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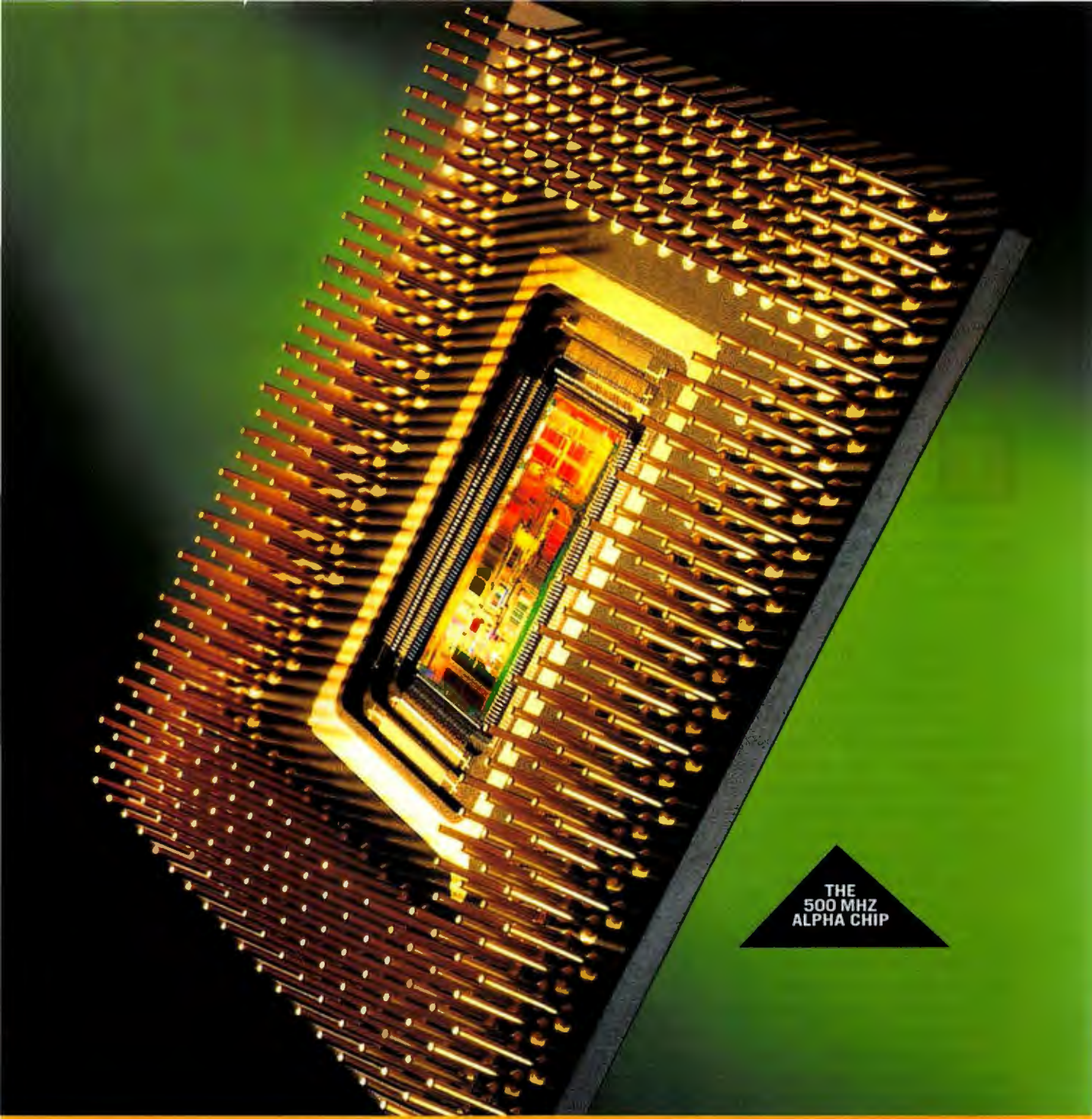

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editorial

Industry Warfare: What's Up with That?

Business is booming, but so are the cannons of competition.

The Mars Pathfinder mission produced over 400 million hits at related Web sites in just the first week. If you were up on the Net in the first hours after the landing, you were probably as bemused as I was. Far from being prepared for this onslaught, a lot of the non-NASA sites that traffic in science/science fiction were totally absorbed by the 50th anniversary of the Roswell, New Mexico, incident. Pseudoscience and dubious history outshining the real thing? Guess again.

Maybe the smart guys ain't always so smart. That's the theme of the computer industry recently. Look at the behavior of some of the major players. The market is booming, but rather than take a "rising tide floats all boats" attitude, they're wasting time and money on infighting. What's up with that?

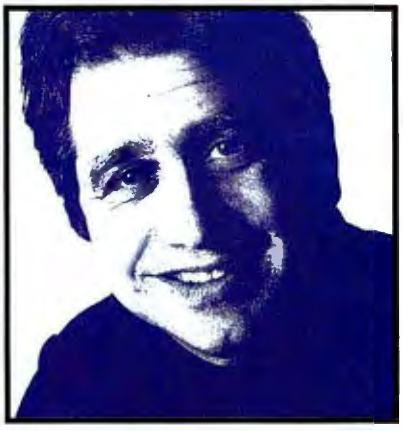
The increasingly contentious Windows and Java camps are a perfect example. They're in a fierce war. The first casualty: openness. The straw man argument of the year is "Standards bodies take too long. Customers want us to get products to market sooner."

Hello! Has anyone noticed this Internet thing? Produced by standards bodies, wasn't it? Both the Internet community and the communications community have known for a long time how to work with standards bodies, anticipate them, get products to market that embody draft standards and are upgradable, and assure users that the road ahead is not fraught with dead ends. Time for the software industry to place more emphasis on that process and less on shipping beta software as finished products.

The fact of the matter is that neither Windows nor Java is remotely close to being open. That doesn't make them bad, but until Microsoft and Sun turn technologies like ActiveX and Java over to committees that can really craft the technologies' futures in a consensual manner, I won't call any of them open. Popular, available, inexpensive, and useful—even extensible—is not the same as open.

How long can Microsoft say that "Java is a language, Windows is the platform" without becoming irrelevant to a significant portion of its customers who persist in multiplatform computing? Doesn't the company remember when Windows was as immature as Java is now and people still chose it over their installed systems? And the Java crowd is going to have to grow out of its puerile "pure Java" stance to embrace living legacies like Windows.

And what's up with Intel? Here at BYTE we're watching the Slot 1/Socket 7 controversy very closely. The historic, relative flexibility of the Intel architecture has certainly helped Intel become the dominant force it is. Now, Intel seems bent on dictating not just processor architecture but computer architecture as well.



Maybe the smart guys ain't always so smart. That's the theme of the computer industry recently.

It's a curious tack to take. A few years ago, we all debated endlessly whether RISC would overtake CISC. That war is over. Intel has brought RISC concepts like pipelining into its architecture. That, and the continued preponderance of integer-based computing, has kept the floating-point kings of the RISC world at bay. If anything, the dual-processor Intel machine running NT has become a very solid alternative to many RISC/Unix workstations. Is Intel that worried about AMD and Cyrix?

We're in the midst of a pendulum swing away from general-purpose computers and toward a greater number of specialized platforms: Web TVs, network computers, PDAs, desktops, uniprocessor servers, quadprocessor servers, and so on. The more Intel owns of the PC architecture, the less able it will be to serve that diversity of needs. If the Sequents and Corollaries of the world had not pioneered symmetric multiprocessing with the 486, would Intel be in a position to turn SMP into a commodity today? No way.

What about emerging technologies like hand-helds or wearable computers? Are they to be stuck with a one-size-fits-all technology like the Pentium II single-edge cartridge? Or will other chip makers fill their needs? Probably not what Intel had in mind, but it could be the outcome.

Mark Schlack

Mark Schlack, Editor in Chief
mschlack@bix.com

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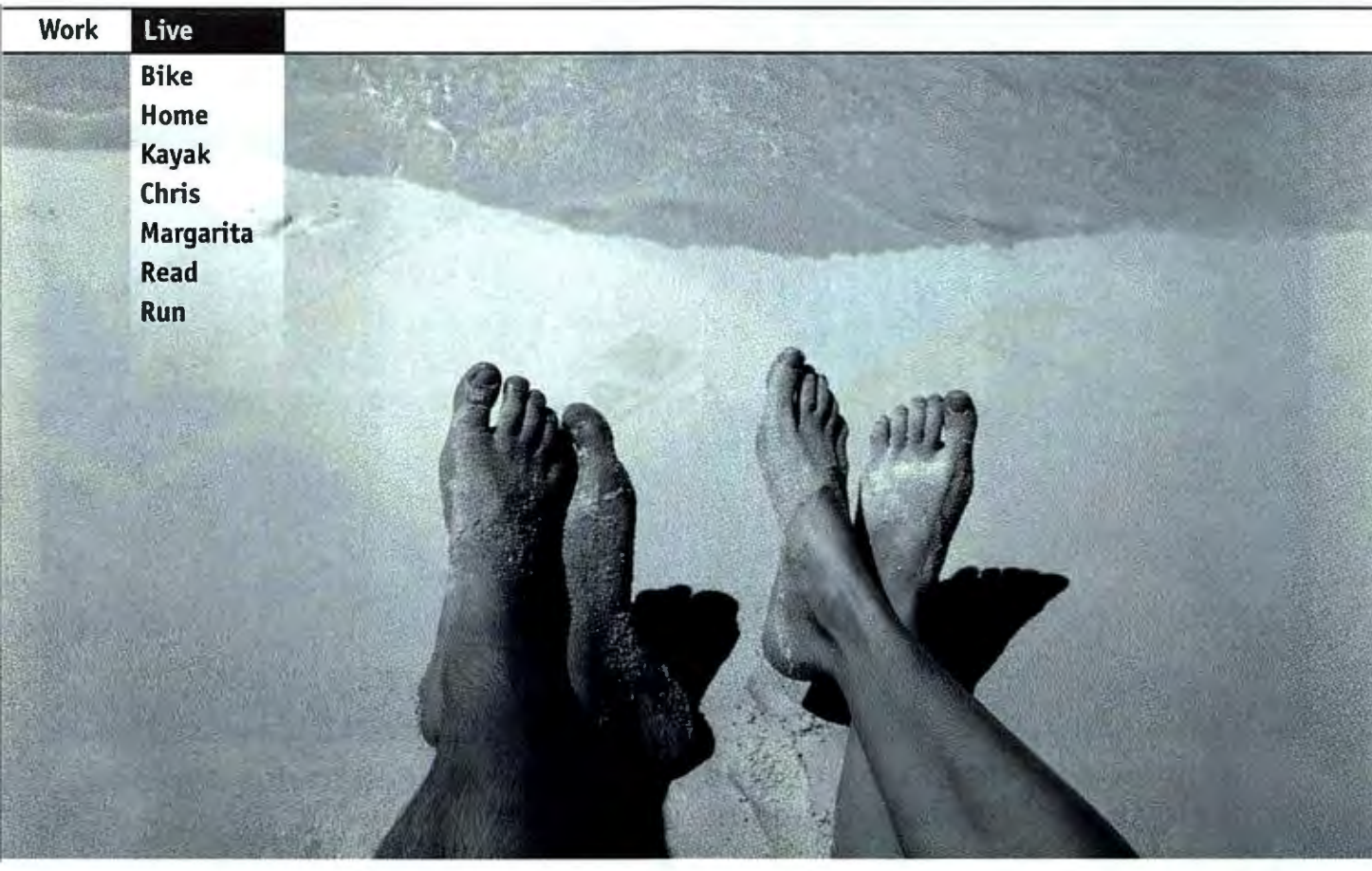
IBM's VisualAge® for Java™ extends existing server apps to the Web without rewriting from scratch.



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Thanks for Not Being Pushy

How refreshing! You actually have the audacity to resist the rampant bandwagon-jumping that threatens to strangle diversity out of the computer industry. I'm talking about "The Pull of Push" (August), in which you call "push" technology what it really is: a useless moniker cooked up by publicists and ad men in the unending quest to attract the all-important consumer dollar.

The pace of change in the computer industry is breathtakingly rapid enough when driven by the one thing that will help us all: technology that makes life easier and more productive. When the widening acceptance and use of computers spurs product creation and promotion through the implementation of "TV think," we are all threatened with unnecessary product obsolescence and the ensuing costs in dollars and loss of productivity.

Thank you for being the first to resist this silly trend. Maybe clear examination of this subject will keep push from becoming the latest addition to '90s-speak.

Michael H. (Ned) Franz
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Steward Observatory Mirror Lab
nfranz@as.arizona.edu

CDPD in the Real World

In "Air War" (Special Report, August), Marty Jerome suggests that CDPD is a standardized and useable product. While CDPD is available and being employed by some wireless users, many of the nation's largest wireless users have shied away from it. On two occasions I have been involved in an evaluation of CDPD technology. In both tests it came up lacking.

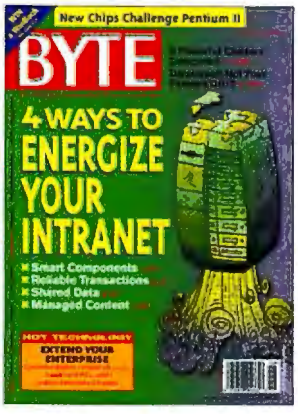
There were two primary concerns with CDPD. First, the suggestion that CDPD works on channels that the voice system is not using. This is technically true, but in a metropolitan environment where cellular traffic is heaviest, most CDPD vendors have supplied dedicated channels to CDPD traffic, and the channel-hopping mode has proven quite difficult to use. Without the overhead of adding TCP to our IP packets, it was almost impossible to get any data through reliably.

Second, the system claims to have coverage that is not really available. Not all cell sites in a given metropolitan area are equipped with CDPD base stations, nor all repeaters. In fringe and rural areas, the coverage is even worse. For our circumstances, with thousands of mobile units using wireless every day, CDPD was not a viable solution.

Chris Chappell
iim1cjc@smtpgwy.roadnet.ups.com

Digital Mud, 1833

Your Future Watch item ("Digital Ink Gives New Meaning to Paper Recycling," August Bits) suggests that the time may come when readers can receive each new issue of their newspaper printed on the same sheet of paper as was the previous issue. That time may have come 164 years ago, if we can believe a note in the Philadelphia *Saturday Courier* of December 21, 1833.



"We heard lately," the note reported, "of a newspaper establishment in Indiana, somewhat novel in character. A printer has provided himself with a supply of wooden type[s], and having set up the form of his paper, each of his subscribers furnishes him with a piece of linen or muslin of the proper size, whereupon the printer inks his type with swamp mud, and takes the impression upon the cloth for each patron, who receives his Paper on Saturday, and after reading it, has the cloth washed in the nearest 'crick' and sent back in time for the next impression."

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School of Library and Information Science
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Stop Making Us Feel Stupid

Jerry Pournelle, whose column I enjoy, says that he was made to feel stupid by not knowing how to prevent DOS-based games from blowing up in Windows 95 (Chaos Manor, August). This is a very computer-literate person who was made to feel stupid by something that is supposed to provide entertainment. Imagine how John Q. Average-Computer-User feels! I have shared Jerry's frustrations, and I have been

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involved with computers for 30 years. I finally gave up and threw out my DOS-based games after trying special boot disks and all the other suggested remedies.

The software producers have lost sight of the fact that their ultimate market potential depends not only on super graphics but also on simplicity and reliability. Inadequate manuals (forget on-line help) and nonexistent technical support are driving customers away. Developers are struggling with the interactions of layers of gigabyte software. Try to explain the advantages of spending megabucks on three-tier intranet data-warehousing systems to a CEO who has misgivings about entrusting his corporate and personal futures to a technology that cannot even run a game.

If the software industry sees its future in ever-larger, more complex, more expensive reissues of current products, it is wrong. The network computer may not be the answer, but Oracle's Larry Ellison is dead on target when he talks about the need for simplicity. Then nobody will feel stupid.

Kim Bassett
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NT's Not Proprietary? Ha!

In response to a letter on the subject of NT and Unix comparisons (Inbox, July), contributor Robert L. Hummel quoted "a significant part of the market" as saying "NT boxes ... don't lock us into a single-vendor hardware solution or become obsolete when the vendor wants a new revenue stream."

Excuse me, but if you substitute "software" for "hardware" in the above statement, you will find yourself describing Microsoft, whose power in the market is based on being a single-vendor software solution with a deadlock on its customers. Yes, RISC boxes tend to be proprietary, but so is Microsoft's software, a fact that the PC press seems to keep forgetting.

All commercial computing is proprietary; that's the nature of the beast. Please don't make yourselves look unaware of this simple fact by throwing "single vendor" barbs at one camp in defense of another camp. You should know better.

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Showdown at the MMX Corral

"MMX Power for Desktop PCs" (Hardware Lab Report, July) featured a small review of AMD's K6 CPU. What a disappointment. I expected a true objective analysis of Intel vs. AMD. And in the end you say that the AMD might be a strong competitor. Might?!? From what I've read and discussed, AMD beats Intel hands-down (including the Pentium II): 233-MHz vs. 233-MHz, AMD wins; 200 vs. 200, AMD wins. Of course, this is all based upon a system being set up correctly.

Josh Javage
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We said further on in that sidebar that as certain performance problems relating to chip sets and BIOSes are eliminated, "the K6 will be a potent competitor to the Intel CPUs." Based on our testing, we conclude that, in general, the K6 competes with the Pentium II almost clock-for-clock in integer performance but definitely lags behind in FP and MMX performance. As we said in the Lab Report, the K6 box we tested—XI Computer's Xi K200 MTower—"turned in a composite performance score

nearly identical to that of its MMX Pentium counterparts." (Also check out our June issue, page 26.) But AMD is slightly behind Intel in offering top clock speeds: The Pentium II is available (albeit in very small quantities at very high prices) at 300 MHz, while the K6 currently peaks at 233 MHz. AMD says it will have a 300-MHz K6 by the end of the year. Intel might be at 350 to 400 MHz by then. So Intel has about a six-month lead in highest clock speeds.
—Editors

IBM Channels and I/O Processors

Although I realize that Tom Thompson's article "I_2O Beats I/O Bottlenecks" (August) addresses bus-based machines, and that Mr. Thompson is speaking of lower-end PC servers, nevertheless his description of the IOP (I/O processor) is almost exactly the description of I/O "channels" on the much-maligned IBM mainframes. IBM recognized the importance of such an I/O subsystem many years ago. Mr. Thompson might have given them passing credit.

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MessagePad Maligned?

Come on, guys. Your August Lab Report ("Hand-Helds Get Serious," by Michelle Campanale) wasn't a fair, accurate article on hand-held computers, was it? Let's check the facts on the Newton MessagePad 2000 you did such a great job of maligning.

Spreadsheet? Yes, there is. Pager? A PC Card pager has been available for several years. Expense filer? Lots of freeware programs are available as extensions to its Notepad. Modem? A 28.8-Kbps PC Card modem is available. Regarding the external keyboard: Yeah, it's big, and that's good because you can actually use it (unlike those laughable CE keyboards). And how about the quick on-screen keyboard? A MessagePad 2000 is a great substitute for a heavy, slow-booting laptop, especially on a business trip. Oh yeah, and here's another big mistake. You say the MessagePad is "proprietary." Last time I checked, Newton OS was running on platforms from a number of different manufacturers.

Paul C. Smith
Tetrainfo@aol.com

While the Newton OS might be available on hardware from manufacturers besides Apple, none of those models met the stated criteria for our review. First of all, they had to be available. Digital Ocean, for example, has announced a Newton-based smart phone and a pager product, but neither was on the market. Harris has an

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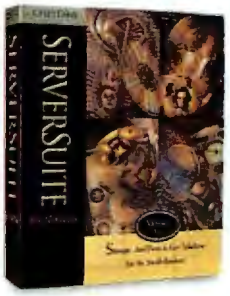

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inbox

industrial hand-held for telecom technicians, but we focused our review on units for general-purpose users. So that the MessagePad would meet our price cap, we didn't include items that were not part of its standard configuration. Likewise, we didn't list the add-ons for any of the other hand-helds.
—Michelle Campanale

FIXES

The "Price vs. Performance" graph (on page 111) of the July Hardware Lab Report on MMX machines was labeled misleadingly. It relates each system's price to its overall rating, not just raw performance. We apologize for any confusion.

For the sidebar "Kill Two Birds with One Phone" (on page 123) in the August Hardware Lab Report, we were given incorrect information about the weight of the Nokia Communicator. It does not weigh a tad over 2 pounds. It actually weighs .875 pound, or 397 grams.

COMING UP IN NOVEMBER

COVER STORY

Satellite Networks

We'll explain how they work, report on who's using them, and forecast the future of this technology.

FEATURES

Intel Sockets and Slots

Intel's Single Edge Contact (SEC) cartridge could backfire: AMD, Cyrix, core logic vendors, and motherboard makers locked out by SEC might band together.

NT Security

Ten steps to flexible lockdown of Windows NT systems.

REVIEWS

Virtual Private Networks

Private, worldwide networks running over IP might be this year's most intriguing use of Internet technology. The BYTE Lab tests VPNs and products that get you there from here.

Personal Protection

Personal encryption software is a must for security-conscious Web users. We test the leading packages. Plus: How to choose digital certificate software and services.

SuiteSpot or IIS?

For more and more Webmasters, the deployment decision comes down to Netscape or Microsoft. With this comparative review, we'll help you decide.

CORE

Inside the Virtual PC

Connectix has developed software that enables Macs to run Windows programs. The core of the Virtual PC is code that translates Pentium instructions into PowerPC instructions. We'll tell you how this software PC does its tricks.

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PC MAGAZINE EDITORS' CHOICE
November 19, 1996
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AGP: Who Needs It?

Intel's new LX chip set with support for Accelerated Graphics Port relieves PC bottlenecks. But applications and OSes that exploit it aren't here yet.

The first PCs that use Intel's new 440LX chip set, which is designed to optimize the performance of Pentium II PCs, have arrived. But software that takes advantage of these new capabilities definitely has not.

Intel's 440LX delivers support for synchronous DRAM, 33-MBps Ultra DMA, and other technologies that improve PC performance. But most of the focus with the 440LX is its support for Accelerated Graphics Port (AGP), which relieves congestion on the PC's PCI bus by moving graphics traffic onto a dedicated point-to-point channel between the graphics controller and the system chip set. And although developers say future versions of their programs will take advantage of AGP, BYTE found no significant difference in performance between the PCI and AGP versions of a popular graphics card when running 3-D modeling and visualization programs on a 300-MHz Pentium II PC.

AGP is designed to improve the graphics performance of Pentium II systems by providing a direct link between a PC's graphics card processor and system RAM through the core chip set. This gets the graphics card off the slower (133-MBps) PCI bus and onto its own dedicated channel. Intel claims AGP will speed graphics operations by allowing texture maps and other graphics data to be moved through a 66-MHz channel directly to main memory. The first implementation of AGP (called AGP-1x) will result in an effective doubling of graphics bandwidth over today's PCI to 266 MBps. Some vendors of graphics accelerator chips and boards will initially support AGP-1x, while others will support AGP-2x, which will deliver about 533 MBps. In 1999, AGP-4x will offer bandwidth of more than 1 GBps.

Applications that take specific advantage of AGP, like Rage's Incoming game, can deliver improved realism and smoother operation. But don't expect these programs to arrive until later this year.

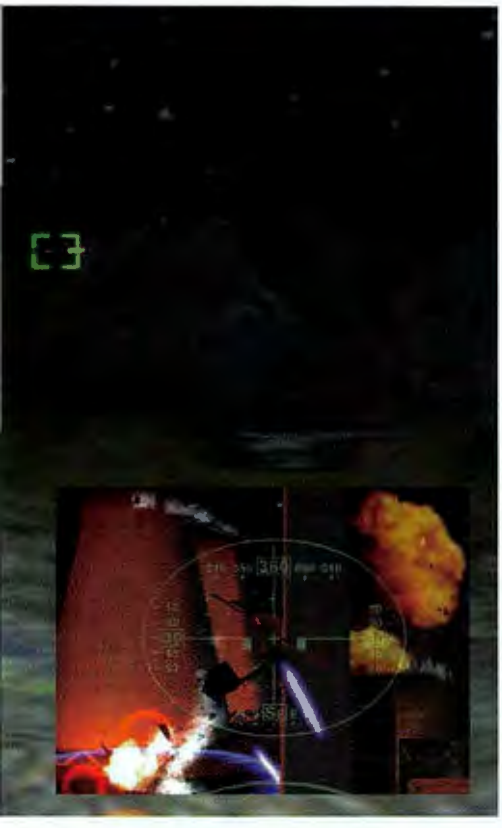
Intel officials say a PCI graphics card in a Socket 7 system doesn't provide enough bandwidth for high-end graphics, and that AGP solves this problem by letting graphics and other data run in parallel over separate channels. But some vendors say the problem with PCI isn't one of bandwidth but one of contention. "The limitations of PCI affect graphics only when your SCSI, network, and graphics cards are contending for resources at the same time," says Phil Parker, director of corporate communications at Number Nine Visual Technology. In most cases, he says, a slow graphics processor, not the PCI bus, is the bottleneck.

BYTE polled Intel and numerous graphics accelerator vendors, and none could provide the name of a single application currently suffering from a bandwidth limitation when using a PCI graphics card. (However, Intel officials say this is partly due to developers who write applications, such as games, so they don't exceed the PC's available bandwidth.) Despite this, many vendors, including Number Nine, Matrox, STB, and ATI, are already fielding AGP-based graphics cards.

Another advantage of AGP touted by Intel is that it reduces the amount of video memory that must be present on a graphics card. AGP allows the use of system memory as a virtual extension of a graphics card's memory, so that a system ven-

dor can include a 4-MB video card instead of an 8-MB one.

But board vendors and software developers dismiss this idea as not meriting serious consideration for high-performance graphics. "Graphics memory is cheap," Number Nine's Parker says. "We see the AGP bus as being a very large pipeline that feeds our graphics technology. 3-D applications will benefit with our AGP implementation by being able to send large textures across the high-speed AGP bus a single time and caching those textures in our processor's 8-KB internal texture cache and on the board's



local memory, up to 16 MB. Once the texture is on-board, the on-board graphics engine can manipulate those textures at speeds of up to 1.6 GBps [which is faster than AGP]. In this case, additional memory on the host is the secondary cache." John Heap, spokesman for U.K.-based Rage Software, whose forthcoming game Incoming will take special advantage of AGP by using highly detailed, large textures, agrees. "It is more beneficial to use the local RAM [on a video card] and then use AGP and system memory as an overdraft on local texture memory."

Several factors are contributing to AGP's lukewarm reception—with the lack of currently bottlenecked applications heading the list. Some manufacturers point out that the increase in the speed of the PCI bus from 33.3 MHz to 66.6 MHz will allow it to shoulder more of a load when servicing graphics cards and postpone any real need for AGP. IT managers also face an additional support headache: Those who embrace AGP will have to support two different styles of video boards—something we thought we left behind with VLB on the 486.

Finally, there's the question of what to do with AGP when you get it. Currently, OS support is minimal. Although touted as a technology for high-end workstations, AGP won't be supported in NT until version 5. For Windows 95, an Intel-written VxD is currently available, but native support for AGP isn't planned until the release of Windows 98.

So who needs AGP? Applications that specifically exploit it are not available today, but AGP puts the foundation in place to provide better support for developers of games and other programs that can benefit from smoother play and more realistic images. And, AGP also provides an immediate benefit by freeing up the PCI slot from having to carry graphics traffic, giving more headroom to high-speed PCI networking peripherals and hard drives. So if you buy a new AGP system, you might as well buy an AGP board, especially since it will likely cost no more than the PCI version of the same card. In the meantime, as we wait for applications that really show off AGP's benefits, it will be interesting to see if some vendor finds a new way to use this contention-free, high-bandwidth channel that's different than what Intel originally envisioned. **–Robert L. Hummel**

File Servers Get Thinner, Cheaper

You've heard of thin clients—now look out for thin servers. Several vendors are touting new file servers that offer easier installation, more flexibility, and lower prices than traditional file servers.

Although implementations vary, these new file servers (also known as network drives or direct-attached storage devices) usually include a low-cost RISC processor, real-time operating system, built-in network connections, ASICs, and disk enclosures for mass storage. The real-time OS approach lets vendors base these thin servers on inexpensive dedicated I/O chips instead of general-purpose CPUs such as the Pentium.

Because vendors port standards such as NFS, HTTP, SMB, and HTTP to run over their real-time OSes, these thin servers can appear as just another drive or server to other computers or applications on the network. Attach a thin server to the network, and the system will

Geek Mystique

Internet Killed the TV Star

Household activities replaced by Internet usage include watching TV (35 percent) and reading (31 percent), according to the 1997 Price Waterhouse Consumer Technology survey. Three out of four surveyed don't have Internet access, and almost half

(46 percent) of respondents without Internet access said they would "never" get Net access at home. But most of those naysayers were 35 years old or older. That means technology companies should focus their efforts on the up-and-coming cybergeneration.

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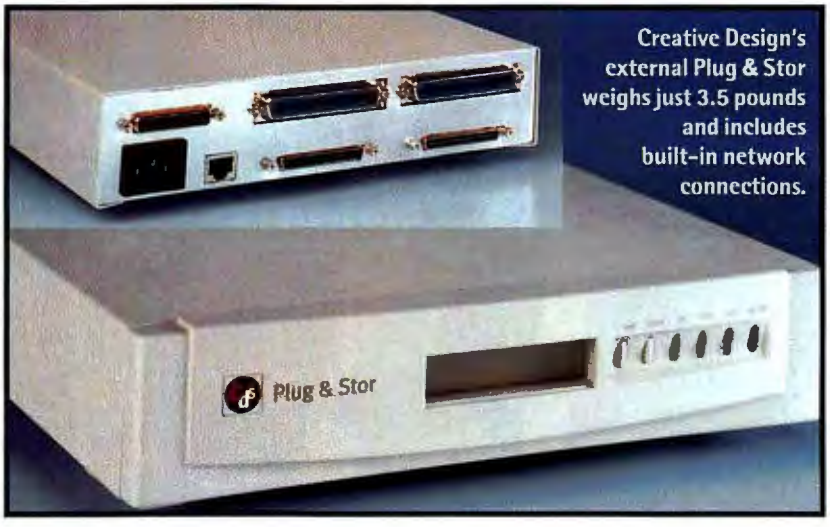
configure itself (while likely asking you a few questions on the way) without requiring you to shut down your server. Using a real-time OS that supports popular networking protocols, instead of NT or NetWare, lets you add storage devices without having to buy new OS licenses. And since you manage the storage using another PC that's already on the network, these miniservers don't require keyboards, monitors, mice, or other peripherals. The end result: a mini file server that's about the size of a bread box and is available for a price that starts at less than $1000.

Mike Peterson, president of Strategic Research (Santa Barbara, CA), a market research firm that covers storage management, says these new types of network-ready storage products offer easier installation and management than traditional solutions, while letting workgroups add storage close to the users rather than at a centralized location. Network-ready storage systems reduce the data traffic going out from one workgroup's subnet across the network.



Creative Design's external Plug & Stor weighs just 3.5 pounds and includes built-in network connections.

Several vendors have begun shipping such devices, including Creative Design Solutions (408-653-1330; http://www.creativedesign.com), Axis Communications (617-938-1188; http://www.axis.com), and soon, Mylex's Network Power & Light division (510-608-2222; npl@mylex.com). Creative's Plug & Stor 100 internal version is an AT motherboard for building storage servers, while the 3.5-pound external version (see the photo) includes a 3.5-inch drive bay and attaches directly to the network. While other vendors use I/O processors, Creative uses the Pentium. Axis' StorPoint HD family uses multiple Iomega transportable Jaz drives and sells at prices starting at $999. Mylex's NPL division won't formally announce its products until later this year, but company officials confirm the products will be based on a dedicated I/O processor and a real-time OS.

Net drives satisfy a variety of needs, especially affordable storage additions for workgroups, vendors say. However, these devices aren't suitable for all server/storage needs. For one thing, unless based on a high-performing CPU that can run NT or a commercial Unix, these peripherals won't be useful as application servers. Also, initial systems are not powerful enough to scale into high I/O loads that a large disk array needs. Like network PCs, network-ready drives won't solve every problem. But they offer an easy, affordable solution to many storage management problems today. **–Dave Andrews**

Future Watch

New Design for Cheaper Digital Cameras

A new design guideline for digital cameras should make these devices work better with PCs and cost less. Started by Intel and supported by HP, Eastman Kodak, Microsoft, and others, the Portable PC Camera '98 Design Guideline places the responsibility for compute-intensive tasks (such as image decompression and enhancement) with the PC processor instead of the camera. Only minimal compression takes place in the camera, reducing the compute requirements for on-camera microprocessors. Minimal compression means the cameras will require more storage, which is why the guideline also calls for removable flash memory. Other key components include support for the FlashPix format and Universal Serial Bus. Intel says the spec, by giving more of the image capture work to the PC processor, will reduce the price of a camera by about $100. But just as important, the guidelines call for smoother integration with PCs. Products based on the guideline should start appearing next year.

Ink-Jets: No Longer Just Low-End

Printer vendors are finding new high-end uses for ink-jet technology. Prices for color ink-jet printers continue to drop, and many companies will continue to market color ink-jets that sell for under $150. But ink-jet technology is increasingly being used to tackle a host of high-end design, engineering, and graphics tasks.

In the small office or home environment, color ink-jets have beaten out low-end laser printers. According to IDC (Framingham, MA), a research and consulting firm, 5-pages-per-minute (ppm) color ink-jets average $425, while 8-ppm monochrome lasers cost $525. The price of this class of laser printers has dropped only 12 percent from 1996, while ink-jet prices have dropped 16 percent in the same time. Plus, these color ink-jets have achieved near-photographic color quality.

Ink-jet companies say color ink-jets will further encroach on other classes of laser printers. "The price for lasers is coming down fast," says Dan Crane, vice president of marketing for Epson. "I think the collision will be at $999." To compete, ink-jets must improve print speeds considerably. Currently, most classes of ink-jet printers are limited to around 5 ppm in monochrome and 3 ppm in color. Ink-jet vendors generally inflate these estimates, warns Charles LeCompte, publisher of the *Hardcopy Observer*, an industry newsletter. But "there is no ques-

tion they will squeeze higher speeds out of these machines," he says. "You can shoot more drops onto the page, or get the ink to dry faster, but some technology will emerge that can improve on what printers are achieving today."

A collision between workgroup laser printers and color ink-jets will not happen for some time. Ink-jet printing speed will probably not increase significantly for several years. The next-highest class of laser printers is the "deluxe personal laser printer," and no ink-jet has been able to match the speed (around 12 ppm) and monochrome text printing capabilities of this class. These lasers will continue to be affordable printers for high-volume monochrome document printing. Laser printers are rapidly coming down in price. They now offer higher print speeds with color printing at prices that start around $3000 (see "Color Lasers: Cheaper, More Compact," August Bits). Also, according to Marco Boer, consultant partner with IT Strategies, color ink-jets are poorly positioned to compete with workgroup printers because only 2 percent of ink-jet printers have network interface cards.

Several strategies are in use to improve speeds in ink-jet printers. Hewlett-Packard's 1600C has paper-heating elements to speed the drying process, but this is an inelegant solution and is not likely to be common in the future. Epson has two technologies that are potentially beneficial—quick-drying ink and piezo print heads—but they have yet to result in significant improvement. The quick-drying ink has not yet produced faster print speeds and, like most color ink-jet printers, requires special paper. Micro piezo print heads, which use electronic impulses instead of thermal pressure, could significantly improve printing speeds, but most vendors are committed to thermal printhead technology.

Despite the limitations, it is a mistake to dismiss color ink-jets as consumer appliances, specialty devices, or low-end color printing solutions. IT Strategies estimates that $19 billion will be spent on wide-format graphics printers (with a printing width in excess of 24 inches) by the year 2000. Ink-jets are a major player in this market. In 1996, 6700 such color ink-jet systems were sold, expected to climb to 24,000 by the end of the century. These printers replace crude CAD plotter printers and are widely used for proofing by art departments. Designers can create inexpensive proofs, and it is simple to output big, bold prints in-house. Color ink-jets are making inroads into print production houses. As professional printers increasingly turn to ink-jets, sales of electrostatic printers have declined 18 percent, and wide-format ink-jets have experienced a 6 percent jump during the same time.

Typical of these color ink-jet printers is the Hewlett-Packard DesignJet 2500CP ($11,995). It has 600-dpi print resolution and can print 16 million colors on paper up to 3 x 150 feet. Some manufacturers are betting on smaller wide-format printers, giving people outside design departments more printing options. The Epson Stylus Color 3000 (less than $2000) enables professional graphics artists and digital photographers to produce color proofs. It prints on paper ranging from 4 x 4 inches to 17 x 22 inches. Tektronix is offering similar functionality in its wide-format solid-ink printers. Ink-jets are beginning to penetrate the textiles market, too. Canon is selling an ink-jet printer to textiles companies that's priced around $1 million.

Vendors will continue to focus on mainstream consumer printers. But for graphic artists, engineers, and office workers, cheaper, wide-format color ink-jets are offering some of the same printing capabilities that professional print shops are deploying. **–Jason Krause**

Better Networks Through Accounting

A new class of applications lets IS managers track who uses valuable network resources and helps them better plan for network usage and capacity. Whether it's called network accounting, Internet accounting, or data accounting, one thing is apparent: Managers now have a way to see who's using the network, how much, and for what purpose.

In most corporate settings, each department or profit center is billed back for use of services—phone calls, paper, secretarial help. Most firms have a lot of money invested in data networks, so some might ask: Why shouldn't the departments or divisions that demand improved access and connectivity (e.g., to the Internet) be charged for that use rather than having it all come from corporate overhead?

Until now, such networking expenses were usually billed to the data processing budget. But in almost every other

Bug of the Month

Man Finds Bugs on Mars

Wherever a computer goes, bugs are sure to follow. When the Mars Pathfinder developed a glitch, NASA had to somehow upload new code without losing valuable time needed for exploration. The most confounding bug on the Pathfinder mission appeared July 10. Steven Stolper, software engineer for the Mars Pathfinder, calls it "one in a million, insidious, and hard to replicate." The snafu arose because the OS, Wind River's VxWorks, developed a mutual-exclusion problem: A low-priority function (in this case, recording weather) interfered with the system's multitasking schedule. The system couldn't finish all the tasks it needed to, missed a real-time deadline, and then shut itself down. "It's a kind of interplanetary Control-Alt-Delete," says Stolper. "When things go wrong, the system goes into a power-safe mode and waits for ground control to help out." Without a fix being implemented, this problem would replay itself over and over.

PHOTOGRAPH: NASA/JPL/CALTECH © 1997

Pathfinder bugs inhibited the Rover.

To identify the bug, engineers recreated the malfunction on Earth, identified the offending subroutine, and uploaded the binary difference between the new code and the buggy code on the Pathfinder. –Jason Krause

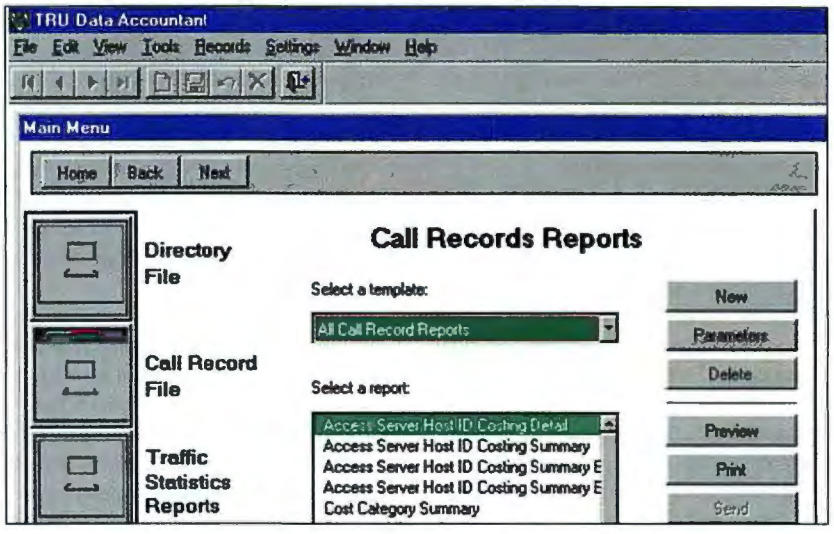
Send yours to jkrause@mgh.com!

accounting bracket, use of resources such as long-distance phone calling gets billed back to the department that uses the resource. Call accounting for telephone calls is widespread and accepted when it comes to voice communications. Soon, the same might be said of data accounting for data calls. As desktop videoconferencing, broadband Internet access, and other bandwidth-hungry applications become commonplace, network planners and beancounters are demanding records of use.

The State of Montana is investigating the possible tracking of data traffic for bill-back and for network planning purposes. "We are hoping to integrate both our data and voice systems into a single system," says Carl Hotvedt, bureau chief for network operations for the state. Such a system would let managers like Hotvedt answer basic questions such as: Who is using the network, how much, for what purposes, and at what cost?

Another common assumption is that if existing bandwidth is not used, it is simply wasted. But no network is free. Somewhere, somebody gets a bill. Increasingly, the financial officers who approve these bills seek to lower or minimize network costs. Simple applications, like in-band transmission of e-mail over the Internet or corporate intranet, need to be accounted for when planning network capacity. Bandwidth is not free any more than long-distance calls or 800 numbers are free. Accountants want to allocate bandwidth use to profit centers. To do that, network planners have to find ways to account for use.

Cisco Systems (408-526-4000; http://www.cisco.com) markets a product called Cisco Enterprise Accounting. CEA 1.0 supports accounting, billing, and reporting of ISDN applications. The software is hardware device-independent. Any Cisco device supporting the Cisco ISDN Call History MIB (11.0(7) or later) can be polled. Raw call data is captured by CEA's SNMP poller and is stored in the software management information bases (MIBs). CEA then translates and filters raw call data into standardized or flexible call data records (CDRs), which are stored in a relational database that drives applications such as end-user accounting, cost allocation, and traffic statistics. In addition, network monitoring lets managers catch network use that's excessive or in violation of a firm's policies.



Telco Research's data network tracking application lets you monitor usage patterns in your company.

Transmission costs far outweigh all other network costs combined, according to Cisco's Bob Berlin. The system Cisco markets was designed by Telco Research (Nashville, TN; 800-488-3526; http://www.telcores.com) and runs on PC-based software linked to a router. The software catches FTP, e-mail, Internet telephony, and all other traffic that passes through the router. "This allows management to build a history," says Stephen Doster, Telco Research's director of marketing. "It is a great tool for network planning and optimization." The State of Montana also uses Telco Research's call accounting system, and Hotvedt hopes to integrate call accounting and data accounting.

Other firms' new releases of network management software, like ForeView 4.1, from Fore Systems (412-772-6600; http://www.fore.com), let integrators and managers mine data-usage figures. According to Fore's David Colodny, network operators need an accounting tool both for billing and for performance analysis, including capacity and quality of service. Fore's tool, developed with PBX switch manufacturer Nortel, is software-based. It collects 40 variables, ranging from call duration to number of calls received.

Telemate.net, from Telemate (770-963-3700; http://www.telemate.com), sifts information from most common firewall logs. Data can be sorted by individual user, company division, or geographic location. "Rather than shutting off use for different sites, like news or entertainment, this allows MIS to hold workers and managers responsible for their use," says Bill Lassiter, marketing manager. The program allows varying

Survey

Will You Implement Wolfpack?

Most companies with under 500 employees won't use NT's integrated cluster failover technology (aka Wolfpack).

Source: BYTE Research Dept. survey. Total responses equals 111.

A higher percentage of companies with 500 or more employees plan to use Wolfpack.

Source: BYTE Research Dept. survey. Total responses equals 25.

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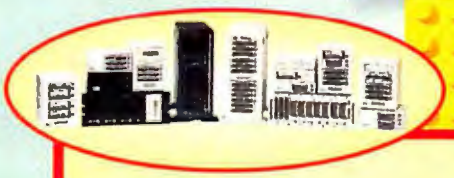

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bill-back charges by time of day, bandwidth, or number of packets used. Telemate.net automatically prepares paper or e-mail reports daily, weekly, or monthly to make sure information is distributed.

Sequel Net Access Manager, from Sequel Technology (206-556-4000; http://www.sequeltech.com), is available in a server version and in a personal version called NetPIM. It filters each IP packet and reports both Internet and intranet traffic, allowing accounting for use. Cost is $499 for a five-user server pack, $20 for the single user.

Bandwidth accounting also is valuable as a planning tool. Exception reporting (crashes, fraudulent use, congestion) helps a network manager see where in the network added capacity is needed. One thing that's starting to change is the concept of the free data network ride.

"The thing to overcome is this notion that bandwidth is free," says Telco Research's Doster. "The voice people know all about charge-back, and now the same is true for data networking."

–Curt Harler

Datapro Report

NT Clustering Solutions Compared

NT clustering solutions, including Microsoft's Cluster Server (Wolfpack), provide affordable ways of maintaining high availability of computing resources. Wolfpack is slated to ship soon , but other solutions already offer capabilities that Microsoft doesn't (yet).

Digital's Clusters for Windows NT

(800-344-4825; http://www.digital.com/)

With Digital's Clusters for Windows NT, two active servers are coupled via a shared SCSI bus to create a single system environment. Each storage device on the SCSI bus is assigned to one or the other server. If one server fails, the other server assumes the failed server's workload and shared storage and file shares. Applications automatically restart on the second server, and Windows clients are automatically reconnected. The two servers need not be identical, but they must both be either Alpha servers or Prioris (Intel) servers. The disks in the shared storage do not need to be Digital disks.

Digital's Clusters for Windows NT boasts numerous application recovery scripts. The cluster management software is strong and offers better integration with server management software than other solutions.

Microsoft's Cluster Server

(206-882-8080; http://www.microsoft.com)

MSCS allows failover between two servers in a shared storage cluster. A second version, expected in late 1998 (or 1999), will support larger clusters and additional cluster functionality, including scalability.

MSCS will initially be supported only on validated configurations. If MSCS is in your plans, ensure that your servers, including the hard drive and network cards, have been validated. Currently, MSCS requires both servers to be identical models.

MSCS is a safe, albeit minimal, choice. You'll have to write many of your own application failover agents or wait for Microsoft and other developers to provide them. MSCS doesn't support automatic failback, and the lack of a TCP/IP recovery agent for MSCS is disappointing.

NCR's LifeKeeper

(800-774-7406; http://www.ncr.com)

Datapro believes that NCR's LifeKeeper is the most comprehensive and flexible clustering solution currently on the market. With its ability to run on many vendors' servers, its support for failover plus a degree of load balancing, its numerous application recovery kits, its two-node active/active or three-node active/standby configurations, its ability to reconnect all client types without additional client software, and its choice of shared or mirrored storage, LifeKeeper should be given first consideration by any organization that's planning to install an NT cluster.

Veritas' FirstWatch

(800-258-8649; http://www.veritas.com)

FirstWatch is available from Veritas or its distributors (Data General, for example, provides a bundle called Cluster In A Box with its Aviion NT servers). Configurations can consist of two servers that are normally active and can failover to each other. Or, a FirstWatch configuration can consist of up to four active servers that may each failover to an idle standby server. FirstWatch also includes a management tool that can be used locally or remotely with any Web browser.

–Jane Wright

For more on Datapro reports: 609-764-0100; fax: 609-764-2814; http://www.datapro.com.

Clustering Product Comparison

	Clusters for Windows NT	Cluster Server (WolfPack phase 1)	LifeKeeper	FirstWatch
Developer	Digital Equipment	Microsoft	NCR	Veritas
Platforms supported	Digital Prioris servers, Digital Alpha servers	Validated server models from a variety of vendors	NCR, Amdahl, IBM, HP, Sequent	Certified Intel/NT servers
Automatic failback	Yes	No	Yes	Yes
Bidirectional failover	Yes	Yes	Yes	Yes
Max. number of servers in cluster	2	2	3	5
Number of application recovery kits available	9	4	9	8
List price per server (US$)	$995	Pricing information not yet available	$2000	$2475

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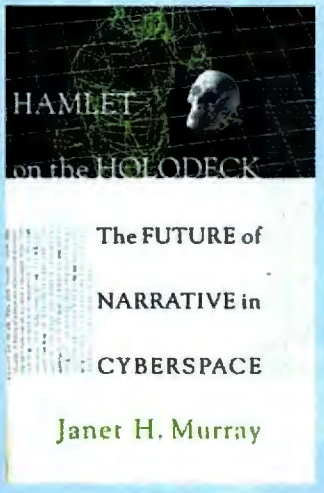
Book Reviews

New Media's Next Revolution

In the age of hypertext, cybersurfing, and interactive virtual environments, we sense ourselves at the cusp of something revolutionary, and yet, at the same time, we feel somewhat underwhelmed. For many users, the reality of the Internet falls short of its possibilities. If we are to fill the gap between promise and reality, it will take visionaries who understand the technical hurdles and the new structural and aesthetic mechanics to transform the media rather than simply recompose it.



Janet Murray, who explores the rich possibilities of new electronic media in her book *Hamlet on the Holodeck*, is uniquely qualified to elucidate the challenges ahead. In addition to holding a Ph.D. in literature from Harvard, she is a senior research scientist in the Center for Educational Computing Initiatives at MIT and teaches interactive fiction in MIT's Film and Media Studies Program. Murray broaches the technical changes needed, such as interfaces designed to fully exploit an interactive/interconnected world, advanced authoring tools for developing "immersive" environments, and a more robust infrastructure to deliver the goods. She also discusses the artistic flourishes required to make the new technologies sing. She argues eloquently for a new genre of interactive narrative, not just for gaming and entertainment but to propel us into a new media age, an age as significant as the one brought about by moving pictures and the widespread acceptance of television.

