add $799.

$4999
Business Lease: $177/Mo., 36 Mos.
Order Code #250101

DELL POWEREDGE™ 2200 SERVER
233MHz PENTIUM II PROCESSOR Dual Processor Capable, RAID Capable

Common features listed above plus:
- 128MB ECC EDO Memory (512MB Max)
- 2GB Ultra-Wide SCSI-3 Hard Drive (27GB Max)
- 24X Max* Variable SCSI CD-ROM
- 6 Drive Bays: 3 Hard Drive, 3 Removable Media
- 6 Expansion Slots: 3 PCI, 3 EISA
- Upgrade to 286MHz Pentium II Processor, add $300.
- 12/24GB Variable SCSI DAT Tape Backup Unit, add $1099.

$2999
Order Code #250100
You'll be doing a double-take once you've seen the new Dell Dimension® XPS D266. Because it's more than just a 266 megahertz demon. We've armed this Intel Pentium® II processor-based system with the new STB Velocity 4MB AGP card, boosting 3D graphics performance a whopping 317% over the STB Nitro 4MB PCI video card. And faster graphics means more realistic and more lifelike graphics. On this Dell Dimension XPS D266, design, CAD/CAM, virtual reality imaging, web content development, games and just about any other 3D application will blow you away. We've also included high-speed SDRAM memory that "bursts" data twice as fast as EDO memory, and a 8.4GB Ultra ATA hard drive (up to 8.4GB available) with two times the data transfer rate of a non-ATA hard drive. So give us a call or visit our website today.