Murray describes an environment where clicking on a character changes the perspective of the interactor, shifting the viewpoint and even the values and judgements of the narrator, where moving to a different room triggers completely new storylines or interface modes, where interactive television shows develop fully realized worlds beyond a single episodic slice. She also cites real-world experiments, from the MIT Media Lab and other sources. At MIT, for example, a 12-foot computer screen acts as a "magic mirror," reflecting the interactor's image among virtual characters.

An intimate account of her experiences at Sony's IMAX Theater in New York, a 3-D theater with a screen eight stories high and a hundred feet wide, describes an environment where characters from the past become "a resurrection of the dead; we are given the ability to see them and to see the world through their eyes with stunning immediacy." Such piquant examples animate the possibilities of the new media and make us hunger for more accessible technologies.

As the title suggests, the book is steeped in references to literary and popular culture. Just after detailing a sequence from the *Star Trek* holodeck, the author grapples with moral implications of Aldous Huxley's *Brave New World* and Ray Bradbury's *Fahrenheit 451*, two seminal works about the dehumanizing propensities of immersive technologies. She seems equally comfortable citing Shakespeare, Joyce, or *Babylon 5* while displaying a firm grasp of the technology's historical development.

But this is not simply a book about 3-D games and *Dungeons and Dragons* across the Internet. *Hamlet on the Holodeck* resonates best when it reaches beyond the scope of interactive narrative and encompasses the global possibilities of emerging technologies. As we develop technologies and interfaces that are more interactive, more immersive, and more compelling, every aspect of the computing experience is enriched. It is toward this future that Murray draws us, a future where seamless interfaces, robust architectures, and new interactive genres enable computing environments that we cannot now envision.

Stan Diehl *is a frequent contributor to BYTE. He used to be the director of the BYTE Lab.*

Hamlet on the Holodeck
by Janet H. Murray, The Free Press, a division of Simon and Schuster, 1997
324 pages (hardcover); $25
http://www.SimonSays.com
ISBN: 0-684-82723-9

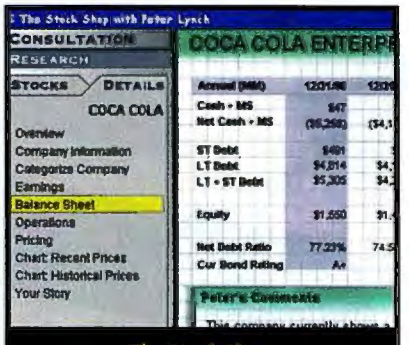
Stock Shopping on CD

Not quite blue chip

If ever there were a marriage made in cyberheaven, it's the Internet and stock trading. Traders require the kind of dynamic, up-to-the-minute access to information that the Internet delivers. *The Stock Shop with Peter Lynch* combines multimedia presentations with an on-line link to financial data.

In a set of solid tutorials, Lynch, former manager of Fidelity Magellan Fund, uses audio narration, video clips, and slick interactive worksheets to cover basic terminology, financial analysis, and key market determinants.

Lynch looks for a tangible reason to invest in a stock, what he calls a company's "story." You build a company's story by analyzing financial numbers, by considering the corporate vision, and by using your own knowledge and experience. Through an Internet link, *The Stock Shop* captures dynamic financial data and flows the information into well-organized tables.



The Stock Shop
Houghton Mifflin Interactive
$69.95 (plus $6.95/month for stock downloads through Telescan)
http://www.hminet.com

The Stock Shop is an effective tool, but the program should poll various news services for items directly related to selected companies. I also wanted more information about on-line trading, perhaps even a link to an on-line broker. In the marriage of Internet and stock trading, *The Stock Shop* comes up a little shy of a full commitment.

–Stan Diehl

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Viewperf CDRS Benchmark[α] Test Workstations – Relative Price Performance[†]		
Dell	WorkStation 400 266MHz w/ELSA Gloria-M Glint MX	$195
IBM®	IntelliStation M Pro Model 26U INGR w/Intense 3D Pro 1000	$220
SGI	O2 R5000/180MHz SCO2	$533
Sun Ultra	Ultra 1 Creator3D Model 170E w/Creator3D	$446
Digital	Personal Workstation 266i w/AccelGraphics AccelPro 2500TX	$624
SGI	Octane 1x175MHz R10000 SI w/Tram	$922

†Price per composite score. Lower number indicates greater price value. For more in-depth information, refer to www.specbench.org/gpc/opc/opc.cdrs.summary.html.

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Blasts from the Past

5 Years ago in BYTE

A big shift in personal computer architecture for video devices and other peripherals was arriving with PCI, QuickRing, and VL-Bus. QuickRing never really caught on, and VL-Bus had its time in the sun, but PCI eventually prevailed.

10 Years ago in BYTE

Laser printers with roughly 2-ppm performance ranged from $1995 to $3695. While reviewing Tandy's new 386-based PC, we noted prices for 386 boxes had dropped from about $6499 to $4299 (with 40-MB hard drive and monitor) in about a year.

15 Years ago in BYTE

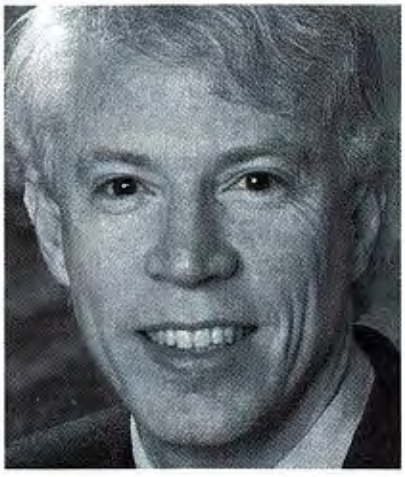
Did the power of the PC spreadsheet help drive the leveraged buyout mania of the 1980s? Our cover story discussed how PCs and programs like VisiCalc were delivering new ways to quickly analyze complex financial data.

20 Years ago in BYTE

We looked at a new high-level programming language that was originally designed to run under Unix on the DEC PDP-11 series of machines. This new language was called C. Also covered: How to analyze your car's gas economy with your computer; APL interpreters; and a BASIC version of the Othello game.

Windows Wish List

Jim Allchin, Microsoft senior vice president of U.S. business systems management, discusses what he'd like to add to future versions of Win 95 and NT.



BYTE: *If you could add only one feature to the next versions of NT and 95, what would it be?*
Allchin: That's hard to say because frankly we still aren't finished adding to NT 5.0. But one thing we're working at, and that I want to continue to strive for, is tied to simplicity for the end user. For example, we're wiring in communications into every nook and cranny of the NT system so that it becomes a great citizen in transient networks and in wireless networks. Today if you are connected to a network, things run pretty well. However, if the connection drops in a particular line or if you move between cells and you're communicating, the system needs to be more intelligent about dealing with the changes in the network. Today, configuration can be time-consuming and complex, and certainly errors are not, in my opinion, handled on any system as seamlessly as they should be.

BYTE: *What are some other areas where you could make things simpler?*
Allchin: We're going to look at areas like the networking control panel and try to make it dramatically easier for remote access, which today takes like 26 steps to set up. Other areas to improve are in Plug and Play and autosensing whether a DHCP server is in existence or not, and get rid of all this binding gunk that no one understands. My dream would be that the system can figure out a lot more about what's going on, not just in communications but in terms of the entire control-panel configuration. The control panel is confusing; we need to simplify that. With Memphis [aka Windows 98], we're not too interested in adding anything else new to the system. We are focusing on quality improvements now.

BYTE: *You've said you hope to increase the diversity of systems and footprints that NT will run on. Are we going to see with NT a similar model to Office, that is, a small business edition, professional version, enterprise version?*
Allchin: Yes. NT's small business server is a classic example of how the server family line will be extended. I'm sure you've heard about the enterprise version of NT; that's another example. So, the server family will get broadened, with one common kernel across them, but tailored for appropriate use. For example, in the small business case, we know there's only going to be one domain, so we don't have to ask the user a lot of questions. This way we can provide a much simpler end-user experience. On the client, you can expect to see the same thing. This scenario is different from the one for Win 95 and NT today in that these [NT] versions will be exactly the same system technology-wise. But they will be tailored to usage. There is a difference between whether you are running a system in an entertainment environment that you are using in your den and running a system at work. The key thing is that there will not be multiple versions of Windows, there'll just be Windows. But it will be tailored to the different environments.

BYTE will print a more in-depth article, based in part on discussions with Allchin, in a future issue.

CyberMax's ValueMax C5 promises Pentium II power at Pentium prices. ***By Tom Yager***

First 6x86 PC: Generally a Winner

In most organizations, the push to provide users with powerful computers is running smack-dab into the need to save money. Fortunately, $2000 can now buy a mature system with a previous-generation Pentium chip or—even better—a leading-edge powerhouse with a processor from Cyrix or AMD.

CyberMax, often first or second in line with systems sporting new non-Intel CPUs, sent me the $1999 ValueMax C5 PR 233, a Cyrix 6x86MX–based machine.

The unit came with 32 MB of RAM and a 4-MB Matrox Millennium II graphics adapter. (CyberMax's Web site lists a 4-MB Matrox Mystique card as standard.) The test unit also had a 6-GB Enhanced IDE (EIDE) hard drive, a 24× CD-ROM drive, an Ensoniq AudioPCI wave-table sound card, and a Computer Peripherals 56-Kbps flex modem with speakerphone features. The system also included two universal serial bus (USB) ports with the connectors installed.

I was impressed with the choices CyberMax made for the internal hardware, but not with the external components. For example, the ValueMax C5's case, keyboard, and mouse are flimsy.

I loaded such familiar applications as Microsoft Office 97 and Microsoft's Visual Studio development tools. They installed and ran fine, and I was pleased with the performance. To test OS compatibility, I loaded Windows NT Server 4.0 and Caldera OpenLinux. Both installed effortlessly, thanks partly to BIOS support for bootable CD-ROMs.

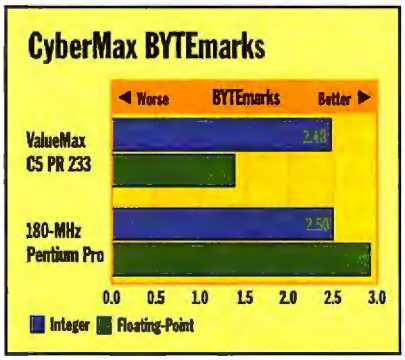
The ValueMax's beefy configurations include a 24× CD-ROM drive, a 56-Kbps flex modem, and a 4-MB Matrox VGA card.

The Hellbender game ran smoothly at 640 by 480 pixels, taking advantage of the Millennium II's hardware-accelerated 3-D graphics. Doom II was mute under DOS, but it successfully ran (with wave-table orchestration) in a Windows 95 DOS box. However, Kinetix 3D Studio Max under Windows NT 4.0 crashed when I tried to load certain scene files.

I ran BYTEmarks on this system and compared the scores to those of a 180-MHz Pentium Pro machine. Integer tests on the ValueMax C5 were comparable, yet floating-point scores were well below the Pentium Pro's (see the benchmark table). Running my 3D Studio Max test, it took 36 seconds on the ValueMax C5 to render a scene with ray-traced shadows. That's nearly double the 19 seconds for the Pentium Pro machine to draw the same scene.

For $2000, you can't buy a Pentium Pro or Pentium II system configured as well as the ValueMax C5. If you're running CAD, heavy graphics, or financial or statistical applications, this system might not be right for you. But for general-purpose applications, software development, home offices, or even light server duty, floating-point doesn't matter. The ValueMax C5 is an impressive buy, a real power machine at the price of a basic desktop unit. B

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



Tom Yager is a freelance analyst and writer located in north Texas. You can reach him at **tyager@maxx.net**.

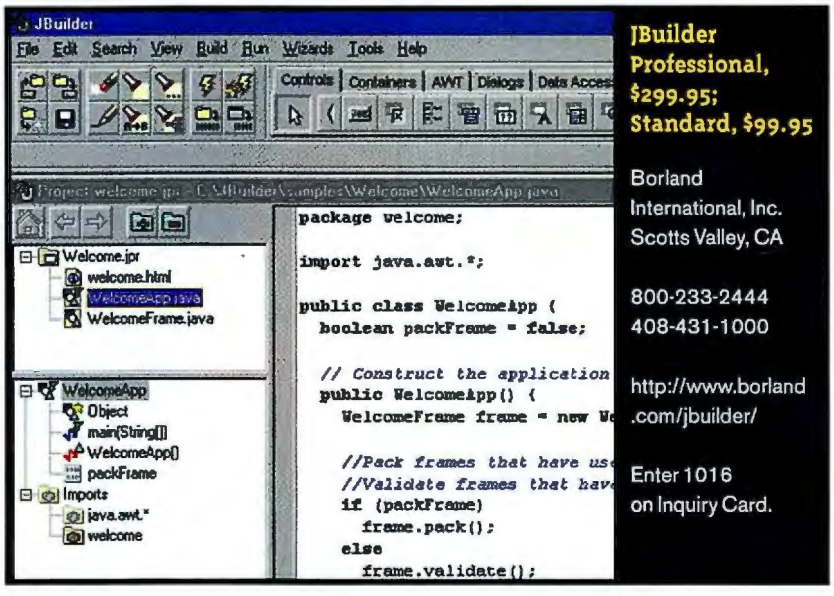
Java comes of age with a full-featured development environment from Borland. By Peter Wayner

JBuilder Makes Java a Piece of Cake

When Java burst onto the scene in 1995, Sun offered it to the world with Stone Age Unix tools. It was only a matter of time before top-grade Java tools made it to market: Microsoft responded with J++, which integrated Java with ActiveX. This summer Borland introduced JBuilder, a highly integrated Java environment that produces pure Java and JavaBeans.

The news is good for programmers. Java's structure makes it much cleaner than C++ and gives developers plenty of room to exploit that structure and automate much of their production.

The automation is obvious from the beginning. When you open a new file, you don't just get a text window waiting for code: JBuilder presents a dialog box so that you can create a new Applet, Application, JavaBean, Class, Component, or a host of other items. JBuilder produces a skeleton for the code when you fill in dialog boxes with object parameters. It's possible to thread together the bulk of an application using built-in tools, coding only the program logic itself.



The JBuilder interface combines a component toolbar, hierarchical trees for project files and class methods, and a code-editor window.

JBuilder builds properly structured JavaBeans, persistent objects that you can customize and that are easy to manipulate and build into GUIs. A wizard constructs the basic shell structure of a JavaBean for you. The parameters and details are bound up with the code and are dynamic, unlike in traditional development environments, where code is static and doesn't change once it's compiled.

The most attractive part of JBuilder may be its database integration: It comes with some standard Java Database Connectivity (JDBC) components to integrate with databases, although to use JBuilder for heavy database work you need JBuilder Professional, which comes with a set of tools, called DataExpress, that simplifies SQL database access. Most professionals will want the Professional version, which adds extra wizards, live graphing components, and a range of database tools.

Borland knows what programmers want, and JBuilder offers most of that, although a Client/Server version with tools for developing enterprise-wide products is still in the works. JBuilder's broad range may represent a turning point for Java. A year ago, people struggled to make items dance across a Web page; today, coding stand-alone applications is as convenient in Java as it is in C++. Many programmers are already switching from C++ to Java for the built-in memory management and Java's write-once, run-anywhere philosophy. JBuilder makes the switch all the more attractive. B

RATINGS	
TECHNOLOGY	★★★★★
IMPLEMENTATION	★★★★½

TECH FOCUS

Code Obfuscation

JBuilder's intriguing "code obfuscation" feature makes it harder for others to download your Java code, modify it subtly, and release it as their own. The process involves two parts, the first of which is not necessarily new. The compiler often rearranges code to speed up execution, and these manipulations often obscure the details in the information-rich Java byte code. The second step involves giving private and local variables strange, uncompilable new names that make it harder to trace through the code by hand. Decompiled code is also guaranteed to be uncompilable because it comes with illegal characters in the names.

Peter Wayner is a BYTE consulting editor based in Baltimore. His home page is at **http://www.access.digex.net/~pcw/pcwpage.html.**

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

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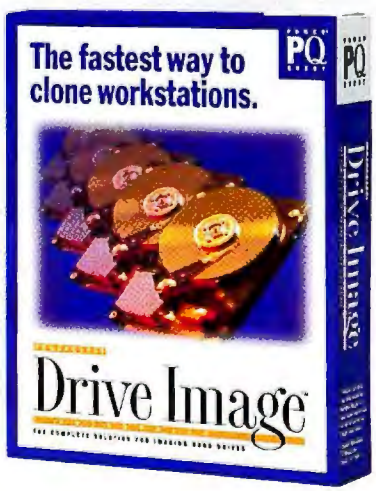

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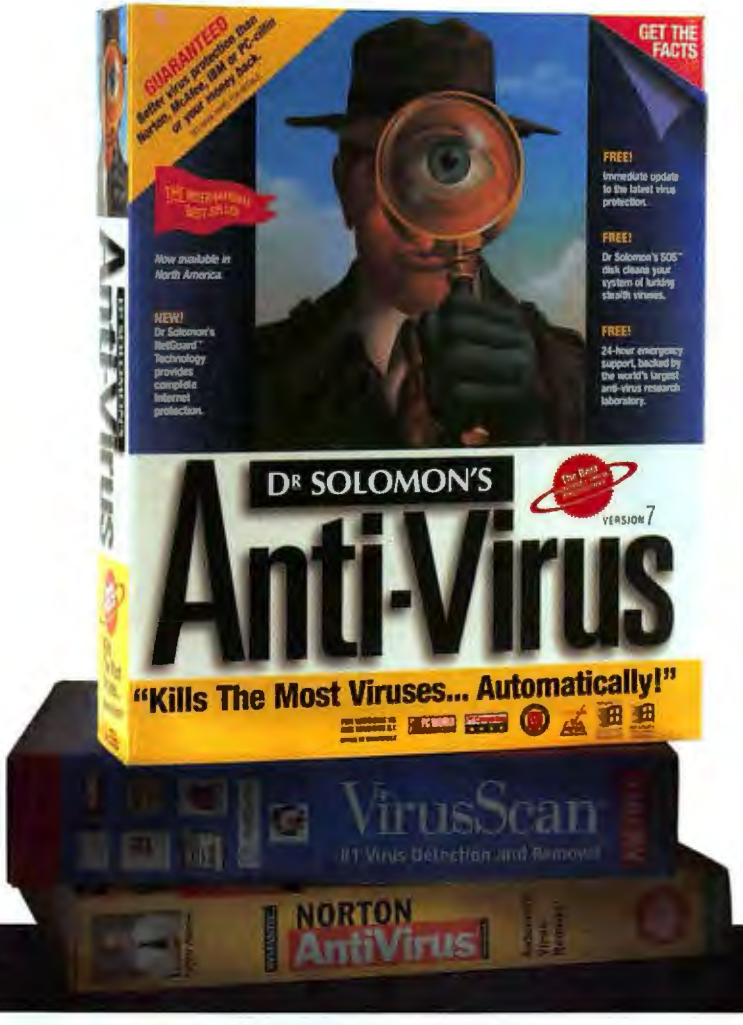

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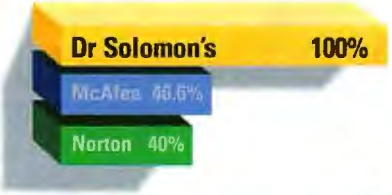


SOURCE— Secure Computing, January 1997

Circle 131 on Inquiry Card.

The next-generation ThinkPads offer DVD and 20X CD-ROM options, full MPEG-2, and more. ***By David Essex***

The Best ThinkPad Gets Better

BYTE has raved about IBM's high-end ThinkPad notebooks before. The 760CD was voted Best Notebook in our Fall 1995 Comdex awards, and we named it an Editors' Choice that same year. Now IBM is upgrading this elite line with clear improvements in nearly every feature.

The ThinkPad 770, which was due out in September, strikes you first with its too-roomy-to-be-believed 14.1-inch color thin-film transistor (TFT) screen. IBM claims a 34 percent brightness increase, and while I didn't test this with a light meter, my prebeta unit had the brightest, clearest screen I've seen on a notebook.

Powering the LCD is a 64-bit Trident chip set, providing SVGA at 1280 by 1024 pixels. Clear viewing is maintained at about 45 degrees off-center in all directions. Try as I might, I couldn't find a single blurry spot or dead pixel, and even the brightness is more or less consistent.

For raw power, the 770 beats its predecessors by a mile, offering either a 233- or 200-MHz MMX Pentium CPU. (A less-expensive 13.3-inch screen is available on both models, which range from $5500 to $7000.) You can squeeze in up to 256 MB of high-speed synchronous DRAM (the system comes with 32 MB). The high-end model has a 5.1-GB hard drive.

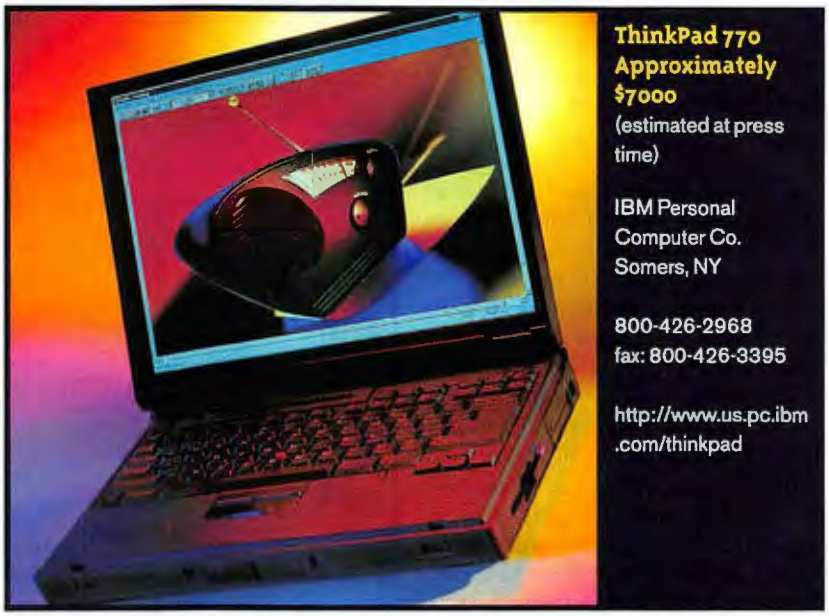
Besides improving existing features, IBM made some major design changes. The keyboard is now integrated into the main unit rather than on an angled, pop-up plane. IBM says that it adopted the keyboard from the ThinkPad 560 line, and it expanded the palm rest for greater comfort.

The ThinkPad's eraser-like Trackpoint mouse controller has also changed. You can now double-tap on it directly to select a screen item without having to press the buttons on the palm rest. Joining the latter is a new center button that you can use for fast scrolling and panning around documents, as well as for zooming in.

Eliminating the pop-up keyboard removed the entry point for the older ThinkPad's UltraBay storage slot. The new slot, called the UltraBay II, now sits in the front of the notebook's right side. You get to it by moving a small front-mounted slider, which releases a large lever that pushes out the storage device. The digital videodisc (DVD) drive will go here when it's ready later this year. This bay also accepts a removable floppy drive, a CD-ROM or Zip drive, a second hard drive, or a battery. An optional screw underneath lets you lock the storage device in place for added security.

As a piece of multimedia road equipment, the 770 needs to keep up on standards. Boy, does it ever. Hardware-based MPEG-2 offers full-screen, full-motion video—a big improvement in pixelation over the already-decent quality of the 760's half-horizontal-resolution MPEG-1. In addition to the typical microphone, headphone, and audio/video in/out ports found on older models, the 770 now has ports for universal serial bus (USB) peripherals and Sony/Philips Digital Interface (SPDIF) audio devices.

My test unit wasn't ready for benchmarking, and I couldn't use the PC Card slots or DVD, so performance and reliability are unknowns. But by upgrading its multimedia ThinkPad line on nearly every front, IBM has made a great notebook even better. B



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(estimated at press time)

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The 770's 14.1-inch screen shows off graphical images in all their hi-res glory, including MPEG-2-driven full-motion video.

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

David Essex is BYTE's director of reviews. You can reach him at **dessex@bix.com.**

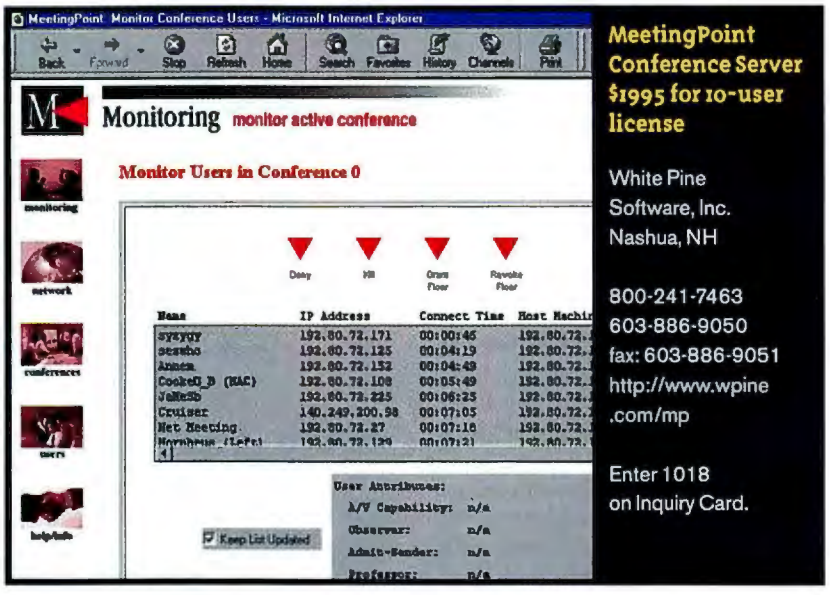
PHOTOGRAPH: SHAFFER/SMITH PHOTOGRAPHY © 1997

Open-standards-based multipoint videoconferencing over IP is a reality with White Pine's MeetingPoint. By Steve Gillmor

A New MeetingPoint for Videoconferencing

White Pine's MeetingPoint Conference Server marks a major advance in the convergence of computers, video, and telephones. This companion product to the pioneering CU-SeeMe videoconferencing client extends a welcoming hand to all H.323 standards-based clients and allows multipoint conferencing over the Internet. MeetingPoint arrives just in time to leverage an always-on and always-connected world that's becoming even more so with Microsoft's H.323-compliant client NetMeeting (bundled with Internet Explorer) and Netscape's promised H.323 client for Communicator.

Building on White Pine's Reflector server, MeetingPoint merges multiple streams of video, audio, chat, whiteboard, and other data using open standards. MeetingPoint automatically detects bandwidth congestion and balances low-speed modem, ISDN/frame-relay wide-area, and high-speed LAN connections, so conferences are not dragged down by the lowest common denominator. You control the number of conferences, participants per conference, and data types per conference, setting upper limits on data rates for transmissions.



You can monitor and administer live conferences using MeetingPoint's Web-browser interface.

MeetingPoint installs three default conferences covering a range of bandwidth situations from direct LAN users to dial-up modem users. The Monitoring screen lets administrators or conference chairs grant or revoke user access and the ability to send data streams.

Installing MeetingPoint on a Windows NT 4.0 server with 64 MB of RAM and a 200-MHz multimedia extensions (MMX) processor, I configured the server with a browser GUI enhanced with Java applets. I tested the Winnov Videum capture board/camera combo and Connectix's QuickCam 2 parallel-port solution on local- and wide-area connections, hosting a MeetingPoint conference with a mix of CU-SeeMe and NetMeeting participants.

MeetingPoint scales well, supporting IP multicast in the corporate LAN; multicast support will also reduce bandwidth demands for Internet connections once multicast is more widely supported. I successfully connected two MeetingPoint servers on separate LANs via 128-Kbps Internet ISDN links, maximizing local bandwidth and sending the combined traffic over the smaller wide-area pipe.

RATINGS	
TECHNOLOGY	★★★★★
IMPLEMENTATION	★★½★★

Before I got my hands on MeetingPoint, IP videoconferencing seemed to me an interesting toy. After using it, I'm convinced it's a powerful tool. MeetingPoint enables truly open conferencing, linking different H.323 clients in group conferences on a single screen, something never before possible. B

You can contact Steve Gillmor, who is a consultant for Southern Digital, Inc., at **sgillmor@southerndigital.com**.

TECH FOCUS

Following Conference Protocols

CU-SeeMe clients connect to MeetingPoint via a single port, first using TCP to determine information about active conferences and then switching to a single UDP port to send all conference data: video, audio, and chat. Each UDP packet contains information in the header that describes which user sent the packet. By contrast, H.323 clients such as NetMeeting receive five UDP ports during the initial TCP connection sequence, using correspondingly more server resources to maintain the connection.

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

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The Web's content can be harvested for information that's crucial to making strategic decisions. By Richard Hackathorn

Farming the Web

The Web and data warehousing (DW) are a powerful combination. Publishing warehouse data via the intranet has become a highly productive approach. By generating dynamic pages from Web-enabled databases, whole new areas of data analysis are supported. No one, however, has seriously considered putting content from the global Internet into the data warehouse. Web content is considered too unreliable, and data external to the organization is often considered to have little business value.

But I would argue to the contrary. As markets become turbulent, the old way of doing business with data only from internal operational systems becomes less relevant. A company must know more about its customers, suppliers, competitors, and government agencies than ever before. Much of this external data is readily available on the Web. The challenge is to wade (with big boots) through the Web, discovering and acquiring those pieces that do have an impact on the business.

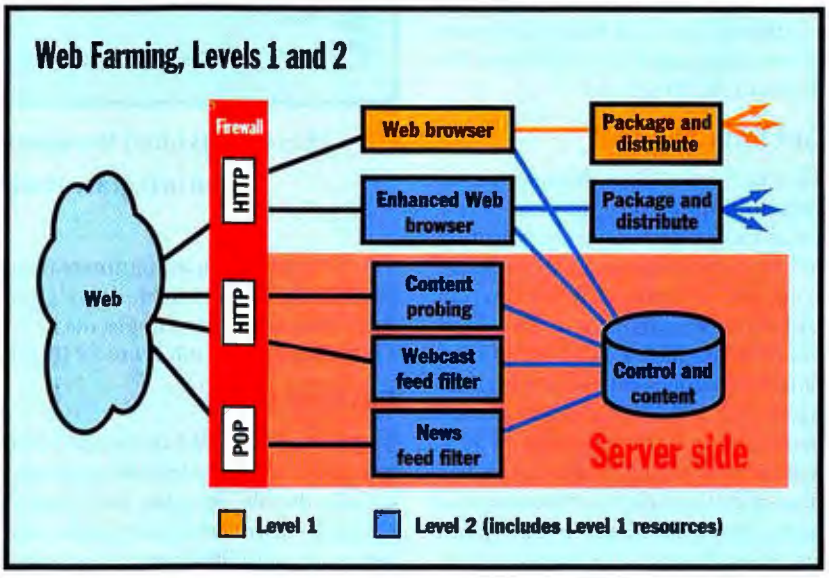
The emerging area that is concerned with this challenge is called Web farming (WF). WF is the systematic discovery and acquisition of business-relevant Web content as input to the data warehouse. It has three goals. First, to discover and acquire Web content that is highly relevant to the business. Second, to structure that data so that it becomes an integral part of the existing data warehouse. Third, to accomplish this in a systematic manner that evolves into a production system. WF must deliver information of value to the business, to the right people at the right time. This is the same objective as the data warehouse. Hence, WF and DW should be closely integrated.

Getting Started

The first level of WF documents the external factors that affect the business, and predicts the potential factors that will affect it in the future. Possible avenues of investigation are: analysis of recent company reports and press releases; critiques of your company by news and investment analysts; and observations of typical customers performing transactions. Then, compile a detailed, hierarchically organized list of these external factors. Prioritize the list based on the potential impact (either positive or negative) of each factor upon the business.

Formulate a systematic plan for searching the Web for relevant information, starting with the highest-priority factors. When a useful item is found, format and package it as memo, report, spreadsheet, chart, presentation, or e-mail. Immediately disseminate it to the people who should have a keen interest in it. Then, track the reactions to this information.

In the first level, you're building the foundation for determining what is important to the business. The principal cost item should be a highly skilled business analyst who has a solid understanding of the business. This level should be implemented quickly and cheaply, with feedback expected in one or two months. The end result should be documentation of the business factors associated with an organized list of URL bookmarks.



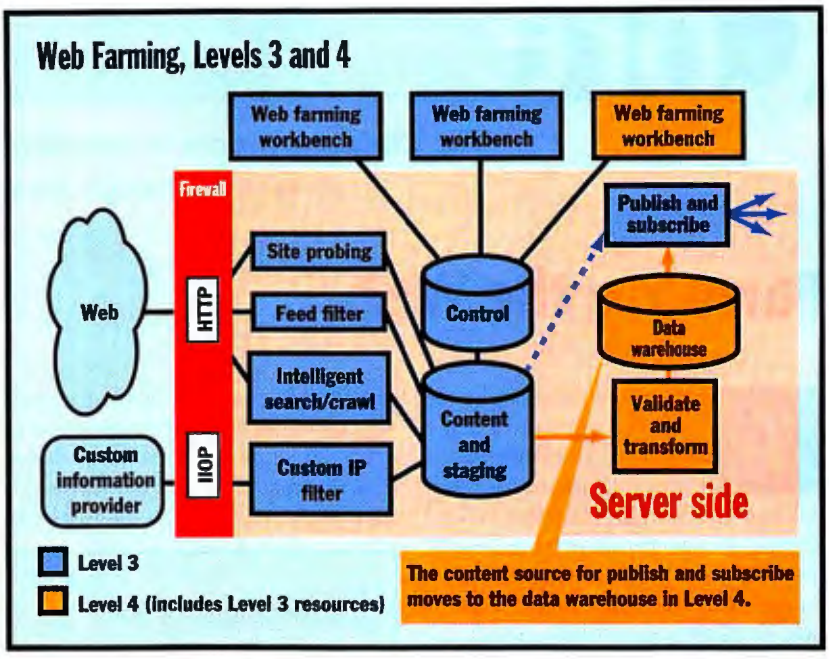
These levels determine the feasibility of Web farming and build its infrastructure.

Getting Serious

The second level of WF requires a serious management commitment of resources to pursue WF as a means of expanding coverage for the data warehouse. Its objective is to establish the WF infrastructure within a secure server environment. Under the umbrella of the DW group, the data within the existing data warehouse should be supplemented by expanding its coverage of those external factors impacting the business. The second level involves the transition from

a self-contained workstation to a secure server environment, as shown in the figure "Web Farming, Levels 1 and 2." On the client side, the number of analysts should increase as demand of packaged information from Web content increases.

The important changes occur on the server side of the architecture. A database shared among the analysts manages the Web content and various control information such as favorite bookmarks, useful searches, and the like. Data center staff should administer the WF server. Besides the sharing of common data among the analysts, the server takes on the active role of periodically probing those Web pages identified as important. As useful information becomes available on Webcasting channels, e-mail feeds, and newsgroups, you should implement filters to capture, filter, and format that data into the WF server.



These levels build the operation into an intranet Web site and integrate it with the data warehouse.

Get Smart

The third level of WF builds upon the previous infrastructure to increase the relevance of Web content to your business. Its objective is to get smart about discovering and acquiring new information, and about distributing it. This focus occurs in two places. First, the information acquisition is expanded with intelligent Web searching and with custom information providers. Second, the information distribution is expanded enterprise-wide through the implementation of the publish and subscribe (P&S) mechanism (as shown in the figure at right).

At this level, the objective is to transform the content database into a full-function intranet Web site that serves as a custom resource center for the entire company. The goal is to shift over time from static content of digested Web pages to dynamic content generated from warehouse tables.

Another change is the adoption of a WF workbench environment for analysts. Controlled via a common database, the workbench integrates the browser with other tools, such as linguistic analysis and information visualization. The workbench should increase the productivity of the analysts to discover relevant information. Using P&S, specific channels of information related to important business topics are published. Various people (and applications) can then subscribe to these channels to receive a flow of information on a continuing basis. Finally, you should contract custom information providers to supply reliable data via efficient links using, for example, the Internet Interoperable ORB Protocol (IIOP).

Getting Dirty

The fourth level of WF refines the transformation of Web content into structured data for the DW. As in the previous levels, the WF activity characterizes the business relevance of Web content and establishes the infrastructure to use it.

This level's objective is to exploit the business potential of Web content as input to the data warehouse. Now comes the dirty work of structuring Web content into the proper format. The challenge is twofold: First, adding a reliable time dimension to the detailed facts. Second, linking into the proper fact or dimension tables in the data warehouse. The most frequent application will be augmenting an existing dimension table with an additional attribute. However, the most potential comes from creating new fact tables that allow exploration of external business factors.

Here are some suggestions on how to proceed: Investigate the current data warehouse. Obtain the schema definition. Understand the major fact tables and key dimensions for those tables. Dump some typical data on the main tables. Compare the list of business factors to the warehouse schema. Note the gaps. Next, consider how external data would fit into the schema. Decide if attributes for existing dimensions should be augmented or if new dimensions for existing tables should be added. Finally, prioritize specific business factors that have the greatest potential for extending coverage for the data warehouse.

Looking Externally

As companies look externally for their next competitive advantage, WF will become a necessary function of all DW systems. Content providers will have an economic incentive to supply reliable and quality information that is prestructured into generic warehouse schemas.

WF requires a new set of skills. It also requires an expanded infrastructure for networking and DW. Both require time to evolve into a production system. It will all come together if you work through the four WF levels I've described. B

*Dr. Richard Hackathorn (**richardh@bolder.com**) is president and founder of Bolder Technology, Inc. (Boulder, CO).* *This article was extracted from a forthcoming book from Morgan Kaufmann Publishers. You can find a resource center for Web farming at http://www.bolder.com/.*

Psion's EPOC32 OS provides sophisticated real-time services for hand-held devices. ***By Dick Pountain***

A New Epoch for Hand-Helds

You probably know Psion as a hardware vendor—the one that offers the neat Series 3 hand-held computer. Now its software division, Psion Software PLC, is actively seeking to license a new OS called EPOC32. Psion developed this object-oriented, multithreaded, real-time OS initially for its own new 32-bit ARM-based hand-held, the Series 5.

The cramped hardware environment of a hand-held computer makes designing a suitable OS tough. Hand-helds have slow CPUs and small memories, yet they are increasingly expected to handle real-time tasks and offer a robust OS. Power economy is also crucial, because hand-helds are expected to run for weeks, rather than just hours, on batteries.

EPOC32 addresses these needs by cramming features that you would expect to see only in a big-iron OS into minimal ROM space: It supports preemptive multitasking, hardware memory protection, and an innovative threading model that yields very low interrupt latency. Psion intends EPOC32 to be at the heart of future generations of smart telephone and communicator products, which means real-time performance is of the essence.

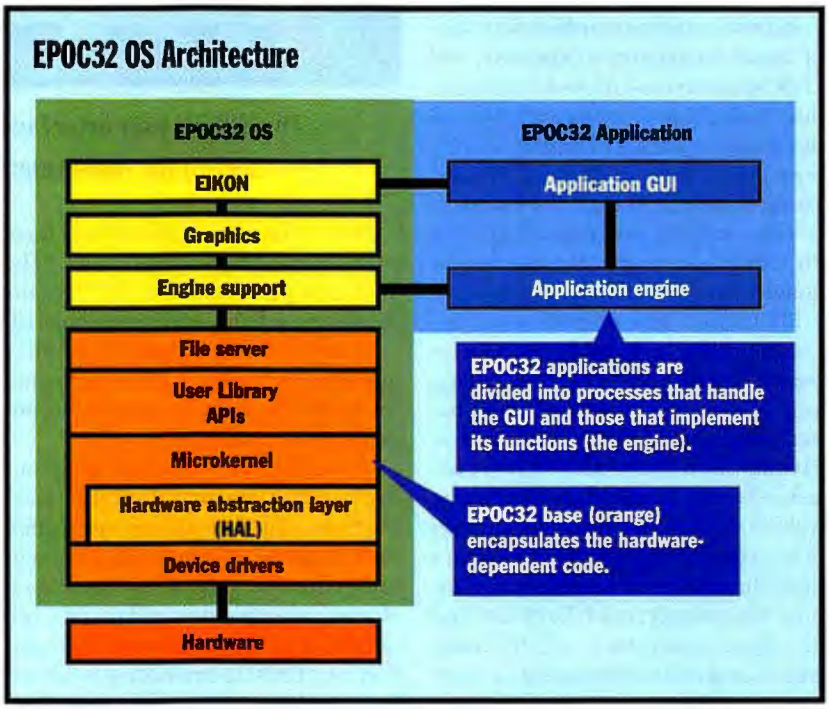
As the screen on page 46 shows, the Series 5 implementation of the EPOC32 OS includes a full set of personal productivity applications—word processor, address database, sketch pad, diary, world clock, alarm, and sound recorder—that run under a pen-navigated GUI called EIKON. The EIKON interface is built as a clearly separate layer on top of the core OS. This setup allows you to replace the EIKON interface with a fully custom GUI while still reusing the underlying font, bit-map, and rich-text abilities.

Clients and Servers

EPOC32 is built on thoroughly modern design principles using a microkernel, a client/server structure, and object orientation. The kernel provides basic system-wide services, such as memory allocation, thread creation, semaphores, and timers. Some higher-level services are provided directly from the I/O device drivers via an object-oriented User Library API. All other EPOC32 services are provided by system threads acting as servers, which run as separate processes outside the kernel.

The Psion Series 5 implementation includes 10 such servers, among them window, file, database, communications, and font/bit map. A key feature of EPOC32 servers is that they are responsible for cleaning up all resources used by their clients—after both normal and abnormal termination—to avoid resource leaks.

A scaled-down version of EPOC32, used in embedded applications, still provides the core OS services but limits the system to a single thread of operation. This restriction provides increased speed and reduced interrupt latency, which can be important in a real-time embedded system application.



Much of the EPOC32 OS code can be simply recompiled for any processor.

Threads and Superthreads

EPOC32's kernel exploits ARM's memory-management unit (MMU) hardware to provide a separate address space for every process running in the system. Threads are preemptively scheduled within these processes. The kernel executive runs in privileged mode and has access to all parts of the system. *continued*

Unprivileged user (i.e., application) threads must access all services via the kernel server. Applications are not allowed to directly access the system hardware, I/O, or interrupt hardware. This architecture allows EPOC32 to run with interrupts enabled almost all the time—and thus be very responsive to interrupt requests. A null thread, which runs only when there's nothing else to do, controls the ARM's power-saving circuitry.

For the very lowest latency tasks, EPOC32 provides "superthreads" that run on the kernel side and allocate their own resources without going through the kernel server. Such a task might be a GSM satellite phone application, where certain events require a response within milliseconds, with a permitted tolerance of just a few hundred microseconds.

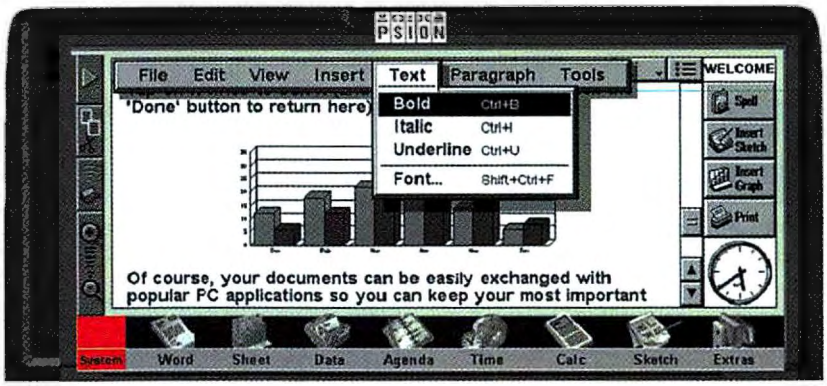
A communication that crosses process or thread boundaries is expensive, and EPOC32 servers use tricks to minimize this: Multiple processes aren't allowed simultaneous access to the same data file; the window server queues requests and executes them in batches; the font server shares its heap so clients can BIT-BLT directly from it; and all communications servers run within the same process.

EPOC32 uses an innovative asynchronous model for kernel and I/O service requests. To avoid power-wasting polling loops, each server spawns an "active object" that manages a request and waits on its completion. In effect, these active objects offer nonpreemptive multitasking within a single thread, so few applications or servers ever need spawn more than a single thread. A word processing application, for example, reads keyboard and pen input, reformats text in the background, and updates the state of GUI controls, all while concurrently using active objects within a single thread.

Engines, Objects, and Embedding

All EPOC32 applications divide cleanly into an "engine" that provides the application's basic functions and a separate GUI that drives it, as shown in the figure on page 45. Applications access their data only via the engine's API methods, never by direct knowledge of its file format. An important EPOC32 module provides support services for application engines and their GUIs, in addition to two core data models—the stream store and the text content.

Stream stores underlie every data structure in EPOC32: files, the clipboard, even the undo buffers. Each application's persistent data is a collection of streams (text, sound, or bit maps) linked by pointers and contained within a single store. This is similar to Microsoft's Structured Storage, except that it's built into the heart of EPOC32 right from the start.



The EIKON user interface has fixed icons around the screen for rapid selection and task switching.

EPOC32 uses its engine-support layer to build several higher-level "views." The Text view provides a user interface for displaying, editing, and formatting rich text; the Chart view provides business graphics, such as bar and pie charts; and the Grid view is a rich text grid that underlies the spreadsheet.

These views provide images for printing as well as for screen display. By reusing them, you can make any application truly WYSIWYG with negligible programming effort. To make a new application able to embed pictures and sounds, you just use a Rich Text view as one of its components. EPOC32 embedding is limited compared to OLE: You can edit embedded documents in place, but you can't embed previously created documents. A future release will overcome this limitation by adding a linking mechanism based on HTML.

Developing for EPOC32

EPOC32 is intended for final deployment only on ARM7- and StrongARM-based platforms. Psion has built a simulator program, called WINS, that uses the actual EPOC32 code to emulate EPOC32's behavior in a screen window under Windows NT or 95. Only the EPOC32 kernel's hardware abstraction layer (HAL) needed to be rewritten for the Intel x86 CPU, since Win32 supplies all the graphics and file services.

All EPOC32 file-server references are mapped to a designated "safe" area on your hard disk to ensure that buggy development code can't touch your PC files. You can use WINS to develop EPOC32 applications in C++ with standard Microsoft Visual C++ tools and run them directly in the emulator environment. Once your application is fully debugged, you perform a final cross-compile onto the ARM using a tool set based on GNU C++. Later this year, Psion will release OVAL for EPOC32, a Windows-based rapid application development (RAD) language environment that's much like Visual Basic.

WHERE TO FIND

Psion Software PLC
London, U.K.
+44 171 208 1800
http://www.software.psion.com/

Psion hopes that this easy development path will help it to license EPOC32 not only to other hand-held computer manufacturers but to vendors of set-top boxes, mobile telephones, and communicators. Launching a new hand-held OS that competes with Microsoft's Windows CE takes a lot of confidence, but Psion has reason to be confident in this arena: According to Forrester Research, the Series 3 is the hand-held market leader, with a 33 percent share and worldwide sales of more than 1 million units. B

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

New IP-switch designs help move low-latency data such as sound and video through large networks. By Mick Seaman

Smarter and Faster IP Connections

Not so long ago, 80 percent of all network traffic was contained within common subnets. Today, the phenomenal growth of the Internet and business intranets has dramatically increased the amount of traffic that must be routed among separate subnets. Furthermore, network administrators who once had to worry far more about the reliability of data and little about when it arrived are now faced with demands for bidirectional audio and video. In these examples, it's expected that there will be a small, acceptable data loss, but the issue of when this real-time data arrives at the desktop via increasingly busy networks has become vital.

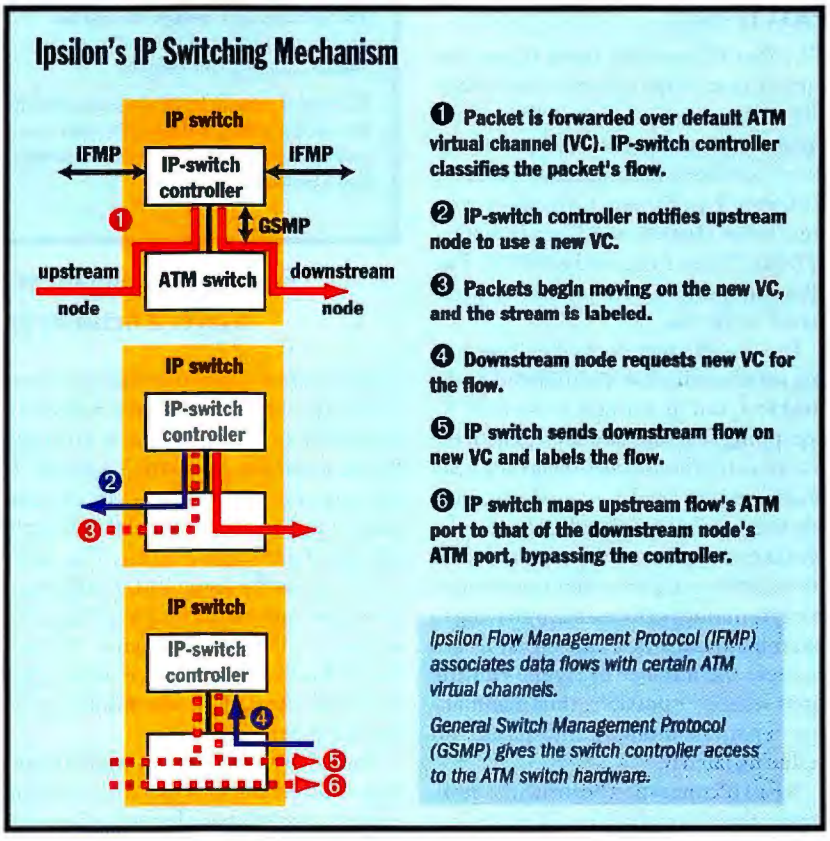
Unfortunately, current routing technologies are not suitable for cost-effective, multigigabit low-latency traffic. This means that most LANs use switching as the basis for high-speed traffic among subnets on a local network, but they use slower routers for moving data among subnets on different LANs. Thus, as data moves among subnets (an ability made possible by the routers), it can face unpredictable delays.

For these reasons, network managers want to design their LAN infrastructures on high-speed-switching architectures, because switches provide wire-speed forwarding between separate LAN segments while creating a single logical LAN between end systems. New solutions being brought to market by two leading network suppliers aim to provide the control-policy functions of routing with the wire-speed performance of switching.

IP Switching

Ipsilon's IP Switching establishes virtual circuits that bypass routers' Open Systems Interconnection (OSI) network level 3 layer using flow-matching techniques. In IP Switching, which is targeted at asynchronous transfer mode (ATM) networks, each IP node sets up a virtual channel on each of its ATM physical links to be used as the default forwarding channel. An ATM input port inside each switch receives incoming traffic on this default channel and sends it to Ipsilon's intelligent routing software in its switch controller. In addition to forwarding the packet over the default channel, the switch controller identifies the flow. A flow is a sequence of packets with the same point of origin, the same destination, the same protocol type, and other common characteristics.

The switch then performs a decision-making process to determine whether a flow should be routed or switched to a high-speed ATM virtual circuit. For a time-critical flow, the switch controller establishes a virtual circuit, eliminating the need for further router processing, as shown in the figure "Ipsilon's IP Switching Mechanism."



You can send low-latency data directly through an ATM virtual channel, bypassing the IP controllers.

While this architecture does result in performance improvements, there are several potential drawbacks to Ipsilon's switching solution. First, the architecture involves moving the router aside in favor

of the Ipsilon switch controller, all in one step. Network managers may be unwilling to make such a change with the core piece of their networking infrastructure.

Second, there's IP Switching's flow orientation. While opening a virtual circuit makes sense in many cases, the technology relies on predictions from the switch controller whether to establish the circuit. For relatively small data transfers, opening the virtual circuit may not be worth the overhead that creating the virtual circuit imposes.

Finally, IP Switching is suited only for ATM network architectures. Few LAN backbones are solely ATM-based. Therefore, Ipsilon's IP Switching technology is suitable for only a small segment of the marketplace.

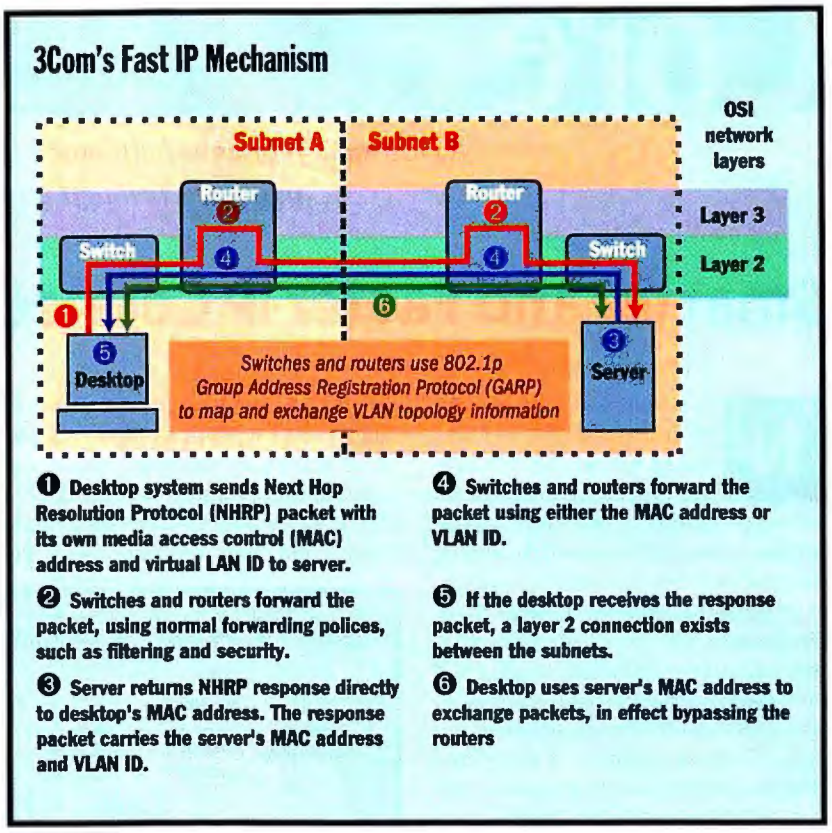
Fast IP

The Fast IP protocol from 3Com (the author is an employee of 3Com) offers the performance of switching with the control of routing over all types of network backbone technologies, including Ethernet, Fast Ethernet, Gigabit Ethernet, Fiber Distributed Data Interface (FDDI), Token Ring, and ATM OC. Fast IP is applicable in both packet- and cell-based networks.

Fast IP is different from other IP-switching solutions in that it is initiated at the desktop, not in a router or switch. By equipping desktops and servers with the means to tell the network what they need and when they need it—and then explicitly tagging the associated frames—networks can implement the required quality of service policies without guessing or compromising performance by having to examine details in frames. Fast IP also reduces the number of layer 3 routing hops wherever possible, thus maintaining network simplicity and speed, and reducing latency.

A Fast IP connection begins at the desktop system through a Next Hop Resolution Protocol (NHRP) request and response technique. NHRP uses source and destination media access control (MAC) addresses to establish a layer 2 connection. It also optionally uses tags defined under the IEEE-802.1q "Draft Standards for Virtual Bridged LANs," known as Group Address Registration Protocol (GARP).

The desktop addresses its first packet to the layer 3 router. The router forwards the packet to its destination, while applying common filter/firewall policies. When the server receives the packet, an NHRP response is sent via layer 2 directly to the originating desktop's address. If the response packet reaches its destination, it indicates that there is a directly switched path to the server. The desktop then uses the server's MAC address to communicate via layer 2, bypassing the routers, as shown in the figure "3Com's Fast IP Mechanism." If the response is not received, the data flow continues to be routed as before.



Fast IP uses standard network protocols to establish a layer 2 network link for low-latency data.

In addition to simplifying management and enhancing speed by bypassing routers, Fast IP is based on several emerging standards, including IEEE-802.1q, Internet Engineering Task Force (IETF) NHRP, and IEEE-802.1p "Draft Standard for Traffic Class and Dynamic Multicast Filtering Services in Bridged LANs."

Fast IP is an affordable solution, being software-based. Because it is initiated and controlled solely by desktops and servers, it requires no changes to switches and routers. All that's needed to achieve Fast IP benefits is to add software to the appropriate systems. Client software and support for switches will be available from 3Com in the second half of this year. Fast IP client software will be bundled with certain PC network interface cards (NICs), and you can download it from 3Com's Web site (http://www.3com.com).

Migration Path

What's probably of interest to the network manager is that Fast IP offers a gradual migration path. It does not remove the router. It simply speeds up the router's performance. As mentioned earlier, it requires only software installation on the end systems (desktops and servers). No changes are necessary to the hardware or software of existing routers in the network to support Fast IP. Importantly, Fast IP interoperates with switches that don't support 802.1p, 802.1q, and NHRP. Thus, a manager can slowly upgrade the end systems without worrying about bringing down the network. B

Mick Seaman is vice president and chief technical officer of 3Com's network systems operations. You can contact him by e-mail at **editors@bix.com**.

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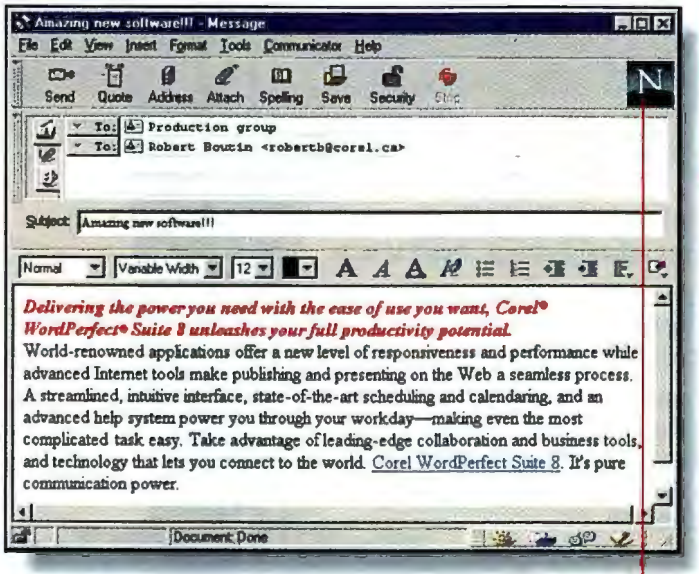

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***PC Magazine*, August, 1997**

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***Fortune*, May 26, 1997**

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***Wall Street Journal*, July 10, 1997**

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Circle 92 on Inquiry Card.

A Pentium-class processor rebels against current design trends with a vastly simplified microarchitecture. **By Tom R. Halfhill**

Keeping It Simple

Can simplicity and elegance surpass complexity at the processor level? That's what Centaur Technology is betting as it prepares to ship a new Pentium-class microprocessor, the IDT-C6. It's a stripped-down CPU that radically departs from modern trends in CISC and RISC design.

At first glance, the IDT-C6 is a simple design—one might almost say old-fashioned. It flunks almost every buzzword benchmark: no superscalar pipelines, no superpipelining, no out-of-order execution, no speculative execution, no rename registers, no reorder buffers. It doesn't even do branch prediction—the first x86 chip without that feature since 1993. At first glance, it resembles a 1980s-vintage 486.

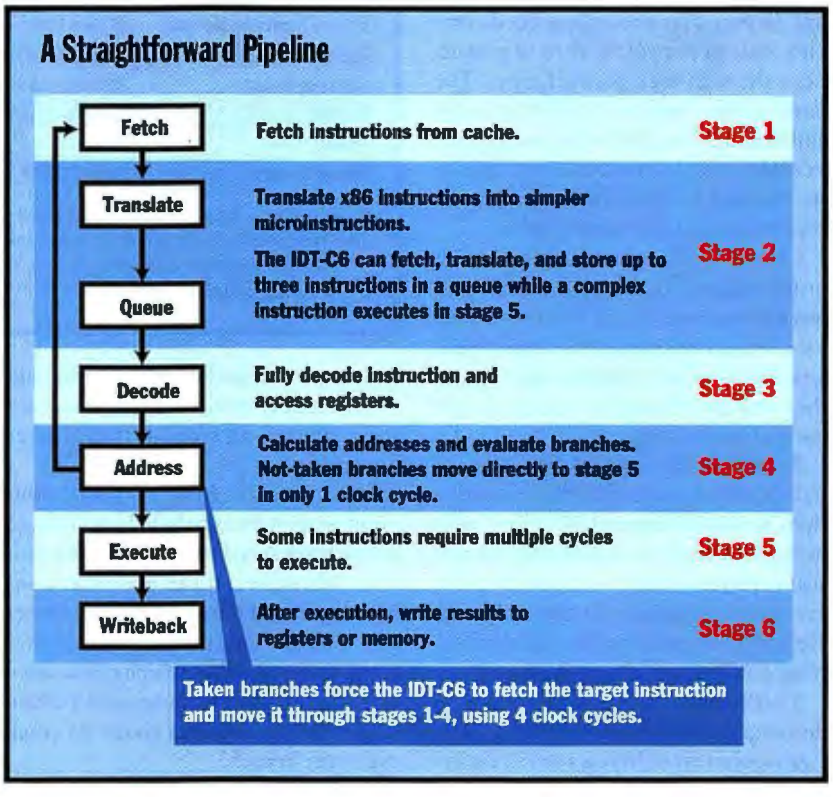
Stranger still, the IDT-C6 is the debut product from an unknown start-up company. Centaur is a new subsidiary of Integrated Device Technology (IDT), which is a well-known manufacturer of static RAM (SRAM) chips and Rx000-series RISC processors under license from Silicon Graphics/Mips. However, IDT has not had any previous experience with the x86 architecture.

Internally, the IDT-C6 has little in common with other fifth- and sixth-generation x86 processors. Yet according to Centaur, it closely matches the performance of a multimedia extensions (MMX) Pentium when running the Winstone 97 business benchmark (37.7 versus 37.5 Winstones at 200 MHz). And as the table "Processors Compared" on page 52 indicates, it has a much smaller die size than a Pentium, which means it should cost significantly less.

However, at this writing, Centaur had not yet announced prices, and BYTE was unable to verify the performance claims by running the BYTEmark suite or Bapco's Sysmarks. Although Centaur was showing samples of the IDT-C6 in May and June, final-production silicon wasn't expected until mid-August—too late to benchmark for this issue.

When BYTE does test a production chip, it will likely finish behind an identically clocked Pentium on the BYTEmarks. Although BYTEmark programs use real-world algorithms, they are still CPU-intensive synthetic benchmarks. Centaur agrees that its chip will do better with application-level benchmarks, such as the Winstone or Sysmark suites.

The reason for this is the processor's ascetic design. The IDT-C6 sacrifices raw core throughput to gain other advantages: large internal caches (32 KB each for instructions and data), high clock speeds (150, 180, and 200 MHz to start, with 225 and 240 MHz likely this fall), low power consumption (14 W maximum at 200 MHz for the desktop chip, and 7.1 to 10.6 W for the mobile chips), a tiny die size (88 square millimeters), and rapid upgrades (Centaur hopes to deliver improved versions every six to 12 months).



The IDT-C6's pipeline resembles a 486 pipeline.

One at a Time

The idea of a streamlined x86 processor has been cooking for years in the mind of Glenn Henry, Centaur's president. He is a former IBM Fellow and RISC pioneer who came to IDT by way of Dell and Mips. At his last job, Henry worked on a

hybrid RISC/CISC processor that could execute both the Rx000 and x86 instruction sets.

That project fizzled, but Henry took his ideas to IDT. In April 1995, Henry and his first three engineers sat down at his kitchen table in Austin, Texas, to sketch out the IDT-C6. They conceived a chip that had a single six-stage instruction pipeline. That alone was heresy. Virtually all of today's processors—both CISC and RISC—are superscalar devices. This means they have multiple pipelines that execute two or more instructions at once. The exceptions are low-cost embedded processors.

The decision to have only a single pipeline immediately saved millions of transistors (and the associated complexity). Superscalar processors need complex logic to control the flow of instructions through their parallel pipes. The latest CPUs—such as Intel's Pentium II and Pentium Pro, AMD's K6, and Cyrix's 6x86MX—can also execute multiple instructions out of order before retiring the results in original program order.

Centaur's chip is obviously a strict in-order machine, because it executes only one instruction at a time. That saves even more transistors, because it doesn't need a reorder buffer, rename registers, or the extra control logic to manage all that instruction shuffling.

Because of these design decisions, the IDT-C6 requires significantly less testing than a more complex CPU. "Trying to design and verify an out-of-order superscalar processor is a real problem for everybody, especially for an x86," notes Henry. "Only two years later, we're sampling our Pentium-class processor."

That's about half the time it takes to design and verify most other CPUs. NexGen labored for eight years on its first x86 chip. Intel is spending about five years on Merced.

The Branch Not Taken

Raising even more eyebrows among the digerati, Henry decided to omit branch prediction, too. Although this decision eliminates a branch target buffer and other related circuitry, it appears to be an odd trade-off. Branches are so common in modern code (about one for every five instructions) that it seems as if a little extra complexity could significantly boost throughput.

To understand why the company made this decision, take a closer look at the chip's pipeline, as shown in the figure "A Straightforward Pipeline" on page 51. It's similar to a 486 pipeline (fetch, decode, address calculation, execute, writeback) except for an additional translate stage (stage 2). During that stage, the IDT-C6 translates x86 instructions into simpler, 33-bit-long microinstructions or retrieves microcode from its internal ROM, much as other x86 chips do. In stage 3, the chip fully decodes the instruction and accesses the registers. In stage 4, it evaluates branches.

If the program doesn't branch at this point, stage 4 takes only 1 clock cycle, so instructions keep flowing and life is beautiful. However, if the program does branch, the CPU must fetch the target instruction from the cache and herd it through the pipeline, which consumes 4 clock cycles. Most branches aren't taken, so the IDT-C6 averages about 2.5 clock cycles per branch.

By comparison, a Pentium needs only 1 clock cycle per branch if it correctly predicts the outcome. However, if a Pentium guesses wrong, it needs 4 or 5 clock cycles to recover. Henry calculates that a Pentium averages about 1.8 clock cycles per branch. In his judgment, the Pentium's extra complexity buys only a little more efficiency.

For all its simplicity, the IDT-C6 still has a few tricks to speed execution. The IDT-C6 has an eight-entry call-return stack. When a program branches, the CPU pushes the return address onto this internal stack. Most other CPUs would store and retrieve the address from memory. Centaur predicts that the IDT-C6 will save a slow memory access by pulling the address off the return stack about 90 percent of the time.

Another special feature is a cache that holds eight entries from the page-directory table, a lookup table that x86 processors use to access memory. About 90 percent of the time, the IDT-C6 finds the pointer it needs in the cache instead of looking in the table, which saves yet another memory access. And to keep complex instructions from paralyzing the chip's lone pipeline, the IDT-C6 also has a special queue incorporated into stage 2 that lets it fetch and translate up to three instructions while executing another instruction.

In other words, the IDT-C6 isn't as primitive as it first appears. It's not just a recycled 486 chip with MMX tacked on. Rather, it's a bold attempt to quickly produce an x86 processor that offers competitive performance at an affordable price.

"We're going to get hit by all the technical journals because we don't have superscalar pipelines and out-of-order execution and all that other stuff," says Henry. "But microprocessors ought to be commodities. Our theme was to develop a chip for the common masses. This project was my labor of love." ■

Processors Compared

	Centaur IDT-C6	Intel Pentium (P55C)	Intel 486DX4*
Top clock speed	200 MHz**	233 MHz	100 MHz
MMX instruction set	Yes	Yes	No
MMX instruction issue	One per cycle	Two per cycle	N/A
Number of integer pipelines	One	Two	One
L1 cache (instruction plus data)	32 KB + 32 KB	16 KB + 16 KB	16 KB unified
Number of transistors	5.4 million	4.5 million	1.6 million
Fabrication process	0.35-micron CMOS	0.35-micron CMOS	0.6-micron CMOS
Die size	88 sq. mm.	140 sq. mm.	345 sq. mm.
Pin-out	Socket 7	Socket 7	486 socket
Introduction date	September 1997	June 1997	March 1994

*The 486DX4 was Intel's most powerful 486. Earlier 486 chips (first introduced in 1989) ran at 66 MHz or slower, had an 8-KB unified L1 cache, and included only 1.2 million transistors.
**The 225- and 240-MHz versions are likely this fall.
N/A = not applicable

Tom R. Halfhill is a BYTE senior editor who is based in San Mateo, California. You can contact him at **thalfhill@bix.com.** *Additional information about the Centaur Technology IDT-C6 can be found on its Web site at http://www.centtech.com.*

This language allows for the easy writing of threaded programs with bidirectional communications. ***By Larry Rau***

Programming In Limbo

Limbo is a new general-purpose programming language developed by Lucent Technologies for writing applications that run on the Inferno OS (see "Inferno: One Hot OS," June BYTE). Limbo uses attributes from well-known existing languages as well as adding a few twists of its own. It has several features that allow for the creation of very dynamic, concurrent applications.

Limbo bucks the current object-oriented programming (OOP) trend: It contains no language features that aid in the development of OO applications. Instead, it's a procedural language that uses the concepts of modules with separate interfaces and implementations that allow developers to create well-structured applications. The Limbo language reference manual, along with the Limbo compilers, is available with the Inferno Development Kit on-line at http://www.lucent.com/inferno.

Language Features

C and Pascal programmers will find that Limbo syntax looks familiar. Limbo declarations are in the Pascal style of name/colon/type, and statements and expressions are generally similar to C's in both syntax and semantics. Unlike C, Limbo contains a rich set of built-in types and is strongly typed (both static and run-time). It's also very dynamic, uses garbage collection, and offers support for threads and communications.

Limbo contains the typical primitive types—`byte`, `int`, `big`, and `real`. Unlike C, these primitives have well-defined sizes (`int`s are 4 bytes, `big`s are 8 bytes, and so on). This improves code portability across different architectures. More complex data types include arrays, strings, and the Abstract Data Type (ADT—something between a C `struct` and a C++ class). Limbo also contains additional high-level structured types—lists, tuples, modules, and `chan` (channels).

Arrays in Limbo are always created dynamically from memory in the heap and referred to via a reference. (References are much like C++ references for parameter passing. One of Limbo's advantages is that it does not support pointers.) Assigning an array, or passing it to a function as a parameter, passes a reference to the contents of the original array.

Along with the traditional array-index operations, Limbo also provides slicing. A *slice* is a subarray that's specified by an index range. A slice is a reference to the original array; therefore, if it's modified, so is the original array. The Limbo language reference manual provides details about various flexible forms of creating and manipulating arrays.

The ADT is Limbo's counterpart to the C++ `class`. As with C++, functions can be encapsulated with the type. However, neither inheritance nor polymorphic functions are supported. ADTs are value types; assigning an ADT results in a copy of the data contained in the original ADT. Limbo does not allow a programmer to manipulate the references themselves—only the data referred to in the references.

Lists and Tuples

The Limbo `list` type allows for a sequence of like-typed items to be collected and manipulated. Limbo contains three list operators: `hd`, `tl`, and `::`. The `hd` operator returns the head (i.e., first) item of the list. The `tl` operator returns the tail (i.e., the list of items following the

Limbo Code Sample

SortExample.b

```
implement SortExample;
include "sys.m";
  sys: Sys;   # declare module instance
    # import sys names into current module scope
    print: import sys;
include "draw.m"; #need some decls
include "Sort.m"; #bring in Sort module decl
  sort : Sort;  #declare mod instance var

SortExample : module
{
  init : fn( ctxt : ref Draw->Context, args : list of string );
};
init(ctxt: ref Draw->Context, args: list of string)
{
  sys = load Sys Sys->PATH;
  if ( len args < 3 )
    exit;
  args = tl args;  #ignore prog name
  alg  := hd args;  #declare and assign algorithm name
  modname : string;
  case ( alg )
  {
```

continued

head). The infix operator :: is used to construct lists. The following code fragment shows lists:

```
stuff := 30 :: (20 :: (10 ::
  stuff));
(head,tail) := (hd stuff, tl
  stuff);
```

This example contains a useful, yet uncommon, type called a *tuple*, which is an ordered collection of items—essentially an unnamed record. Tuples in Limbo are first-class types and can be used as variables, function parameters, and function-return values.

A unique Limbo type is the `chan` (or *channel*) type. Channels represent a synchronous bidirectional typed communications path between threads. Limbo offers a number of language features that use this very powerful type.

A communications operator (`<-`) sends and receives values along a channel. Limbo also provides an `alt` statement, which is similar in structure to a `case` statement. It allows for a set of channels to be given a fair chance for a send/receive operation to complete. This ensures that a single heavily used channel will not keep less frequently used channels from communicating in a timely manner.

Channels are simple to use. Once one is created, any thread that has a reference to it can read or write to it. When a thread writes to a channel, the thread blocks until a corresponding read takes place (likewise for thread reading). This feature allows a channel to be used as a means for synchronizing threads.

Limbo programs are organized into logical blocks called *modules*, which contain declaration and implementation files. A module declaration file contains the module's exported types, constants, and functions and defines the interface to the implementation. A module implementation file provides the actual code. A module implementation can have additional types, constants, data, and functions that are considered private.

Programs explicitly load modules at run time. When a module is loaded, it's assigned to a variable that is declared to have a type of a specific module; this assignment is protected via a run-time type check. This allows instances of modules to be passed into and out of functions, as well as stored. Furthermore, multiple instances of a module can be loaded; each instance maintains its own set of module data while sharing code.

Threads and Communications

Limbo provides a single, simple language element—the `spawn` statement—to support multithreaded programming. This statement accepts a single parameter, which provides a function that the new thread executes. In Limbo, threads are extremely lightweight and are intended to be treated as an inexpensive, primitive resource that an application can use to accomplish a task.

The aforementioned `alt` statement allows an application's thread to simultaneously operate on multiple channels. This simple statement is a powerful feature of the Limbo language and greatly aids in creating robust and efficient concurrent applications. A single thread can block waiting on one of many channels to complete a read or write operation and then perform an action that depends on which channel completed. This statement is similar to—but is a great deal more powerful than—the `select()` and `poll()` functions used in Unix.

A Sample of Limbo

The text box "Limbo Code Sample" contains part of a simple and contrived program, SortExample.b, that shows some of Limbo's features. It should help get a new Limbo programmer up and running.

SortExample.b has a small driver program that shows how to load one of two modules, each of which implements a different sort algorithm, thus leaving to run time which sorting implementation to use. This example is more complex than it needs to be, but it's useful for demonstrating how to use threads and channels in Limbo.

For the actual sort, a thread is spawned using the sorting function as the secondary thread. A channel is used to communicate the results of the sort back to the main thread. The main thread blocks on the channel read and thus waits until the sorting thread completes. This file, the sort modules, and the header file are all available for downloading from The BYTE Site (http://www.byte.com/art/downloads/download.htm). B

Larry Rau (Whitehouse Station, NJ) is a member of the Inferno development team. He can be reached at **larryr@lucent.com**.

Limbo Code Sample *(continued)*

```
    "Bubble" or
    "Insert" or
    "Quick"  => modname = alg+"Sort.dis";
    *        => exit; #unknown
  }
  sort = load Sort modname; #dynamic module load
  # convert list of strings to array of int
  nums := tl args; #rest of arguments
  vals := array[len nums] of int;
  for( x:=0; nums != nil; nums = tl nums )
    vals[x++] = int (hd nums);
  # do sort of list of integers
  ch := chan of Sort->Result; #create channel for result
  # start thread to do sort
  spawn sort->SortInts( vals, ch );
  # wait for results
  (result,err) := <- ch;
  if ( err != "" )
  {
    print( "Error: %s\n", err );
    exit;
  }
  # print numbers
  for( x=0; x<len result; x++ )
    print( "%d ", result[x] );
  print("\n");
}
```

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Once the unsinkable Titanic of high-speed networking, asynchronous transfer mode (ATM) looks like it might have a hole in its hull. The icebergs in this case? Inexpensive frame relay, IP WANs, and Gigabit Ethernet.

The ATM protocol stack was developed to run everywhere from the desktop to the server to the largest phone company switches. But high costs are keeping it from most desktop systems. And thanks to the rise of Gigabit Ethernet, there will be no shortage of bandwidth among servers.

That leaves the traditional argument for using ATM: to collapse many different networks—voice, video, and data—onto a single backbone. But ATM doesn't look like the only way to do even that anymore. Instead of ending up as most things to most people, ATM will turn out to be some things to some people—particularly phone companies that have already climbed the ATM learning curve. The increasing speeds at which frame relay runs, along with the promise of new IP services such as guaranteed bandwidth and voice over frame, are challenging ATM's assumed dominance as a public WAN service. Furthermore, frame relay is based on IP addresses, whereas ATM's addressing scheme is based on ISDN phone numbers. With IP-based services at the local exchange carrier and offered by many Internet service providers (ISPs), it will be difficult to "dial" others using an ISDN-based system they aren't subscribed to. The growth of frame relay, coupled with new technologies to speed packet services and counter congestion, promises to preserve familiar IP addresses and routing protocols (such as OSPF) instead of forcing a migration to whole new schemes.

If you haven't yet implemented the technology, and especially if you're not a phone company, the bottom line is this: Get ready for an explosion of reasons not to incorporate ATM into your customer premises equipment (CPE). The age of IP dial tone is at hand.

ATM and Frame Relay

If you thought ATM was the only way to get a high-speed WAN connection, think again. Frame relay is breaking through its T1 (1.544 Mbps) and T3 (45 Mbps) speed barriers. Ascend Communications is running frame relay at 155 Mbps in its lab today, according to Dick Kachelmeyer, the company's director of product marketing.

Thanks to the Internet Engineering Task Force (IETF) and the Frame Relay Forum, frame relay is also gaining some decidedly ATM-like features, including voice, guaranteed bandwidth, and flow control management. One of the most important of these is FRF.11, a standard for voice over

ATM's SHRINKING ROLE

Internet technologies have put a hole in the boat carrying ATM to shore.

By Scott Mace

frame relay, which the Frame Relay Forum ratified in May.

Also, by the time you read this, the Frame Relay. Forum should have approved a fragmentation implementation agreement that will outline how to break frame relay frames into smaller frames. This agreement will give frame relay even more ATM-like capabilities, such as quality of service (QoS) levels, which could be mapped to equivalents in ATM hardware through interworking, says Larry Greenstein, vice president of technology for the Frame Relay Forum.

Also this year, the Forum hopes to finalize service-level agreements (SLAs). These would let carriers describe their services to users, then let those users measure the service they're getting to determine if they're getting what they pay for. While frame relay's existing committed information rate (CIR) is a way of determining the minimum rate at which frames get sent over a connection, SLAs could let customers or carriers specify the number of frames that could be discarded over a given time period, and provide customers with financial refunds if that number is exceeded. Despite concerns that the new standards would require frame relay hardware to be upgraded, manufacturers such as Ascend Communications say the new features will require only a software upgrade. In fact, Ascend plans to release its version ahead of the standard, then upgrade to meet the standard when it's completed.

So, think it's time to jettison ATM for frame relay? Not quite. For starters, OC3-speed (155-Mbps) frame relay has a long way to go: Ascend has to announce and deliver products before service providers can roll out the technology. Moreover, the Frame Relay Forum group isn't working

EXTENDING THE ENTERPRISE

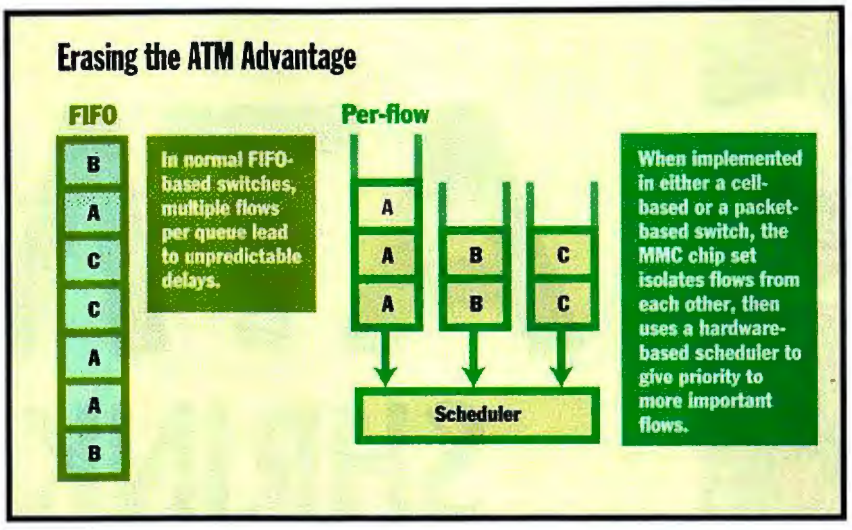
on any standard frame relay speeds beyond T3.

Second, voice over frame relay isn't ready for widespread use over public networks yet. "If the network experiences peak traffic and congestion, voice doesn't perform so well," says Heidi Brandte, senior product marketing manager at Ascend Communications. It's mostly useful for intracompany voice traffic today, she admits. Carriers such as Bell Atlantic hope to announce voice over frame relay services by the end of this year.

"Today, if you allow a large LAN traffic frame to go in between voice frames, it will obviously affect quality," according to John Rolfe, senior product manager for frame relay at Ascend. Fragmentation will help frame relay reduce latency and deliver advanced services—even video, Rolfe says.

When you get down to it, voice is just plain tricky. Even ATM still has some problems dealing with voice. While some proprietary solutions, such as Fore Systems' ForeRunner VoicePlus network module, shipped earlier this year, the ATM Forum standard to provide plain old telephone service (POTS) to PC desktops still lacked a number of features at press time, including the ability for a user to hear a busy tone. The enhancements needed were headed for final ballot by early August. Even so, the proposed standard won't work with anything other than constant bit rate (CBR) ATM, which provides data at a guaranteed rate with rigorous latency control. "There are some difficult timing issues that need to be worked out" to get voice to run over ATM's more cost-effective variable bit rate (VBR), says George Dobrowski, president of the ATM Forum.

Ultimately, packet-based services are less than ideal for handling high volumes of private branch exchange (PBX) phone calls. If WAN traffic is to include PBX-to-PBX traffic, it has to carry clocking information, the output of old time division multiplexers, across the network. "There's still a huge legacy phone system," says Ascend's Rolfe. It's a phone system that doesn't tolerate the kind of jitter, or variations in latency, common on packet networks. Unless thousands of legacy PBXes suddenly add buffering, it'll be packet networks that have to adjust.



In MMC's Xstream chip set, packets and cells both gain from a scheduler that gives priority to time-sensitive traffic.

ATM, IP, and QoS

How will they adjust? Try IP. The future of WANs could hinge on whether anyone can figure out how to provide priority service for critical traffic. The IP camp has Resource Reservation Protocol (RSVP), an imperfect scheme at best. RSVP relies on network devices, such as routers, to make a best-effort attempt to deliver isochronous traffic, such as video. It may, however, initially be best at simply prioritizing non-time-sensitive packets that can still live with some latency.

ATM, of course, already specifies QoS classes that can guarantee end-to-end latency. But at a price: Once an ATM switch reaches its capacity of virtual circuits, the switch refuses additional connections, and routing must again commence to carry excess traffic around the congestion.

The debate about how to end congestion in switches and routers rages. IP fans believe that new technology, such as MMC Networks' Xstream chip set (see the figure above), implemented in Cisco's new LightStream 1010 router, lets IP as well as ATM switches give isochronous traffic priority.

ATM proponents insist that it has to be done with ATM. "The average packet traveling across the Net takes 16 hops," says Dave Nelsen, senior marketing director at Fore Systems, a leading provider of ATM switches. "About half of those occur on the backbone. When you put in ATM as a replacement backbone and push the

WAN Services Cost Comparison

Frame relay is among the lowest-cost transparent LAN services, which includes all needed customer premises equipment and access links. (Source: TeleChoice)

	Frame relay	1.544-Mbps DS1 ATM	10-Mbps native LAN service	1.544-Mbps DS1 (T1) private line	10-Mbps ATM	N by T1 private line	45-Mbps (DS3) T3 private line
Local access	$277	$277	N/A	$277	$3487	$1662	$3487
Service costs	$2668	$3578	$5500	$4425	$16,202	$26,550	$39,843
Router interface	$33	$33	$33	$80	$278	$278	$667
CSU/DSU	$42	$119	N/A	$100	$389	N/A	$400
Inverse muxes	N/A	N/A	N/A	N/A	N/A	$667	N/A
Management	$833	$833	N/A	$833	$833	$833	$833
Total monthly cost	$3853	$4840	$5533	$5715	$21,189	$29,990	$45,230

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Two ISPs Show How IP Challenges ATM

Consider one of the major bandwidth-hungry Internet service providers (ISPs), Media One. It's gambling that it won't have to use any ATM in its national backbone. Media One's decision is ample evidence that even in the WAN, once-unchallenged assumptions of ATM's superiority are under attack.

Instead of ATM, Media One will use "packet over SONET," a way of transporting IP packets over the Layer 1 Synchronous Optical Network, an ANSI standard for high-speed, high-quality digital optical transmission, which many ATM networks rely on. Media One plans to offer all the snazzy new services that ATM promised to deliver, such as voice and video, all using IP over SONET.

There are various flavors of packet over SONET. Cisco Systems, whose routers built the Internet, announced in February that it is moving forward with PPP over SONET. Four months later, Cisco bought Skystone Systems, which makes chip sets to allow Ethernet/PPP and frame relay protocols to run over SONET fiber, and announced that it would incorporate Skystone technology into "next-generation Cisco products." Cisco's OC3 PPP over SONET is working its way through the Internet Engineering Task Force (IETF) as RFC 1163. Cisco is already planning its own OC12 (622-Mbps) version.

Another ISP, Best Internet, has already ditched ATM on its redundant SONET DS3 lines and instead went to Border Gateway Protocol (BGP), a TCP/IP routing protocol for interdomain routing in large networks. "Most people use ATM because it's cheap, but it's not as useful as a direct point-to-point link," says Richard White, Best Internet's chief technical officer. "We don't do backbone routing—we let the national service providers do our backbone for us."

But the move to replace ATM with IP is risky. Few experts predict that IP alone can become the standard transport for WANs. "There has to be an underlying packet technology under IP to build scalable IP networks," says Chuck Davin, chief technical officer of PSINet, a leading ISP. "We know from experience that the most critical factor that determines Internet application performance is not so much bandwidth as it is packet loss." These packets are often lost by congested Internet routers, Davin says.

routers to the edge of the ATM core, traffic can move directly from the access router to the egress router with no router hops in between."

As a way of eliminating the need for routers, telecommunications companies are also rushing to deliver switched virtual circuit (SVC) service for ATM. SVCs will offer ATM customers more flexible usage-based billing, and they are more affordable for lower-usage customers than permanent virtual circuits (PVCs), according to Nick Nechita, senior architect of broadband technologies and service for the New Brunswick Telephone Company (Saint John, New Brunswick). In the U.S., AT&T recently became the first interexchange carrier (IXC) to offer ATM SVC as a public service. IXCs are also widening their ATM pipes, from OC3 and OC12 today to OC48 within 12 months. This is one area where frame relay is lagging.

Both approaches have their merits. As long as the Internet keeps growing, applications that need QoS will still experience brownouts and blackouts. In fact, there's even an effort to bypass the debate not by switching all traffic but by building faster routers. Far better, critics say, to maintain the existing democratic routing hierarchy, which gracefully degrades service but does not deny it.

So, would you rather have affordable videoconferencing service with variable quality, pay for a service that could have busy signals, or just stick with pricey point-to-point systems? You may be asking that question whether you go with ATM or stick with IP on your WAN.

WHERE TO FIND

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Rough Seas

Even ATM's strongest proponents now concede that public WANs, including connections to ISPs, will be a mixture of frame relay and ATM. Phone companies' ATM support on their T1 lines is increasing dramatically, but ATM will still be playing catch-up to frame relay, which is already offered in practically every market.

But frame relay's lack of SVCs impacts the ability of providers to charge sensibly for it, and for customers to know what they're paying for. "It's very hard to count IP packets," says David Dorman, chairman, president, and CEO of Pacific Bell. "It's easy to count how long a circuit has been open and who opened it." The phone companies continue to push hard for this to become a part of IP services, so Internet access can be metered instead of flat-rate. If current trends continue, by 1999 more than half of Pacific Bell's traffic will be data, not voice, Dorman says.

Despite technological challenges and slower-than-hoped acceptance, ATM represents a healthy business. Frame relay growth has slowed only to double digits, while ATM remains in triple-digit territory, according to both the ATM Forum and the Frame Relay Forum. When you add up equipment and services, both are billion-dollar-a-year industries.

Where ATM makes sense today is at the core of some very large networks. Phone companies, for example, remain bullish on ATM pushing its way to the very edge of the Internet. "ATM has traffic management capabilities, segregation, and prioritization of traffic," says Andy Schmidt, product manager for Ameritech Data Services. "It's very difficult to get that done with IP alone." Sixty percent of today's Internet traffic, including frame relay, is carried across backbones in ATM cells.

But all the value-added services ATM promises—voice, video, variable bit rate transmission—have been late in coming. The reason: ISPs are doing all they can just to keep up with demand for existing services. Bursty, Web-based Internet traffic doubles every three or four months, according to Alan Taffel, vice president of marketing at UUNet Technologies. B

*Scott Mace (**smace@dev5.byte.com**) is a BYTE senior editor in San Mateo, California.*

Preparing for Gigabit Ethernet

Like a gourmet meal, serving up the latest LAN backbone shouldn't be a rush job. Here's help.

By Mike Hurwicz

Pundits say that Gigabit Ethernet, because of its relatively low cost and easy fit with existing Ethernet, will be adopted quicker than previous high-speed technologies such as Fiber Distributed Data Interface (FDDI) and asynchronous transfer mode (ATM). Still, if you're like most users, you're not even in the tire-kicking phase yet with Gigabit Ethernet. You're just walking around the car and flexing your toes. Here are 10 tips for users who plan to deploy Gigabit Ethernet and want to make sure their shoelaces are tied before they start kicking the tires.

Track Interoperability Tests

The Gigabit Ethernet standard (802.3z) should be officially approved in the first quarter of 1998. However, chip makers have already spun silicon, and equipment makers are turning out products based on the evolving standard. Lacking an approved standard, vendors must prove that the present standard is workable by doing interoperability tests.

Tests were done at Networld+Interop in Las Vegas in May by 28 vendors, among them Alteon Networks, Cisco Systems, Extreme Networks, Foundry Networks, Hewlett-Packard, IBM, Packet Engines, Rapid City Communications (acquired by Bay Networks in June), and 3Com. While the tests were encouraging, they were based on the D2 draft of the standard, which was frozen in March.

Gigabit Ethernet products that vendors are releasing will typically feature new silicon and firmware/software based on the draft that was frozen in July. Fall Networld+Interop in Atlanta will provide a public forum for tests of products based on the current draft. In July, the Gigabit Ethernet Alliance, representing the industry, announced the formation of a Gigabit Ethernet Consortium at the University of New Hampshire interoperability lab. At press time, the consortium was preparing for testing at the lab this fall.

Although many of them are sworn to secrecy by their testing partners, ask vendors whom they've tested with and what the results were. Knowing whom people are testing with is important. The more

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testing being done with the product you're considering, the better. Also, you may get a sense of the overall problems with Gigabit Ethernet interoperability and problems involving particular products.

Another useful strategy when it comes to interoperability: Buy multiple network components from the same vendor. For instance, Alteon sells both a Gigabit switch, the AceSwitch 110 (OEMed by Sun Microsystems as the SunSwitch), and Gigabit Ethernet network interface cards (NICs). You know they have been thoroughly tested together, so you have one less element of interoperability to worry about.

Find Out What 100-Mbps Ethernet Will Do

You'll probably want to compare Gigabit Ethernet–based solutions with 100-Mbps Ethernet. Start now by looking at all the available 100-Mbps solutions.

If you will be testing Gigabit Ethernet cards for servers, know what you can do with multiple 100-Mbps Ethernet cards. To save slots in the server, consider solutions such as the quad-Fast Ethernet adapter from Sun, which gives you four 100-Mbps Ethernet ports on one card. With new trunking software from Sun, you'll be able to aggregate those four ports into one channel, though you'll still need a 100-Mbps switch port for each connection.

Similarly, Cisco Systems' Fast EtherChannel technology connects switches, routers, and servers with up to four 100-Mbps Ethernet links. You can aggregate the links or use them in redundant, parallel fashion. (Cisco will upgrade EtherChannel to support multiple Gigabit links in the future.)

Although price/performance is a big attraction of Gigabit Ethernet, this is still a leading-edge technology. Adapter cards may cost $1200–$1500 or more. Switches may cost $2500–$3000 per Gigabit Ethernet port. Gigabit Ethernet often costs around four times more than 100-Mbps Ethernet. If you can get four times the performance, lowered management and equipment costs (e.g., fewer switch ports) may make the jump worthwhile.

What kind of performance improvement can you expect with Gigabit Ethernet? Due to the limitations of most of today's servers (e.g., CPU, bus, OS, and protocol stack), you will probably not get 10 times the application throughput you got with 100-Mbps Ethernet. A Gigabit Ethernet connection on a 7.88 SPECint95 Unix server can deliver three to five times more TCP throughput than 100-Mbps Ethernet before the server CPU runs out of cycles, according to tests done by Alteon.

Whether you are better off upgrading your server adapter to Gigabit Ethernet or going with a quad-Fast Ethernet card depends largely on the horsepower of the server, but also on the adapter you use. A high-end server will be able to take better advantage of the Gigabit card. Intelligent adapters, which off-load host processing functions such as TCP/IP checksum computation, can also maximize host CPU availability and increase throughput.

"Performance varies tremendously from server to server, and only testing can give you a realistic idea of what Gigabit Ethernet can really do for your applications," says Selina Lo, Alteon's vice president of product management.

When you start pushing 100-Mbps technology, testing may show that you don't have the traffic or the servers to justify Gigabit speeds. Again, multiple 100-Mbps links may be all you need for now. You can afford to wait while prices drop and the technology matures. On the other hand, with high-end servers, you may find that Gigabit Ethernet will speed things up, save you money, and simplify management, even if it delivers only half its nominal throughput.

Check Your Fiber

The initial 802.3z standard prescribes a Fibre Channel physical layer, which means it requires fiber-optic cabling for cable runs that are longer than 25 meters. (Up to 25 meters, there is also a shielded-twisted-pair [STP] option, 1000Base-CX. An unshielded-twisted-pair [UTP] standard is still under development. Current UTP Gigabit Ethernet products are proprietary.)

With 62.5/125-micron multimode fiber, the most commonly installed fiber in the U.S. (and the fiber used in most FDDI installations), the 802.3z standard allows runs of up to 300 meters with a short-wavelength (e.g., 850 nanometers) 1000Base-SX transceiver or 550 meters with a long-wavelength (1300 nanometers) 1000Base-LX transceiver. Single-mode fiber, which is customarily used in conjunction with long-wavelength transceivers, is good for distances of 2 to 3 kilometers.

A potential problem arises because FDDI supports 2-kilometer runs on 62.5/125-micron multimode fiber. If you have fiber that was installed for FDDI, check the length of the runs. If they're in the 300- to 550-meter range, look for Gigabit Ethernet products that support long-wavelength transceivers. If the runs are over 550 meters, you must use single-mode fiber. If you're installing cabling now, include single-mode fiber for backbone links over 550 meters.

Plan to Recycle

What will you do with 100-Mbps backbone equipment when you replace it with Gigabit Ethernet? Plan redeployment now.

Perhaps you are still extending 100-Mbps Ethernet backbones today but expect to be deploying Gigabit Ethernet backbones in 12 to 18 months. After the

Adding Up the Cell Tax

When asynchronous transfer mode (ATM) switches must convert variable-length packets into fixed-length cells for transport over ATM WANs, there's a price. First, each ATM cell contains a 48-byte payload and a 5-byte header. Thus, 10 percent of the ATM "pipe" is immediately lost to overhead. But it doesn't stop there. If a cell carrying a packet gets dropped, not only must the entire IP packet be retransmitted, the other cells from the "broken" packet continue on their way. One router manufacturer, using a reasonable estimate of 31 cells per average packet, estimates that a 1 percent cell loss can translate into a 30 percent packet loss.

Foundry Networks, a Gigabit Ethernet start-up, estimates that using a reasonable frame size of 256 bytes, Gigabit Ethernet will provide a latency of 2 microseconds across the network. ATM at 622 Mbps will provide 4 µs of latency. But Gigabit Ethernet's variable-length packets provide 93 percent bandwidth use, while ATM achieves only a 77 percent bandwidth efficiency. Thus, the actual bandwidth required to carry a 2-Mbps video stream is 2.15 Mbps for Gigabit Ethernet and 2.59 Mbps for ATM.

ATM proponents counter that today, only ATM can provide the quality of service that applications such as video streaming need. Also, ATM switch maker Fore Systems notes that adding security to IP packets imposes a 20-byte overhead per packet; if the IP traffic is primarily short packets, that could negate the cell tax in short order, Fore officials note. But if traffic is made up, as it increasingly is on the Internet, of long "bursty" packets, it's unclear just how much this could level the playing field.

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coming of Gigabit, 100-Mbps Ethernet backbone switches may be reassigned to workgroup LANs.

Consider ATM Replacement

You're probably not in any rush to throw away ATM equipment that's doing an adequate job or to replace it with new and largely untested Gigabit Ethernet. However, there are arguments for migrating toward a purer Ethernet environment over the long run. Management will be simplified. Equipment that supports only Ethernet will probably be much less expensive than equipment that supports ATM. In addition, translating Ethernet frames into ATM cells and back again increases the latency of the network (see the text box "Adding Up the Cell Tax" on page 64).

However, there are good arguments for sticking with ATM in the long run, too. Carriers aren't offering Gigabit Ethernet WAN services yet. For now, ATM may be the best way to interface with the WAN (see "ATM's Shrinking Role" on page 58).

Plan ATM Coexistence

If you have ATM, how are you going to integrate it with Gigabit Ethernet? The solution may involve switches, routers, multiplexers, and hubs that support both technologies.

Alteon's AceSwitch is a Gigabit Ethernet switch that will offer ATM links later this year. In addition to the ATM option, which is being jointly developed with NEC America, Alteon plans to support FDDI links. The switch offers eight half- or full-duplex 10/100 Ethernet ports, a full-duplex Gigabit Ethernet port, and a PCI option port that you can currently configure as a second Gigabit Ethernet port. The PCI port will also support the ATM and FDDI options when they are released.

Find Management Tools

Management often lags behind when new technologies arrive, especially when they emerge as fast as Gigabit Ethernet has. Some current approaches may be hard-pressed to handle Gigabit Ethernet.

"Some tools don't work well at that speed," says Nate Walker, Cisco's product line manager for Gigabit Ethernet. "For example, an RMON probe that has to examine every packet may not be designed to do it at Gigabit speeds."

Many early products have only basic management capabilities, says Walker. "Most companies have thought about managing the physical and media access control (MAC) layers, but some have done very little about layer 3 and switching. That's one of the risks of looking at early products."

A third-party market for Gigabit Ethernet management is emerging, however. LANQuest is trying to fill the gap with version 4.0 of Windows NT–based Net/WRx (pronounced "networks") traffic generation and analysis software. Net/WRx can generate and analyze not only Gigabit Ethernet but also ATM traffic. Its focus is capacity planning. By generating traffic using Net/WRx, the network designer can see how much more traffic the network can handle before users see a slowdown.

Learn About Routing Switches

With high-bandwidth technologies such as Gigabit Ethernet, routing functions are increasingly likely to create a bottleneck. There are half a dozen proposals for new interswitch protocols or modifications of the IP protocol that will give customers the performance enhancements that come with layer 2 switching, while retaining the services that routers perform, such as security, traffic prioritization, and policy management.

Initially, most of these proposals target ATM, including Ipsilon Networks' IP switching, Cisco's tag switching, and the ATM Forum's Multiprotocol Over ATM (MPOA), which the ATM Forum adopted as a standard in July. For Ethernet, Bay Networks' acquisition Rapid City Communications has implemented IP routing in silicon, permitting switch-speed routing without introducing any new protocols between switches.

The concept of a switch that performs optimized IP routing is one whose time has come. If nothing else, it lets you get the speed benefits of switching without having to totally rearchitect your IP addressing scheme, as you would have to if you flattened your network architecture by just substituting switches for routers.

Unfortunately, most of the layer 3 switching technologies are immature. Products also may lack essential features. A vendor may claim that its product is a switch router even if the only routing protocol it supports is RIP. That won't do for many customers.

To prepare for Gigabit Ethernet, customers need to educate themselves about the various layer 3 switching technologies. However, you may not be able to pick a clear winner, either in the market in general or for your application.

You don't necessarily have to think in terms of picking one layer 3 switching technology, which today implies committing to a particular vendor, because standards are unfinished or too new. Nor is your only alternative avoiding all layer 3 switching schemes for the time being. Instead, you can buy only products that require no change in the routing protocol between switches.

It's also possible to deploy multiple layer 3 switching schemes. In that case, equipment running each scheme forms an *island*. Islands are connected by ordinary IP routing. You might use tag switching in an area of the network that is based primarily on Cisco routers, MPOA in an area that's dominated by Fore Systems' ATM switches, and ordinary IP for backbone extensions based on the Bay Networks F1200 Gigabit Ethernet switch (which was

How Gigabit Ethernet and 10/100-Mbps Ethernet are similar	How they differ
Access method: CSMA/CD. All devices on the network listen for transmissions first before they begin transmitting. If two devices start transmitting simultaneously, they detect this, back off, and then each begins transmitting again according to a randomly generated time interval. Each technology permits one repeater per collision domain. Most Gigabit Ethernet implementations are switched full-duplex, which uses no CSMA/CD.	**New devices:** Gigabit Ethernet adds a new class: buffered distributors–full-duplex, multiport, hub-like devices that interconnect two or more 802.3 links operating at 1 Gbps or faster. The buffered distributor forwards all incoming packets to all connected links except the originating link. Unlike an 802.3 repeater, the buffered distributor is permitted to buffer one or more incoming frames on each link before forwarding them.
Types of products: Switches, uplink/downlink modules, network interface cards (NICs), repeaters, router interfaces.	**Encoding/decoding circuits:** Initial implementations of Gigabit Ethernet use optical components derived from Fibre Channel, an ANSI-standard high-speed interface for linking mainframes and peripherals. Gigabit Ethernet also uses Fibre Channel's 8B/10B encoding/decoding schemes for serialization and deserialization.
Frame format: 802.3 Ethernet.	

Source: Gigabit Ethernet Alliance

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formerly Rapid City's flagship product).

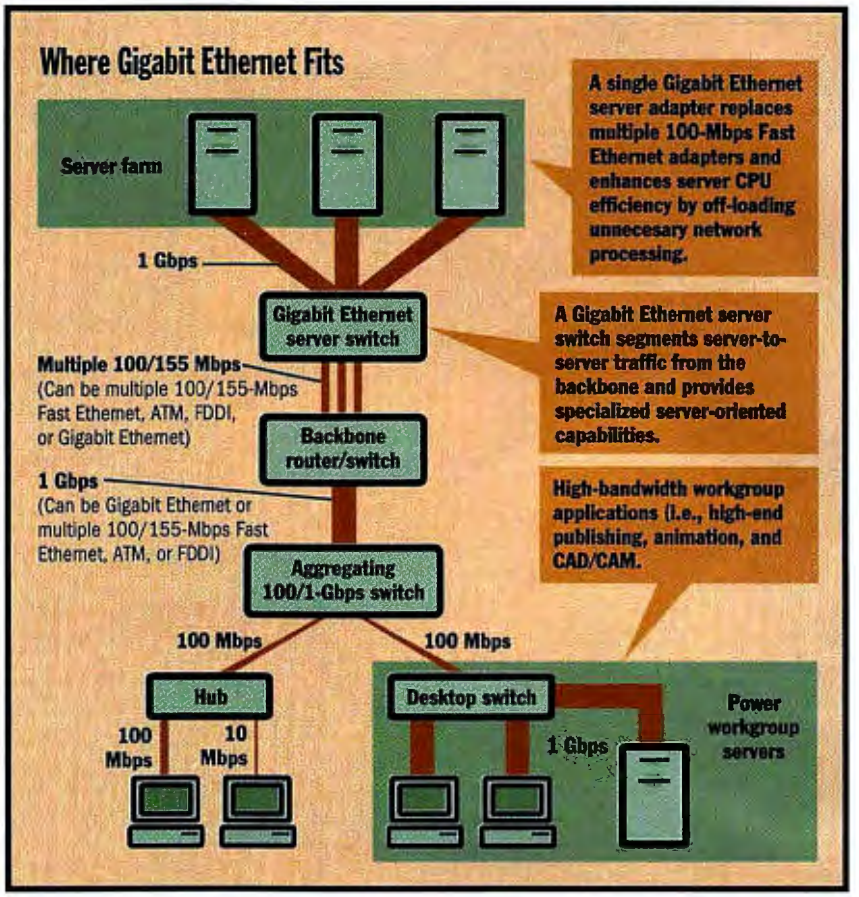
Clearly, that adds management complexity, but it may make sense to go with the technology each vendor favors in areas of the network dominated by those vendors. There may be only minimal management integration between these parts of the network anyway.

Upgrade Servers

The first application that comes to mind for Gigabit Ethernet is often the backbone, where the increased bandwidth yields the most benefit for the most users. However, the backbone is also a single point of failure for the entire network. Servers can be a safer place for your first production rollouts of Gigabit Ethernet. To stay even further from the limelight, you could start by implementing Gigabit Ethernet only for server-to-server links, for functions such as backup, replication, shadowing, and synchronization, suggests Alteon's Lo. If anything goes wrong with these back-end server connections, it's less likely to have a direct and dramatic impact on users.

Server-to-server traffic is growing as fast if not faster than client/server traffic, according to Alteon. It also may be characterized by long frames that are well suited to Gigabit Ethernet technology.

If you implement Gigabit links to today's PC servers, the servers will be much slower than the network. This is an opportunity to get better performance by upgrading servers. You may just want to install faster storage. Perhaps you want to consider the Fibre Channel–based disk interfaces on Compaq's newest ProLiant servers. You can also look for Gigabit Ethernet products that target servers, such as Alteon's NICs and switches. The NICs off-load protocol processing from servers; the switches offer features such as dual homing, extended frame size, and server-to-server load balancing, improving server reliability and performance.



Gigabit Ethernet makes sense as a way of linking Fast Ethernet LANs with servers and each other.

However, even the fastest of today's PC servers can't get past the 1-Gbps data rate of the 32-bit PCI bus, which limits throughput on their network connections to perhaps 300–400 Mbps, according to Jeff Wilbur, director of hub products in Compaq's networking products division. That will change in the first half of next year, with a 64-bit PCI bus boasting a 4-Gbps data rate.

"Even Gigabit Ethernet might not be fast enough for servers with a 64-bit PCI bus," says Steven Moustakas, director of network products marketing for Sun. Sun plans to introduce servers with the new bus, though a date had not been announced at press time.

The bottom line: If you are going to give a server a Gigabit connection, consider upgrading the server to take advantage of it.

Accelerate IP Convergence

Many Gigabit Ethernet products are optimized for IP. For instance, Bay Networks' F1200 Gigabit Ethernet switch routes only IP. Other protocols, such as AppleTalk and IPX, are bridged. Because routing functions have been implemented in silicon, the F1200 can route just as fast as it can bridge. So you can get the management and security benefits of routing with no performance penalty—but only if you feed the switch IP packets.

You can enable or disable IP routing on a per-port basis, so you can migrate to IP at your own pace. However, you can prepare to take full advantage of the F1200's capabilities by converting as many networks to IP as possible. The F1200 has six slots, each of which can support either two Gigabit Ethernet ports or 16 10/100-Mbps Ethernet ports. B

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http://www.iol.unh.edu/consortiums/ge/index.html

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http://www.sun.com/products-n-solutions/hw/networking/sunswitch/index.html

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Batter Up for Broadband

Whether wired or wireless, bandwidth is sure to hit home offices next year; road warriors will have a longer wait.

By Mark Brownstein

Imagine this scenario: You've brought some work home. You go into your home office, turn on the computer, and press an on-screen button marked "Internet." Immediately you're connected to an Internet Service Provider (ISP) at 1.5 Mbps—about the speed of your office network's ISP connection. The ISP in turn establishes a connection to your corporate WAN via virtual private network (VPN) technology.

While the VPN portion of this equation could be rolling out now, the wide-scale rollout of various bandwidth-rich broadband technologies—based on the telephone network, cable, or even wireless—will begin late this year, with a rapid ramp-up occurring in 1998 and beyond. Road warriors may have a longer wait for the same technology to hit hotel rooms, however.

The most important new remote-access technology is Digital Subscriber Line (DSL), but it's not alone. Local Multipoint Distribution Service (LMDS), cable modems, digital satellite broadcasting, and other contenders are all still in the race. Telephone companies will deliver DSL services starting late this year; meanwhile, cable companies are continuing to roll out trials.

ILLUSTRATION: DOUGLAS FRASER © 1997

DSL Diaries

DSL comes to you over standard phone cable—that four-conductor, twisted-pair copper wire that's installed almost everywhere. It carries both an analog signal for audio (a 4-kHz chunk often referred to as plain old telephone service [POTS]) and a digital signal for data. DSLs run from a telephone company's central office (CO) into a customer's building, where they're eventually connected to one or more telephones, fax machines, or modems.

Asymmetric Digital Subscriber Line (ADSL) is a specific kind of DSL developed to send video signals over existing POTS lines without needing to add to the existing copper infrastructure (see "Break the Bandwidth Barrier," September 1996 BYTE). ADSL delivers more data downstream (i.e., from the phone-company switch) to the subscriber than it receives upstream. Delivery of digital video was

once thought to require a downstream bandwidth of as much as 1.5 Mbps, although an upstream rate as low as 64 Kbps was more than enough for VCR-like control signals coming from the viewer.

Upstream data rates actually range from 16 to 640 Kbps, depending on the downstream rate, which is itself a factor of the distance from the telephone company's CO. As a result, these rates are related to the length of the copper line.

ADSL, like the other flavors of DSL, is subject to a number of limiting factors, including the distance of the user's phone from the CO (see the figure "Farther Equals Slower" on page 73). As the distance from the CO increases, the strength of the signal drops, reducing the amount of data that can be reliably received. Further obstacles include crosstalk between adjacent digital lines, line splices between the CO and the user site, loading coils that trap the signal above 4 kHz, random line noise, and breaks in the loop caused by phone jacks that aren't connected to a telephone.

According to a variety of sources, between 70 percent and 80 percent of the wired locations in the U.S. are located within the 18,000-foot ADSL transmission limit. A repeater, which amplifies the line signal, can overcome these distance limitations, making possible the delivery of ADSL to many locations beyond the 18,000-foot limit.

Delivering ADSL involves several steps. At the CO, a modem modulates and encodes signals from either the digital data provider (an ISP) or the phone company's Internet service connection, or data from a connection to a corporate network, into an ADSL signal. The modem combines the 4-kHz POTS signal with the DSL signal before sending it to the consumer over the existing phone wiring. Downstream, at the consumer's PC, a splitter separates the POTS signal from the digital signal. The digital signal is then demodulated, decoded, and passed to the PC.

Transferring data from the PC to the CO works in reverse—the modem modulates and encodes the upstream digital signal and combines it with the 4-kHz POTS signal. At the CO, the POTS signal is again separated from the ADSL digital, and the upstream signal is demodulated, decoded, and sent to the digital data provider.

Since it's a full-time digital connection, ADSL is always active. Although it uses telephone-company wiring, the connection is actually a link to a network. When it's installed, the connection can be made to an ISP, to a company's high-speed network, or through the CO to an Internet connection that the CO provides. There's no dial tone, and your connection to an ISP or corporate network is hard-wired, so you won't be able to change service providers without having changes made at the phone company's CO.

The POTS signal, which is combined with the ADSL signal on one wire, is powered by the phone company. It retains power even if the ADSL line goes down or your computer is turned off. Once it enters the user's location and is split from the ADSL signal, the POTS line is a standard phone line. This issue may prove to be a challenge to some ADSL providers that have not developed the infrastructure necessary to address the high security requirements of some users.

ADSL signal-modulation methods have been a major area of dispute among ADSL hardware developers (see the table "Rival ADSL Technologies" above). Carrierless amplitude and phase modulation (CAP) was the first method applied to ADSL. CAP combines the upstream and downstream data signals, separating them at the receiving modem using echo cancellation. This method has been used successfully in V.32 and V.34 modems. "CAP is what developers of ADSL started with," says Joseph Mouhanna, manager of a research group that's evaluating broadband technologies at Microsoft. "Most of the equipment today remains CAP, but in the future, most equipment will be DMT."

DMT, short for discrete multitone, separates upstream data from downstream data. It splits the signal into separate 43-kHz carrier bands. DMT has been adopted by ANSI (ANSI T1.413) as a standard method for modulating ADSL, and the technology could be used with other flavors of xDSL as well.

CAP and DMT ADSL modems are incompatible, but until ADSL modems begin to be unbundled from services—which will occur sometime late next year—interoperability won't become a critical issue. By that time, many expect DMT to overcome CAP's early lead.

While the industry has not yet chosen a standard modulation method, the clear message is that it shouldn't matter to users. "Users should never be exposed to that stuff," Mouhanna says. "They don't see CAP, they don't see DMT—all they should see is what comes out the other end." As long as the PC and the modem at the CO use the same modulation method, xDSL should work. And since ADSL

Rival ADSL Technologies

	Discrete multitone (DMT)	Carrierless amplitude/phase (CAP)
Technological factors	Separates spectrum into 4-kHz bands; analyzes signal-to-noise ratio in each band and changes the bit rate on each band accordingly.	Uses decision-feedback equalizer, a form of noise minimization, to maximize use of bands smaller than 1 kHz.
Standards	ANSI and ETSI (European) standard for ADSL. A companion RADSL standard is set for approval by ANSI this fall. DMT for ADSL is moving forward as an ITU standard, but interoperability lags.	ANSI working group discussions for a standard based on RADSL are continuing; prospects for an ITU CAP standard are dim.
Other considerations	DMT will also be implemented in a light version of ADSL for lower-speed modems.	None
Available chip sets and enabling technology	ADI/Aware, Alcatel, Amati, Orckit	Globespan
Chip sets and enabling technology in development	Motorola, PairGain, Texas Instruments	None
Installations claimed	10,000 modems	250,000 modems across all DSL technologies

modems won't appear in stores for two years, according to TeleChoice analyst Kieran Taylor, there's time for the standards to sort themselves out.

Other DSL variants are also being developed and/or tested. Symmetric Digital Subscriber Line (SDSL) provides upstream and downstream signals of equal size. Although SDSL's speed may not be as well suited to speedy downloads, it works well for such bidirectional applications as videoconferencing and real-time editing of code or documents.

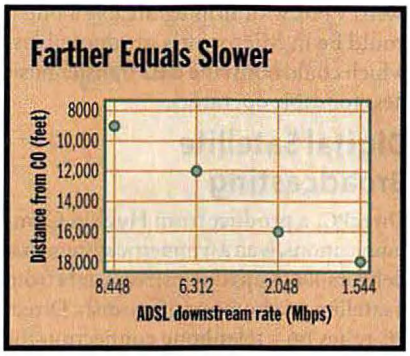
However, it's possible for phone companies and ISPs leasing copper wires to configure their switches to make ADSL behave symmetrically, although the downstream rate would drop. For instance, Pacific Bell is now talking about providing symmetrical DSL, but initially only at 384 Kbps. The rate, and the symmetrical transmission, will permit "full VHS-quality videoconferencing" for $50 to $80 per month, according to David Dorman, president and CEO of Pacific Bell.

Phone companies and ISPs are also studying other flavors of DSL. The capabilities and distance restrictions of the versions of xDSL now being developed are shown in the table "Comparing xDSL Technologies" on page 74.

Connecting an ADSL line to a PC is a challenge being addressed largely with standard 10Base-T Ethernet or universal serial bus (USB) connections. ADSL's high data rates preclude the use of a standard serial port. ADSL modems that are installed as internal devices handle the interfacing to the computer.

Bell Atlantic, GTE, Pacific Bell, and many small ISPs have successfully tested ADSL. The service has been deployed by a number of firms, including Signet Partners, an ISP in Austin, Texas, and Network Access Solutions, a local-exchange carrier that licenses copper lines from a regional Bell operating company (RBOC). Pacific Bell planned to deliver ADSL service to the Silicon Valley, Los Angeles, and the San Francisco Bay area by September and offer regional coverage by the end of 1998. Pricing for ASDL services ranges from $50 to $150 per month.

The cost of configuration is currently in the $500-to-$1000 range, which includes a modem at the CO and at the end user's PC. Initially, the modem is supplied to the user as part of the monthly service contract. Industry observers expect a wide-scale rollout of ADSL at the end of the year, with extremely rapid growth beginning in 1998.



ADSL bandwidth varies in response to the distance from the CO.

A Look at LMDS

LMDS is a recently developed technology that uses radio frequencies in the 28-GHz band. Although it's small now, LMDS seems to have the potential to quickly grow into a powerful beast.

An LMDS service provider attaches an antenna that's roughly the size of a Ping-Pong paddle to a window or a wall. This antenna is then connected to an LDMS receiver, and the digital signal flows to an interface card installed in the computer.

The extremely high frequency of LMDS limits the transmission signal to a radius of about 25 square miles. This short range may be one of its most attractive features. Because transmission distances are so limited, signals from antennas placed 10 or more miles apart can use identical frequencies without the risk of crosstalk or other interference problems that are common with radio frequencies that have a longer reach.

The FCC has allocated LMDS a huge frequency bandwidth: 1300 MHz. By comparison, broadcast TV uses 6 MHz of bandwidth, while cell phones use 25 MHz and broadband radios use only 30 MHz.

CellularVision America, a New York–based company that was involved in developing LMDS technology, launched its broadband data-transmission service in June. "This is not a test," insists Bruce Judson, CellularVision America's executive vice president.

The service, which was originally offered to subscribers in Manhattan and parts of Brooklyn, delivers a 500-Kbps signal downstream. The current implementation uses a dial-in modem for upstream communications. Business users pay $79.95 per month, with a one-time installation fee of $225. Home users pay $49.95 per month, with a one-time installation fee of $199. Currently, the company's system supports only Windows 95.

CellularVision will introduce a higher-speed system in January; later, the company plans to offer two-way transmissions over the 28-GHz radio frequency. "We have the equipment to go two-way," says Judson. Before offering the service, the company will wait until the demand for two-way transmissions develops. Judson expects two-way to become economically viable in late 1998.

With all the services it plans to offer, CellularVision America will be able to serve a virtually unlimited number of customers. "Bandwidth is not a problem; we can serve the city," Judson says. "If we need additional capacity, we can dedicate additional channels, and we can also decrease the distance between cells."

The FCC plans to auction LMDS frequency for other parts of the country later this year. Meanwhile, Motorola and Texas Instruments are developing LMDS products. "LMDS could be a dark horse," says Marshall Taplinsky, vice president of marketing at Hayes Microcomputer Products. "It's elegantly simple for the consumer to hook up, and pipes will be available for everybody, so the system won't get overloaded."

Cable Modems

The cable modem faces an uncertain future. Although technically it may satisfy the needs of many users, it may be too big a risk for many cable providers to offer this type of service.

The basic idea behind the cable modem is simple: A portion of the cable bandwidth carries data, and the cable modem extracts the data signal from the cable. Although this idea is elegant in theory, cable operators face many challenges. Cable TV's generally poor financial performance, aggravated by the loss of market share to digital satellite broadcasts (e.g., DirecTV), has forced many operators to be especially conservative about new investments.

Most cable is unidirectional; that is, it's designed to carry a video signal from a cable company's CO to subscribers' residences. A large percentage of installed cable supports downstream only. The cost of upgrading a system to bidirectional will probably delay any improvements until

larger cable companies can demonstrate an acceptable return on investment.

Even if the cable companies successfully deploy digital data services over their cables, their very success might eventually prove to be their downfall. Cable transmission requires an inverted tree topology: A large trunk carries the signal from the cable company. Branches (i.e., cables) are split off, and additional branches are further split and brought into subscribers' homes.

All users on a branch share the cable's bandwidth. If the cable can deliver 6 Mbps of data, a solitary user on a branch enjoys more capacity than he or she can use. But when you add 50 or 100 or more users on the same branch, a 6-Mbps downstream signal, divided by the number of people vying for bandwidth, may deliver data to each user only at speeds comparable to those provided by an analog modem. Additional channels might have to be added, and additional cable may have to be pulled, to deliver high bandwidth.

Microsoft recently invested $1 billion in Comcast, a major cable-service provider. Mouhanna describes the investment as "part of an effort to jump-start broadband over the public network. The cable industry needed a little boost to make it happen."

Microsoft's involvement may go a step further. Although its acquisition of WebTV was just approved in August, there was speculation that special versions of the WebTV box with an integral cable modem could be in Microsoft's product plans, which could boost the data transfer business for cable operators.

Digital Satellite Broadcasting

DirecPC, a product from Hughes Communications, is an asymmetric system that delivers 400-Kbps downstream data from a satellite to a home or office dish. DirecPC relies on a telephone connection for upstream communication.

While DirecPC uses a satellite dish similar to the one used by DirecTV, separate dishes are required for the two systems. Hughes will someday offer a method for using one dish for both DirecTV and DirecPC, although no target date has been announced. Hughes has also announced a PC card that will let a PC user view DirecTV signals on a monitor. Various pricing plans range from $9.95 per month, with a charge of 60 cents to 80 cents per megabyte downloaded, to $129.95 per month for unlimited access. Service charges do not include ISP fees.

Another service, DirecPC/EE (DirecPC Enterprise Edition) offers transfers of up to 24 Mbps of shared or dedicated bandwidth. This service, which is available to corporate customers, can be useful for transmitting large amounts of data to field locations or other sites that are equipped with very small aperture terminal (VSAT) receivers.

Motorola, Teledesic, and a growing number of other companies have announced plans for the placement of satellites around the globe to provide point-to-point communications, data access, telephone service, video, and other services. Teledesic's plan, which is backed by Bill Gates and Craig McCaw, calls for the deployment of 288 satellites. The employment of satellites for data transfer will increase significantly when the first satellites are successfully launched and become fully operational, beginning around the year 2000.

Obtainable Today

Technologies delivering high bandwidth are here today. Within the next 18 months, availability of one or more high-speed options to homes and offices should be almost ubiquitous.

The situation for road warriors looking to obtain high-speed remote access, however, currently remains unclear. The Marriott in Washington, D.C., is installing in its guest rooms OverVoice, a system that provides connection to an ISP at 1.5 Mbps; as yet, the hotel chain hasn't said what this service will cost. According to Marriott, if the test is successful, the chain will consider expanding the service to its other hotels.

As for the phone companies, the short-term opportunity lies in allowing consumers to access corporate resources from home, says Kamran Sistanizadeh, director of network-systems engineering at Pacific Bell. "Later phases of the program on a larger scale will address small- and large-business market segments," he adds. With luck, that will put high-speed access everywhere anyone needs it. B

Mark Brownstein (Northridge, CA) is a writer/editor specializing in high technology. He has written five books and has been editor of three magazines. You can reach him by sending e-mail to **Mark@brownstein.com**.

Comparing xDSL Technologies

Technology	Downstream rate	Upstream rate	Distance (feet) (24-gauge wire)
IDSL (ISDN DSL)	128 Kbps	128 Kbps	18,000
HDSL (High-bit-rate DSL)*	768 Kbps	768 Kbps	12,000
ADSL (Asymmetric DSL)	1.5–6 Mbps	640–1000 Kbps	12,000–18,000
SDSL (Symmetric DSL)	1.5, 2 Mbps	1.5, 2 Mbps	10,000
RADSL (Rate-Adaptive DSL)	7 Mbps	1 Mbps	12,000
VDSL (Very-high-rate DSL)	13–52 Mbps	1.5–2.3 Mbps	1000–4500

* Single-pair

Source: TeleChoice

WHERE TO FIND

ADSL Forum
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http://www.adsl.com

Amati Communications Corp.
San Jose, CA
408-879-2000
http://www.amati.com

Bell Atlantic Network Services, Inc.
Arlington, VA
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http://www.bell-atl.com/adsl

CellularVision America
New York, NY
212-751-0900
http://www.cellularvision.com/speed

DirecPC Hughes Communications
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http://www.direcpc.com

Globespan
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http://www.globespan.net

Hayes Microcomputer Products, Inc.
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Speed to 56 Kbps and beyond with ×2, K56flex, ISDN, and ADSL devices.
By BYTE Editors

Bandwidth on a Budget: 34 Fast Modems

When it comes to data transfer, getting it there is more than half the fun—it's the whole ball of wax. Faster is better, but selecting the best modem requires more than simply running your finger down a bar chart looking for the highest throughput numbers or the lowest price. Choosing the correct modem for your particular application means navigating your way through several competing and incompatible technologies.

In the burgeoning consumer market, 56-Kbps modems are the current frontrunner. In addition to promising higher speeds, these modems provide full backward compatibility with existing standards and a host of new features. Aimed squarely at the Internet consumer, 56-Kbps modems promise to reduce file transfer time, Internet service provider (ISP) access fees, and your telephone bill. As our tests clearly showed, however, full promised throughput is rarely, if ever, achieved.

The hype surrounding the 56-Kbps technology has engendered a number of myths and misconceptions. Although you must buy 56-Kbps modems (or upgrade existing ones), 56 Kbps doesn't require any changes to your phone lines. Vendors are quick to note that this is a significant advantage over ISDN. Unlike previous modem standards, however, 56-Kbps speeds aren't supported in peer-to-peer connections. High-speed transfer is a one-way street from service provider to user only.

Even if you choose 56-Kbps, you must still standardize on one of two incompatible proprietary specifications. U.S. Robotics, currently the largest modem maker, was the first to deliver its ×2 56-Kbps modems. Rockwell Semiconductor Systems, on the other hand, is promoting its K56flex implementation of 56 Kbps.

Both the ×2 and K56flex camps are jockeying for top position in the standards arena. Expect most vendors to offer upgrades to the eventual single standard—many will do so for free.

The continued need for high-bandwidth connections has pushed ISDN modems nearly to commodity status. While modems are available, connections often aren't. Not nearly as universal as some claim, ISDN is generally available in most major markets.

Basic ISDN service provides two B-channels, each of which can carry 64 Kbps of data or a voice call. Combine the two channels, and you have 128 Kbps of bandwidth on tap—two and a half times that of even an ideal 56-Kbps connection and four times that of a 33.6-Kbps V.34 modem.

ISDN's all-digital nature allows it to provide connections that don't depend on the vagaries of the Public Switched Telephone Network (PSTN). Unfortunately, the need to provide a dedicated digital line is also ISDN's big disadvantage. Even if ISDN service is readily available at your home or office, the start-up fee, installation cost, monthly fee, and per-minute toll quickly mount, making ISDN an expensive solution for casual surfers.

One of the most intriguing and elusive data transfer technologies today is Digital Subscriber Line (DSL). Potentially, DSL makes a high-speed data channel available to anyone with a standard copper telephone line. The pervasiveness of plain old telephone service (POTS) makes DSL an attractive alternative to ISDN or cable modems. And with a DSL modem at both the phone company's central office and your location, you can receive data at speeds hundreds of times faster than the best ISDN line. Asymmetric DSL (ADSL) can provide a bandwidth from 608 Kbps to 8 Mbps to customers over a single copper loop. Additionally, upstream (customer to network) data rates of 9.6 to 944 Kbps and telephone voice service can be supported simultaneously on the same loop. Although potential data rates decrease as the distance from the central office increases, some ADSL systems can also operate over distances of up to 18,000 feet or more. This lets ADSL service be offered to most existing telephone customers.

BYTE BEST
HIGH-SPEED MODEMS

Boosted by its outstanding performance score, the **Zoom Telephonics 2849-PC** external modem took top honors, both overall and among its K56flex companions. Slightly behind the Zoom in performance but with a much better feature score, the **U.S. Robotics Courier V.Everything V.34** external modem took first place among ×2-based modems. Not surprisingly, third and fourth place overall went to the U.S. Robotics' and Zoom's internal counterparts, respectively.

Despite a high price, feature-richness and extreme usability let the **3Com ImpactIQ** take honors among ISDN modems.

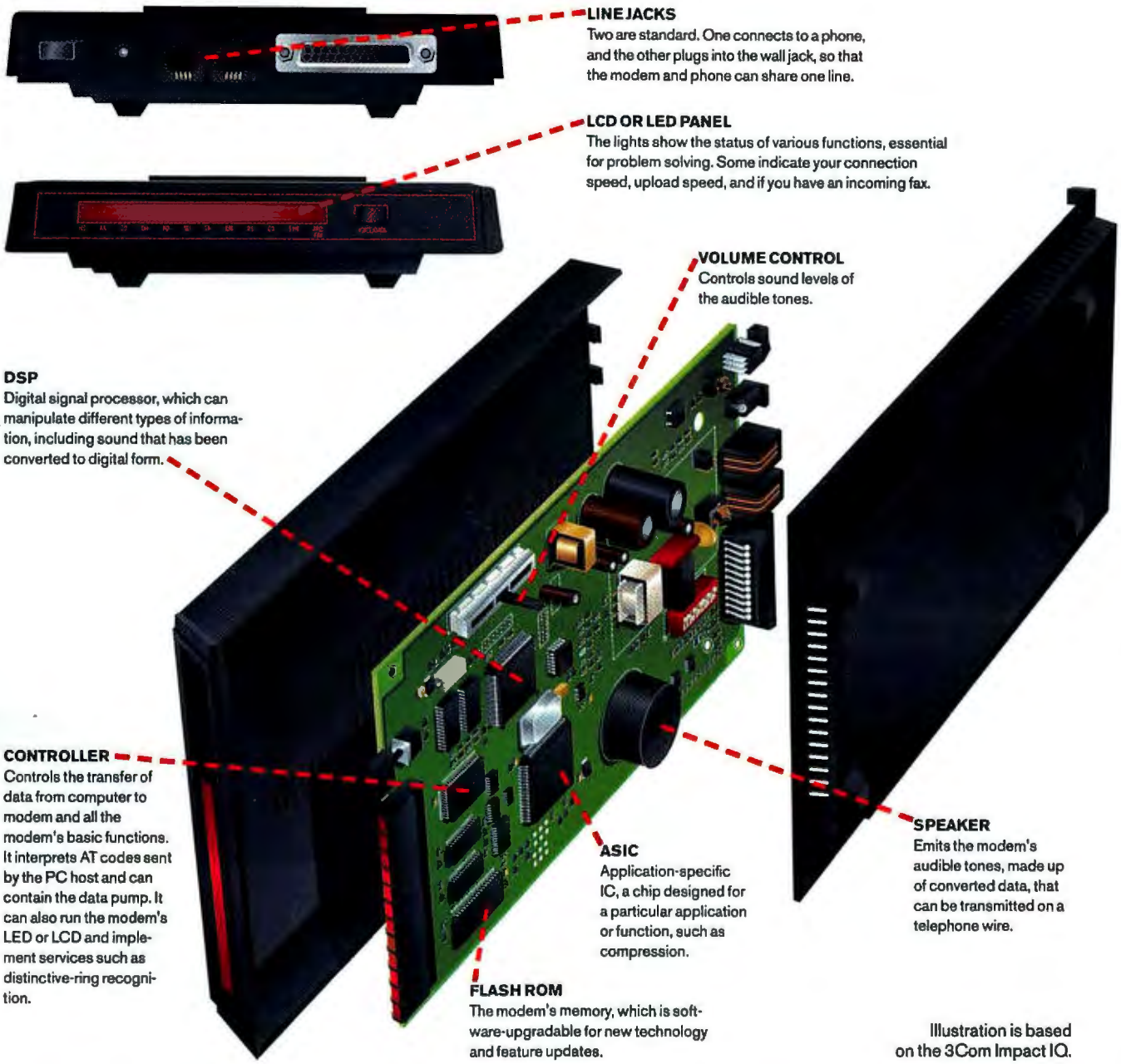

Illustration is based on the 3Com Impact IQ.

Defining the Field

We asked manufacturers of 56-Kbps, ISDN, and ADSL modems to provide hardware for this omnibus Lab Report. The 56-Kbps modem vendors responded with enthusiasm. Thirteen vendors submitted 18 modems—eight based on x2 and 10 based on K56flex technology. Prices of the nine internal and nine external modems ranged from a low of $148 to a high of $275. Of all 56-Kbps vendors in our tests, only Practical Peripherals had offerings based on both standards.

The field for ISDN modems was considerably narrower. Seven vendors submitted modems for our evaluation. Prices for these modems were attractive—many undercut the more expensive 56-Kbps offerings. The bargain of the group sells for a mere $195, and the pricier units will set you back $399. There was no correlation between price and performance, although the most expensive unit also led in features and usability.

Rounding up ADSL modems proved to be the most challenging task of all. Although more than two dozen equipment makers claim to offer DSL products, only seven of them were able to produce modems for our review. Full production of these units may be as low as only thousands per quarter. For service providers preparing to commit to DSL service, this lack of boldness should serve as a warning to go slowly when choosing high-speed modems.

Pricing for ADSL is less than straightforward. Single-unit prices ranged from $995 to $10,000. But the more realistic 1000-unit pricing is generally between $500 and $1500 per line. You'll have to hammer out volume pricing with the vendor of your choice.

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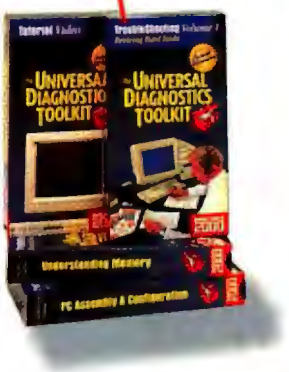

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BEST OVERALL HIGH-SPEED MODEMS

Modems based on 56-Kbps, ISDN, and ADSL technologies are so different that separating the products according to their underlying technology clearly makes sense. Within those categories, we applied different criteria based on the technology's maturity.

Off-the-Shelf ISDN

In keeping with our view of ISDN modems as commodities, we reduced the weight given to performance to 50 percent. Because ISDN modems have a reputation for being difficult to install and set up, we based 30 percent of the overall score on each modem's usability rating. We allocated 20 percent of the overall score to the modem's feature set.

The leader in the ISDN category was the 3Com Impact IQ. Although its performance was a few percent shy of the Arescom Flash 200, the performance leader, the Impact IQ more than compensated for it in other categories. The Impact IQ tied the U.S. Robotics Courier I-Modem w/V.Everything for top score in features. But the Impact IQ's high usability rating put it over the top as the clear winner in its category.

Although it delivered performance, usability, and features, the Impact IQ tied as the most expensive of the ISDN modems—$399. If you're willing to invest some time and effort during installation and setup, however, the $195 Flash 200 can cut your equipment costs in half without compromising on performance.

Double or Nothing

In the 56-Kbps arena, we did see quantifiable performance differences between the two varieties of 56-Kbps technologies as well as among the modems using each technology. Because performance varied—and fell short of advertised speeds—we put a 70 percent emphasis on data throughput under both clean and impaired conditions. Usability, still an important issue when adding or upgrading modems, accounts for 20 percent of the overall score. Features, mainly a function of which chip set the manufacturer uses, have a 10 percent weighting.

Because the two 56-Kbps encoding technologies, ×2 and K56flex, are incompatible, we chose a Best Overall from each camp. Even so, the top four overall winners were simply internal and external versions of the same two modems.

The K56flex winners were the external and internal versions of the same modem: the Zoom Telephonics 2849-PC. The Zoom external version produced our top performance score among all modems, regardless of technology. Performance for the internal version lagged about 10 percent behind its external twin, putting it fourth overall. Solid usability and feature scores helped ensure both modems a first-row finish.

If you're looking for an ×2 modem, we suggest either the internal or external version of the U.S. Robotics Courier V.Everything V.34. Both Couriers turned in top performance scores among ×2 modems, with the faster Courier external modem placing about 6 percent behind the K56flex speed champ. The Couriers' top feature scores helped balance out their relatively low usability ratings.

Adolescent ADSL

Representing the new kids on the block, ADSL modems turned out to be too slippery to pin down. Standards, test requirements, and feature sets for all the variations of ADSL are still under development. Although a number of ADSL modems were available for testing, it's not fair to say that they're in mass production. Because ADSL technology is too immature, we declined to name a Best Overall winner in this category. Instead, we present some test results of what we believe is a real-world scenario.

ADSL Conundrum

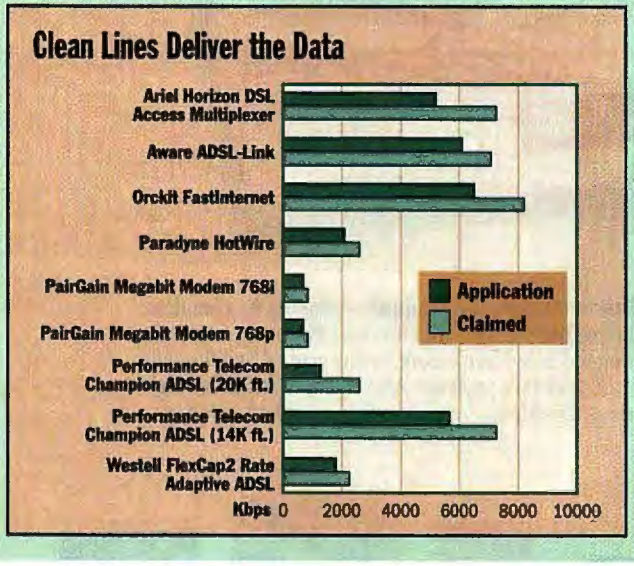
Because the technologies that are used by ADSL modems are too different and are not interchangeable—and they have no formal standardized test suites—we declined to choose a Best Overall ADSL winner from among them. However, we did uncover some interesting data during our testing.

The distance between the modem and the central office plays a significant role in an xDSL modem throughput. The closer the modem is to the central office, less signal degradation occurs.

The good news is that manufacturers are being realistic about their claims of ultimate throughput. In well-tailored packet-blast tests over clean lines, we were able to prod each ADSL modem to almost its advertised maximum throughput speed.

Packet blasting produces high numbers, but it's hardly a realistic operating mode. We wanted a sense of how these modems would perform with real applications.

To imitate a typical application, a single client opened eight concurrent IP sessions over a clean line with a mixture of FTP and HTTP—simulating a typical Web-page access. The accompanying graph shows that the throughput results we measured compare well to the speed claims of the vendors.



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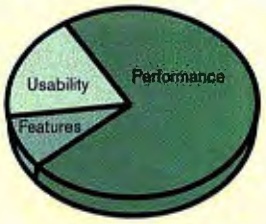
LAB RATING RESULTS

BEST OVERALL: 56-KBPS MODEMS ×2 TECHNOLOGY

U.S. Robotics Courier V. Everything V.34 (E)

Excellent performance and a high feature score more than compensated for below-average usability and propelled the U.S. Robotics Courier V.Everything V.34 external modem into first place among ×2 modems. The U.S. Robotics Courier V.Everything V.34 internal modem finished close behind its external sibling.

WEIGHTING



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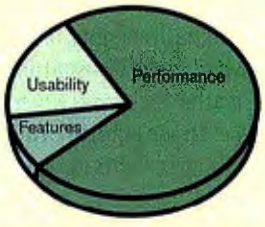
U.S. Robotics Courier V.Everything V.34 (E)	**$275**	★★★★	★★★	★★★★	★★★★★	★★	★★★★
U.S. Robotics Courier V.Everything V.34 (I)	$245	★★★★	★★★	★★★★	★★★★★	★★★★	★★★★
MaxTech GVC NetPacer Pro XPVS561 (I)	$149	★★★★	★★	★★★★	★★★	★★★	★★★★
Logicode Quicktel 56P (I)	$169.95	★★★★	★★★	★★★	★★★	★★★★★	★★★★
Cardinal Connecta (E)	$199	★★★★	★★	★★★★	★★★	★★★	★★★★
Archtek America SmartLink 5634BTV (I)	$149.99	★★★★	★★	★★★★	★★★	★	★★★
Practical Peripherals PP Data/Fax (E)	$239	★★★★	★★	★★★	★★	★★★	★★★
Zypcom Z34-SC (E)	$179	★★★★	★★★	★★★	★★★	★★★	★★★

BEST OVERALL: 56-KBPS MODEMS K56FLEX TECHNOLOGY

Zoom Telephonics 2849-PC (E)

Besting not only its K56flex companions, but the entire ×2 field as well, the Zoom Telephonics 2849-PC external modem was our overall winner. Its top performance score was boosted by above-average usability and an adequate array of features. The internal version of the 2849-PC took fourth place, behind the two ×2 Couriers.

WEIGHTING



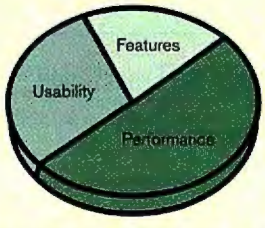
	PRICE	TECHNOLOGY	IMPLEMENTATION	PERFORMANCE	FEATURES	USABILITY	OVERALL RATING
Zoom Telephonics 2849-PC (E)	**$199**	★★★★	★★★	★★★★★	★★★	★★★★	★★★★★
Zoom Telephonics 2849-PC (I)	$199	★★★★	★★★	★★★★	★★★	★★★★	★★★★
Diamond Multimedia Systems SupraExpress (I)	$149.95	★★★★	★★★	★★★★	★★★	★★★	★★★★
Practical Peripherals PP K56 Flex (I)	$179	★★★★	★★	★★★★	★★★	★★	★★★★
Diamond Multimedia Systems SupraExpress (E)	$169.95	★★★★	★★★	★★★★	★★★	★★★	★★★★
Motorola ModemSurfr (E)	$179	★★★★	★★	★★★★	★★★	★★	★★★★
Hayes Accura 56K (E)	$189	★★★★	★★	★★★★	★★	★★★	★★★★
Motorola ModemSurfr (I)	$159	★★★★	★★	★★★★	★★★	★★	★★★★
Boca Research BocaModem (E)	$169	★★★★	★★★	★★★	★★★★	★★★	★★★
Apex Data Rapid Transit (I)	$148	★★★★	★	★★★	★★★	★	★★

BEST OVERALL: ISDN MODEMS

3Com Impact IQ

Although pricey, the $399 3Com Impact IQ ISDN external modem combines the performance, features, and usability you'll want for your ISDN connection. Bargain hunters should consider the $195 Arescom Flash 200, which turned in top performance at a rock-bottom price.

WEIGHTING



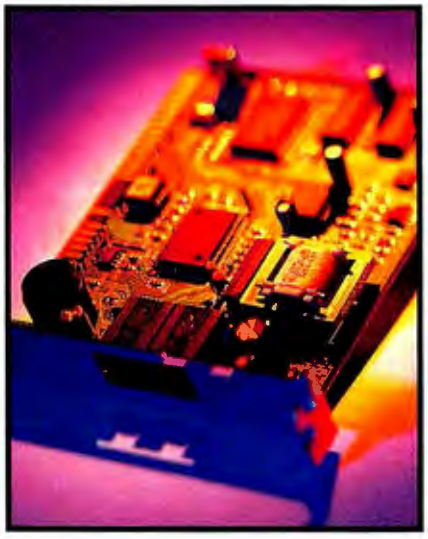
	PRICE	TECHNOLOGY	IMPLEMENTATION	PERFORMANCE	FEATURES	USABILITY	OVERALL RATING
3Com Impact IQ	**$399**	★★★★	★★★★	★★★★★	★★★★★	★★★★	★★★★★
ZyXel omni.net	$299	★★★★	★★★★	★★★★★	★★★★★	★★★★	★★★★
Motorola ISG BitSurfr Pro EZ	$285	★★★★	★★★★	★★★★★	★★★★	★★★★	★★★★
Boca Research Webglider	$399	★★★★	★★★★	★★★★★	★★★★	★★★★	★★★★
U.S. Robotics Courier I-Modem w/V.Everything	$370	★★★★	★★★★	★★★★★	★★★★★	★★★★	★★★★
Hayes Microcomputer Products Accura	$279	★★★★	★★★★	★★★★★	★★★★	★★★★	★★★★
Arescom Flash 200	$195	★★★★	★★★	★★★★★	★★★★	★★★	★★★★

★★★★★ Outstanding ★★★★ Very Good ★★★ Good ★★ Fair ★ Poor (I) = Internal (E) = External

DETAILS

ISDN Inside

Logicode's internal ISDN modem connects to an ISA slot and is the only unit of the ISDN lot that connects internally.



Small Lights, Big Documentation

Motorola's ISDN modem has a miserly six lights, and there's no power switch on it. However, it ships with a CD that includes copious documentation, good for set-up-intensive ISDN modems.

Zoomin' Ahead of the Rest

The Zoom 2849-PC modem has the most interesting form factor of all the 56-Kbps modems we looked at. It's little, 5.25 inches wide and 6.5 inches long. It sports 14 indicator lights, one of which tells you when you're transmitting at 33.6 Kbps; another alerts you when you reach 56 Kbps. A message light, used by some software packages, lights up when a fax is waiting.

TECH FOCUS | 56-KBPS MODEMS

56-Kbps Reality Check

When the news broke that 33.6 Kbps was the end of the line for Public Switched Telephone Network (PSTN) modems, we had no reason to doubt it. Perhaps that's why we were so enraptured with the debut of new technologies that could increase data transfer speeds to the previously unimagined 56-Kbps level. Now, with more than a dozen 56-Kbps offerings and two distinctive technologies on the market, it's time to pause for a 56-Kbps reality check.

By now, everyone knows that designating these modems as 56-Kbps devices is somewhat dishonest. Their ultimate speed is currently limited to 53.3 Kbps by FCC dictate. Even when operating at their theoretical maximum, 56-Kbps technology is asymmetrical. You can hope for 53.3-Kbps downloads, but you're still limited to a maximum of V.34 upload speeds.

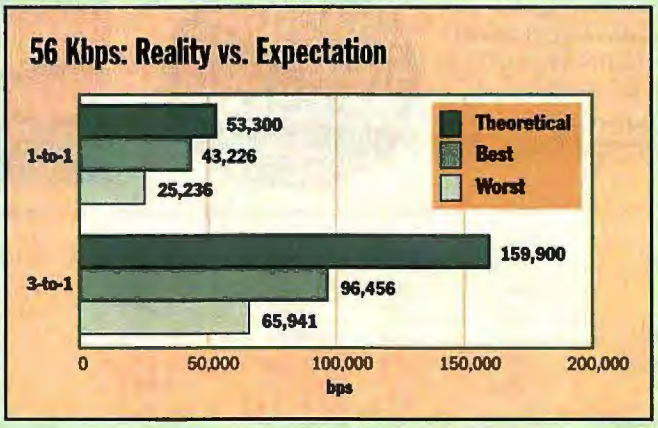
For example, only the best local lines can support the demands of 56-Kbps operation. Poor-quality local loops generally result in download speeds in the low 40-Kbps range.

Another bottleneck that's often overlooked may be inside your system: your antiquated serial port. If you're using a standard 16550 universal asynchronous receiver/transmitter (UART) and an external modem, you're limiting your baud rate to 115.2 Kbps—regardless of the capability of your modem. Add in data compression of over 2-to-1, and you've saturated your serial port.

Fortunately, a number of high-speed serial-port products are available to address this problem. When required during our testing, we used the Digi AccelePort 4r—PCI DB25, from Digi International, to provide access of up to 230 Kbps. Lava Computer claims that its LavaPort-PnP port can support a baud rate as high as 460 Kbps.

The accompanying graph compares a 56-Kbps modem's theoretical data throughput to the best and worst data rates delivered by the modems we tested. In the first test, we used an incompressible file that ideally should have delivered a full 53.3 Kbps over clean lines. Instead, the slowest modem reached just 47 percent of that goal, and the fastest just over 81 percent.

Next, we switched to a file that was designed to support 3-to-1 compression under V.42bis. Our worst and best results were 41 percent and 60 percent of theoretical capacity, respectively. In both cases, we used a high-speed serial port good for transfer rates of up to 230 Kbps.



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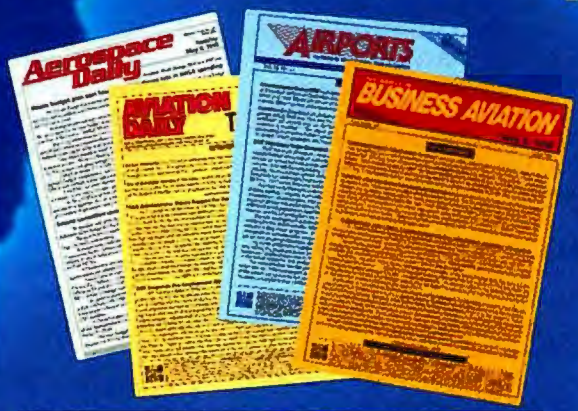

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AVIATION WEEK GROUP

The three types of modems we evaluated—56-Kbps, ISDN, and ADSL—use specific technologies to solve different problems. We rated ISDN and 56-Kbps modems based on their performance, features, and usability (on a scale of 1–5 stars). In the ADSL arena, we didn't choose a winner because we feel the technology is too immature at this point.

TAS Series II telephone network emulator and Model 240 loop emulator from Telecom Analysis Systems.

The 56-Kbps Methodology

We evaluated 56-Kbps modem performance in terms of data compression and throughput. We tested over clean lines as well as over lines with various impairments. Because 56-Kbps modems rely on two competing and incompatible chip sets—K56flex and x2—we assembled two test-beds tailored to each technology. Before testing, we configured each modem to use hardware-based compression and the maximum connection rate supported by the modem's driver.

During a test session, we recorded the time required to download three files, each about 300 KB, and used the result to determine the Kbps throughput rate. The three files we used support a maximum compressibility of 1-to-1, 3-to-1, and 5-to-1, respectively. A serial port supporting baud rates of up to 230 Kbps was used for external modems.

Simulating a typical central-office connection was the TAS Series II telephone network emulator and Model 240 loop emulator. To exercise the specific modems, we used the Total Control system from U.S. Robotics for testing x2 products, and the Max 4000 from Ascend for testing K56flex products.

To measure throughput under impaired conditions, we used the eight line conditions recommended by TAS for 56-Kbps modem testing; these conditions are currently in draft status before the Telecommunications Industries Association (TIA). The impairments represent various combinations of five factors: analog and digital pad loss, robbed-bit signaling, transhybrid loss, and delay. In addition, all lines (including the clean line used for comparison) were subject to the quantization noise, which normally occurs because of the analog/digital conversion involved with 56-Kbps modems.

The overall score for 56-Kbps modems comes from a 70:20:10 weighted rating of performance, usability, and features, respectively (see the pie chart on page 80C). We judged a modem's performance based on raw throughput on both clean and impaired lines. The better a modem's ability to compress data and deliver it at high speed, the higher its score.

ISDN Face-Off

For ISDN testing, our server had a high-speed serial port. A Teletone ISDN Simulator connected the server to the client PC. A high-speed serial port was also supplied on the client side to accommodate the modem being tested.

As with the 56-Kbps modems, the time required to download the three 300-KB test files was recorded to determine the Kbps for each connection. The three files used supported a maximum compressibility of 1-to-1, 3-to-1, and 5-to-1, respectively. Several runs were performed on each file type and used to produce an aggregate score.

Evaluations in this report represent the judgment of BYTE editors, based on tests conducted by NSTL, Inc., as documented in a recent issue of its monthly PC Digest. *To purchase a copy of the full report, contact NSTL at 625 Ridge Pike, Conshohocken, PA 19428; 610-941-9600; fax 610-941-9950; on the Internet, editors @nstl.com. For a subscription, call 800-257-9402. BYTE magazine and NSTL are both operating units of The McGraw-Hill Companies, Inc.*

The "x" in xDSL

Accompanying the emerging Digital Subscriber Line (DSL) technology is a veritable alphabet soup of new acronyms.

New DSL modems are faster than 56-Kbps modems and hold several potential advantages over ISDN. ISDN requires a special telephone line in your home or business, while DSL uses existing telephone wiring. The ISDN data rate of up to 128 Kbps looks good until you compare it to a DSL capacity of 8 Mbps!

All vendors agree that DSL is a transmission scheme designed for high-speed data networking over existing copper telephone wiring. Beyond that, however, it's a wide-open frontier of methodology, implementation, and acronyms. The term xDSL is used to represent a wide variation of DSL technologies. Here's a quick guide to the most common terms you'll encounter.

High-Bit-Rate Digital Subscriber Line (HDSL) has been around the longest. It provides full-duplex T1 (1.544-Mbps) or E1 (2.048-Mbps) data transmission across existing twisted-pair copper without repeaters. By using the existing copper infrastructure, you can implement HDSL systems quickly.

Symmetric Digital Subscriber Line (SDSL) provides symmetric bidirectional variable-rate communications and voice on a single phone line. It transmits data at 160 Kbps to 2084 Mbps. This technology is suitable for applications that require a symmetric data rate.

Asymmetric Digital Subscriber Line (ADSL) provides three separate channels over the same phone line. The asymmetry is based on an approximate 10-to-1 ratio in the downstream-to-upstream data rates—appropriate for high-speed Internet or multimedia access. Phone conversations are carried on one channel, downstream data from the service provider to the user is transferred on another line, and upstream data from the user to the service provider runs in the third channel.

Very High-Bit-Rate Digital Subscriber Line (VDSL) simply means your data rate can increase because you're closer to the central office. Data rates of 13 Mbps at 5000 feet from the central office, 26 Mbps at 3000 feet, and 51 Mbps at 1000 feet are possible.

ISDN REMOTE ADAPTERS FEATURES

	Arescom	Boca Research, Inc.	Hayes Microcomputer Products, Inc.	Motorola ISG	3Com ★	U.S. Robotics	ZyXel
Models	Flash 200	Webglider	Hayes Accura	BitSurfr Pro EZ	3Com Impact IQ	USR Courier I-Modem w/ V.Everything	omni.net
Price as tested	$195	$399	$279	$285	$399	$370	$299
Overall rating	★★★★	★★★★	★★★★	★★★★	★★★★★	★★★★	★★★★
LINE INTERFACE							
ISDN	U (1)	U (1)	U (1)	U (1)	U (1)	U (1)	U (1)
Analog phone jacks	2	2	2	2	2	1	2
Interface to computer	ISA slot	Serial port	Serial port	Serial port	Serial port	Serial port	Serial port
PROTOCOL SUPPORT							
V.120	✔	✔	✔	✔	✔	✔	✔
V.110			✔	✔	✔	✔	✔
Asynchronous/synchronous PPP	✔	✔	✔	✔	✔	✔	✔
Multilink PPP	✔	✔	✔	✔	✔	✔	✔
Other			BOD	AIMUX			
DATA COMPRESSION							
Compression	✔	✔	✔	✔	✔	✔	✔
Maximum throughput speed	512-Kbps	230-Kbps	460-Kbps	512-Kbps	230-Kbps	512-Kbps	460-Kbps
Analog-modem-compatible	✔	✔	✔	✔	✔	✔ (integrated 56-Kbps modem)	✔
TELCO SWITCH STANDARDS							
National ISDN-1, ISDN-2	✔	✔	✔	✔	✔	✔	✔
AT&T 5ESS	✔	✔	✔	✔	✔	✔	✔
Northern Telecom DMS-100	✔	✔	✔	✔	✔	✔	✔
DATA TRANSMISSION RATES							
Rate without compression	128-Kbps	128-Kbps	128-Kbps	128-Kbps	128-Kbps	128-Kbps	128-Kbps
Other	56-, 64-, 112-Kbps	64-Kbps and below			64-Kbps	19.2-, 28.8-, 33.6-, 56-Kbps	56-Kbps, 64-Kbps
FUNCTIONALITY							
Software-upgradable	✔	✔	✔		✔	✔	✔
Fax capabilities	✔		✔	✔	✔	✔	✔
Simultaneous voice and data	✔	✔	✔	✔	✔	✔	✔
Simultaneous analog calls		✔	✔	✔	✔	✔	✔
Security	PAP/CHAP authentication	Caller ID, call screening/ filtering,call logging	Caller ID, IETF handshake authorization	Caller ID	PAP/CHAP authentication, IETF, caller ID	PAP/CHAP authentication	✔
Number of status LEDs	N/A	7	9	6	8	13	10
SIZE (inches)							
Internal or external device	Internal	External	External	External	External	External	External
Width	N/A	5.9	7.0	6.4	5.4	6.3	17.9
Depth	N/A	7.9	5.2	5.3	8.6	10.3	13.1
Height	N/A	1.5	1.5	1.5	1.5	1.3	3.8
Weight	N/A	1.1 lbs.	12.4 oz.	10.5 oz.	1.2 lbs.	4.5 lbs.	13 oz.
CUSTOMER SUPPORT							
Warranty length (years)	3	5	2	5	5	5	2
Fax	510-445-3636	561-997-0918	770-449-0087	205-430-8926	847-933-5800	847-933-5800	714-693-8811
Phone	510-445-3638	561-997-6227	770-441-1617	205-430-8000	See Web site	847-982-5010	714-693-0808
Toll-free phone	None	800-583-2622	800-429-3739	800-894-4736	800-877-2677	800-572-3266	800-255-4101
Web address	http://www .arescom.com	http://www.boca-research.com	http://www.hayes.com	http://www .mot.com/ISDN/	http://www .3com.com	http://www .usr.com	http://www .zyxel.com
Inquiry number	**1020**	**1021**	**1022**	**1023**	**1024**	**1025**	**1026**

★=BYTE Best ✔=yes; N/A=not applicable. ★★★★★ Outstanding ★★★★ Very Good ★★★ Good ★★ Fair ★ Poor

HIGH-SPEED MODEMS FEATURES

	Apex Data Div., Smart Modular Technologies	Archtek America Corp.	Boca Research, Inc.	Cardinal Technologies, Inc.	Diamond Multimedia Systems, Inc.	Diamond Multimedia Systems, Inc.	Hayes Microcomputer Products, Inc.	Logicode Technology, Inc.
Model	Apex Data Rapid Transit Internal Modem	SmartLink 5634BTV Internal Voice/ Fax/Modem	BocaModem/ External	Connecta External Fax Modem	SupraExpress External Modem	SupraExpress Internal Modem	Accura 56K External Fax Modem, 08-02887	Quicktel 56P Internal Modem
Price as tested (MSRP)	$148	$149.99	$169	$199	$169.95	$149.95	$189	$169.95
Overall rating	★★	★★★	★★★	★★★★	★★★★	★★★★	★★★★	★★★★
MAXIMUM RATE (Kbps)								
DDE data/DCE fax/DTE	56/14.4/115.2	56/14.4/115.2	56/ N/A /230.4	61.3/14.4/115.2	56/14.4/230.4	56/14.4/230.4	56/14.4/115.2	56/14.4/115.2
COMMAND SETS								
Hayes	✔	✔	✔	✔	✔	✔	✔	
Ties								✔
Break					✔	✔		
GENERAL-PURPOSE FEATURES								
Modem technology	K56flex	x2	K56flex	x2	K56flex	K56flex	K56flex	x2
Chip set and DSP	Lucent	TI	Rockwell	TI	Rockwell	Rockwell	Rockwell	TI
Data pump	N/A	TI	Rockwell	N/A	Rockwell	Rockwell	Rockwell	TI
Caller ID	✔	✔	✔					✔
Paging			✔					
Voice over data (DSVD)	✔		✔					
Voice compression		✔	✔					
DTMF		✔	✔	✔				
Flash EPROM	✔		✔	✔	✔	✔	✔	
Flash BIOS			✔		✔	✔		
Adaptive speed leveling (ASL)		✔	✔	✔	✔	✔	✔	
Volume-control slide			✔	✔				
BACKBONE FEATURES								
Auto-baud all speeds		✔	✔	✔	✔	✔	✔	✔
Select speeds		✔	✔	✔	✔	✔	✔	✔
Blacklisting								
Callback security								
Carrier-loss redial								
Dictionary sizing					✔	✔		
Remote configuration/password								
Synchronous communication								
X.25 pad								
Software	Bitware Data/Fax/ Voice V.3.30	QuickLink Message Ctr. 3.0	Quicklink Message Ctr. 3.0, Netscape Navigator, Boca Mega-Media CD	FaxTalk Plus V3.0a	FaxTalk Plus 3.0, COMit	FaxTalk Plus 3.0, COMit	Smartcom Message Ctr. 2.0G3	QuickLink II Version 2.1.0
COMMON STANDARDS								
Group III fax		✔		✔	✔	✔	✔	✔
MNP error control	5	5	5 and 10	5	5	5	5	5
V.42	✔	✔	✔	✔	✔	✔		✔
V.fast			✔		✔	✔		
Non-ITU standard		✔						
HST								
Bell 103J and 212A	✔	✔		✔	✔	✔		✔
Additional features	Full-duplex speakerphone and voice-mail features	Full-duplex speakerphone features					Auto-data/Fax discrimination	
CUSTOMER SUPPORT								
Warranty length (years)/coverage	5/P, L, R	5/P, L, R	5/P,L,R	5/P, L	5/P, L, R	5/P, L, R	2/P, L, R	Lifetime
Toll-free phone	800-841-2739	None	800-583-2622	800-947-0808	800-727-8772	800-727-8772	800-347-8388	800-735-6442
Phone	510-623-1231	818-912-9800	561-997-9657	770-840-2157	408-325-7000	408-325-7000	770-840-9966	805-388-9000
Web address	www.apexdata.com	http://www .archtek.com	www.boca-research.com	www .cardtech.com	http://www .diamondmm.com/.diamondmm.com 56K		www.hayes.com	www.logicode .com
Inquiry number	**1027**	**1028**	**1029**	**1030**	**1031**	**1032**	**1033**	**1034**

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

MaxTech Corp.	Motorola ISG	Motorola ISG	Practical Peripherals	Practical Peripherals	U.S. Robotics	U.S. Robotics	Zoom Telephonics, Inc.	Zoom Telephonics, Inc.	Zypcom, Inc.
GVC NetPacer Pro XPVS561 Internal Modem	ModemSurfr Internal Data/Fax Modem	ModemSurfr External Data/Fax Modem	PP K56 Flex Internal Half Card Modem	PP Data/Fax External Modem	USR Courier V.Everything V.34 External Modem	USR Courier V.Everything V.34 Internal Modem	Zoom 2849-PC External Fax Modem	Zoom 2849-PC Internal Fax Modem	Zypcom Z34-SC External Modem
$149	$159	$179	$179	$239	$275	$245	$199	$199	$179
★★★★	★★★★	★★★★	★★★★	★★★	★★★★	★★★★	★★★★★	★★★★	★★★
56/14.4/115.2	56/28.8/115.2	56/28.8/230.4	56/14.4/115.2	61.3/14.4/115.2	56/14.4/230.4	56/14.4/230.4	56/14.4/230.4	56/14.4/230.4	56/14.4/115.2
✔	✔	✔	✔	✔	✔	✔			
							✔	✔	✔
									✔
x2	K56flex	K56flex	K56flex	x2	x2	x2	K56flex	K56flex	x2
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SuperVoice 2.2	Trio communications software	Trio communications software	Practical Message Center V1.33	Practical Message Center V1.031	Stampede Remote Office Gold Client, RapidComm	Stampede Remote Office Gold Client, RapidComm	Winfax Lite, DOSfax Lite, COMit, AOL, CompuServe	Winfax Lite, DOSfax Lite, COMit, AOL, CompuServe	V5.30
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Data compression/ voice and speakerphone functions	V.80-ready voice functions	V.80-ready voice functions			Universal connect, automatic fax/data detection	Universal connect, automatic fax/data detection			Voice and speakerphone functions
5/P, L	5/P, L, R	5/P, L, R	3/P, L	1/P, L	5/P, L, F, R	5/P, L, F, R	7/P, L	7/P, L	2/P, L, R
None	800-426-6336	800-426-6336	800-225-4774	800-225-4774	800-877-2677	800-877-2677	800-631-3116	800-631-3116	None
562-921-1698	205-430-8000	205-430-8000	770-840-9966	770-840-9966	847-982-5010	847-982-5010	617-423-1072	617-423-1072	510-783-2501
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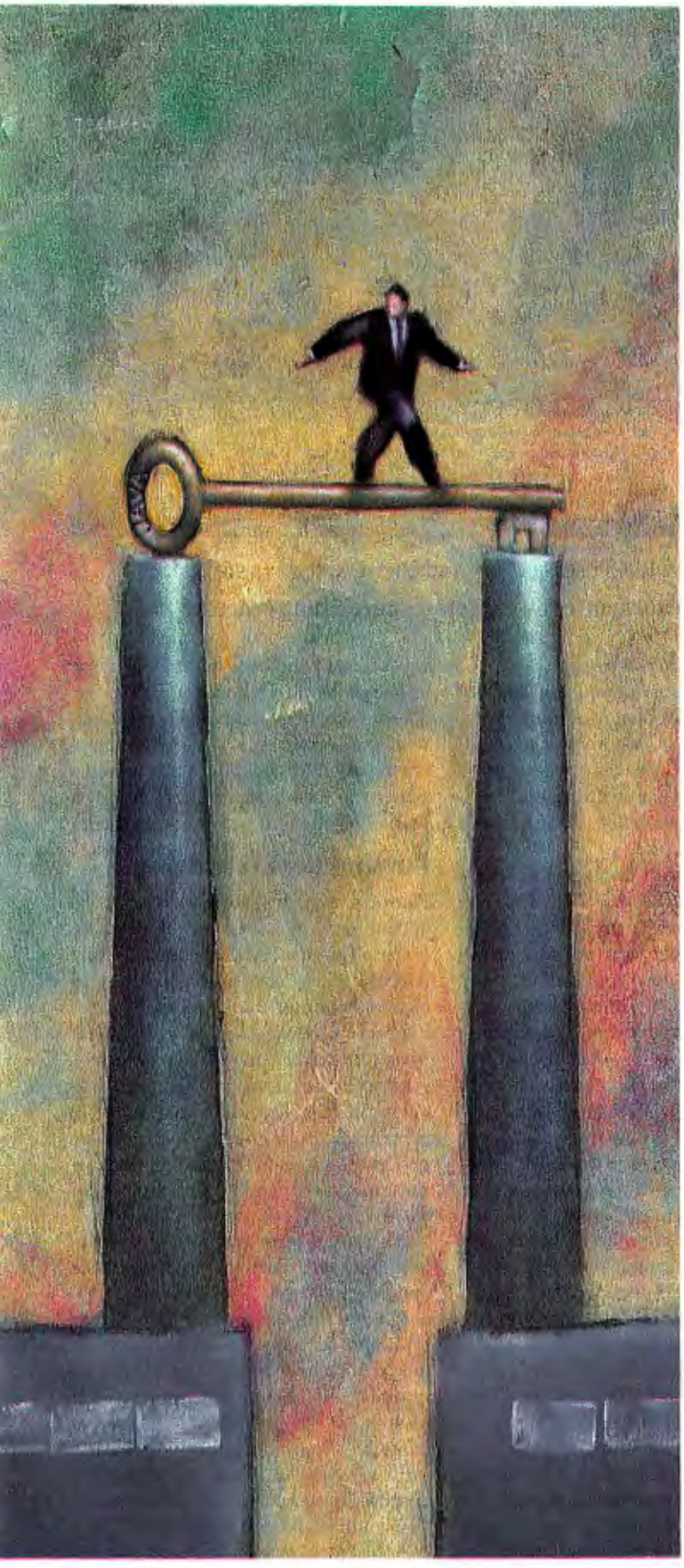


Java is like a child prodigy who can play a Rachmaninoff piano concerto but still isn't potty-trained. The flashes of brilliance and glimpses of future potential are marred by cranky behavior that's typical of a two-year-old.

It's hard to overlook Java's immaturity. Compared to native code, interpreted Java byte code is as slow as a line at the post office. Java development tools are diamonds in the rough—sometimes very rough. Despite the "write once, run anywhere" mantra, there are still nagging differences among Java virtual machines (VMs) that cause Java programs to misbehave on different platforms. Java's API for

JAVA GETS DOWN TO BUSINESS

Critics say Java isn't ready for prime time. But others are using it to solve real-world business problems. What's their secret?

By Tom R. Halfhill

creating GUIs, the Abstract Window Toolkit (AWT), is such a mess it seems everyone is rewriting it. And Sun Microsystems is wrestling with Microsoft over Java's future.

In other words, it's a lot like the chaotic early days of Windows, the Macintosh, and MS-DOS. But few people remember the Stone Age APIs of Windows 1.0, or that Mac developers had to clumsily compile their first programs on a Lisa, or that Microsoft once wrestled with Digital Research over the future of DOS. When any new platform is born, pessimists focus on the flaws while optimists hype the potential. Caught between are developers, who need to solve real-world problems today. When will Java be ready for prime time?

It's ready right now, according to some developers who are currently using Java to do some surprisingly serious

ILLUSTRATION: TIM TEEBKEN © 1997

business, as outlined below.

- A Silicon Valley start-up company built an enterprise-wide purchasing application that eliminates paper-pushing, runs across multiple client platforms, links outside vendors to corporate intranets, and integrates with enterprise databases.
- A Washington-based consulting firm rewrote an employment-practices expert system that it originally developed in C/C++.
- An independent consultant in California is using Java to reengineer the employee-review process at a major biotech company.
- A systems integrator in New Jersey is using Java applets and middleware to provide a help-desk service to corporate customers.
- A businessman who can't write a single line of Java code used a tool that automatically converts Excel spreadsheets into Java applets.
- Sony Online Ventures created a high-traffic commercial Web site with server-side Java components that dynamically generate most of the Web pages.
- Home Shopping Network is using server-side Java software to run a large-scale Web site that hosts on-line auctions and connects to a product database.
- A major defense contractor is using a Java-based indexing-and-retrieval engine to create a parts inventory that engineers can search from a browser on any client.

These are not isolated cases. An independent survey of BYTE readers last May found that 54 percent are developing Java software. In another study commissioned by the Java Internet Business Expo, analysts at Zona Research surveyed 279 IT professionals at organizations that have 250 or more computers. They discovered that 47 percent are using Java today, while the rest expect to use it within the next 12 months. Of the companies that have already adopted Java, 52 percent are rolling out finished applications.

"The average portion of application-development budgets for Java endeavors will rise from 12 percent during the next six months to over 21 percent within the next 24 months," concludes chief analyst Clay Ryder from Zona's study. "Java is more than a passing fad."

Java Trends

For this article, BYTE concentrated on business applications that are either finished or in the early stages of deployment. We found that four trends emerged.

Ariba ORMS uses server- and client-side Java software to automate the corporate-purchasing process.

- Developers are completing some of their projects in a matter of months, despite Java's flaws. Coders praise Java's advantages over C/C++ as an object-oriented language, and they're confident that development will get smoother as the tools keep getting better.
- A great deal of Java development is hidden from view because it's for in-house use by corporations. At this point, few developers are using Java to write shrink-wrapped commercial applications.
- Java programs that execute on servers are at least as significant as Java applets that run in browsers—even though applets are what most people associate with Java. Again, this tends to make Java development less visible than it really is. Some large-scale Web sites and enterprise applications depend heavily on server-side Java, but they use few or no Java applets.
- The main reason developers are selecting Java over other solutions is cross-platform compatibility. In other words, they are embracing Java as a platform, not just as a language. Zona reached the same conclusion, finding that Java's abilities to work with Web browsers and on different platforms are by far the biggest reasons enterprises have for adopting Java.

These trends make sense. Large organizations tend to accumulate many different platforms, and they're not in a hurry to replace perfectly good equipment. But this causes problems while deploying applications throughout the enterprise. The only common denominators are networks and browsers. Java allows developers to pave over the differences between platforms and quickly distribute networked solutions to any number of clients.

Putting Java to Work

Platform neutrality is why start-up Ariba Technologies picked Java for its new Operating Resource Management System (ORMS). Ariba ORMS automates the purchase of equipment, office supplies, furniture, vehicles, and almost anything else that isn't directly required for a company's product manufacturing. Those miscellaneous purchases typically account for 22 percent of corporate costs. It's a business process that screams for automation, because the cost of handling paper forms can exceed the cost of a requisitioned item.

It's also a process that's widely distributed and has to work with existing clients and legacy systems. Nobody wants to discard thousands of usable desktop PCs or replace their mainframes just to accommodate one new application. "If you go into a Fortune 1000 company, they've got AS/400s, they've got Hewlett-Packard systems, they've got Unix, they've got mainframes," says Paul Touw, marketing and business-development manager for Ariba. "That almost defaults you to Java."

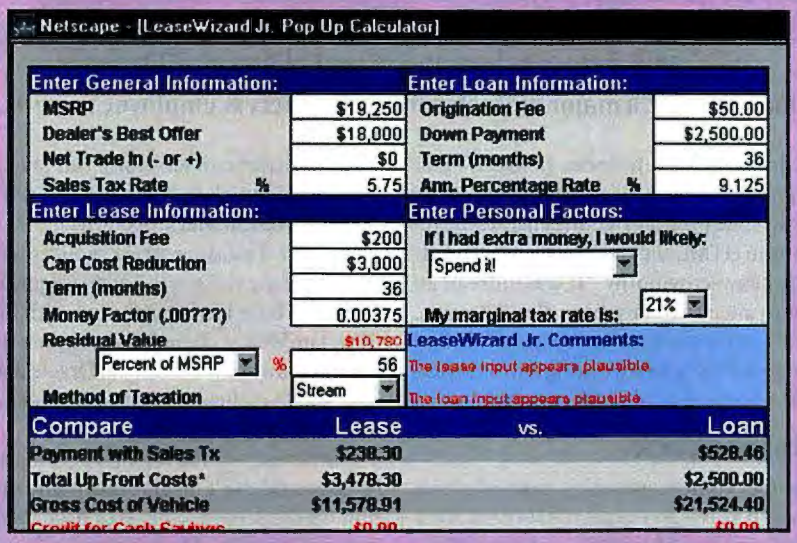
Ariba ORMS extends its reach even be-

Excelling at Java

Some of the latest Java tools make it possible to deliver cross-platform solutions to millions of Web or intranet users without writing a single line of code. Michael Kranitz, director of digital business at The Computer Group, recently used such a tool to convert a commercial application into a Java applet.

The original product, LeaseWizard, is written in Borland Delphi for Windows. It helps car shoppers decide whether leasing or purchasing is a better deal. Kranitz wanted to post a free, abbreviated version of LeaseWizard on his Web site, but he doesn't know how to program in Java. So, he constructed a working prototype in Excel and used a tool called SmartTable, by Visual Numerics, to automatically convert the spreadsheet into a Java applet. SmartTable creates Java class files that duplicate both the appearance and the function of the spreadsheet. Users can enter data and calculate results on-line.

Later, Kranitz hired a programmer to write an HTML/JavaScript version that non-Java browsers can use. However, it doesn't do as much interactive error-checking when users enter data, and it consumes a lot more screen space. "You have to scroll it, and that's a big deal," says Kranitz. "[The Java applet] looks a lot better on the screen."



LeaseWizard Jr. is an Excel spreadsheet converted into a fully functional Java applet.

yond the enterprise. Outside vendors can distill their offerings into spreadsheets that contain prices, product options, stock numbers, and just about anything else—even hyperlinks that point to the vendor's own Web site, which might have data sheets and illustrations. Ariba imports the vendors' spreadsheets into an on-line catalog that users can browse with a Java applet.

The password-protected applet is the front end for the purchasing process. It provides a graphical interface and step-by-step instructions. It also enforces customizable business rules that govern how a company routes and approves purchases.

On the back end, Ariba's server-side Java application acts as the middleman between the applets and the company's legacy systems. It talks to databases via WebLogic's JdbcKona, which is a collection of Java Database Connectivity (JDBC) drivers for Oracle, Sybase, and Microsoft SQL Server. On Windows NT servers, Ariba also links to Crystal Reports.

Remarkably, Ariba's customers began deploying an early version only seven months after Ariba started the project in December 1996. "There's no way we could have built a C++ program in seven months that does everything our Java server does," claims Ariba engineer Boris Putanec.

Not that everything went smoothly; Ariba encountered many problems. A bug in Microsoft's early just-in-time (JIT) compiler caused IF statements to execute incorrectly. Java's thread synchronization was not consistent—Windows NT spawns native threads to handle Java threads, while Sun's Solaris piggybacks all Java threads on one native thread. Java's FINALLY statement can kill a thread that throws an exception. And Ariba's programmers struggled with differences in Java VMs on various platforms. Putanec says wryly, "Instead of 'write once, run anywhere,' it's more like 'write once, debug everywhere.'"

Nevertheless, they got it working. To overcome deficiencies in the AWT, Ariba turned to Netscape's Internet Foundation Classes (IFC), a class library that offers more graphical flexibility and a consistent look and feel across platforms.

Two of Ariba's pilot customers are AMD and Cisco Systems, both based in Silicon Valley. AMD began installing ORMS in June and expected to have it in full production by late August. AMD plans to eventually deploy ORMS on as many as 4000 desktops. Cisco also began implementing ORMS during the summer and expects to deploy it on 8000 to 10,000 desktops around November. Both companies say that ORMS meshes well with existing clients and back-end systems.

"We're doing this for solid business reasons, not just to geek out on the technology," says Pat Guerra, AMD's vice president of supply management. He explains that by automating the paper-driven purchasing process, ORMS is freeing his employees for more productive duties. They are already being retrained to measure the performance of suppliers more accurately and to negotiate better deals.

Guerra says that he selected a Java solution because AMD has everything from Windows PCs and Unix workstations to IBM mainframes and DEC VAX minicomputers. Some of the legacy systems are 15 years old. "Cross-platform compatibility is a huge factor," he explains. "That makes the application support much easier and less costly than a platform-specific solution."

At Cisco, employees use Windows PCs, Unix systems, and Macs, and they're scattered at field offices all over the world. Cisco needed a multiplatform, multilanguage, multicurrency solution that integrated with Oracle Purchasing. Ariba ORMS does all that, and it also generates purchase orders in the ANSI-standard EDI-850 electronic-data-interchange format for vendors that accept them.

Cisco program manager Carolyn DePalmo says the project is on schedule and that she's looking forward to distributing ORMS worldwide. "It's obviously difficult for people in satellite offices to deal with

paper forms. This way, they can just shoot their requisitions over the Web," she says.

Selling to the Feds

Another developer sold on cross-platform compatibility is Washington Consulting Services & Technologies (WCS&T), which recently ported a C/C++ client/server application to Java. The application, called Chinook, is an employee-relations expert system for government agencies and corporations.

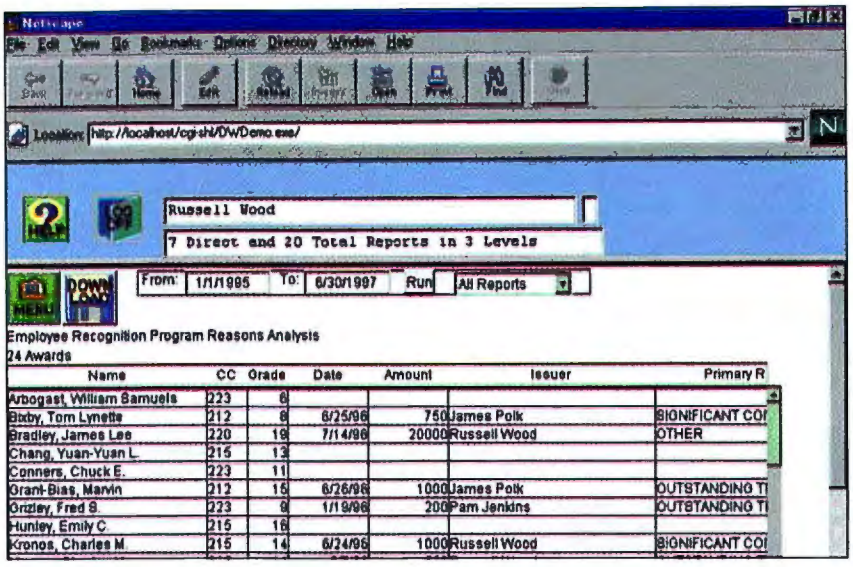
Chinook helps to guide managers through sticky situations that can have costly consequences—employee absenteeism, substance abuse, sexual harassment, discrimination, and so forth. Chinook's decision-logic tables are based on case law, court settlements, company policies, and best practices at other organizations. After asking a manager a series of questions, Chinook generates a risk-analysis report and suggests actions. Those actions might range from writing a letter or a memo—complete with recommended wordings—to specific forms of discipline.

"It's not 'attorney-in-a-can'; it's not a legal advisory tool," says Linda Brooks Rix, president of WCS&T. "But it does help managers deal with these problems. It also helps to level an organization so managers are more consistent in their actions and discipline."

Rix says the C/C++ version of Chinook is used by organizations with as many as 250,000 employees and 40,000 managers. When the software needed a major rewrite, the company decided to convert it to Java so the front end would run on any client. The National Science Foundation is about 50/50 Mac/Windows, she points out, and Macs are also popular at NASA and the U.S. Air Force. "The federal government is very interested in intranet solutions because they're less expensive than standardizing on a single platform," Rix explains.

WCS&T began rewriting Chinook in April. The task was made easier by the fact that the programmers had written the C/C++ version with a rules-based component framework and development suite called Elements, from Neuron Data. When Neuron recently ported the suite to Java, it added a utility that translates C/C++ resource files into Java classes. That slashed the amount of code the programmers had to rewrite, says Gary Frank, director of software development at WCS&T.

They did encounter some problems—mostly due to limitations in Java 1.0.2,



CRC built a custom Java applet that allows all 700 middle managers at a major biotech company to access employee records.

Frank says. Applets under 1.0.2 can't talk to printers or save files on the client, so the server-side program has to generate the reports in HTML and display them in a printable browser window. "It was more of an annoyance than anything else," he says. WCS&T finished the Java port in July and immediately began working with customers to test and deploy the product.

Biofeedback

Another consultant is using cross-platform Java to solve an unusual problem for a 3200-employee biotech company in California. The company stores employee records in a 10-year-old database that runs on Novell NetWare and MS-DOS. The database does an adequate job and is heavily customized, so the company isn't eager to replace it. But to implement a new employee-review process aimed at reducing attrition, the company needed to expand access from about a dozen people to all 700 middle managers. The existing database simply couldn't handle it.

"They could not access this data. It was basically locked up. It was a classic data-warehouse problem," says Chris Christian, principal of CRC Business Solutions, the consultant hired to find a solution.

To complicate the challenge, the biotech company's managers use many different clients—mostly Macs, but also Windows PCs and Unix workstations. All of them need access to the database, and the company didn't want to install any new client software or browser-specific plug-ins. Also, some of their browsers don't run Java.

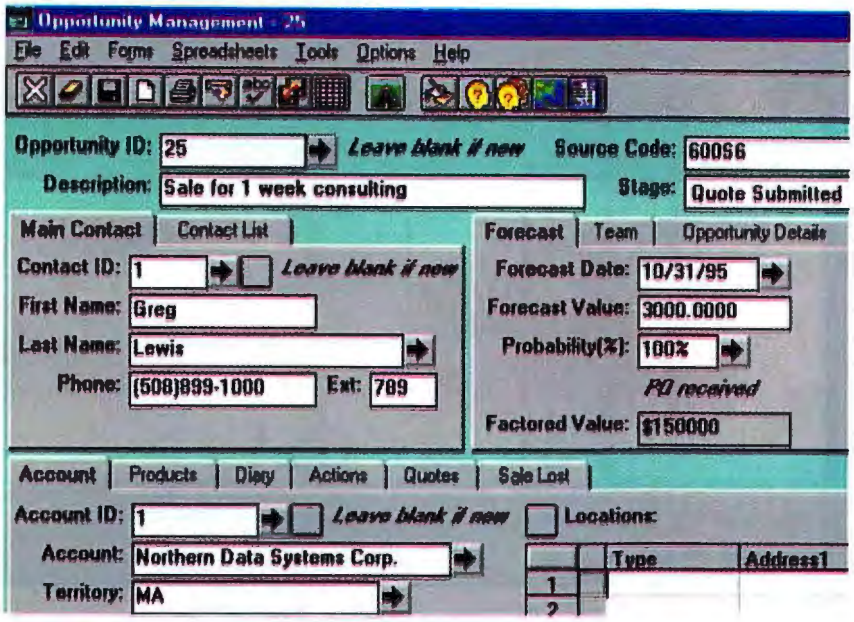
Fortunately, an intranet was already in place, running under Unix on a Digital Alpha server. The same server replicates the DOS database to Oracle 7 every night. So, Christian built his first solution with Prolifics JamWeb, a client/server engine that fetches information from the Oracle database and launches a CGI process to generate HTML pages for the browsers.

Unfortunately, the HTML pages tend to be large and can't display much information on the screen. Christian used a new Java version of Prolifics (3.0) to display the data more compactly in an applet with a scrolling grid widget. The user interface is more consistent on different-size screens, and the applet downloads faster. The Prolifics engine uses a special form-description language to automatically generate HTML and JavaScript for browsers that don't run Java, so Christian didn't have to create multiple versions of his client-side application.

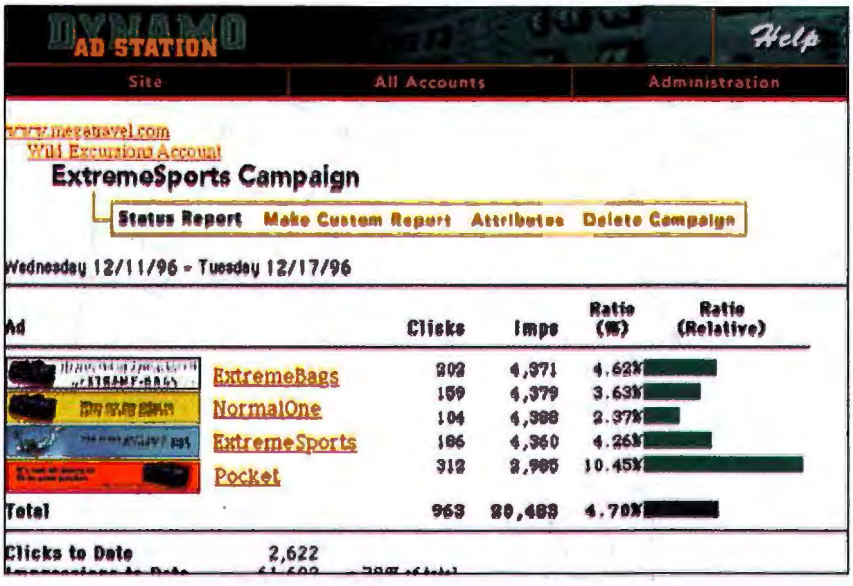
To complete the project, Christian had to tap skills in Java, JavaScript, HTML, SQL, the Prolifics form tool, and even graphics design. "It's not programming as we used to know it," he says. "Developers need a lot of different skill sets. And because the application is running inside a browser, everyone expects it to look like a graphically exciting Web page."

Leveraging the Web

Because the Web amounts to a global WAN, developers are using it to build extranets



Applix Anyware is a suite of Java applets that connects users to back-end databases.



Dynamo Ad Station makes it easier for Webmasters to manage the advertising on their Web sites.

between companies as well as intranets between platforms. The links between Ariba ORMS and outside vendors are one example; another is a help-desk application implemented by LANcomp, a 50-employee systems integrator and reseller in the New York area.

LANcomp is delivering a 24-hour help desk to its customers through a suite of Java applets called Applix Anyware. The applets allow customers to notify LANcomp's technicians about problems and then track the progress of solutions. Both parties also have 24-hour access to LANcomp's knowledge base, which is stored in an Oracle database. The middleware is Applix Enterprise, a native server-side component. The knowledge base contains documentation, solutions to common problems, illustrative screen photos, and hyperlinks to useful Web sites.

"We needed the ubiquitous access of a Web-enabled product that our employees and customers could use from any location or from any client," explains Dan DeVenio, LANcomp's vice president for sales and marketing. "All you need is a Java-enabled browser and a password."

The cross-platform applet is as important to LANcomp internally as it is to outside customers, adds Bob Rudis, technical operations manager. LANcomp's employees use an eclectic mix of Windows PCs, Unix systems, and network computers (NCs) from Sun and HDS. The alternative would have been to write, deploy, and maintain multiple versions of the help-desk program on all of LANcomp's systems as well as those of its customers—a Herculean task that, ironically, would generate help-desk calls of its own.

Server-Side Java

There are thousands of Java applets on the Web, but server-side Java gets less attention because it's generally invisible to users. Some Webmasters (including BYTE's Jon Udell) think Java can be more useful on servers than on clients, at least in the short term.

It's a compelling argument. Server-based programs conserve bandwidth and don't require users to have Java-enabled browsers because they don't download or execute any Java on the client. They're free to use the latest and best Java VMs because they don't have to wait for browsers to catch up. They can boost the performance of critical routines by calling native methods, because server programs usually don't have to run across multiple platforms. And Java's lightweight threads can handle multiple HTTP connections with fewer CPU resources than traditional CGI processes.

All those factors convinced Sony Online Ventures to use server-side Java components to build SonyStation, a family-oriented commercial Web site. With 150,000 to 200,000 users per day, it's one of the busiest Java-powered sites on the Web.

SonyStation users can register for services and navigate the site with a Java applet called the StationPass, but that's just the tip of the iceberg. A suite of server programs known as Dynamo does the bulk of the work. Dynamo, from Art Technology Group (ATG), consists of three integrated Java applications: Ad Station, which manages on-line advertising; Profile Station, which keeps track of user demographics; and Retail Station, which manages electronic commerce. They dynamically

generate about 75 percent of SonyStation's Web pages. On the back end, Dynamo uses WebLogic JDBC drivers to plug into Sony's SQL database.

ATG says Dynamo is a testament to Java's strengths as a programming language. The coders started with an earlier version written in C++, completely rewrote it in Java, and shipped the product only five months later. Most of the code—some 200,000 lines—took just two months to write. And the programmers did it in early 1996, when Java tools were primitive. In fact, they didn't use any Java tools to speak of: They typed the code into EMACS, a text editor, and compiled it with Sun's free Java Development Kit (JDK). They've since adopted Symantec Café.

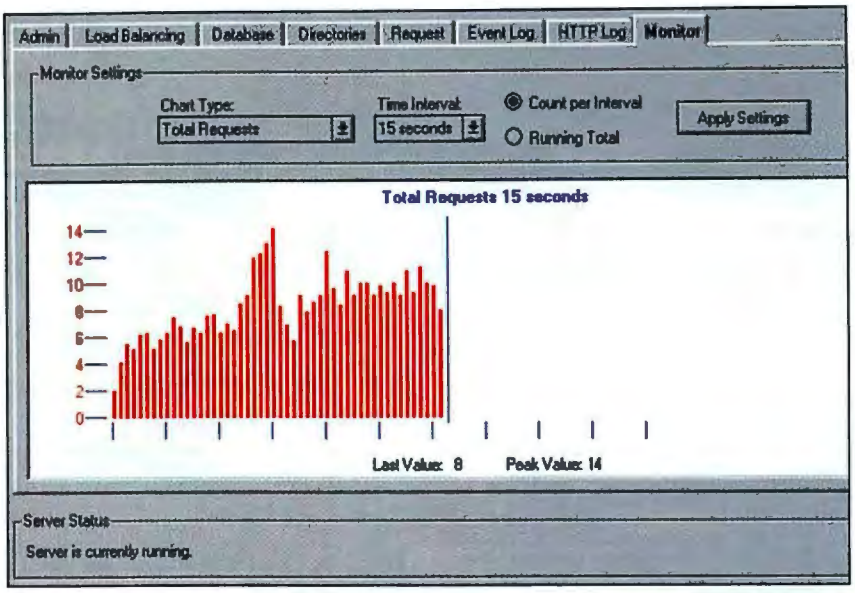
"It was pretty scary when we made the leap to Java," says Jeet Singh, president and CEO of ATG. "We were scared that the uptake on Java wouldn't be as fast as it was. We thought Sun was pitching the wrong things about Java, like animation on Web pages. Nobody was talking about server-side Java at all, and we were trying to build this huge server-side app."

The Java version of Dynamo was easier to write and is easier to maintain than the C++ version, Singh declares, partly because it simplifies multithreading and memory management. Also, it's certified to run on multiple-server platforms: Windows NT (both x86 and Alpha), Solaris, and Irix—or any platform with a compatible Java VM. Singh says the difference in performance between the C++ and Java versions is not significant.

Sony is satisfied with the performance, according to Mark Benerofe, vice president of programming for Sony Online Ventures. Benerofe also likes ATG's open server APIs, which allow Sony's developers to write new applications that access Dynamo's services with only a few lines of code. For example, developers can create on-line games that check the site's list of registered users through Dynamo's gateway to the SQL database. Another API call might return the player's profile, which a game could use to adjust its difficulty level or to display a targeted ad banner.

Not everything worked perfectly at first. "We had a whole host of bugs when we first rolled out because we were on the cutting edge and nobody had ever done a Java site on this scale," admits Benerofe. He says Sony and ATG soon resolved the problems.

Another high-traffic Web site built with server-side Java is First Auction, owned by Home Shopping Network. First Auction users can view data about products and enter competitive bids on-line; winners get to buy the products at their bids. The site went public in June and racked up $100,000 in sales in the first three days, says Keith Foxe, communications manager.



Kiva Enterprise Server is a middle-tier component that links Web servers to enterprise databases.

First Auction runs on a Solaris system with Kiva Enterprise Server, a middle-tier Java component that sits between the Web-server software and an enterprise database. Developers can use Kiva's Java class libraries to write applets or applications that talk back to the server via IIOP (using a third-party object request broker [ORB] from Iona or Visigenics) or Kiva's own communications protocol (based on sockets). The classes are transport-independent, so developers could also use a third-party bridge to DCOM.

Kiva wrote the core services in C/C++ because some of the early Java VMs for Unix weren't multithreaded, but all the application-level services are Java classes. The classes let developers distribute application logic between the client and the server, according to performance and security requirements. For instance, an applet can check the validity of a credit-card number without bothering the server.

Like other Java middleware components, Kiva allows developers to create Web applications that work with existing enterprise systems. First Auction uses Kiva to link its Web server to an Oracle database. "Not many companies are saying they want to write all-new applications from scratch in Java," says Sharmila Shahani, Kiva Software's director of product marketing. "But many companies do want to leverage their existing investment while also taking advantage of new opportunities by migrating to the Web."

Server-Side Portability

Java programs on servers generally don't need the run-anywhere mobility of applets because they live in a controlled environment. Nevertheless, some developers are writing distributed applications that run across heterogeneous servers as well as heterogeneous clients.

A prime example is Innotech's NetResults, a text-indexing and text-retrieval application that lets users find documents anywhere on a network. The server-side pieces consist of an indexer, a search engine, and an administration tool. The client-side component is an applet that allows users to make queries and view sorted results. NetResults was among the first applications to win 100 percent Pure Java certification from Sun.

"Intranets don't often consist of roomfuls of Windows NT servers," explains Simon Arnison, Innotech's vice president for R&D. "We find that many companies have strange combinations of servers running everything from NT, to Linux on Macs, to AIX on PowerPC, to Solaris on SPARC. We wanted to support all those

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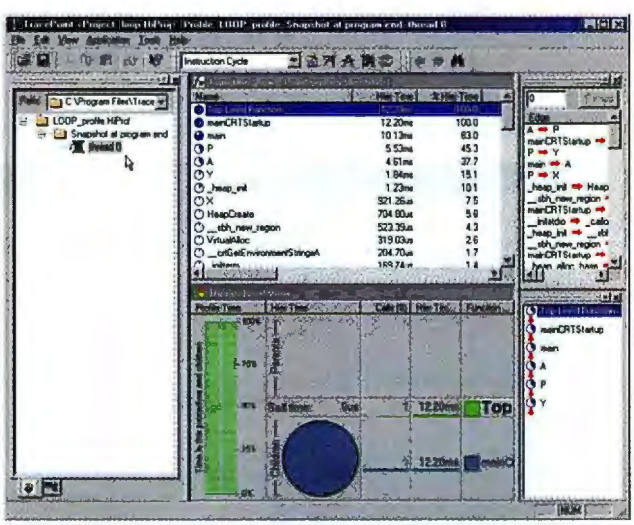

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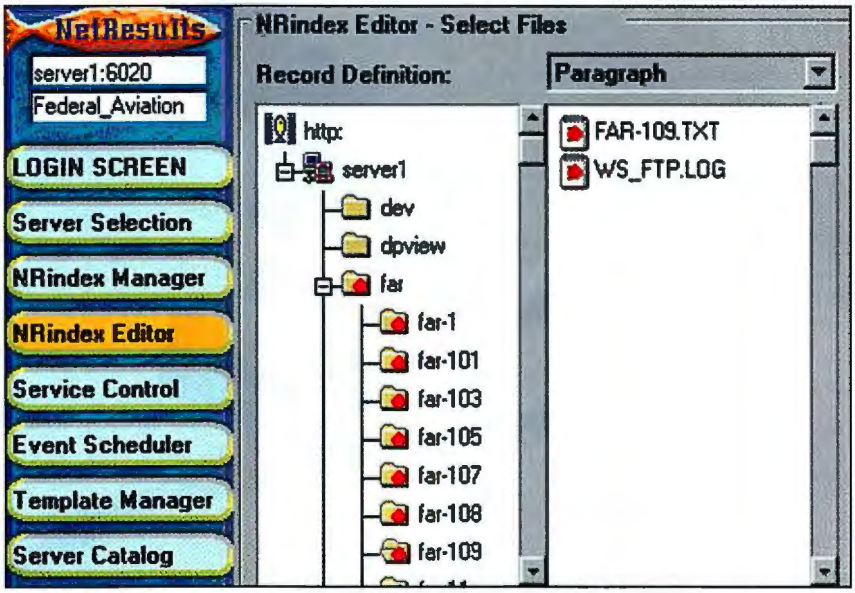
platforms with a single product, without the problems that other companies face by having to create multiple versions for all those platforms."

Java seems like an odd choice for an application that needs high performance. The first version of NetResults was only about a tenth as fast as native code. The latest version is about one-fourth as fast. When compiled with a JIT compiler, it's about one-third as fast. Arnison thinks the performance is sufficient and that the advantages are worth the trade-off. He's confident that future improvements—including Java chips—will eventually banish the performance issue.

Like other Java pioneers (the project began in November 1995), Innotech hit a number of snags. NetResults shipped six months late because of problems with unstable Java VMs, incomplete APIs, and crude tools. For instance, Innotech had to write all its own sort routines because they're missing from JDK 1.0.2. And Innotech doesn't make any loose "run anywhere" claims until after it has tested the code on a slew of platforms: Windows, Power Mac, NetWare, SCO Unix on x86, an SGI workstation, and two different flavors of NCs (a Sun JavaStation and an HDS@WorkStation).

Still, NetResults shipped months ahead of most other Java products, and it's welcomed by those who need a cross-platform solution. Anton Ritter, a consultant for Computer Sciences, is installing it on servers at a major defense contractor. Engineers can use it to rapidly locate data about thousands of complex parts in the company's inventory, even from NCs on the factory floor. A related Java project allows engineers to display an image of a part on-screen, and a future version will render the part in Virtual Reality Modeling Language (VRML) so engineers can manipulate and view the image from any angle.



Innotech's NetResults can index and retrieve files across multiple-server platforms.

"Our main requirement is that it must be multiplatform," explains Ritter. He encountered a few pitfalls along the way—he had to compile the programs with Sun's JDK 1.1 because of problems with JDK 1.0.2—but nothing insurmountable. He's convinced that Web- and intranet-based solutions are the wave of the future.

The Next COBOL

There's still a lot of things that developers can't do with Java. They can't write applications that compete feature-for-feature with leading products, such as Microsoft Office. They can't write programs that demand outstanding performance. They can't write multimedia extravaganzas. And they can't deploy large-size applets that ooze through slow networks like cold syrup.

Of course, before embarking on any project, it's a developer's responsibility to determine whether the tools at hand are up to the task. It's not easy to make that determination with Java because its capabilities keep changing from month to month.

Despite its shortcomings, Java is already making such significant inroads into the enterprise that its future as a programming language for business applications is virtually assured. In a positive sense, Java is becoming the next COBOL—literally, a common business-oriented language.

Unlike COBOL, Java is also a platform. Java could fail in that role while still succeeding as a language. But its ability to deliver cross-platform networked solutions is the biggest reason businesses are adopting Java, and that bodes well for its survival. It's looking more and more likely that Java will be the most successful new platform to take root since Windows made its debut in 1985. B

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CORBA, Java, and the Object Web

The Web is in trouble. CORBA and Java are out to save it.

By Robert Orfali, Dan Harkey, and Jeri Edwards

The next-generation Web—in its Internet, intranet, and extranet incarnations—must be able to deal with the complex requirements of multistep business-to-business and consumer-to-business transactions. To do this, the Web must evolve into a full-blown client/server medium that can run your line-of-business applications. The current HTTP/CGI paradigm is flawed; it can't meet these new requirements. The various CGI extensions—such as cookies, the Microsoft Internet Services API (ISAPI), the Netscape Server API (NSAPI), Active Server pages—are simply Band-Aids. To move to the next step, the Web needs distributed objects. We call this next wave of Internet innovation the "Object Web."

One approach to creating the Object Web is with Common Object Request Broker Architecture (CORBA) and Java. Without the Object Web, CORBA and Java would just be esoteric technologies—mostly of interest to the enterprise client/server market and to object aficionados. As it turns out, CORBA and Java are having a shotgun wedding. Their marriage must be consummated for the higher good of the Object Web. The anxious parents are a coalition of vendors that includes almost everyone in the software industry but Microsoft. Microsoft is building its own Object Web, based on its ActiveX/Distributed Component Object Model (DCOM) technology. This may explain the sense of urgency behind the CORBA/Java wedding. We'll first do the introductions and then tell you all about the CORBA/Java Object Web.

First, we must warn Java supporters that CORBA is a lot more than just an object request broker (ORB)—it is also a very complete distributed object platform. CORBA extends the reach of your Java applications across networks, languages, component boundaries, and operating systems.

Next we must warn CORBA proponents that Java is much more than just another language with CORBA bindings. Java is a mobile object system; it is a portable OS for running objects. Java will allow your CORBA objects to run on everything from mainframes to network computers to cellular phones. Java simplifies code distribution in large CORBA systems: Its bytecodes let you ship object behavior around, which opens exciting new possibilities for CORBA mobile agents. We find Java to almost be the ideal language for writing our client and server CORBA objects. Its built-in multithreading, garbage collection, and error management make it easier to write robust networked objects.

The bottom line is that these two object infrastructures complement each other well. Java starts where CORBA leaves off. CORBA deals with network transparency, while Java deals with implementation transparency. CORBA provides the missing link between the Java portable application environment and the world of intergalactic objects.

So Why the Shotgun?

So why isn't this marriage made in heaven? Until recently, the problem was one of establishing clean divisions between the work of the Object Management Group (OMG, the force behind CORBA) and JavaSoft. For example, JavaSoft started to get into the ORB business when it defined its remote method invocation (RMI) for Java-to-Java communications across virtual machines. It really stepped squarely on OMG's toes with that one—the 700-plus members of the OMG gave it the mission to develop distributed object standards.

continued

The good news is that this turf war appears to be over. JavaSoft adopted CORBA as its distributed object model; it will run the RMI APIs on top of CORBA/Internet Interoperable ORB Protocol (IIOP) with help from the OMG. This June announcement has done a lot to help heal the rift between the CORBA and Java camps. Here's how JavaSoft plans to make CORBA part of the Java core:

Java Development Kit 1.2 (slated for Q3 '97) will include a pure-Java CORBA ORB. The ORB is a subset of Joe—the all-Java ORB included with Sun's NEO. In addition, JDK 1.2 will support JavaIDL, a development environment for generating CORBA stubs and skeletons from IDL. JDK 1.2 will also include an all-Java version of the CORBA Naming Service.

Java RMI will be implemented on top of CORBA/IIOP. This means that JavaSoft will abandon the proprietary ORB on which RMI is currently built.

A future JDK will support Enterprise JavaBeans. Enterprise Beans will communicate with client Beans via CORBA/IIOP (and other protocols). Most important, Enterprise JavaBeans will support the Java Transaction Service (JTS), which is based on the CORBA Object Transaction Service (OTS).

These announcements are very significant for both the low-end and the high-end of the CORBA/Java market. At the low end, you will be able to get from your JDK provider (perhaps even from Microsoft) a free CORBA/Java ORB as well as an IDL development environment. At the high end, you will be able to get transactional JavaBeans. Transactions provide ACID—atomic, consistent, isolated, durable—protection for Beans. They also serve as glue that you can use to synchronize independently developed Beans. Because of all this, what started as a shotgun wedding may be turning into a love affair.

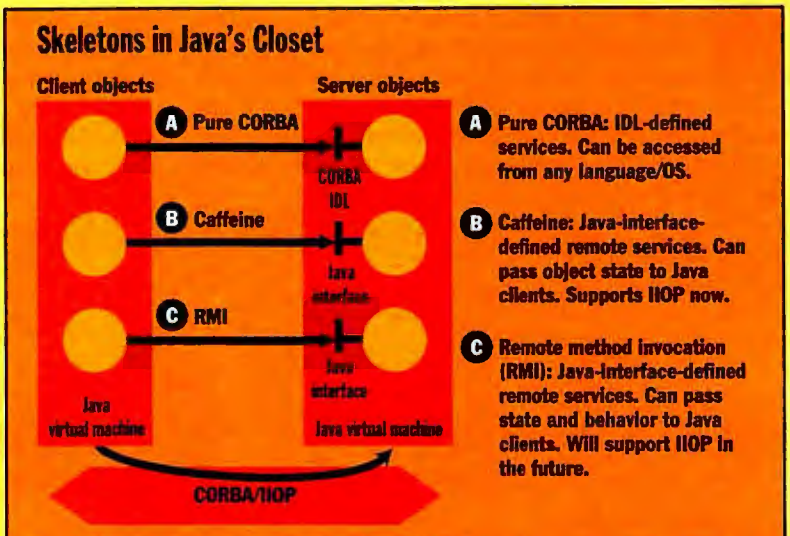
What exactly is a CORBA/Java ORB? It's a CORBA/IIOP ORB that's written entirely in Java for portability. The ORB must be able to generate Java language bindings from CORBA IDL. In addition, any code generated by the IDL compiler must be in pure Java; you should be able to download that code and run it on any machine hosting a Java run-time environment.

So where can you get one of these fabulous CORBA/Java ORBs? As we go to press, we know of three ORBs that fit the bill: Sun's Joe, Iona's OrbixWeb, and Visigenic/Netscape's VisiBroker for Java. Each of these ORBs has strong backers. Joe will be incorporated in JDK 1.2 (you can download the beta). OrbixWeb is sold by Iona, the leading ORB vendor. And VisiBroker for Java is bundled in every Netscape Communicator and Enterprise Server; it is also being bundled with Oracle's Network Computing Architecture (NCA), Sybase's Jaguar, and Novell's IntranetWare. In addition to these pure-Java ORBs, many ORBs written in C++ now provide Java language bindings—for example, Expersoft's PowerBroker, IBM's Component Broker, and soon BEA's ObjectBroker.

Look Ma, No IDL

Today, our world is multilingual. But we hope the day will come when we can write all our code in pure Java—on the client and server. If you are one of the lucky ones who can do this today, you should consider using Caffeine, a tool from Netscape/Visigenic that lets you generate CORBA stubs and skeletons directly from Java interfaces.

The Caffeine development process starts with a Java interface that you declare to be remote by extending it—either directly or indirectly—from CORBA.Object. You must compile your interfaces using javac and then run the output through Java2IIOP—a bytecode post-processor that generates the CORBA stubs and skeletons. With Caffeine, a Java programmer never has to look at the CORBA interface definition language (IDL). The Java remote method invocation (RMI) uses a process similar to Caffeine to define remote interfaces. As parts of the great marriage, Caffeine and RMI may soon adopt the same APIs as well as a common approach for generating CORBA stubs and skeletons from within Java.



These are the three main Java-to-Java ORB-based communication options.

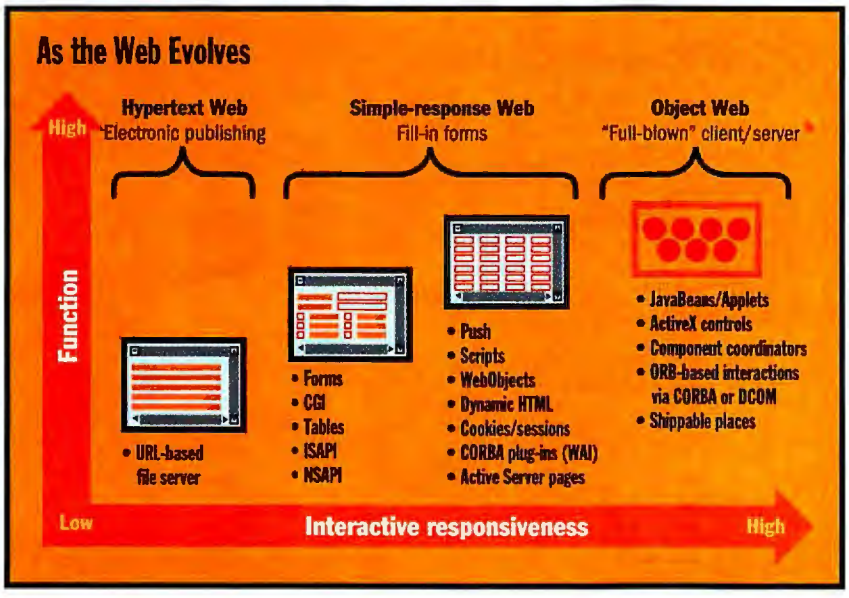
Why Today's Web Can't Hack It

The Web first started out as a giant unidirectional medium for publishing and broadcasting static electronic documents. Basically, it was a giant URL-based file server. In late 1995, the Web evolved into a more interactive medium with the introduction of three-tier client/server, CGI-style. CGI is now used to access every known server environment.

HTTP with CGI is a slow, cumbersome, and stateless protocol; it is not suitable for writing modern client/server applications. CGI is not a good match for object-oriented Java clients. Web server vendors have gone through numerous contortions to work around the limitations of HTTP/CGI. Their solutions are usually in the form of proprietary server extensions and new APIs such as NSAPI, ISAPI, Next's WebObjects, and WinCGI.

To get around HTTP's statelessness, some of these extensions may require that clients pass cookies (i.e., server data held on the client) to identify their state. Others extend cookies with session objects on the server to represent their clients. These attempts are mostly proprietary and seriously flawed.

In addition, CGI is slow; it launches a new process to service each incoming



The Web is moving from file services to full-blown client/server applications.

client request. To get around this limitation, many of the vendor extensions provide memory-resident work-arounds—such as in-process DLLs, server plug-ins, and even ORB-based objects. In general, the server side will do almost anything to keep the services in memory across invocations. Consequently, it introduces another slew of nonstandard (and sometimes platform-specific) extensions.

The main problem with these approaches is that they require HTTP and the Web server to mediate between objects running on the client and on the server. There is no way for a client object to directly invoke a server object. The HTTP form you submit is still the basic unit of client/server interaction. This clumsy work-around is not suitable for full-blown client/server applications that require highly interactive conversations between components. It also does not scale well.

In 1996, the Web finally discovered objects. Java applets were the first step toward creating a client/server Object Web. Java is a necessary but not sufficient step toward creating the Object Web; Java needs to be complemented with a distributed object infrastructure, which is where CORBA comes into the picture.

The Object Web was officially born in June 1997 when Netscape shipped Communicator with a CORBA/Java ORB. On the server side, Netscape shipped both a CORBA/C++ and CORBA/Java ORB with every copy of the Enterprise Server 3.0. The intersection of Java and CORBA object technologies is the first step in the evolution of the Object Web.

Client/Server Interactions on the Object Web

How a Web-based client interacts with its server on the Object Web is pretty simple:

1. Web browser downloads HTML page. In this case, the page includes references to embedded Java applets.
2. Web browser retrieves Java applet from HTTP server. The HTTP server retrieves the applet and downloads it to the browser in the form of bytecodes.
3. Web browser loads applet. The applet is first run through the Java runtime security gauntlet and then loaded

Meet the Object Web Players

A new coalition is building around the CORBA/Java Object Web. The Web transforms CORBA/Java from a set of standards to a set of products that fulfills an intergalactic need. To use a shopping mall analogy, the anchor stores of the CORBA Object Web are Netscape, Oracle, JavaSoft, and IBM/Lotus. This mall is also populated with hundreds of software vendors that provide the boutiques and specialty stores—including specialized object request brokers (ORBs), tools, components, and services. There should be enough critical mass to attract the shoppers with the dollars: independent software vendors, IT shops, and consumers of software.

Netscape is making CORBA ubiquitous on the client. It is bundling the VisiBroker for Java ORB with every browser. Netscape is also using CORBA for its server-to-server infrastructure. Potentially, Netscape can distribute over 40 million CORBA ORBs on the client and over a million CORBA ORBs on the server. CORBA also allows Netscape servers to play with other servers in the enterprise.

Oracle has adopted CORBA as the platform for its Network Computing Architecture. Oracle's entire software line, from the database engines to stored procedures, tools, and the Internet, will be built on a CORBA object bus. For example, the database engine will be componentized using CORBA. Third parties will be able extend the database using CORBA components called Cartridges. Oracle is building most of the CORBA Services on top of the Visigenic IIOP ORB. This ORB will first appear in the next release of Oracle Web Server; it will serve as the foundation for Oracle's Internet products.

JavaSoft is making CORBA the foundation for distributed Java. SunSoft is building its Internet server strategy around CORBA using its NEO ORB and Solstice.

IBM/Lotus is building its cross-platform network computing infrastructure on CORBA/Java. IBM intends to bundle a Java run-time with all its OS platforms. The IBM VisualAge tool will target CORBA/Java objects on both clients and servers across all the IBM platforms. The IBM Component Broker is a scalable server-side component coordinator for managing middle-tier CORBA/Java objects. Finally, the next Lotus Domino is being built on an IIOP foundation.

The boutiques include veteran CORBA players like Apple, HP, SunSoft, Iona, Digital, Novell, and Expersoft. This camp also includes ODBMS vendors—for example, ODI, GemStone, and Versant. Vendors of transaction processing monitors are now morphing ORBs with traditional TP monitors—for example, BEA is building a scalable CORBA-based TP monitor on top of Tuxedo. The boutiques also include tool vendors—such as Symantec, ParcPlace, Borland, Penumbra, and Sybase—and big IT shops. This group also includes the major ISVs that gravitate in the Netscape, IBM, JavaSoft, and Oracle orbits.

into memory.

4. Applet invokes CORBA server objects. The Java applet can include IDL-generated client stubs, which let it invoke objects on the ORB server. The session between the Java applet and the CORBA server objects will persist until either side decides to disconnect. Note that you will need an IIOP-savvy firewall to make this work. Today, Iona's OrbixWall firewall is the only game in town. But by the time you read this, Netscape might have shipped its own IIOP firewall.

5. Server objects can optionally generate the next HTML page for this client. After preparing the next pages, the server can tell the client what URL to download next. This dynamic HTML generation on the server side is typically not needed with the Object Web. A client application is packaged as a single HTML page with embedded components such as applets (or JavaBeans via the Object tag). In contrast to HTTP/CGI, CORBA lets you instantaneously interact with the server by clicking on any of the components embedded in the HTML layers without switching out of the page's context to obtain the response.

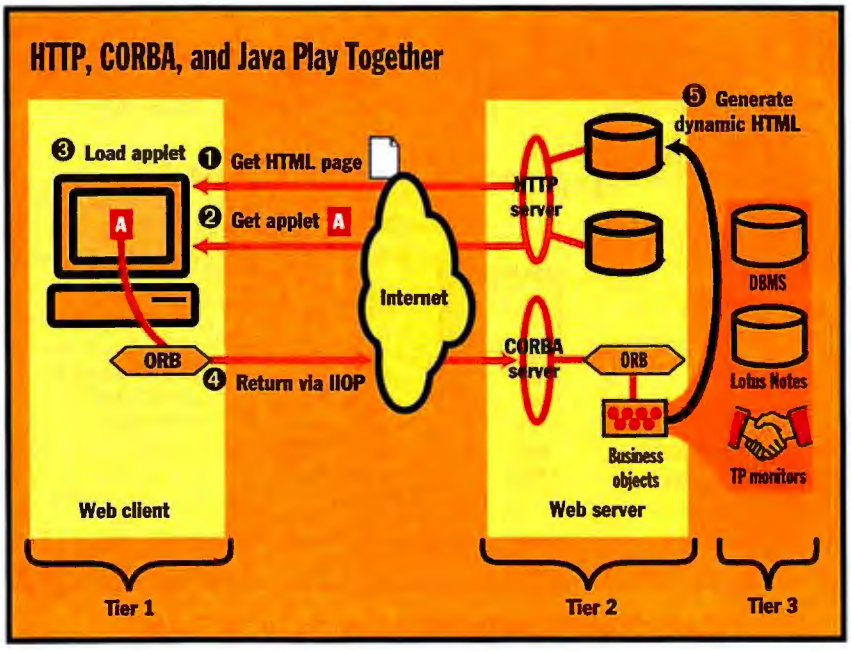
The technology we just described performs surprisingly well today. However, the Object Web is still under construction, as we explain next. Some key pieces will have to become available before we can declare the Object Web ready for mission-critical prime time.

How CORBA/Java Augment Today's Web

Augmenting the Web infrastructure with CORBA/Java provides two immediate benefits:

1) CORBA avoids the CGI bottleneck. It allows clients to directly invoke methods on a server. The client passes the parameters directly using precompiled stubs, or it generates them on-the-fly using CORBA's dynamic invocation services. In either case, the server receives the call directly via a precompiled skeleton. You can invoke any IDL-defined method on the server, not just the ones defined by HTTP. In addition, you can pass any typed parameter instead of just strings. This means there's very little client/server overhead, especially when compared with HTTP/CGI.

2) CORBA provides a scalable server-to-server infrastructure. Pools of server business objects can communicate using the CORBA ORB. These objects can run on multiple servers to provide load balancing for incoming client requests. The ORB can dispatch the request to the first available object and add more objects as the demand increases. CORBA allows the server objects to act in unison using transaction boundaries and related CORBA services. In contrast, a CGI application is a bottleneck because it must respond to thousands of incoming requests; it has no way to distribute the load across multiple processes or processors.



A five-step process takes the browser from HTML to Java to CORBA client/server and back to HTML.

The Three-Tier CORBA/Java Object Web

All new applications on the Object Web will be built and packaged as components. You can use CORBA IDL to wrapper existing code, written in almost any language, with object interfaces. For example, you could use CORBA to magically make a million lines of existing COBOL code look like an object (and eventually you might even masquerade it as a CORBA/JavaBean). Any IDL-described object can now play on the Object Web in a first-class manner. This magic works because CORBA—like Java—maintains a clean separation between the interface of an object and its implementation.

Components require a thriving ecosystem to be commercially viable, and the Object Web provides one. The major computing companies—including Sun, IBM/Lotus, Netscape, Oracle, Sybase, Novell, and BEA—are betting their shops on this killer app. They have chosen both CORBA/IIOP and JavaBeans as the common way to provide a high level of plug-and-play between their products. To understand what is going on, let's go over the three-tier client/server architecture of this emerging Object Web.

The Client. The first tier belongs to traditional Web browsers and the new Web-centric desktops (see "The New User Interface," July BYTE). As opposed to today's static Web pages, the new content will have more of the look-and-feel of real-world objects—for example, you'll see places that contain people, things, and other places. This very dynamic content is provided by ensembles of JavaBeans embedded in mobile containers, such as HTML pages or Jars, that contain shippable places. You will interact with these objects via drag-and-drop actions and other forms of direct manipulation. Client Beans will be able to interact with other client Beans in the container as well as with server Beans. In addition, server Beans will be able invoke methods on client Beans using CORBA events and callbacks. Note that both IIOP and HTTP can run on the same networks. HTTP is used to download Web pages, Jars, and images; CORBA is used for Java client-to-server

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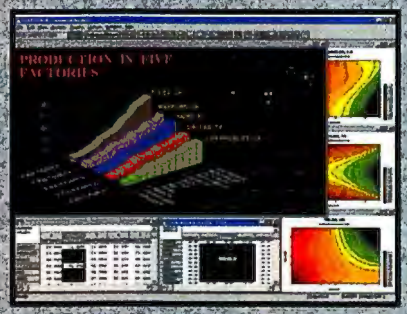

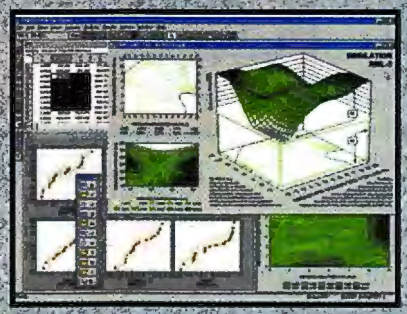

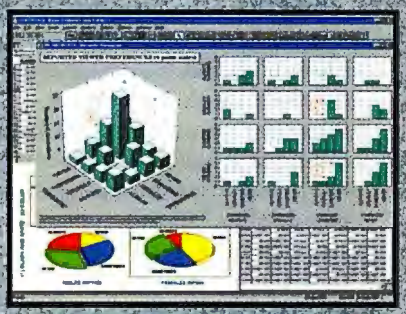

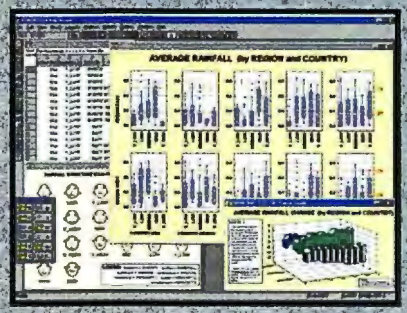

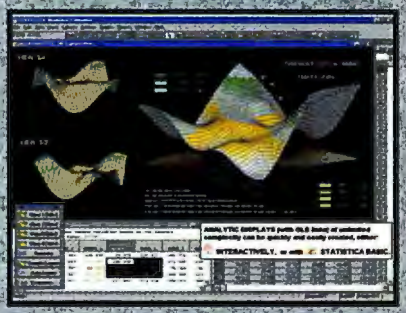

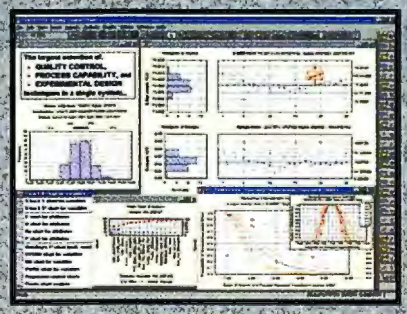

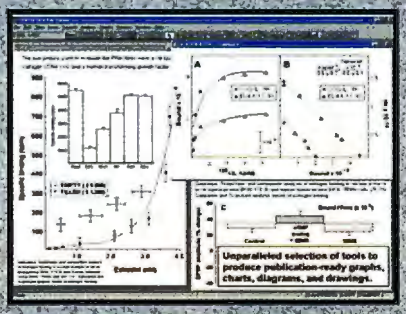

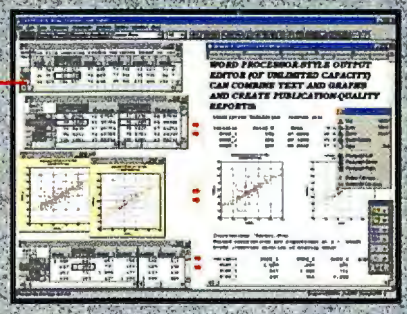

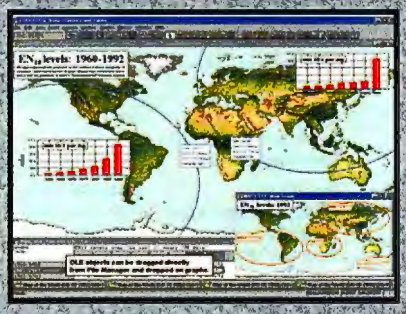

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Circle 112 on Inquiry Card.

and server-to-client communications.

The Middle Tier. The second tier runs on any server that can service both HTTP and CORBA clients. This CORBA/HTTP combination is supported on almost every server OS platform—including Unixes, NT, OS/2, NetWare, MacOS, OS/400, MVS, and Tandem NonStop Kernel. CORBA objects—which could eventually be packaged as Enterprise JavaBeans—act as middle-tier application servers; they encapsulate the business logic. These objects interact with client JavaBeans via CORBA/IIOP. Less scalable applications can also call these objects via scripts that run in HTML server pages—for example, Netscape's Web Application Interface (WAI) provides such a bridge.

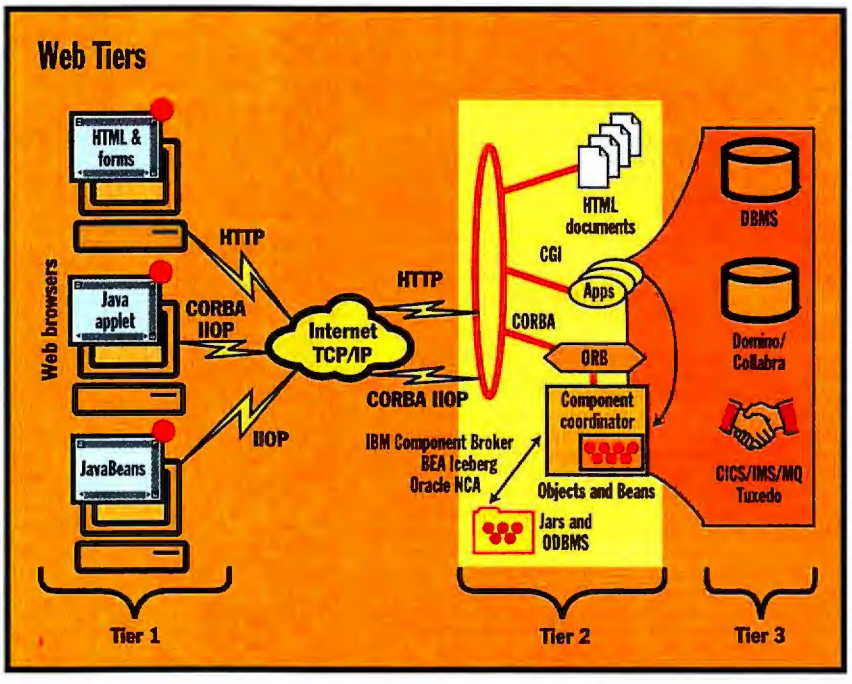
The CORBA objects on the server interact with each other using a CORBA ORB. They can also talk to existing server applications in the third tier using SQL/Java Database Connectivity (JDBC) or other middleware. You can even use the CORBA/IIOP server backbone as a general-purpose data bus. This is the technology Oracle is building for its data plug-ins. JDBC-on-IIOP data backbones are available today from I-Kinetics and Visigenic.

The second tier must also provide a server-side component coordinator—also known as an object TP monitor. These component coordinators are TP monitors built on ORBs. Instead of managing remote procedures, they manage objects. The component coordinator prestarts pools of objects, distributes loads, provides fault tolerance, and coordinates multicomponent transactions. Without these component coordinators, you cannot manage millions of server-side objects—a key requirement of the Object Web. Examples of CORBA-based component coordinators are IBM's Component Broker and BEA's Tuxedo/Iceberg. But, what is a server-side component? It's a CORBA server object that also implements a minimum set of component services. A good example of this is the Oracle Cartridge. Cartridges are named CORBA objects that are also transactional, secure, and capable of emitting events.

A server component must also be toolable. This means that it must provide introspective interfaces that let you assemble it using visual tools. This toolable server-side component technology will be provided by CORBAtized Enterprise JavaBeans. The CORBA/JavaBean technology is being integrated in visual builder tools from Symantec, Penumbra, ParcPlace, IBM/Taligent, Borland, and Sybase.

In a CORBA/Java Object Web, the second tier also acts as a store of component titles, HTML pages, and shippable places. These can be stored in shippable Java Jars that are managed by an ODBMS or DBMS. ODBMSes are better suited for the task.

The Back End. The third tier is almost anything a CORBA object can access. This includes procedural TP monitors, message-oriented middleware, DBMSes, ODBMSes, Lotus Notes, and e-mail. So the CORBA business objects replace CGI applications in the middle tier, which is good. Eventually, you will be able to get CORBA/Java components that encapsulate most of the third-tier functions. This is an area where CORBA's interlanguage communications capabilities will come in handy. Look at some of the I-Kinetics work to understand what you can do with these back-end components.



The full-blown CORBA/Java Object Web involves an incredible mix of products and protocols.

Architectural Glue

CORBA and Java provide the architectural glue that connects products on the Object Web. This is our industry's first attempt to provide plug-and-play at the software product level, which is the ultimate open system dream.

In parallel, Microsoft is building its own rendition of the Object Web; it is based on DCOM and ActiveX. The Microsoft Transaction Server (nee Viper) is the DCOM component coordinator; it is Microsoft's secret weapon for ruling the Object Web. Currently, the Microsoft Web appears to be a single-anchor mall with tons of boutiques all running on Windows NT. So, let the games begin. B

WHERE TO FIND

BEA
Sunnyvale, CA
800-817-4232
408-743-4000
http://www.beasys.com

IBM
Somers, NY
http://www.ibm.com/Java/Sanfrancisco

JavaSoft (Sun Microsystems)
Mountain View, CA
800-528-2763
650-960-1300
http://www.javasoft.com

Netscape
Mountain View, CA
650-937-2555
http://home.netscape.com

Oracle
Redwood Shores, CA
800-672-2531
650-506-7000
http://www.oracle.com

Robert Orfali, Dan Harkey, and Jeri Edwards are authors of many books, including The Essential Client/Server Survival Guide *(Wiley, 1996) and* Client/Server Programming with Java and CORBA *(Wiley, 1997). Orfali and Harkey are distributed-object consultants for IBM and head the CORBA/Java Distributed Objects Lab at San Jose State University. Edwards is VP of strategy for BEA Systems, maker of Tuxedo. You can reach them c/o* **editors@bix.com.**

Debunking Object-Database Myths

Skeptical about ODBMSes? That's fine, but arm yourself with the facts first.

By Joe Celko and Jackie Celko

Object-oriented database management systems (ODBMSes) were one of the hot ideas of the early 1980s. Objects were the next wave, so everyone was object-happy. Computer scientists working at universities and for large corporations developed prototypes. Developers scrambled for venture capital.

The only problem was that the early ODBMSes were not complete database systems. They lacked backup and recovery functions. Data models were conflicting. Languages were proprietary. Because of their structure, it was impossible to do true queries. ODBMSes were not scalable and required huge amounts of memory.

Many vendors backed away from the early ODBMS products. According to Jeff Jones, IBM's program manager of the data management marketing group in Santa Teresa, California, IBM tried to use a pure ODBMS as the embedded database in Visual Warehouse. It licensed Object Design's ObjectStore for the first releases of the product. However, performance was so poor that IBM replaced it with DB2 in later releases and wound up adding features and reducing the amount of code.

Experiences such as this made the ODBMS little more than a laboratory curiosity. Except for some niche markets such as telecommunications, ODBMSes remained, even for their supporters, a technology in search of a problem to solve. This is where conventional wisdom froze. As ODBMS technology and the needs of users changed, the conventional wisdom was that ODBMSes were inherently flawed. But they aren't. Let's take an updated look at six bits of conventional wisdom about ODBMSes. (For more information on ODBMS products, see the Software Lab Report on page 122.)

ILLUSTRATION: JOHN UELAND © 1997

1. ODBMSes Are for Niche Markets

This is almost a truism. In some sense, every database product is designed for a niche market. According to the Meta Group, the relational DBMS (RDBMS) market in 1995 was $2.5 billion, while ODBMSes had only a $250 million market. Relational databases currently make up about 90 percent of the financial market.

However, relational-database advocates do not often mention that only 12 percent of all business-processing data is on RDBMS products. Most of the world consists of old file systems and legacy data. By this measure, the RDBMS is a niche product. RDBMSes are ideally suited for scalar data such as names, address fields, and amounts. They are extremely stable and fast. It is possible to execute complex queries. These features make RDBMSes ideally suited for business and financial applications.

However, the RDBMS model is based on sets of rows with columns, and it can be seen as 2-D. The object model allows for the complex modeling of objects as they exist rather than trying to squeeze the objects into a 2-D structure. The growing interest in multimedia applications and the Internet has created new markets for ODBMSes.

From that perspective, ODBMS technology is ideal for the most popular applications. The huge growth of the Internet, video games, multimedia applications, and the development of distributed databases that do not lend themselves to the relational model are bringing renewed attention to ODBMS. Because Java is an object-oriented language, Internet applications are particularly suited to object databases. Because there are now de facto and de jure standards for object technology, you can deploy

an application to the whole world.

Telecommunications is a good market for ODBMSes. We found several vendors whose products model and control communications networks in real time.

2. ODBMSes Have No Theoretical Foundation

This piece of the conventional wisdom is also true (although less so than in the past). But it ignores history. For example, calculus produced correct and usable results for over a century without a proper theoretical foundation. Newton's infinitesimals were just plain nonsense, and everyone knew it. The real question is whether an object database works for a given application, not whether it has a scientifically approved theoretical framework.

Relational databases have the advantages of a strong mathematical model and a set of well-developed tools for designing databases. ODBMS systems lack a firm theoretical foundation and have no well-developed design tools. Chris Date is particularly critical of this lack of theory in object databases. He and Huge Darwen wrote "The Third Manifesto," which goes into detail on this point.

But so what? A theory lets you design tools. For example, an RDBMS designer can use an entity-relationship diagramming tool to mathematically verify that his or her design is in third normal form. An ODBMS designer does not even have a concept similar to normal forms for his or her objects. Ultimately, the issue of tools is disappearing. For example, Computer Associates' Jasmine has a very good development environment.

3. A Relational Database Can Do Objects

No, it can't. If a vendor says it can, it is lying to you. Let's look at terminology.

You can classify database models as hierarchical, network, relational, object-relational, extended-relational, and object. Nobody cares about the hierarchical and network models anymore—the relational model replaced them. A relational database represents entities and relationships in tables that contain rows, that contain columns, and that contain scalar data-type values.

Nobody has any trouble telling apart products based on hierarchical, network, and relational models today. But when they were first introduced, programmers tried to make relational products behave exactly as a file system. It can be done, but at fantastic performance cost. Dare we say it? We needed a paradigm shift to appreciate the power of a relational system. As Jeff Jones points out, "The shift from IMS [an IBM hierarchical database product] to SQL was pretty painful, because you also had to learn a new paradigm along with the new software. No one really wants to do that again with object databases."

Today, everyone is confused by the extended-relational, object-relational, and (pure) object databases. The biggest

Selecting an ODBMS

There are eight key areas to examine before making an object-database purchase.

Language support: What languages do you need—Java, C++, OQL? Some proprietary languages are faster than OQL, but choosing a product that uses a standard language will be more flexible and portable.

Scalability: What is the largest database the product will support? What is the largest database using the product that is up and running? How many users access the database at one time?

Security: How is security determined—by user, group, or both?

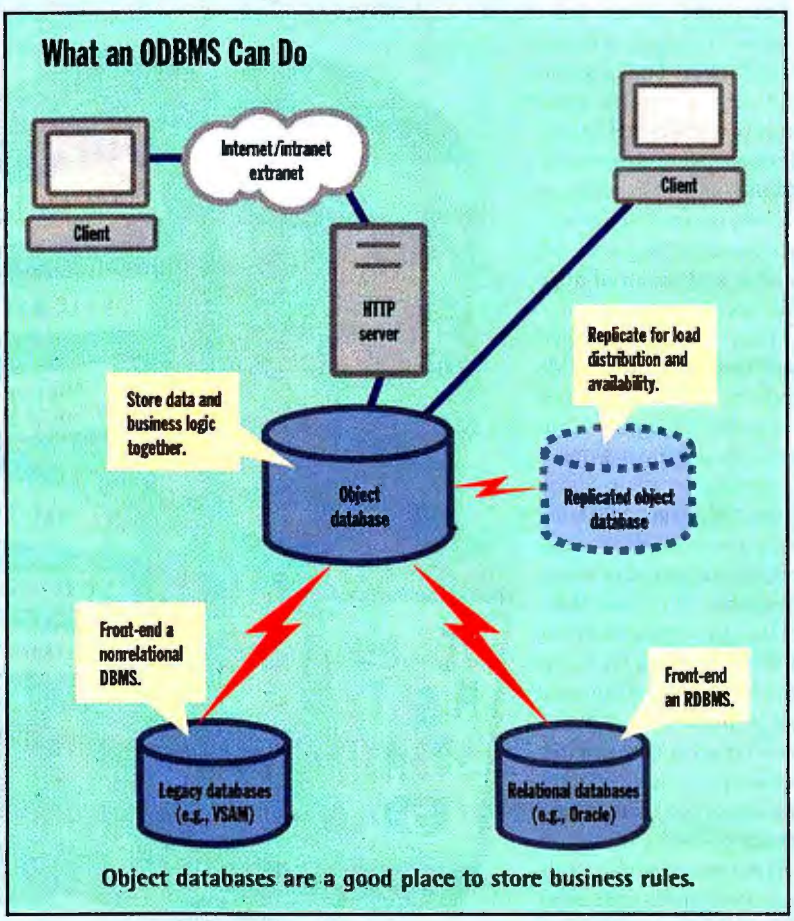
Backup and recovery: How does the product handle backup and recovery?

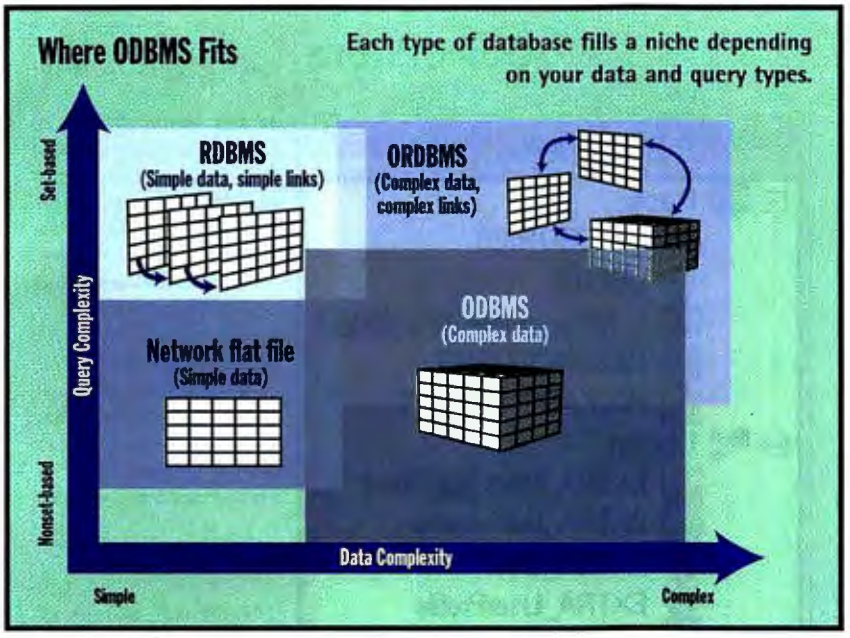
Transactions: Does the database allow for transaction logging, recovery, and rollback?

Methods: How does the ODBMS store methods? To be a true ODBMS, it should store them in the database itself.

Collection classes: What collection classes can the database handle? The ODMG, Java, and several object class libraries—notably STL—have defined certain common collection classes. Use of standardized collection classes increases portability and flexibility.

Support and training: What kind of support and training does the vendor offer? How long will it take to train your staff?





SQL3's Object Extensions

The SQL3 project aims to add object-oriented (OO) extensions to the SQL-92 syntax, making SQL object-friendly and enabling relational databases to handle more complex data types. But there have been some serious and fundamental problems with the SQL3 effort.

First, the committee began with a discouraging word in 1993, when Bjarne Stroustrup, the inventor of C++, said that he knew of four ways to store persistent objects and that they were all bad. He then stated that he believed the OO paradigm was good for programming but bad for data.

Second, the rules of the Standards committee require SQL3 to be upward-compatible with the current SQL-92 standard. Consequently, any ODBMS features must be cast into a syntax that might not be good for OO constructs. The solution is an informal agreement between the ODMG and NCITS H2 to make the queries in SQL3 and OQL identical, or at least to overlap each other on most major points. But the schema declaration languages are still quite different.

Another area of concern is the interface. The 3GL host languages for which an interface to SQL-92 is defined (FORTRAN, Ada, C, M, COBOL, Pascal, and PL/I) have no basic disagreements about how to handle the scalar data types used in SQL. But C++, Smalltalk, Java, Eiffel, and several minor OO languages all disagree on OO fundamentals, such as inheritance, polymorphism, and encapsulation. OO vendors solve this problem with object brokers that automatically convert one object model to another one. Thus, the object database matches its host program.

There are political considerations. The object effort in SQL3 began with three sides, represented by Hewlett-Packard, Oracle, and IBM—three RDBMS vendors. Each had a different object model and different features to add to SQL3. Having little experience with ODBMS, the committee approved proposals from all three companies. The internal contradictions and inconsistencies in the SQL3 draft document became so great that the ANSI X3H7 Object Standards committee sent a memorandum of concern to ANSI X3H2 on reviewing the document. Most of the current effort in SQL3 has been the cleanup of these problems.

Finally, in interviews we conducted, there was little endorsement of or enthusiasm for SQL3 from the ODBMS vendors. If they have to do it, they will. SQL3 will not be an approved de jure standard before 1999. By that time, the market will have established de facto standards. The most likely candidates for an object-database language are OQL and Java. OQL is already defined and has wide vendor support. Java is becoming the de facto language of the Internet, where the capability of ODBMS products to handle nontraditional data will shine.

problem that the pure ODBMS has is its name. The term should have been *object-base* instead of *object database*, because the goal is not to store, manipulate, and retrieve data within an object, but to store, manipulate, and retrieve objects themselves. Relational databases allow elaborate queries on simple data. Pure object databases allow relatively simple queries on complex data.

Object-relational products try to have both relational data and objects stored in one system. The difference is that the objects are added as an afterthought or a shell around the database rather than integrating them into the database engine. If you cannot tell the query optimizer, the indexing, and the database-engine functions how to handle the new data types invisibly to the user, they are not integrated.

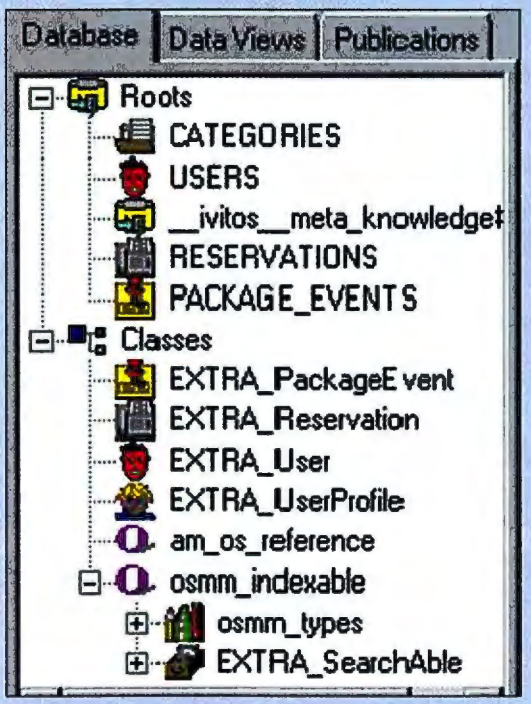
IBM and Oracle have object-relational offerings for their relational databases. To put it bluntly, the result is like a fish with feathers—it can neither fly nor swim very well. To quote Esther Dyson, "Using tables to store objects is like driving your car home and then disassembling it to put it in the garage. It can be assembled again in the morning, but one eventually asks whether this is the most efficient way to park a car." (*Release 1.0*, September 1988)

Chris Date advocates an extended-relational model, and Informix implements it with DataBlades. In 25 words or less, an extended-relational database allows the creation of more complex user-defined data types and integrates them into the database. But the operations are still relational, and data still exists in tables. This is a good approach for a particular class of common problems and should replace many of the existing simple relational databases, which do not need a full object

Objectivity

The Objectivity DB product from Objectivity is aimed at the high-end market—OEMs, ISVs, and large companies. Its customers include Motorola, Citibank, CERN, and Fermi Laboratories. Applications include process control, telecommunications, and scientific applications. The product provides real-time data acquisition and is extremely scalable. It has an ODBC tool that lets it use SQL for reporting. Backup and recovery include fault-tolerant options.

ObjectStore



Larry Alston, director of product management at Object Design, believes that an ODBMS allows true "multimedia" performance because objects are mapped directly. ObjectStore, Object Design's database product, is aimed at distributed Web applications as well as more conventional database applications. ObjectStore has been used in these areas: finance, education, publishing, and telecommunications.

ObjectForms allows you to see what is inside an ObjectStore database and publish it to a Web site via simple point-and-click commands.

model. You could use an extended-relational database for employee records with fingerprints or a photograph but not for a multimedia library with interactive objects or for a model of the stock market.

A pure object database has methods, classes, and other things that characterize the object-oriented model in the database engine. Objects are active. Relational data is passive, and you need a host program to do something with it.

Don't confuse ODBMSes with extended-relational and object-relational products. They are designed to solve a different set of problems. To paraphrase Esther Dyson again, using a pure object database to store relational data is like keeping auto parts fully assembled into cars and disassembling the fleet when you need to count the screws you have in stock. One eventually asks whether this is the most efficient way to conduct an inventory.

4. ODBMSes Have No Standard Language

SQL is literally the only NCITS/ISO standard programming language for databases and is relational. NCITS, the National Committee for Information Technology Standards, was formerly the ANSI X3 committee for information-processing standards before its name changed in January. (NCITS is pronounced "insights.")

The argument is that having a standard language has made relational databases less expensive to build and much more portable across products and platforms. ODBMSes have no such standards, so you have to work with strange proprietary languages and learn a new one each time. Therefore, the argument goes, they are not good for serious development work.

This wisdom is de jure true today, but not de facto true. In the next few years, it may be completely false.

While the ISO standards process was going on (see the text box "SQL3's Object

Versant

Versant has the capability to dynamically modify its schema. Dynamic languages such as Java, Smalltalk, and C++ can define a class within an application, instantiate it, and then modify it. After this class modification, Versant will automatically and transparently evolve the instances of the modified class as they are used. In short, a class is as easy to change as an object.

Poet

According to Dirk Bartles, CEO of Poet Software, the Poet Object Database is the only object-database product designed for Windows applications. It is compact, with a footprint of less than 1 MB, and is comfortable on a single machine or on a network. Poet supports Java, C++, and ActiveX as well as OQL. Although there are no tools for backup and recovery, it does include transaction rollback and recovery features. There are Poet databases currently running in the 16-GB range with 150 concurrent users.

Extensions" on page 103), the Object Database Management Group (ODMG), a group of ODBMS vendors, began trying to set standards for object databases outside the ISO framework. The ODMG produced a standard for an ODBMS query language in 1993 under the name OQL. *The Object Database Standard*, edited by Rick Cattell (ISBN 1-55860-302-6, Morgan-Kaufmann), shows what version 2.0 of the project looks like. Sixteen vendors agreed to support OQL.

5. ODBMSes Are Not Scalable

Completely false. Yes, scalability was a major problem with early ODBMS products, because many of them could run only in main memory. If the machine went down, so did your database.

You can get small, medium, and large ODBMS systems. Small desktop systems include Poet. Medium enterprise-level systems include Versant, ObjectStore, and Jasmine. Large systems are at least terabyte-size and include a petabyte-size Objectivity DB project at the European Laboratory for Particle Physics (CERN).

These are real databases, with security, backup, and recovery features just like any RDBMS.

6. Object Query Languages Are Hard

This one's true. David Beech of Oracle submitted a paper to the H2 committee in March 1996. It gave a simple SQL3 schema using some new SQL3 declarations. The schema dealt with street addresses. The reader had to submit queries to answer a set of questions. Nobody on the committee submitted correct queries. These are

people with a lot of experience with SQL. If they had problems, what will the average programmer do?

Beech said: "Querying may be fun in the era of SQL-92, but will it still be so with SQL3? In the course of working on the SQL3/ODMG paper, I was obliged to become more intimately acquainted with SQL3 queries than I had ever been before, and I was surprised by some of the things I learned.

"This raised in my mind the question of whether the language has perhaps become too difficult for its intended users, which could mean that the potential simplification offered by some of the OQL features is not merely an optional luxury, but is an absolute necessity.... Even if committee members solve them all correctly, it may seem that SQL users as a whole (the majority of whom are as yet unborn) would find the language error-prone and should therefore, if possible, be spared some of the problems and lengthy education.... Its [failure to answer the problems] would show that even spending 40 hours with the query parts of the SQL3 foundation document may not be sufficient training for someone with 20 years' acquaintance with SQL and semiformal standards to be relied upon to write correct SQL3 queries."

The New Conventional Wisdom

Object databases are back. They are still maturing, still misunderstood, and still hard to use. But they are gaining acceptance, thanks to the explosive, and somewhat speculative, growth of the Internet and multimedia applications.

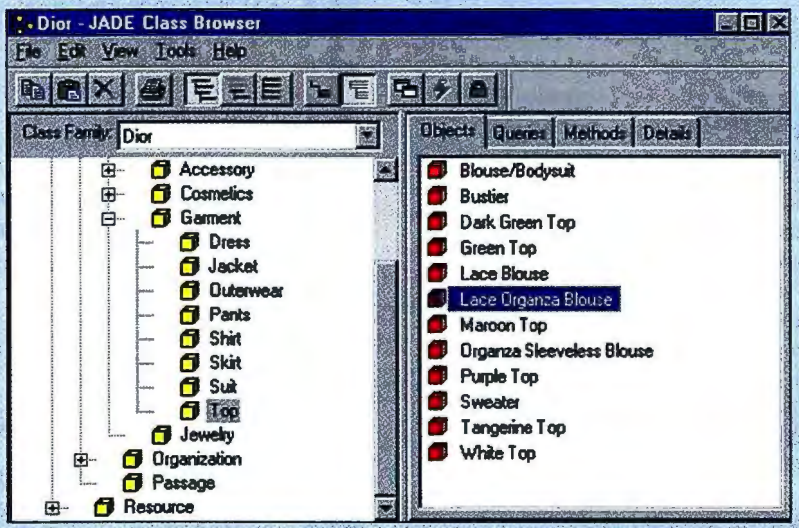
Relational vendors that are making noise about object features added to their products are like the nonrelational vendors of several years ago who made false claims about relational features. The object-database model and the relational model coexist because they are designed for different applications.

Put another way: Don't fit the data to the database. Choose the database type and product based on what kind of data you have and how end users will access it. For example, a real estate firm that wants to do a database of home listings should choose a relational database if it will include only descriptive data, such as addresses and phone numbers. If the listing will include floor plans, text, or photographs, an object-relational database may be a better choice. If the database will include 3-D drawings, filmstrips, an animated walk-through, or a variety of complex data types, you should consider an object database. And if you do decide to choose an object database, be sure that it will support the kinds of queries end users will be making.

A final word of warning: The shift to object technology may be hard because of the heavy financial and human investments in relational technology. Projects involving an object database will take longer with an inexperienced staff. But even if you're dealing with experienced object-database people, the project will take longer and be more costly because of the inherent complexity of object technology. If you're prepared for that, you're prepared for an object database. B

Jasmine

Computer Associates believes that object-relational databases cannot support complex objects completely. It tried for over six months to combine the two and could not come out with a viable hybrid. The company designed Jasmine in cooperation with Fujitsu to be an object-oriented database and application-development system that is multimedia- and Internet-aware. It has a small-footprint execution system so that it can become a Web-browser plug-in. Jasmine has a multimedia authoring tool and connectivity to the major relational databases. It comes with a class library, all packaged as JADE (Jasmine's Application Development Environment).



With Jasmine, you can drag objects directly from the database and drop them onto an application scene.

WHERE TO FIND

Computer Associates, Inc.
Islandia, NY
516-342-5224
http://www.cai.com/products/jasmine.htm

Object Design, Inc.
Burlington, MA
617-674-5000
http://www.odi.com

Objectivity, Inc.
Mountain View, CA
650-254-7100
http://www.objy.com

Poet Software Corp.
San Mateo, CA
650-286-4640
http://www.poet.com

Versant Object Technology
Menlo Park, CA
650-329-7500
http://www.versant.com

Joe Celko has been a member of the NCITS H2 Database Standards Committee since 1987 and helped write the ANSI/ISO SQL-89 and SQL-92 standards. He is the author of three books on SQL: SQL for Smarties *(Morgan-Kaufmann, 1995),* Instant SQL *(Wrox Press, 1995), and* SQL Puzzles & Answers *(Morgan-Kaufmann, 1997). You can reach him at* **71062.1056@compuserve.com.** *Jackie Celko is an Atlanta-based technical writer and researcher.*

Data Networks Speak Up

Forget the promises of inexpensive long-distance rates. Can you really trust your voice network to frame relay or IP?

By Alan Joch

Think about it: You've already got that nice LAN wiring all over your building, connecting every office. Plus, you've got WAN connections linking all your remote locations. Using this existing infrastructure to carry telephone calls—without bothering the phone company's billing department—seems like a no-brainer. But nothing is that easy. The one accepted standard—frame relay—is fraught with internal dissension. Besides, IP is an important competing standard that you cannot ignore.

Frame Relay: One for All?

Universally accepted standards: What a pain! Communications-hardware vendors all used to use proprietary compression technologies to squeeze voice traffic through frame-relay networks. But last spring, the Frame Relay Forum announced an interoperability standard, FRF.11, that seemed to finally put an end to all that. For the first time, companies could shave 35 percent or more off their intracompany long-distance bills without committing to a single vendor's hardware and software.

The key to these glad tidings was G.729A, a voice compression/decompression (codec) protocol. Hardware vendors almost universally agreed that G.729A was good enough for toll-quality voice. In fact, the protocol provided nearly the same voice quality as the Public Switched Telephone Network (PSTN), which cost thousands of dollars a month more. Service that had previously cost a company $120,000 annually cost only $40,000 with frame relay. A bonus was the fact that interoperability could convince antsy customers that frame relay was mature enough to trust for both data and communications.

But the plot was thickening. The proposal was unraveling even before the ink was dry. France Telecom North America (FTNA), the University of Sherbrooke, Lucent Technologies (based on work done at Bell Labs), and other companies had all provided some technology pieces to G.729A; each contributor now wanted a piece of the licensing action. Telephony vendors could end up paying dearly if they incorporated the codec in their systems.

How dearly? That was the other problem. Intellectual property claims were nearly impossible to sort out, leaving vendors in the position of ignoring G.729A in favor of each one's own proprietary codecs. So much for interoperability.

This was all the more painful because frame relay has improved its voice quality greatly. Two years ago, some disparaged frame relay because of annoying delays in two-way conversations. But although it's still not perfect, frame relay today almost equals PSTN under pristine network conditions.

Worse still, frame-relay fans must quickly sort out their problems now that a competitor, IP, has emerged. As corporations construct IP intranets, many see the next logical step to be voice services on those networks. Maybe. Headlines may buzz about voice over the Internet, but anyone who has listened to such calls knows that, right now, they're more a parlor trick than a Fortune 1000–level solution. The real potential for voice on IP is for calls within an enterprise, to connect headquarters with remote subsidiaries—the very turf that frame relay has been trying to claim.

Now, as firms wonder if they should find alternatives to expensive long-distance service, they're also asking which is best. Frame relay and IP both offer hope for tomorrow's single-pipe data/multimedia dream. The big question: Is either technology mature

enough for you to commit now? Here's how to decide.

Giving Frame Relay a Voice

Frame relay's variable-size packets efficiently do what their original design dictated: move blocks of data across WANs. Hardware at each end of a link handles error correction and flow control, so frame relay avoids the overhead burden of its older cousin, X.25. Plus, service providers typically sell frame-relay service for less than the cost of T1 or fractional T1 lines. That can add up to significant savings for data-intensive businesses.

If a company uses a public frame-relay network—offered by AT&T, MCI, Nynex, Sprint, US West, Wiltel, and others—it taps into the public frame-relay "cloud." That saves it from having to buy its own routers and switches. (See the text box "Saving with Frame Relay" on page 109.)

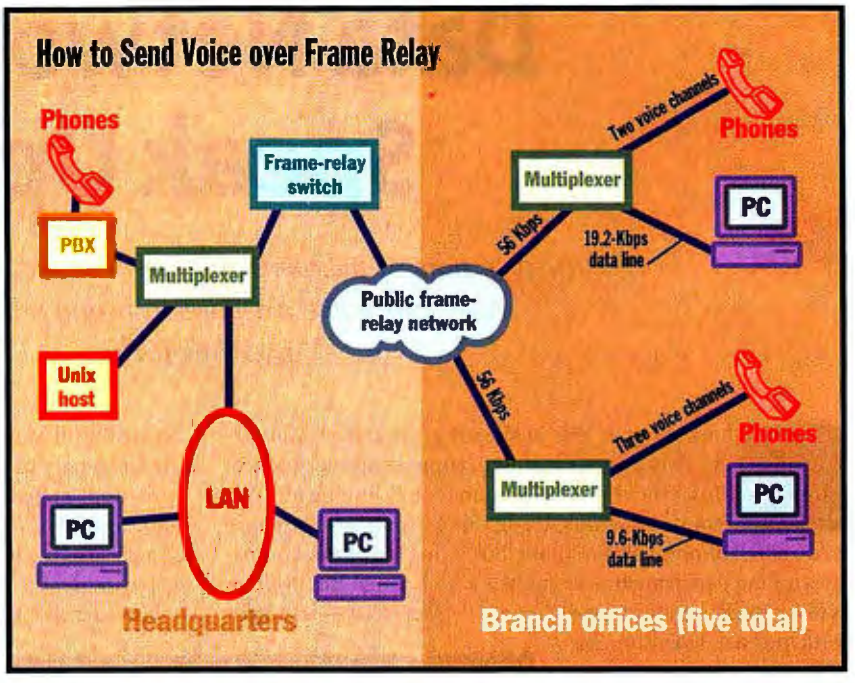
A bonus is *dual dial tone*, which reduces long-distance charges further (see the figure "Leaky PBXes" on page 109.) This feature—disparaged by long-distance providers—allows subscribers to call remote numbers for the price of a local call. A caller in New York, for example, dials a prefix number, sending the call to the frame-relay network, and hears the first dial tone. The caller then dials an outbound extension at a PBX in a remote office in, say, San Francisco, and hears a second dial tone. Then the caller can dial a remote customer as if making the call from San Francisco. Companies are reluctant to admit they do this, but one spokesperson said, "We hear it works just fine."

Coastal Construction Products connects its Jacksonville, Florida, headquarters to six remote offices using frame relay. In 1995 came the decision to add voice to the fractional T1 and 64-Kbps data lines. "We knew that if we could run voice over those networks, we'd pay for any additional equipment from our reduced long-distance phone charges," explains Jack Caven, MIS manager.

The company spent about $55,000 for Micom equipment, including its software FRAD. (FRADs—frame-relay assembler/disassemblers—package data into frame-relay packets; today, vendors sell integrated hardware that combines traditional FRAD with routing, switching, and multiplexing.) The frame-relay link itself cost about what the former leased line did.

Caven estimates the company recouped its investment in 18 months, but reduced costs were not the only benefit. "We began to have better communications within the office," he explains. "Because we could call Miami as easily as calling the office next door, our people began to communicate more—not long conversations, but more short conversations to check availability of products." Conference calls among remote staff members had previously been expensive, with the telecom provider patching calls together. "Now conference calls are free," Caven adds.

With Coastal's circa-1995 equipment, voice codec algorithms are old and compression is only to 16 Kbps (versus 8 Kbps, the current standard). Consequently, the system is primarily for intra-office calls.



A Miami food distributor needed only to add multiplexers and switches to send voice over its data network and cut phone charges.

IP's Say

Voice over IP offers similar savings: Voice gateways produce a voice/fax layer on an IP intranet. Gateways can be simple. For example, Micom's V/IP is a standard ISA card that plugs into a business-class PC connected to a PBX and a network. The V/IP card digitizes voice and puts it in IP packets (at the sending end) and unpacks the IP packets (at the receiving end). Similar PCs run at each remote facility.

IP-based intranets move voice and faxes through an enterprise well. And the Internet can be an important low-cost link for one-way calls, such as checking voice messages or sending a fax while on a trip. And IP also provides dual dial tone.

IP gateways create a directory of phone numbers and IP addresses associated with each destination gateway. To place an IP-network call, users need only to dial a single-digit access number to reach the IP network, a number to reach the destination office, and, finally, an individual's telephone extension. The gateway sets up the call (often in 1 or 2 seconds).

Vienna.way, a call-processing server in the Vienna Systems product family, performs traditional PBX duties so that users can place or receive calls through their PC's IP gateway or a special serial-interface telephone. The server runs on Pentium PCs using Windows NT or Unix. Multiple Vienna telephony cards (with four or eight DSPs) in each PC can support up to 96 simultaneous calls to the PSTN. To handle more users, you can string together multiple servers.

VocalTec's Telephony Gateway 3.0 provides similar capabilities using VocalTec software and Dialogic telephony boards. Unlike Vienna's product, the VocalTec gateway runs only on NT (using 200-MHz or faster Pentium PCs). VocalTec recently announced Atrium, intranet software that conferences multiple callers, even if some use traditional telephones and others use PC connections to the IP network.

The software, which was due to ship this summer, costs $2400 for a one-user license.

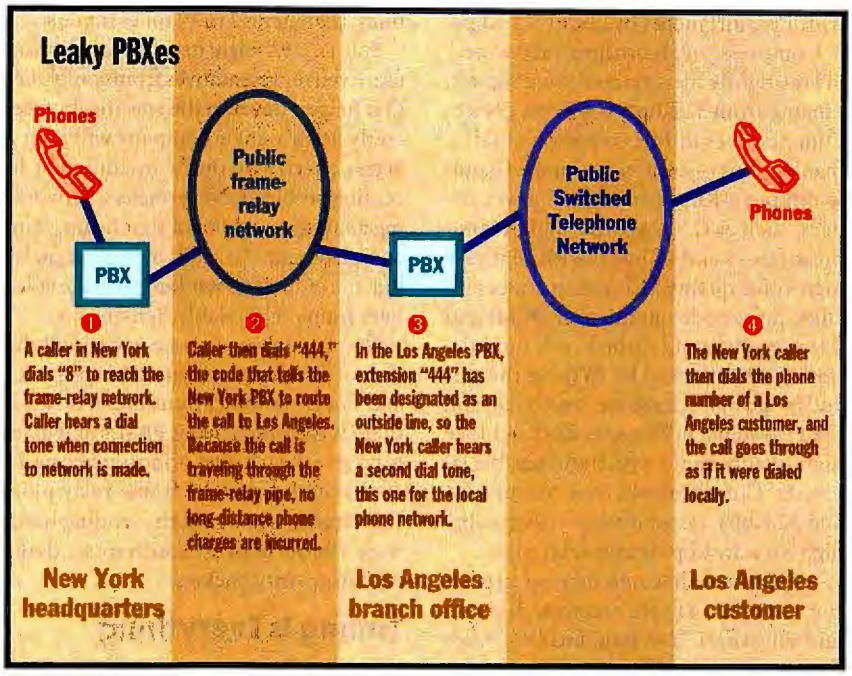
FTNA is currently testing voice over IP, using Micom's gateway boards. The project's first goal is to add telephony to the Sprint frame-relay data/e-mail network among the company's New York, Chicago, and San Francisco offices.

FTNA focuses on voice and fax over IP as part of intranet experimentation. It gets first-hand experience in future development of voice-over-IP services. "If we're running voice over IP at layer three [of the OSI model], we can use frame relay or ATM [asynchronous transfer mode]," says Jean-Francois Mulé, manager of information systems.

ABC Bücherdienst, a Regensburg, Germany, bookseller, is testing an innovative use of voice over IP. The company recently hired sales agents in Boca Raton, Florida, to handle inquiries from European customers after normal business hours. When Bücherdienst closes, the headquarters PBX routes sales calls over a leased line to Florida. A customer talks to a German-speaking sales agent and may not even be aware that the call has traveled outside Europe, despite some degradation in voice quality, according to Michael Gleissner, managing director.

"We're looking at the Internet as a way to enable us to shift our operations internationally without a huge telecommunications cost," Gleissner says. "It's hard to get experienced people in Germany who are willing to work at night." The system, which is about a month into a six-month beta test, provides many standard telephony features, such as voice mail and fax capabilities, Gleissner adds.

Lucent provided all the hardware, software, and services in exchange for the bookseller's being a test site. The system was not "plug and play": Lucent has been upgrading software, as often as twice a week, to tweak voice quality. But the quality of voice over the Internet is still volatile, depending on how the conversation connects. "You quickly figure out the call isn't going through the normal telephone lines," Gleissner says. "But the quality is improving every week."



Although service providers consider it wrong, frame-relay customers are able to call long-distance customers for free.

Speech Quality Evolves

Such encouraging implementations of voice over data networks are a recent change. "If you asked me a year and a half ago if voice over frame relay had a chance to succeed, I would have said no," admits Tom Jenkins, broadband consultant for TeleChoice, a Verona, New Jersey, telecommunications consulting and market-research firm. "But I've changed my mind."

Voice over frame relay had earned a dubious reputation for high latency, taking over 100 milliseconds on average to send packets across a network. (The human ear starts to notice delays with latencies of 50 ms. At 300 ms, conversation becomes difficult. At 500 ms, conversations are annoying.) IP also suffers some of the same problems as frame relay.

A new generation of codecs, such as G.729A, not only compress conversations more efficiently but work with telephony applications that ingeniously interleave voice and data so that data sneaks through during the silences in all conversation. This is known as *silence suppression*. (A Bell Labs study found that silence can make up as much as 60 percent of a typical conversation.) Vendors estimate that silence suppression can reduce band-

Saving with Frame Relay

Senior vice president Kevin O'Donnell helped launch voice over frame relay at Florida food distributor Bonacker & Leigh in 1994. The company sought to cut hundreds of thousands of dollars in annual long-distance charges for communications among its Miami headquarters and five remote offices.

The company's existing network had slow 9.6-Kbps dedicated leased lines with multiplexers for sending data from Miami to each subsidiary. A separate voice network was strung together with tie lines and inbound and outbound 800 numbers.

After spending about $130,000 for ACT-net equipment, the company consolidated data and voice networks into one 56-Kbps frame-relay link. A multiplexer connects a frame-relay switch located at the Miami headquarters with a Unix machine and the office's LAN, PBX, and fax machines. Multiplexers now turn voice, fax, and data into frame-relay packets. The switch then addresses the packets and launches them into a public frame-relay network (here, Intermedia Communications). Multiplexers at each remote office open the packets and send the data to the appropriate phone line, fax machine, or PC.

Because Bonacker & Leigh chose to install its own switches and multiplexers (rather than renting Intermedia's), it needed only the "raw" pipe into a frame-relay cloud. This cost about $40,000 a year—versus the annual $180,000 charges the company had been paying for the slower, parallel-network implementation, O'Donnell says.

width requirements by about 3.5 Kbps.

Compression algorithms vary widely in how tightly they squeeze voice signals, ranging from 32 Kbps to 4 Kbps. (Note: Older codecs didn't compress smaller than 32 Kbps—still a large chunk of bandwidth in 56-Kbps networks. Newer codecs, such as G.729A, offer higher compression—8 and 4 Kbps—with relatively high voice quality.) Common codecs include pulse code modulation (PCM) and adaptive differential pulse code modulation (ADPCM), used by PSTN in the U.S. and by postal, telephone, and telegraph (PTT) systems in Europe. Both achieve high-quality audio with unnoticeable latencies. Unfortunately, they consume 64 and 32 Kbps, respectively, unacceptably high for a 56-Kbps frame-relay pipe.

Algebraic code-excited linear prediction (ACELP), a more recent technique, underlies the G.729A standard for 8-Kbps compression. ACELP can produce "near-toll-quality" sound in subjective tests.

G.729A is a cousin of G.723, the compression scheme pushed earlier (as part of H.324) by Intel and Microsoft for videoconferencing over PSTN. G.729A was developed because G.723 needs significant computing—about 30 percent of a standard Pentium 100's power. G.723 also has a longer frame size—30 ms— resulting in 90- to 100-ms latencies. With a smaller frame size of 10 ms and only 30- to 35-ms delays, G.729A became a simpler and higher-quality choice for voice applications. (Latency is 3 to 3½ times frame size.)

Still, G.729A might never see widespread use. Even representatives from companies that helped develop the specification secretly hope a single company will offer a better alternative that's unsaddled by licensing problems. Nevertheless, networking analysts see this as a significant, if incomplete, gain. "It sends the right signals" that the industry is working to make voice over frame relay viable, Jenkins says.

Voice hardware also can control the flow of different data types. Because voice and fax communications break down if there is too much delay, FRADs and gateways give them higher priority when packets travel through the frame-relay pipe. Data traffic remains in the sending hardware's buffer until the hardware sends the higher-priority packets.

Timing Is Everything

For the time being, and even if G.729A finds resolution, your safest choice still is to buy FRADs from a single vendor. Unresolved standards issues beg the most fundamental question for both frame relay and IP: Is the time right to combine your voice and data traffic?

The answer: Only for select applications. Neither technology offers enough quality for a large corporation to scrap traditional voice services. For example, Kevin O'Donnell, senior vice president at Florida food distributor Bonacker & Leigh, says he has noticed steady improvements in voice over frame relay in the past two years. But the quality still is not high enough "to talk with my best customers." For internal conversations, however, especially after workers get used to slight delays, frame relay is acceptable. "When you're saving $15,000 a month in long-distance charges, you get used to the sound quality pretty fast," O'Donnell quips. (See the figure "How to Send Voice over Frame Relay" on page 108.)

Mulé estimates that 90 percent of FTNA's New York–to–San Francisco calls travel over the IP network. His rating of IP voice quality? "Pretty good for our internal purposes." Unlike over the Internet, you can control the quality of calls over a private intranet.

Nevertheless, the relatively short payback times of hardware costs for voice over frame relay or IP make it easier for large companies to commit part of their voice services to one of these technologies. Long-distance savings can pay for a FRAD in half a year, so even if the technology changes in a year or two, you will probably recoup your costs. (Voice-capable FRADs range from about $2000 to $10,000, with most in the $4000–$6000 range.) And once you launch a combined voice/data network, later transition to one-stop-shopping services is easier.

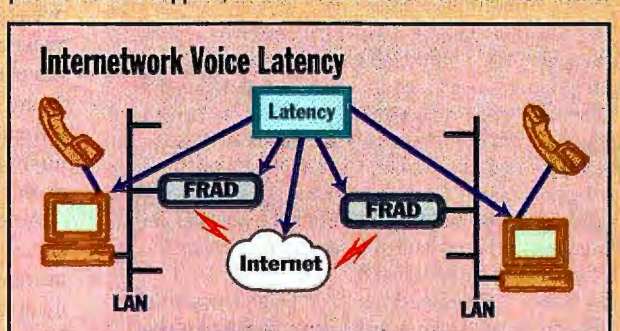
Just don't expect comfort in numbers: Today, according to Jenkins, voice represents only about 3 percent to 5 percent of the traffic over frame-relay networks. De-

Hopping the Networks

Some companies might consider sending voice over their frame-relay network, then over an internal IP network, and perhaps even over the Internet. Today's FRADs and gateways theoretically make this possible, but the practical benefits are unclear.

An IP gateway could encapsulate voice into IP packets: Workers within a company could converse from PC to PC. The IP packets could then go to a FRAD. The FRAD would enclose the IP voice packets like a nested box within a frame-relay packet, then across the company's WAN to a remote site. There, another FRAD would strip off the frame-relay envelope and send the IP packet across the LAN. At the destination PC, the IP packet would disappear, and the message would turn into voice.

The capability exists to take this one step further. Most service providers can connect their frame-relay networks to the Internet so that, along the way, the voice data could jump off onto the Internet.



Network-hopping your voice traffic is possible, but the latencies it introduces make it impractical.

That's the potential; the practical aspects of network hopping are plagued by the high overhead of all that packing and unpacking. Today's codecs might compress the voice data to 8 Kbps; however, an extra 7 Kbps in overhead might be needed to send the data, according to TeleChoice's Tom Jenkins. The result is more degradation in voice quality than what users already experience with voice over frame relay or IP.

Jenkins adds that he doesn't expect network hopping to be significant in the evolution of voice over data. "Companies are more likely to choose frame relay or IP," he says.

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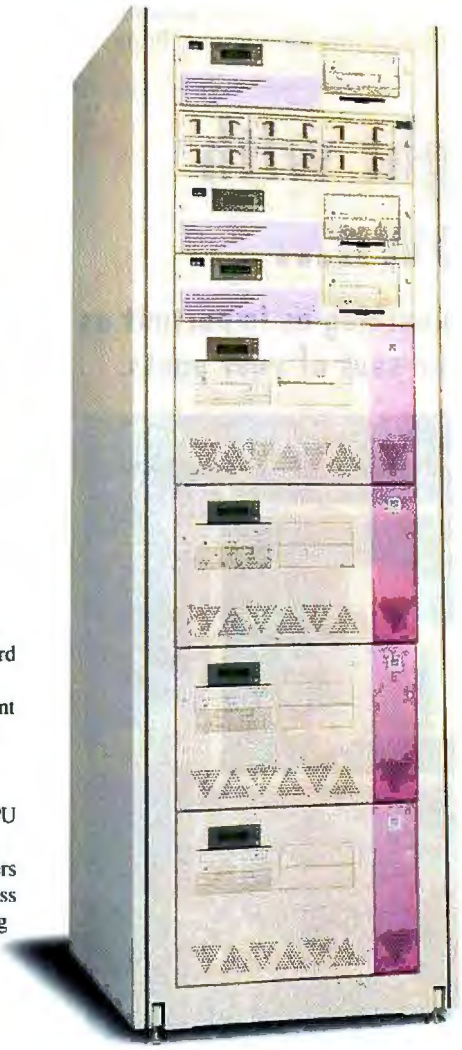

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spite alluring cost-savings potential, many companies are reluctant to commit to the technology because of equipment that changes rapidly and, ironically, a lack of standards. Also, frame-relay and IP can't yet provide advanced telephony features, such as cost allocation and minute-by-minute call tracking.

By the year 2000, even if standards work out, voice may not reach 10 percent of frame-relay traffic. This is partly because companies don't want their communications to be jeopardized by network downtime, and partly because of intractable turf wars between communications and information-systems (IS) managers. "Turning all your voice services over to the IS department isn't a good move for empire-building," Jenkins says.

How You Choose

If you have the pioneer spirit and are ready to run part of your voice communications over a data pipe, first prepare yourself. Hardware vendors will bury you with proof of how each FRAD or IP gateway offers the best voice quality. Instead, do your own investigating: Bring loaner equipment into your organization for real-world testing. While service providers theoretically supply the same frame-relay services, customers note anomalies that are seemingly dependent on how calls get routed within a single enterprise. "We recently upgraded our multiplexers at each office, and invariably one or two of the sites couldn't use the frame-relay system," says O'Donnell. His suspicions focus on differences in how data travels to each location when it comes down from the fiber-optic backbone.

Jenkins suggests asking hardware vendors for recommendations for frame-relay service providers, and asking service providers for hardware recommendations. Try to test equipment from several vendors at the same time for comparisons. Audio quality is highly subjective, and comparisons might be the only way to quickly judge how well the hardware is delivering high-quality voice data.

Voice over IP, on the other hand, benefits from the widespread commitments to intranets that companies everywhere are making. "A corporation needs an intranet," Mulé says. "Once it builds a full TCP/IP network, adding voice to it becomes a good solution. You just put gateways where you need them."

Solution Sells

Once single pipes routinely handle voice and data, debate over frame relay versus IP will probably become irrelevant. Instead, service providers will sell results rather than technologies. Your traffic might use frame relay, IP, ATM, or combinations of each. "We won't see service providers selling a technology," says Jenkins. "Instead, they'll say, 'connect into my network; we'll deliver the data.'" B

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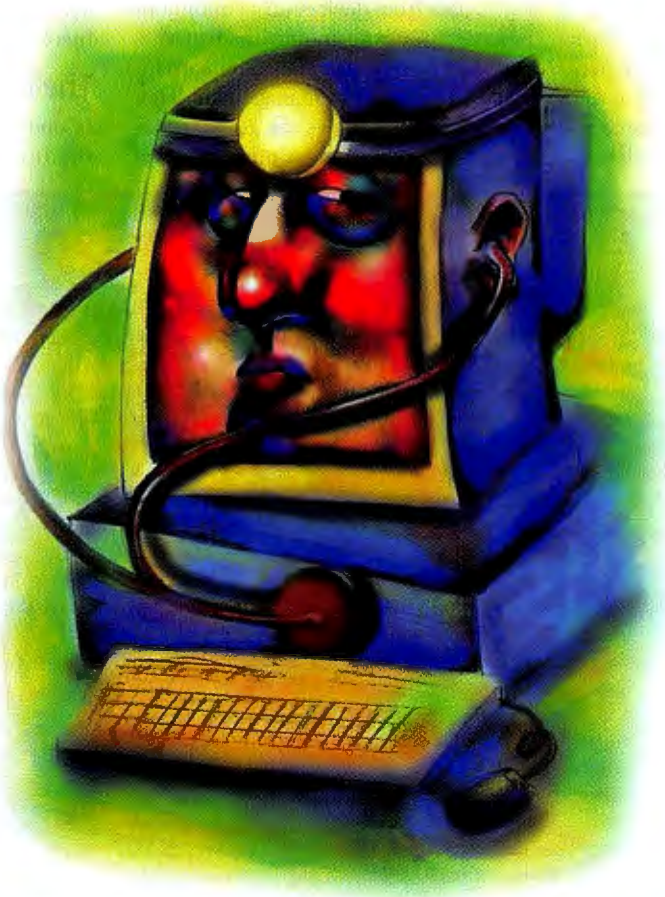
I'm Failing and I Can't Boot Up!

Embedded diagnostic hardware and new standards simplify the monitoring of system components.

By Nancy Nicolaisen

In 1960s-vintage movies, one sign that your computer was having problems was smoke billowing out, followed by a series of explosions. Naturally we wish to avoid this today. We would prefer to receive notification about impending problem situations—especially on remote machines—so that we can intercede and fix things promptly. Even better would be if the machine would diagnose and fix itself, then let us know about it. Now a combination of embedded diagnostic hardware in computers and peripherals, along with ways to channel their reports to us, could make diagnosis and maintenance—even remotely—simpler than ever.



But not all equipment has the embedded smarts to spot problems. Only the newer versions are starting to offer this. Besides, the many different (often proprietary) systems for reporting what the diagnostic hardware detects usually do not talk to each other, and getting a complete status of all devices can be a chore. But it's a start.

Naturally, there is a financial aspect to this. Desktop computers are everywhere, and so is the realization that expenses don't stop at delivery. Cost of ownership is a new worry for already overburdened IT managers. Early results are shocking. In almost every study, the cost of maintaining systems exceeds their purchase price manyfold over their useful life span.

In addition, distributed computing, by its very nature, places users and equipment far from those most capable of monitoring, diagnosing, and troubleshooting problems. However, remote monitoring systems have tended to be crude, proprietary, and somewhat oblique in terms of the information they provide.

With recently introduced technologies and emerging standards, future desktop and server systems will report their own status remotely, take proactive steps to mitigate their self-predicted failures, and submit to automated management tools.

Hold Still for the Doctor, Dear

In some cases, the intelligence needed to monitor a particular device's current state, and its prospects for continued health, requires nearly omniscient hardware. However, more often this can happen with more modest systems. Commonly available microprocessors—such as the 8051 family (developed by Intel but now a commodity), Motorola's 68HC11 line, and the PIC16 and PIC17 lines from Microchip Technology—can provide the smarts. These are not dumb chips but true computers-on-a-chip, often including RAM, ROM, UART, analog/digital translators, and application-specific sensors. Management applications collaborate with application-specific firmware running on these chips on top of a highly portable real-time operating system. (See "Embedded Diagnostic Hardware," page 112NA 2.)

These RTOSes have been central to other embedded applications, ranging from antilock brakes to network hubs, routers, and switches to the dinosaurs in the Jurassic Park ride at Universal Studios. RTOS vendors include Chorus Systems, Diba, Integrated Systems, Microtec, Phar Lap Software, QNX Software Systems, and Wind River Systems. Companies like emWare write tiny code (less than 1 KB) that expands the chips' laconic communications to more accessible network and human interaction.

Marrying easily portable embedded-systems hardware and RTOS-based software with enterprise network management was

a natural. It's like space exploration processes applied to the needs of network managers doing long-distance troubleshooting. Without embedded diagnostics, it's as difficult to get reliable diagnostic information from a crashed server in Podunk as it is from a Mars rover.

"Essentially, in the past, the diagnostic user interface was some blinking LEDs," says Wind River's product manager for embedded Internet, Joerg Bertholdt. "Now the network becomes the user interface to embedded devices." Sensors that can communicate over the network make up for a lack of physical access to widely distributed devices. However, this is only one of the challenging aspects of managing and administering distributed systems, and not the most formidable.

The Tower of Management Babel

There has been no lack of options for monitoring components, at least on networks. In fact, there may have been too many, which has contributed to the difficulties. First, many monitoring and diagnostic protocols are proprietary. Then, there are protocols that may not be proprietary but don't talk to each other well or at all. Some protocols are extremely vertical, looking at only a certain component or type of component: not ideal with a vast array of different components to monitor. Some protocols must query the device directly for data. And many protocols do not have World Wide Web capability: a pain if Web access would simplify management, but worse if you're trying to manage a corporate intranet.

Two long-time standards are SNMP's Remote Monitoring (RMON) and OSI's Common Management Information Protocol (CMIP). All by itself SNMP can query network devices, which is fine if the device is in any condition to respond. RMON is an extension to SNMP that keeps closer tabs on a variety of conditions and errors. SNMP 2 gets data from devices on a continuous basis without explicit individual queries.

CMIP is another venerable standard for exchanging network management data. Management consoles can get information from applications or other management consoles. CMIP versions run on a variety of networks, almost regardless of network protocol or access method.

What everyone would like is a single diagnostic, monitoring, and maintenance standard. This standard should allow other existing (possibly proprietary) standards to work within its framework, and exchange information, too. The standard should allow monitoring of multiple components, even if those components use other standards. Devices could send ongoing status information, or respond to queries. This standard should be Web-friendly, since so many want to use the Web to monitor remote components. Finally, the standard should be extendible, to incorporate new technologies that arise. Simple, fast, and free would be nice, too, but let's not push it.

The good news: Such a thing is at hand. The bad news: Instead of one "standard," there are two (or more) to consider.

The DMTF Effort

In one move toward a rational standard, the Internet Engineering Task Force

Embedded Diagnostic Hardware

Sophisticated diagnostic software and standards might be attracting all the attention, but the best software is powerless without defensive hardware. Printers, disk drives, and some system components can predict, minimize, and mitigate the effect of hardware failure.

Disks Get SMART

Disk drives are particularly vulnerable because a single catastrophic failure can annihilate data (and business) in fractions of a second. The goal of using smart sensors to improve overall reliability, accurately forecast failure, and allow for prefailure mitigation bound together major drive vendors, including Conner, Seagate, Quantum, Western Digital, IBM, and Cheyenne. This consortium used IntelliSafe, pioneered by Compaq, to develop a disk reliability standard, called Self-Monitoring, Analysis, and Reporting Technology (SMART). SMART has on-drive sensing hardware to report drive status, plus optional software to receive and interpret that data. The SMART consortium enhanced IntelliSafe, adding elements of IBM's Predictive Failure Analysis technology, and generalizing it so a broad range of storage devices could use it.

One category of hardware failure is highly predictable because it is the result of gradual and quantifiable physical degradations in device performance. SMART—today a part of virtually every new drive shipped—provides prior notice to users and network administrators when it detects an imminent failure. (The computer or network monitor must have the software end to receive and interpret what the drive sends.) The exact prediction method varies with drive type and manufacturer, but basically it works this way:

Drives have sensor chips that monitor key parameters, storing values in their small local memory. SMART can track over 200 possible parameters, but most devices watch a small subset of these. These parameters commonly include head flying height, throughput performance, spin-up time, seek-error rate, seek-time performance, and drive calibration retry count. When any fall outside specified ranges, the drive sends an alarm. With luck, someone's listening. Administration software can access the stored parameter values, sense any alerts, and initiate actions, like warning the user or administrator. Compaq's Deskpro line can detect imminent-failure SMART alerts and back up threatened data automatically.

Action at a Distance

Printers use many diagnostic sensors, for good reason. Computers without printers are basically space heaters, so it's important to keep printers up and running. Especially when administrators are trying to monitor and maintain printers from remote locations.

The Minolta Color PageWorks 3000 is one such printer. It tracks things like toner level, paper jams, and whether the cover is closed. All these things can show up at the administrator's console. When a user calls to say the printer isn't working, the administrator can look at one screen and suggest, for example, closing the cover.

Hewlett-Packard provides similar diagnostic and reporting systems for a wide range of its products. A single screen can monitor the status of many different types of HP printers.

Future Smarts

Expect this trend toward embedded diagnostic hardware to continue. There is a desire to keep overall costs down. That means both anticipating problems and fixing them expeditiously. There is the need to manage components remotely. This need will become even more important as embedded components gain Web consciousness, thanks to embedded software companies like emWare. There is the goal of homogenizing hardware components, to simplify upgrades and maintenance. Finally, there is the aim to deter or detect theft of components.

Smart embedded hardware can help in all these areas.

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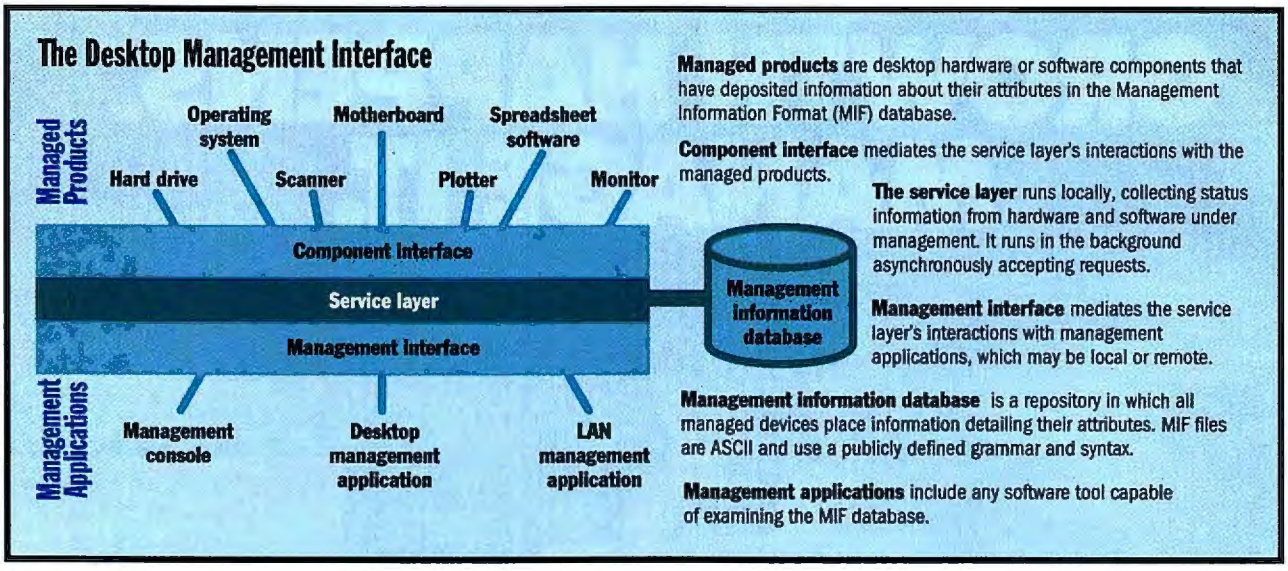

(IETF) has chartered the Desktop Management Task Force (DMTF) subgroup. DMTF represents the spectrum of stakeholders in remote system management, including leading hardware and software vendors—such as Compaq, Dell, Digital, Hewlett-Packard, IBM, Intel, Microsoft, NEC, Novell, Santa Cruz Operation, SunSoft, and Symantec—as well as users. DMTF is currently working on standards for an open and interoperable architecture for objects dispersed across a network to converse and collaborate with remote management tools.

The DMTF's steering committee handles direction and strategies, and a technical committee develops the standards and offers technical support. Working committees come in and out of existence to deal with specific issues, including cost of ownership, support management, and application management.

DMTF's first standard was the Desktop Management Interface (DMI), in 1994. DMI 1.0 described and gathered information from stand-alone PCs. DMI 2.0 followed in 1996, allowing remote data access and troubleshooting of network components. The DMI information format includes the type of processor, date of installation, printers and other peripherals, and maintenance history.

The DMTF working committees have created standard sets of manageable attributes, in a file format called the Management Information Format (MIF), for products including PCs, servers, printers, software applications, and mobile devices. Vendors can DMI-enable products by providing the appropriate information in MIF files. More than 200 products from major vendors are already DMI-enabled.

While DMTF started with networks in mind, it became clear that management over the Internet is necessary. The result is the Common Information Model (CIM), a systems management model. Essentially, CIM is metadata: information that defines the attributes of, and relationships between, the real, raw data.

DMI also defines *service providers*, pieces of code that run in the background. Service providers "expose" a management interface (by which consumers of DMI data—like management programs—can more easily access device data) and a component interface (by which device status is made public). DMI also defines a pair of APIs: one between DMI service providers and system management tools, and another between service providers and the component objects under scrutiny themselves. In addition, DMI defines a set of remote communication services. With DMI in place, devices and software can report their health and status and participate in highly refined, automated remote inventory monitoring.

Items that provide DMI management information are collectively known as managed products. Management applications use this information. The DMI service layer running locally in the background receives information from managed products (like printers, PCs, or applications) and stores it in the management information database (in MIF). The standard includes three groups of information that a managed object may report: the component ID group, the event group, and the DMI service provider group. The various groups of reported DMI data in MIF records reside in a database accessible by DMI-compliant information providers and consumers.

A managed object must provide information for the component ID group. This specifies basic identifying attributes, including the manufacturer's name and description, product name, serial number, version, and the date and time of the object's installation.

An *event* is a change of state or a notification of a condition of particular interest to a DMI-compliant object. For example, a printer might raise a DMI event in the case of a paper jam. An event can occur without anyone being told about it.

By contrast, an *indication* provides notification of an event to a DMI consumer. With the printer example, an indication reporting a paper jam might go to remote management tools across a network connection. An administrator would then be able to view this indication and take appropriate corrective steps.

In the printer example, a "listening" management tool is an *event subscriber*, and it announces that it wants to receive indications through "subscription." Indications themselves are not rich in data; they simply document a change to the MIF database. To receive the actual content of the event that triggered the indication, a consumer must also designate which event data to forward. Indication types include predefined common types (such as add/delete component, add/delete language mapping, add/delete group), but this system allows for the

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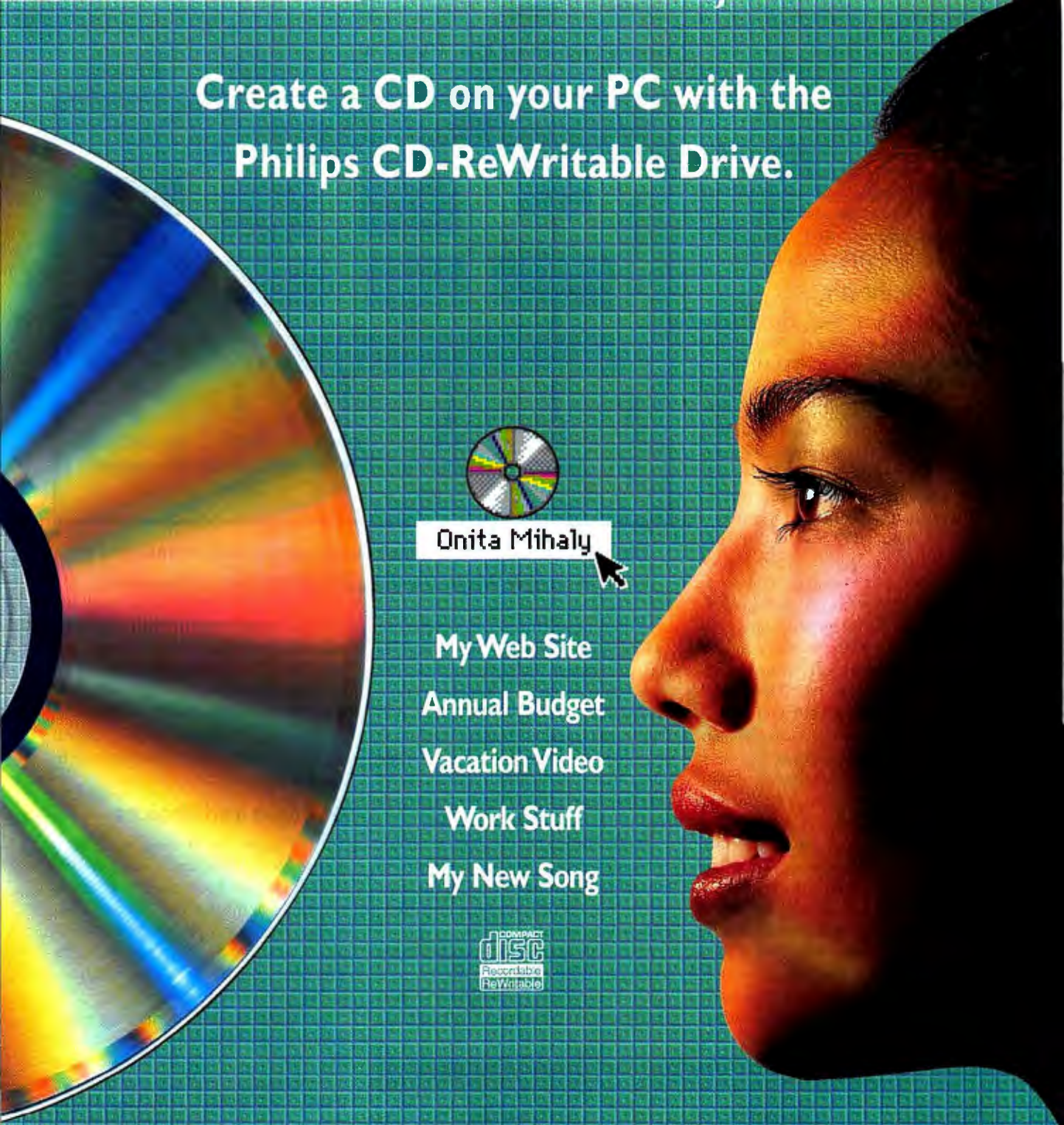

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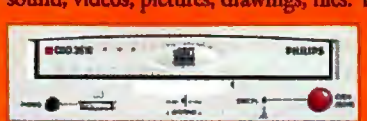

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extension of standard types and addition of proprietary types.

DMI is a network management protocol that adds to what existing protocols such as SNMP or CMIP provide, but it does nothing to reduce the complexity of the overall management snarl. Enter Web-Based Enterprise Management.

WBEM on the Air

Besides DMI, DMTF has a parallel standards effort in progress, the Web-Based Enterprise Management (WBEM) Initiative. ("Web" doesn't imply any reliance on browsers, HTTP, or other Web-specific methods.) The WBEM draft standard is an effort to define a generalized management information model that will allow it to work with DMI and many non-DMI proprietary management systems.

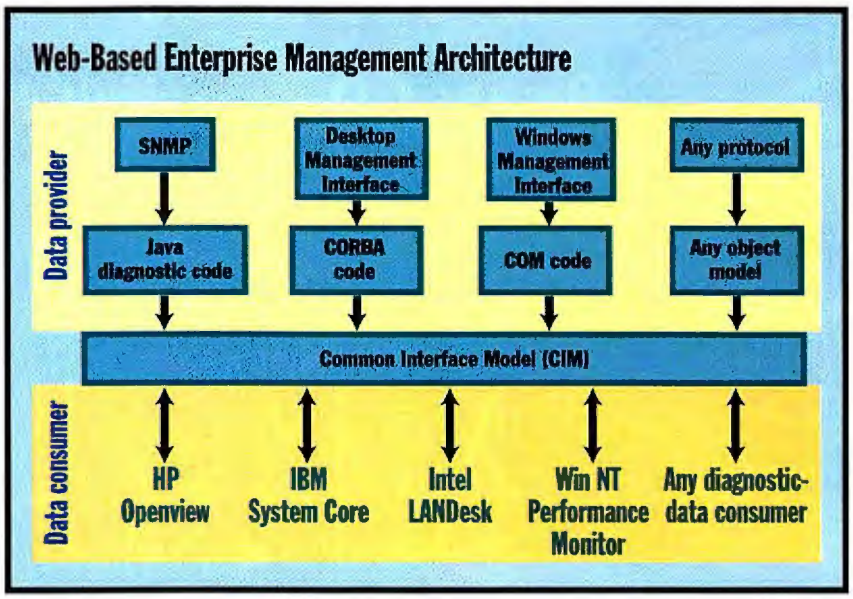
"We learned a lesson from the Web, which is that you can have a provider of information and a consumer of information that don't know anything about each other but that still communicate very effectively," says Microsoft's product manager for systems management marketing, Michael Emanuel. "This model has great advantages." Different management systems should talk to each other. Microsoft is betting on WBEM.

WBEM is a superset of other standards, encompassing several new protocols and some current Internet standards. It relies heavily on the same Common Information Model (CIM) metadata structure that the DMI 2.0 specification introduced.

CIM allows any existing protocol, either standard or proprietary, to provide data for WBEM use. The data resides locally, on a hub or router, for example. Because it assumes nothing about the object model or protocol used, it is absolutely independent of vendor or platform. Devices are not "wired into" specific management tools, and management tools of many types can access device data from any connection. WBEM management will be able to synthesize data reported by components using any other protocol and deliver it at a single point, in contrast to current practice, where administrators use a different management tool for each object being managed.

WBEM already has the support of over 70 major vendors. Any method that can incorporate existing systems, permit new extensions, and deliver component information is a winner.

Microsoft expects to leverage WBEM in its own Windows Driver Model strategy, in a—surprise!—proprietary format: the Windows Management Interface (WMI). "WMI was not designed to be portable, it was designed to be optimal for Windows," says Microsoft's Emanuel. Compliance with the overall WBEM initiative should guarantee that all drivers shipped with Memphis and NT 5.0 will include very consistent and comprehensive instrumentation.



The WBEM architecture allows devices and management tools to send and retrieve diagnostic data, despite differences in protocols.

Outlooks and Choices

The real questions are about when we'll see products. Major vendors already offer DMI-compliant components. WBEM is still a spec in the making. Nevertheless, we can reasonably expect WBEM-compliant products next year, especially with Microsoft tossing its admittedly proprietary version into the ring.

For administrators, combining many monitoring systems into one must seem like a dream come true. For managers, for once, they cannot make a wrong decision. If they choose DMI and the world turns WBEM, it doesn't matter: DMI will work under WBEM. If they choose WBEM and the world turns DMI, it doesn't matter: WBEM can talk to DMI. Even if they stick with SNMP or CMIP or a proprietary system, WBEM will simplify their lives. Eventually they will manage things from one console, and listen only to devices, rather than users, complain. Heaven at last! B

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Next-Generation News Servers

Try out the latest Internet news servers from Netscape and Microsoft, and you'll see why NNTP is fast becoming the foundation for Internet-based groupware.

Over a year ago, I started BYTE's public newsgroups on a Linux server running the standard Internet news server, INND. There they remain, because the setup continues to work nicely. More recently, the BYTE staff has begun to collaborate privately in a different set of newsgroups. I could have used INND for these as well, but instead I've been experimenting with two newfangled INND derivatives: Microsoft's Internet News Server (INS) and Netscape's Collabra Server.

These new groupware servers are more approachable—and, in some respects, more powerful—than INND. Deploy one alongside your Web server, and you will reap some enormous benefits. Thanks to the latest generation of HTML-aware newsreaders (see last month's "HTML + NNTP = Groupware"), news servers have become, in effect, read/write Web servers.

With these servers, users can exchange not only plain ASCII files but also rich HTML documents enhanced with styling, links, graphics, binary attachments, and active content. Visitors to your public newsgroups (anyone, anywhere, anytime) and users of your private newsgroups (your staff, also anywhere, anytime) can use the same client software: Netscape Navigator or Communicator, or Microsoft Internet Explorer (MSIE).

Why does this matter? Here's one key benefit: Collaborators can flexibly manage the scope of their collaboration.

Information Scoping

I run a set of private newsgroups just for my own team—BYTE's three-person New Media department. Another set of newsgroups is accessible to the entire BYTE staff. Finally, BYTE's public newsgroups are world-visible. Because I use the same client to participate in all three realms, I can respect boundaries—or cross them—as it's appropriate.

For example, we New Media team members use our private newsgroups to document the ever-changing procedures and configurations that underpin The BYTE Site. Much of this chatter would only annoy the rest of the BYTE staff, but it's vital to us. We post a stream of messages not only to communicate with each other but also to document what we do so that we (or perhaps a future new team member) can recover this knowledge three or six months from now.

What if our private discussions raise issues that are relevant to other groups? If it's a matter of BYTE policy, the proper scope may be another BYTE department or the entire BYTE staff. If it's a general issue, though, the proper scope might be global. Unless there are reasons for privacy, why not tap into the collective brain trust at work in BYTE's public newsgroups?

The scope of collaboration doesn't always expand. Sometimes discussion needs to move from public space to private space. For example, I've just started a public on-line focus group for our marketing team. Issues raised there will probably need to move into private space for internal debate.

When you need to mirror one server to another, you appreciate how both Collabra and INS hide the details.

Newsgroup Access-Control Strategies

Conventional INND servers create zones of private discussion using a control file called `nnrpd.access`. Here's how I might create a world-visible group, a staff-wide group, and two departmental groups:

```
*:Read,Post:::public_forum
*:Read,Post:edit:ep:staff_forum,
```

PHOTOGRAPH: KELLIE WALSH © 1997

```
  edit_forum
*:Read,Post:sales:sp:
  staff_forum,sales_forum
```

These lines say: "Any IP host (*) can read and post to public_forum. Allow only user edit (password *ep*) or user sales (password *sp*) into staff_forum. Only user edit can get into edit_forum. Only user sales can get into sales_forum."

What's hard about this? Nothing at all, once you've got INND up and running. But that can be a big hurdle. Other than Internet system administrators charged with providing Usenet service for companies or Internet service providers (ISPs), very few people have ever used INND.

That could change in a hurry, though. Microsoft and Netscape have given INND a pretty face that won't intimidate regular folks. Anyone who's comfortable deploying these vendors' Web servers should also be able to deploy their news servers. [Editor's note: *The version of INS that I use comes with the Microsoft Commercial Internet System (MCIS) and is not generally available. Another version of INS will be included in the forthcoming IIS 4.0. I haven't tried that version yet, but Microsoft says that it's comparable to the MCIS version.*]

Ironically, both require more configuration effort than does INND to achieve the four-zone setup illustrated above. But since the task involves tabbing through dialog boxes and mouse-clicking, rather than hand-editing Unix-style configuration files, many users who regard INND with terror will embrace INS and Collabra. To all you Unix graybeards: Don't rush to mock those who prefer the new breed of news server. INS and especially Collabra do things that INND can't: Secure Sockets Layer (SSL) encryption, client authentication, integrated full-text search. These features transform INND into a compelling groupware platform.

Although they're comparably easy to use, the Microsoft and Netscape news servers differ radically in their methods of access control. Microsoft's INS integrates with Windows NT's stand-alone or domain security. Netscape's Collabra relies on a local or remote LDAP database. Both approaches have pros and cons (see the text box "Comparing NNTP Access-Control Methods" on page 116).

Which approach is best? All other things being equal, I would recommend INS for an NT-based, intranet-only solution, and Collabra for Unix hosting or for a mixed Internet/intranet clientele.

Either server can accept connections over an SSL-secured channel. That puts you a step ahead of the standard INND, which sends user names and passwords in the clear. The SSL capability may or may not matter for an intranet deployment. But it matters greatly if you locate company-private content on a world-visible server.

Why do that? Collaboration knows no bounds. Documents that your coworkers share with you in NNTP conferences do you no good if you're at at home or on the road and can't reach through the firewall to read them. Cleartext authentication using NNTP's `authinfo` command is only the weakest kind of security. SSL sessions encrypt your credentials as well as the data that flows between news clients and servers. To enable SSL, you need a digital certificate for your news server, just as you need one to secure your Web server (see "Digital IDs," March BYTE).

If you're running INS for a homogeneous population of Windows clients, there's a middle-ground option. You can use NT's challenge/response authentication protocol. In that case, session data won't be encrypted, but credentials will be. That's still a big improvement over cleartext authentication.

Managing Shared Documents

NNTP conferences are starting to look more and more like Lotus Notes document databases. That's partly a function of HTML-aware newsreaders. Many of the advanced features I discussed last month flow from NNTP clients, not servers, and so they work with legacy INND servers as well as with Collabra or INS. But two Notes-like features in Communicator's Collabra client—full-text search and categorization—require Collabra Server.

Collabra Server comes with its own search engine—unlike INS, which instead relies on Microsoft's generic Index Server. Collabra could (and perhaps eventually should) similarly leverage Netscape's

To Replicate or Not to Replicate?

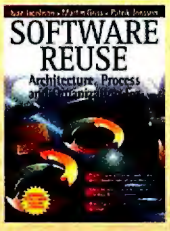
Every night, vast quantities of data replicate across the worldwide network of NNTP servers that is the Usenet. Making these feeds run smoothly is a tricky business, and it accounts for much of INND's feared complexity. As I've explained elsewhere, though (see "Let's Talk," May 1996 BYTE), you can radically simplify matters by running INND in stand-alone mode. BYTE's public and private newsgroups originally worked this way.

We had some problems, though. First, our corporate firewall wouldn't let NNTP through. Then that got fixed, but bandwidth constraints made it hard to use NNTP effectively. (NNTP is connection-oriented and thus more sensitive to marginal network conditions than stateless HTTP is.) So I reluctantly got into the replication business. I started using NNTP feeds to mirror our world-visible (i.e., outside) servers to a set of firewall-protected (i.e., inside) servers. When working at home or on the road, we can use an outside server. From any of our three primary intranet-linked offices, we can use the corresponding inside server. Replication keeps everything in sync.

Despite my trepidation, this scheme was easy to set up (see the screen on page 113) and has worked reliably. Now that our firewall and bandwidth problems are solved, I'll probably turn off replication. As the administrator of all this stuff, I like to minimize the number of moving parts. But I'm glad to have added NNTP replication to my arsenal. I may need it again someday.

BOOKNOTE

Software Reuse: Architecture, Process and Organization for Business Success



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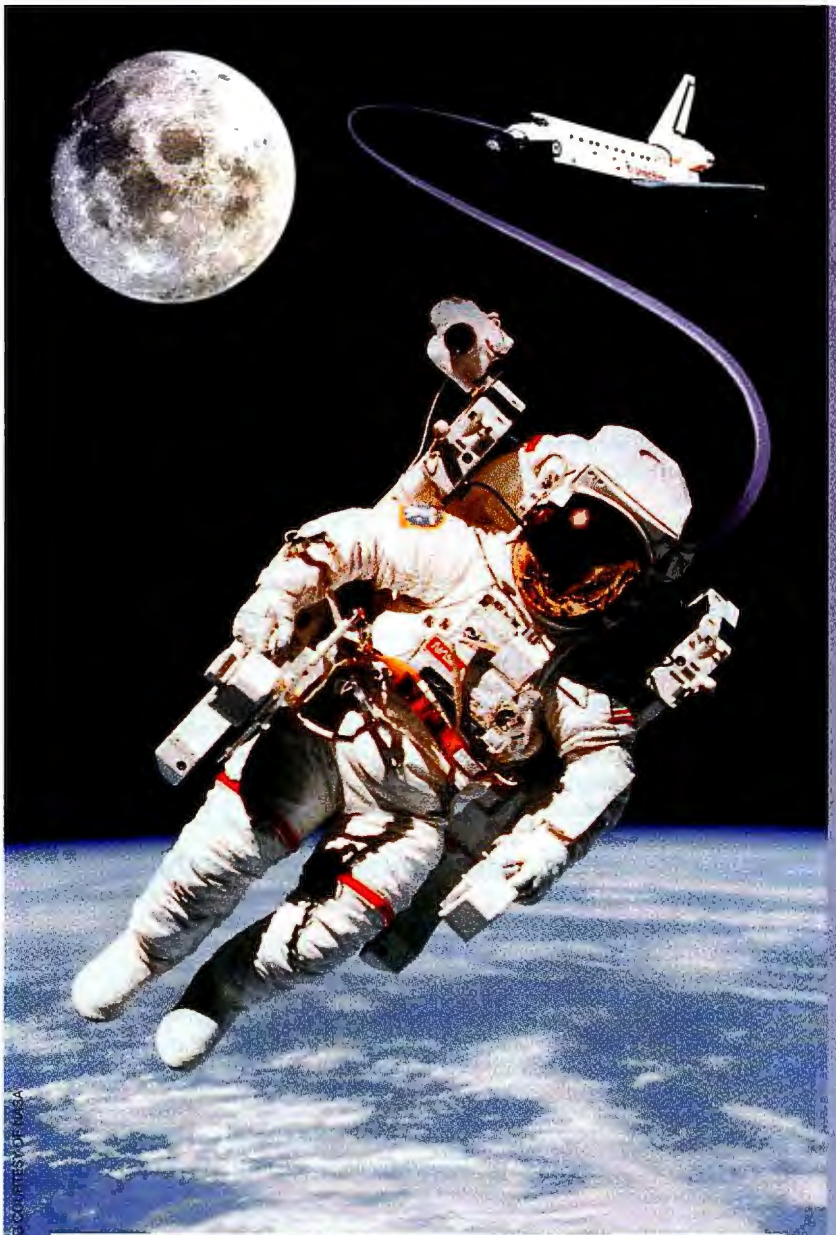

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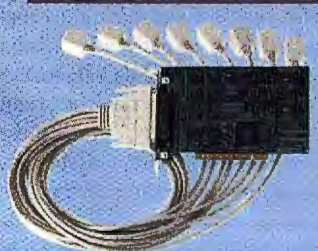

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general-purpose indexer/searcher. But for the 3.0 server, Netscape chose—I think wisely—to focus on tight coupling with the Collabra client.

The two products jointly implement a search protocol that Netscape has proposed as an extension to the NNTP standard. As a result, you can search newsgroups directly from the newsreader. And, crucially, a user not permitted to read a newsgroup won't ever see a search hit from that newsgroup. This secure search capability would be difficult to achieve with INS and Index Server—or, indeed, with any mechanism (such as The BYTE Site's conference searcher) that operates in Web space rather than in NNTP space.

TOOLWATCH

Business::CreditCard

(free)

Jon Orwant <orwant@media.mit.edu>

ftp://ftp.cis.ufl.edu/pub/perl/CPAN/modules/by-module/Business/

If you're using Perl CGI scripts to take credit-card orders, don't reinvent the wheel. Here are the routines you need to identify card types and check the validity of card numbers.

Collabra can also create customized views of discussions. It does this in two ways: categorized newsgroups and virtual newsgroups. If the Collabra Server administrator declares a newsgroup as a categorized one, its subgroups interact with the otherwise-inactive "Show Categories" feature of the Collabra client.

When I tried this, I solved a mystery. The newsreader's third (newsgroup) pane has vanished in Collabra, apparently replaced by the Message Center, which runs as a separate application. But when you point the newsreader at a categorized discussion, the missing third pane reappears. That's how Collabra displays categories.

However, this is only marginally useful to me. Legacy newsreaders don't see the categories, and since I support a mix of newsreaders, there's no incentive to create them. I'd rather have the third pane back as it was in Navigator.

Virtual newsgroups are more interesting. In last month's column I showed a Collabra-based full-text search for the term *vpn*. When I used the search dialog box's Save As button, Collabra performed a neat trick. It created a newsgroup called virtual.vpn and put copies of the found articles in that virtual newsgroup. What's more, as new messages matching the *vpn* search flow into any of our private conferences, they are also automatically routed into virtual.vpn!

Nifty as virtual newsgroups are, I'm still left wanting a more powerful way to categorize newsgroups. Specifically, I'd like to be able to declare custom headers for a given group—in our contacts group, for example, these might be Company, Product, and Lastname—and then have the newsreader build sorted views based on those headers. I think this scheme won't even require any modifications to the NNTP protocol. News messages, like mail messages, are already full of custom headers, such as X-Mozilla-Status. Why not X-Company and X-Product? The server won't mind these extra headers; the client can make excellent use of them.

The latest news servers are works in progress. What's encouraging, though, is that they *are* progressing. NNTP techology was for years a diamond in the rough. The standard INND already did more than most people realize. INS and Collabra have staked out important new territory. I can't wait to see what's next, but in the meantime I'm building some slick collaborative solutions around what's here today. B

Comparing NNTP Access-Control Methods

Method: Based on Windows NT local or domain security
Server: Microsoft INS

Pros:

- Leverages your understanding of NT security. If you know how to set permissions on file-system folders, you know how to govern access to newsgroups.
- Leverages the existing user/group database. If you've already populated a domain database, you can reuse those names when configuring NNTP security.

Cons:

- Works only on NT.
- Every NNTP user needs an NT domain account. Not a problem for your staff, usually. But if you park an NNTP server on the Internet so that your staff can collaborate with the outside world, you'll have to create one or more accounts for these outside users. That's scary.
- Access schemes are tied to file systems. If you want to migrate conferences from one NT box to another, you have to migrate a file-system subtree and all its associated permissions. If you want to temporarily disable authentication, you're stuck. Recursively granting full access to everyone is a one-way transformation from which you cannot easily recover.

Method: Based on local or remote LDAP database
Server: Netscape Collabra

Pros:

- Works on all Netscape-supported OSes.
- Doesn't export OS accounts to Internet users.
- Supports client authentication. If you specify a mapping between a field of a client certificate (e.g., Common Name) and an LDAP attribute (e.g., user name), you can dispense with user-name/password log-ins and control access entirely by means of certificates.

Cons:

- You have to learn how to use the local LDAP database bundled with Netscape servers or else acquire, install, and learn how to use a Netscape or third-party directory server.
- You have to populate the LDAP directory; there's no migration tool for capturing existing OS-based accounts.

Jon Udell is BYTE's executive editor for new media. You can reach him by sending e-mail to **jon_u@dev5.byte.com.**

Rick Grehan

Javatalk

Rebuilt Parts

Parts for Java delivers an excellent visual-programming environment for Java.

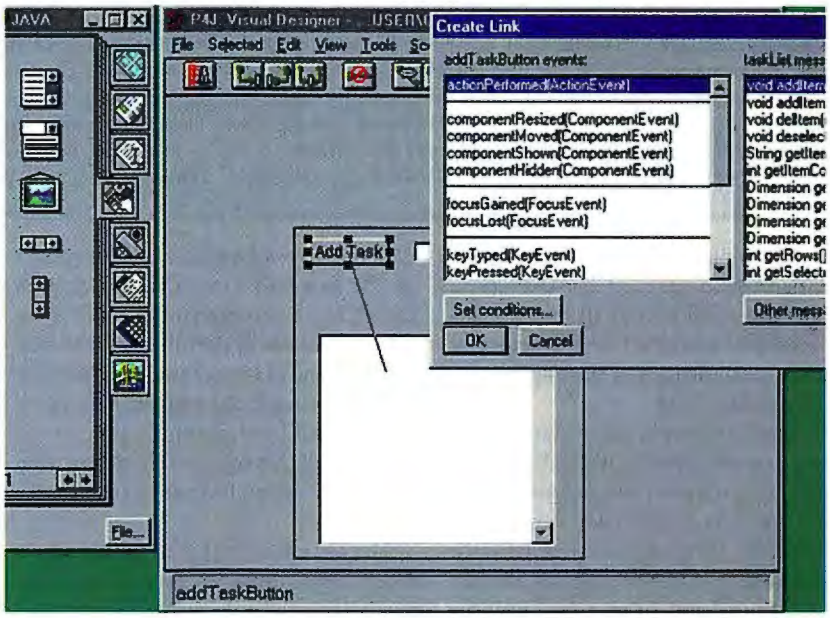
Well known for its Smalltalk-based products, ParcPlace-Digitalk (via its ObjectShare division) has released Parts for Java (PFJ). This is an integrated development environment (IDE) for Java development that inherits much from its Smalltalk parentage. The migration of the part concept, PFJ's atomic component, from Smalltalk to Java has been made possible largely thanks to the ongoing maturing of the Java bean. A PFJ part is a bean.

As the Java Development Kit's (JDK) beans definition has solidified and support for beans in the Java community has improved, "bean mechanics" have become more and more sophisticated. A growing number of Java development systems incorporate robust bean support; such is the case with PFJ.

PFJ's parts are the visual and nonvisual objects that populate a PFJ application (or applet). You create a Java application by the now-familiar activity of dragging and dropping parts into a Java application's frame.

Once a part (which is really a bean) is in place, you modify its characteristics through property sheets—dialog boxes that are packaged with the part (rather than being part of the IDE) and that provide access to a part's characteristics (such as its color or font).

Ordinarily, you access a part's property sheet by double-clicking on the part. PFJ improves on the bare-bones property sheet dialog box by adding a drop-down listbox (within each property sheet dialog box) that provides quick access to other parts in the application. This allows you to rapidly move from one part to another in the application; you don't have to close the dialog box and then click on the next part to open the new property sheet dialog box.



PFJ's create link dialog box shows available events and compatible receiving methods.

Programming with Wires

I've seen many implementations of visual programming by means of wiring together on-screen objects, such as buttons or scroll bars. IBM's Visual Age for Java was my most recent encounter with an IDE that used this paradigm. (In fact, Visual Age also used parts as the fundamental visual-programming component.) PFJ demonstrates what I think is—so far, at least—the best visual-programming environment of this sort for Java.

For example, suppose you want to establish a relationship between one part that is an event source and another that is the recipient of (and will respond to) that event. If you right-click on the source part and drag to the destination part, PFJ opens a dialog box showing the events provided by the source and the responding methods offered by the destination. Select the event and receiving method, and PFJ will deposit the correct source code in your application's .java files.

Simultaneously, PFJ draws a connecting line between source and destination parts, and displays floating text boxes that carry the prototypes of the source event and recipient method. PFJ inserts placeholders in the latter's argument list; each placeholder consists of the corresponding object's data type and a solid-color diamond. (The diamond is replaced with the actual argument once you complete the definition of the method call.) If

PHOTOGRAPH: KELLIE WALSH © 1997

Java Gets Personal

It's no secret that Sun's vision is for Java to become a truly cross-platform language. It is perhaps more accurate to say that Sun hopes Java will become a *pan-platform* language; that is, not only *the* language for desktop systems but for nondesktop systems as well. And to that end, JavaSoft is sculpting a series of Java APIs that will be aimed at varied levels of functionality.

JavaSoft recently released the version 1.0 draft specification for the PersonalJava API. This draft is available on the JavaSoft Web site (http://www.javasoft.com) for a special 60-day period, during which time Sun will accept public comments on the specification and possibly rerelease modified versions of the draft as it incorporates worthwhile comments.

PersonalJava's targets are personal consumer devices that make heavy use of communications. The specification suggests set-top boxes and intelligent telephones as potential candidate applications. Of necessity then, an implementation of the PersonalJava API will occupy a smaller footprint than an implementation of the full Java Development Kit (JDK) 1.1. (JavaSoft estimates that the PersonalJava virtual machine and supporting class libraries will fit in 2 MB of ROM and approximately 1 to 2 MB of RAM.)

The PersonalJava API is sort of a subset of the full JDK 1.1 API. I say "sort of" because, though most of the PersonalJava API is indeed a simple reduction of the JDK 1.1 API, you won't find some new elements of PersonalJava in JDK 1.1.

For example, PersonalJava defines new Timer and TimerSpec APIs, which let PersonalJava applications create objects that provide what amounts to a millisecond-resolution alarm clock. You can attach a kind of "interrupt handler" to a timer, in much the same way that you attach a listener object to an event source in the JDK 1.1's event handler.

In addition, PersonalJava extends the Abstract Windowing Toolkit (AWT) with new APIs for handling such things as display output double buffering and mouseless input. (Double-buffered systems provide an external buffer memory into which all the drawing is done. The updated display is shown on-screen by copying buffer memory to the actual screen's memory. This reduces unsightly side effects that can occur while the application and display hardware are battling for screen-memory access.)

Most interesting are the goals of the PersonalJava API. Specifically, that products "...based on PersonalJava should be usable by people with no computer experience." We'll see.

a link is incomplete—perhaps you haven't specified arguments needed in the receiving method—it glows red. (If you're building a complex user interface, this helps you quickly spot portions of the application that are unfinished.)

PFJ handles complex event/target relationships easily. That is, although an event implies a source part, which generates an event, and a target part, which responds to that event, the relationship can be more elaborate than that. For example, the target might call a third part to supply an argument for the target method. Just as you can wire the source and target together, you can connect a part to an argument in the target's method. That's where the placeholders come into play. They act as anchors for the connection between part and argument.

So, suppose that in response to a button-click event, a listbox copies the contents of a text box into the list. You can create a link between the text box and the method called in the listbox by right-clicking on and dragging between the placeholder I mentioned earlier and the text box. The IDE will open a dialog box showing available "getter" methods in the textbox part for retrieving the text box's current string. When you select the proper getter method, PFJ does the coding for you.

Compliant with JDK 1.1.2

PFJ supports the JDK 1.1.2's delegation event model. This makes it among the first IDEs that I've seen with explicit support for the delegation event model, though more JDK 1.1.2–compliant IDEs will probably be available by the time you read this. Now, instead of PFJ generating an explicit source code event loop for managing event/target links, it simply generates a method call that registers the destination part as an "action listener" to the source part.

The source code that PFJ generates is deceptively simple. This simplicity is due partially to the delegation event model (and the consequent lack of an event loop). It's also due partially to the implementation of parts as beans. This latter fact means that a part's behavior is encapsulated in the bean and never appears in the source code that PFJ automatically generates. Nevertheless, because so much behavior is abstracted into the parts, the mechanics of the generated code are quite easy to comprehend.

Good Parts

Beyond the IDE, PFJ also includes support for Common Object Request Broker Architecture (CORBA) and remote method invocation (RMI). On the CORBA side, PFJ arrives with a trial version of Iona's OrbixWeb (which supports IIOP). On the RMI side, PFJ's RMI wizard guides you through setting up both sides of a remote method call.

PFJ's ClassMaster browser is its most obvious inheritance from the Smalltalk world. A classic three-pane browser, ClassMaster provides a unified view of a given class. That is, it will show you not only methods defined within the class, it will also show you any methods that the class inherits from its superclass in a single view. In that way, you can quickly get a picture of a class's total functionality.

Finally, PFJ's debugger, which is multithreaded and as good as any that I have seen, is written entirely in Java. That makes it portable to any platform that supports Java.

Although I haven't tried it yet, this portability should allow you to tackle those situations where an application runs well on one platform but fails on another (yes, this sometimes happens with Java applets). You can move the debugger wherever you need it.

Parts for Java is available from ObjectShare for a price of $149. You can purchase it at the following Web site: http://www.objectshare.com. B

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

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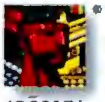

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Port switching, Layer 3 routing, and Gigabit Ethernet will redefine how you design your network. By Mike Hurwicz

A Major Switch in Network Design

It's not easy being an Ethernet these days. Traffic is exploding. And it's getting less predictable, too. The poor Ethernet is supposed to handle it all without complaining. Backbones are particularly hard hit, with more and more Internet and enterprise-level traffic every day. Yes, it's tough out there. But, Ethernets of the world, don't give up hope. Help is on the way, at every level from the workgroup to the backbone. In the workgroup, the "switching hub" or "port switch" is addressing the problem of increasing and unpredictable traffic. At the level of backbone switches, Layer 3 switching is poised to remove the performance bottleneck traditionally associated with routing. Finally, Gigabit Ethernet is on its way to backbones and critical servers, to alleviate the bandwidth crunch. Here's what you need to know to implement these three technologies.

The Port Switcheroo

There's a good chance you already have a port switch installed. It's by far the most mature of these three technologies. A switching hub is a type of segmented Ethernet hub that can reassign, on the fly, any port to any segment. Like all segmented hubs, the switching hub represents a compromise between high-cost, high-performance switching and low-cost, low-performance shared connections. On a shared hub, all stations attached to the hub contend for a single network segment. A segmented hub reduces contention by dividing the hub into multiple segments. A port switch optimizes the segmented architecture with flexible port assignment. Finally, a switch gives every port its own segment, so there is no contention within the switch (though there might be blocking if switch buffers fill).

Port switches have been available for three or four years. Now, because of the demands of today's networks, many observers believe port switching is the future of the hub. "If you don't have port switching, you don't play. It will be a given, a commodity in the managed hub market," says Nate Walker, Cisco Systems' product manager for Gigabit Ethernet. "Probably even most unmanaged hubs with more than eight ports will do port switching," adds Bradford Winkler, vice president of sales and marketing for LANart, a manufacturer of

"I seldom see a big value in having a private 10-Mbps switched Ethernet connection for every workstation."

—Greg Glasgow

Gigabit Ethernet switches and network interface cards (NICs).

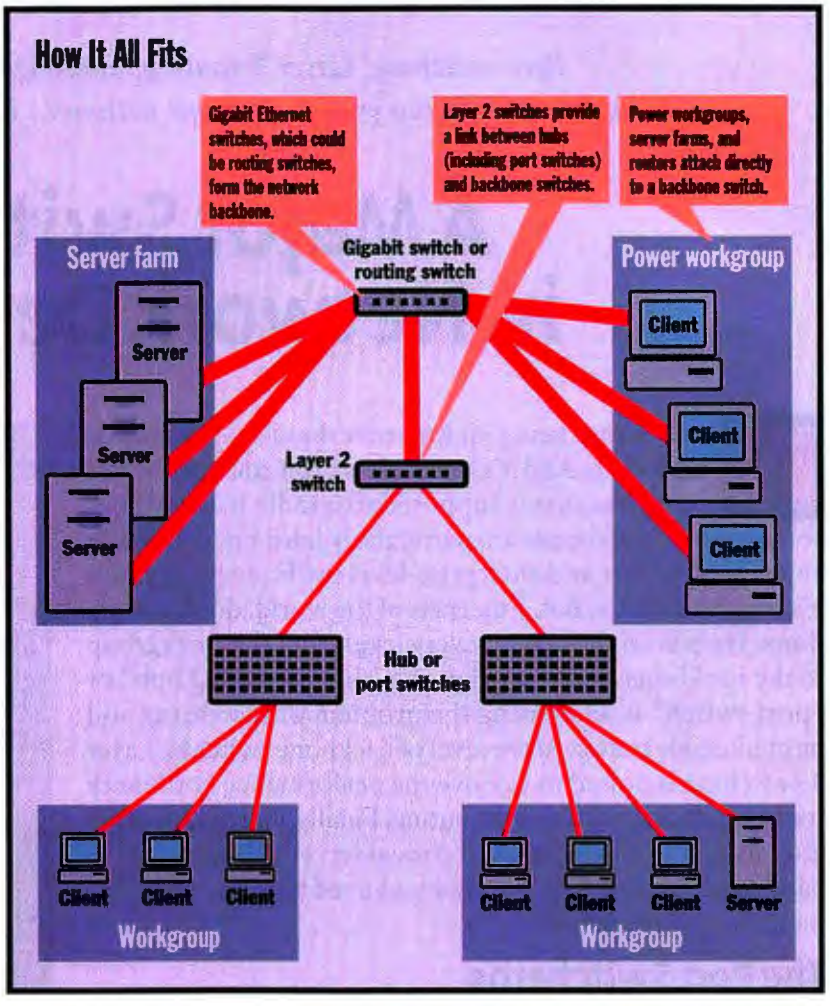
Aside from reducing collisions, what's the big deal? To start with, try easier moves and changes. Instead of having to rewire a station to connect it to a different segment, the change can be made in software, without visiting the wiring closet.

To the administrator, the ability to assign ports to segments is like the "virtual LAN" feature offered by many switches—with none of the delay introduced by a switch. A virtual LAN gives the appearance of a single segment, but a port switch gives real single-segment performance.

Some port switches also feature automatic load balancing, in which the hub assigns ports to segments based on traffic. Automatic load balancing may be dynamic, taking place without any external command, or static, requiring the administrator to issue a command to initiate the load-balancing operation. Some port switches support both.

Automatic load balancing provides bandwidth on demand, a more cost-effective alternative to dedicating a switch port to each user. However, automatic load balancing also makes it impossible to control which segment any particular station is on. Thus, for instance, if you want to isolate sensitive servers on their own segment, you have to put them on a separate hub.

With static configuration, the situation is exactly reversed: You don't get bandwidth on demand, but you can use segments for isolation. Or you can, for example, increase efficiency by putting stations that exchange a lot of traffic on the same segment, or you can isolate equipment for testing or repair.



Gigabit Ethernet switches, routing switches, Layer 2 switches, hubs, and port switches can all play a part in a network architecture.

The Switching Hour

Although port switching may be the future of hubs, some observers see switches, not hubs, as the future of networking. "For customers who don't need a lot of bandwidth, port switching may work just fine," says John Armstrong, principal analyst for networking with research and consulting firm Dataquest (San Jose, CA). "In general, though, with the price of a dedicated, managed switch port from a mainstream vendor down to $100 for a 10-Mbps port, or $250 for a 100-Mbps port, one has to ask, 'Why go half way?' The real issue for most customers is not whether to go with port switching or a dedicated switch, but whether to go with a dedicated 10-Mbps or 100-Mbps switch port."

Other observers aren't so sure about that. Strictly on the price front, some port switches will fall to $25 per port by the end of 1997, says Steve Stange, a product manager with Transition Networks, maker of the StackMaster Pro SPS2000 port switch. In contrast, Armstrong says, switch prices may hold more or less stable, having already dropped rapidly in the past year.

But the big argument is over performance: Some hub proponents question the need for a switch at all. "I seldom see a big value in having a private 10-Mbps switched Ethernet connection for every workstation," says Greg Glasgow, a vice president at LAN Solutions (San Diego, CA), a systems integrator. "It sounds good, but it's too expensive, and there's a performance hit going through a switch."

Furthermore, if you've got 100 workstations hitting one server, the server is the bottleneck, and a switch probably won't do much to improve performance, says Rand Morimoto, president of reseller Inacom Oakland (Oakland, CA). Spread the traffic among multiple servers, and a switch might do you some good.

In addition, many older PCs can't benefit from anything more than a 10-Mbps shared connection, says Dave Hoppock, vice president for sales with Thibault Associates (Pleasant Hill, CA), a systems integrator with many clients that are small to medium-size companies. He notes that many of his customers are putting 10-/100-Mbps cards "into everything" but are not using the 100-Mbps capability because the machines aren't even stressing the 10-Mbps hub. (Inacom's Morimoto notes that the high price of 100-Mbps hubs has also delayed

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upgrades to 100 Mbps.)

In the end, it seems likely that port switches will find a niche based on both price and features. "I think we'll see a lot of designs where servers and maybe some power users have 100-Mbps full-duplex ports on switches," says Hoppock. "The rest of the users will be on 10-Mbps shared hubs or port switches."

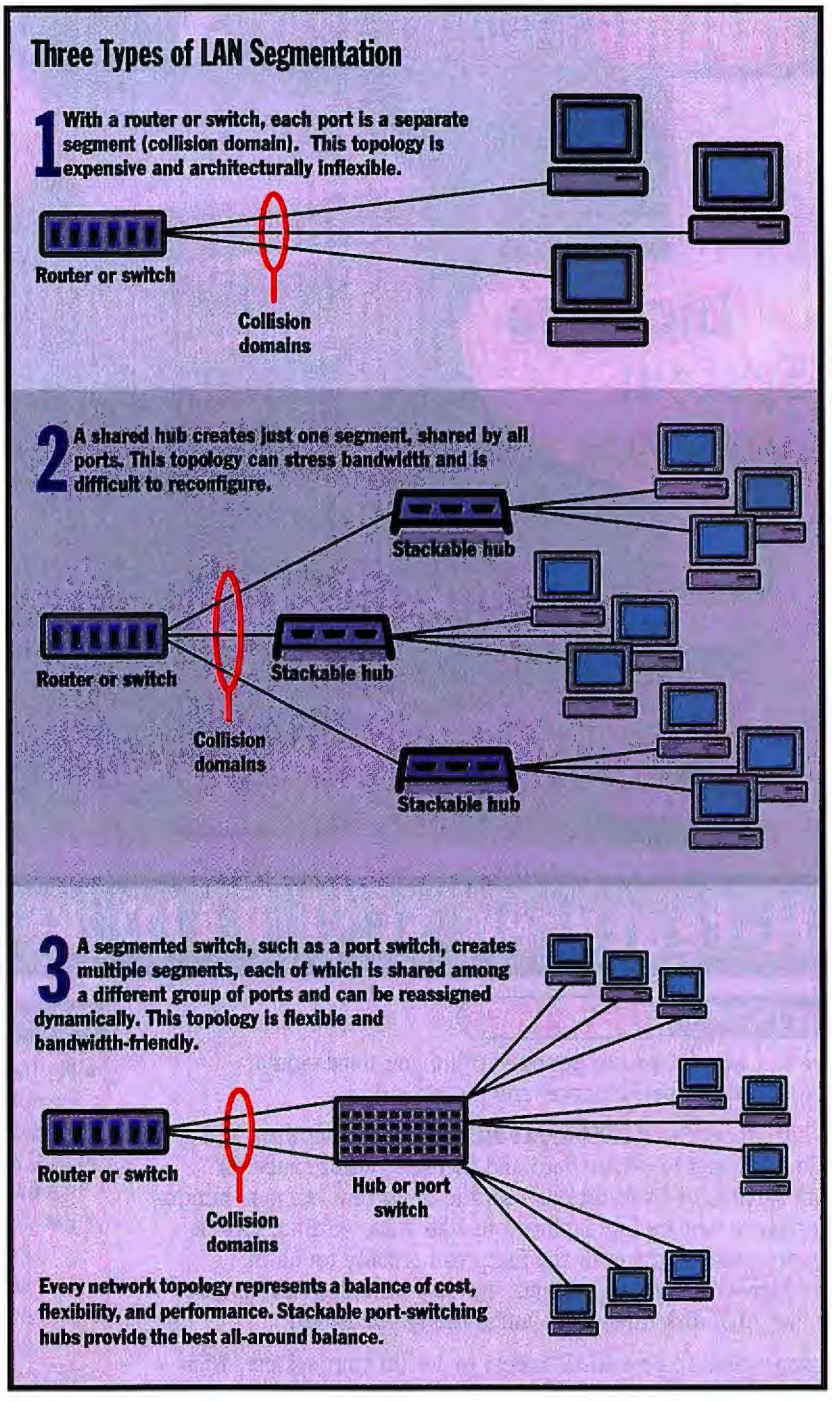
Faster Routes

While hubs and switches alone can handle sizable workgroups, organizations with more than a few hundred workstations typically also need routers. Routers segment the network to enhance performance, enforce security, and manage the flow of data according to the company's policies. Unfortunately, router often means "bottleneck": The route-computation engine has to extract information from each packet and make often-complex decisions based on it. As networks grow, routing tables grow also, and routing tends to become slower and slower.

Two basic approaches to this problem are evolving. Both approaches are most likely to be implemented in backbone switches and in distribution switches that sit between workgroup switches and backbone switches. Both approaches also focus on IP. Other Layer 3 protocols, such as IPX and AppleTalk, are bridged, not routed, so Layer 3 switching does nothing to improve their efficiency.

The first approach—which has so far been used only with ATM, not with Ethernet—reduces the results of route computation to a single piece of information, which is inserted into the packet and thereafter used by switching engines to determine the switching path. Because new protocols or protocol modifications are involved, upgrading one or two network devices does no good. Ideally, all switches and routers in the network should adopt the new protocol (see "Faster, Smarter Nets," April BYTE).

The second approach, pioneered by Rapid City Communications (acquired by Bay Networks in June 1997), centers around an ASIC that performs route computation at switch-like speeds. Rapid City implemented unmodified IP routing in an ASIC in its F1200 Gigabit Ethernet routing switch. The ASIC enables the F1200 to do IP routing at switching speeds, without any new or modified protocols. Each switch port has its own ASIC, so you can turn routing on for individual ports. Unlike approaches that depend on new protocols or protocol modifications, the second approach gives results even if you upgrade only one switch.



At Networld+Interop in May, the F1200 forwarded 7 million packets per second (pps). By comparison, high-end routers may forward 1.5 million pps, while high-end switches may hit 2 to 5 million pps. The more complex the routing task, the poorer the performance. For instance, a priority scheme can degrade overall routing performance—although priority traffic might get better performance. With routing in an ASIC, the routing task doesn't affect performance.

Even Faster Ethernet

Which brings us to Gigabit Ethernet. The initial question with Gigabit Ethernet is where to install it first. A longer-term question is to what extent Gigabit Ethernet will be used instead of asynchro-

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nous transfer mode (ATM).

On the question of initial installation, it's natural to look to the backbone. "Traditionally, there has been a concept of a hierarchy of bandwidth in Ethernet network design," says Jeff Wilbur, director of hub products in the networking products division of Compaq Computer. "You might start out at the lowest level with 10 Mbps shared, then go to 10 Mbps switched one level up, then to 100 shared, and so on. Gigabit Ethernet fits in very naturally at the top of that pyramid."

Alteon Networks, a vendor targeting the server market with its Gigabit Ethernet products (the AceSwitch and AceNIC), argues that servers are the safer place to get your first production experience with Gigabit Ethernet: Fewer users are affected by a failure. You may even be able to limit Gigabit Ethernet to server-to-server traffic, such as replication, or to bulk data transfer operations, such as backup. Users would probably not know about any problems on the Gigabit links.

Gigabit Ethernet and ATM

In the end, however, Gigabit Ethernet will be important for backbones. Companies that have ATM backbones largely because of its scalability beyond 622 Mbps may now be drawn back into the Ethernet fold.

"The technology developed for Gigabit Ethernet provides a solid base for 10-Gbps Ethernet," notes David Cheriton, a professor in the department of computer science at Stanford University. ATM no longer has a scalability advantage, he says.

It's widely accepted that ATM can provide smoother delivery for real-time traffic such as video and voice. But, Cheriton points out, the maximum packet in Gigabit Ethernet lasts 12 microseconds. "Human beings don't even begin to notice delay and jitter for voice and video until they're at least in the tens if not in the hundreds of milliseconds," he says. Rather than trying to manage bandwidth carefully to avoid delay, high-speed, inexpensive, switched Ethernet technologies will allow enough bandwidth to handle voice and video smoothly without special management techniques, says Cheriton.

Once sites start deploying Gigabit Ethernet widely on their backbones, there are arguments for migrating to a pure Ethernet backbone over time. "The trouble with moving from Ethernet to ATM and back to Ethernet is that you've got to disassemble the Ethernet packet into ATM cells, and then reassemble the packet when it gets where it's going," says Neal Upton, president of LANTech, an Indianapolis-based reseller.

Since carriers do not offer Ethernet interfaces, corporations might maintain some ATM just to interface with the WAN. But Cheriton thinks even that could change over the long run. He believes that if corporate networks are dominated by Ethernet, carriers and service providers will be motivated to provide Ethernet interfaces for customers and eventually even to use Ethernet for their own long-haul links. "The transition issue is the need for more buffering in WAN switches and routers," says Cheriton. "Initial switches and routers may be more restricted in buffering than what you might want for the WAN."

He points out that ATM switches suffer from the same problem, though. "ATM switches are dramatically low on buffering, and studies show how badly the first generation of switches is working. High-speed memory is an expensive component. You have to have a little bit of pain before vendors are willing to step up to putting the right amount of memory in their products."

Hubs and Switches at a Glance

	Hub	Port Switch	Switch
Price/Port	$10–25	$50–$100	$100–$250
Pros	Inexpensive; known technology	Can reassign any port to any segment on-the-fly, minimizing congestion.	Low congestion, high performance
Cons	Unsegmented traffic leads to congestion.	Seen by some as a half-way solution. You can get a 100-Mbps port for about the same price.	High price

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The decision to use unmanaged hubs, segmented hubs/port switches, or switches at the workgroup level is one that comes up for every network design. Despite the widespread popularity of switches, many resellers think hubs can save their customers a few dollars without affecting performance, and maybe adding a few features to boot.

Layer 3 switching, on the other hand, will work only for large networks for now. The software-based approaches to Layer 3 switching will affect only large ATM networks—and only a minority of those, at least until the competitive situation sorts itself out. Resellers should understand software-based Layer 3 switching, but mostly they can steer their customers away for the time being. Silicon-based Layer 3 switching is a less risky proposition. It can fit transparently into existing networks and provide impressive throughput while preserving the routing architecture, but it has a drawback: It does not help optimize currently installed equipment.

Gigabit Ethernet is still in the pioneering stages but is moving fast. Small networks probably don't need it today, but many medium and large networks will incorporate it over the next year or so. Resellers should be helping their customers find the best initial uses for the technology as it follows the usual curve from cutting edge to commodity. B

Mike Hurwicz is a writer and consultant who lives in Brooklyn, New York. You can send e-mail to him at **mhurwicz@attmail.com.**

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High availability and fault tolerance are coming to servers near you. By David Baum and Gregory Karpain

The Server that Wouldn't Die

When your power goes out, it's upsetting. If your phones go down, it's catastrophic. So why are we willing to accept less from our computer systems? Simple: The power company and the phone company have money. Lots and lots of money.

Traditional high-availability (HA) solutions are very expensive, limiting their customer base to the likes of Fortune 500 companies. However, new, less expensive HA systems are catching the eye of smaller companies. Even fully fault-tolerant (FT) systems are coming down in price. Customers are starting to expect HA in their servers.

Why HA Now?

According to Donna Scott of the Gartner Group, the lower costs of HA technology and production, the increasing prevalence of the Internet, and the growth of globalization, mobile computing, and 24-hour, seven-day-a-week customer-service requirements are all fueling the fire for HA solutions.

Where big-league HA solutions used to cost $1 million and up, Unit Systems, an NCR VAR, can now offer top-notch systems ranging from $250,000 to $300,000, says Christopher Radzik, president of Unit Systems. This puts the technology within the grasp of some of today's fastest-growing markets, such as those required by Internet service providers (ISPs) and for companies installing voice-processing systems. Armed with ammunition such as this, companies outside the Fortune 500 are installing HA systems.

Companies and Technologies

Computer vendors have been quick to respond with HA and clustering solutions for the VAR and end-user community. Data General, Digital Equipment, Hewlett-Packard, IBM, NCR, Silicon Graphics, Sun Microsystems, and myriad smaller vendors have taken up the HA torch. Tandem Computers and Stratus Computer lead the pack with FT solutions.

For example, IBM has extended its extensive experience with highly available systems in the mainframe arena to its RS/6000 and AS/400 platforms, where its High Availability Cluster Multi-Processing (HACMP) software brings HA solutions

PHOTOGRAPH: KELLIE WALSH © 1997

"Proper administration and maintenance of clustering systems is one of the biggest challenges in the mid-market today."

—Tom Foley

down into the midrange turf. Digital has leveraged its pioneering VAXcluster technology into its AlphaServer line with TruCluster software for Unix and OpenVMS systems.

HP is another solid contender, with its HP-9000 midrange servers and MC Service Guard clustering software. NCR, one of the biggest suppliers of HA solutions, offers midrange solutions using its WorldMark 4300 with LifeKeeper clustering software. Sun, a latecomer to the HA field, offers an HA solution on its Sun 4000 and 6000 enterprise servers. When it comes to FT systems, Tandem rules the roost with its NonStop Himalaya systems. Stratus comes in second with its Continuum series.

Building Experience

Server technology alone does not make an HA solution. "Proper administration and maintenance of clustering systems is one of the biggest challenges in the midmarket today," says Tom Foley, president of Baystate Computer Group. "You can invest $2.5 million in a sophisticated HA solution but can't expect to administer it with a $45,000 technician. The customer must train, train, and train again."

The Gartner Group's Scott suggests that customers build HA "practices" in their companies. "An HA solution is one-third technology, one-third business practice, and one-third organization," she says. "Organizations must develop proper HA procedures; train personnel; automate wherever possible to prevent user error; implement good testing, deployment, and configuration management procedures; and look at network and systems software that predicts problems," Scott summarizes. "Successful HA is not an out-of-the-box solution. It is a complex formula that must be expertly executed."

HA vs. FT

The degree of HA needed for each application depends on the risk factors: How devastating is downtime, and how much is the customer willing to spend to prevent it? In most organizations, 99 percent availability is good enough. Even the phone company promises only "five nines," or 99.999 percent uptime.

What makes the difference between 99 percent and 100 percent availability? Clustering technology exists that can achieve a failover swap in less than a second. But what about the transaction in process? You can roll it back and reconstruct it in a matter of minutes. For many companies, this is acceptable. For others, 100 percent availability means nonstop computing, without even a nanosecond of downtime or a byte of data lost. For these solutions, customers turn to FT technology (see the text box "Defining Terms" above).

Traditionally, FT systems have come with the highest price tags. However, improvements in production and technology similar to those that have benefited HA solutions are making FT solutions more affordable as well. "A business can now afford an FT system at only 30 percent higher cost than an HA-cluster solution," says Jon Howe, who is the chief technical officer at ACI. "As with any technology, we are always pushing the price down over time." *continued*

Defining Terms

While self-healing systems remain the stuff of science fiction, solutions are available that can provide up to 100 percent uptime. Just how close they come to that ideal is a key difference between high-availability (HA) and fault-tolerant (FT) systems.

As Howard Richmond, a Gartner Group analyst, defines it, HA is one of the branches on the continuous-availability tree, which is an amalgam of two major components: fault tolerance or fault avoidance and rapid recovery (RR) or clustering (see the figure "Clusters and Redundancy").

HA is concerned with circumventing all unplanned outages and consists of both FT and RR solutions. HA generally means RR or clustering; the terms are used interchangeably.

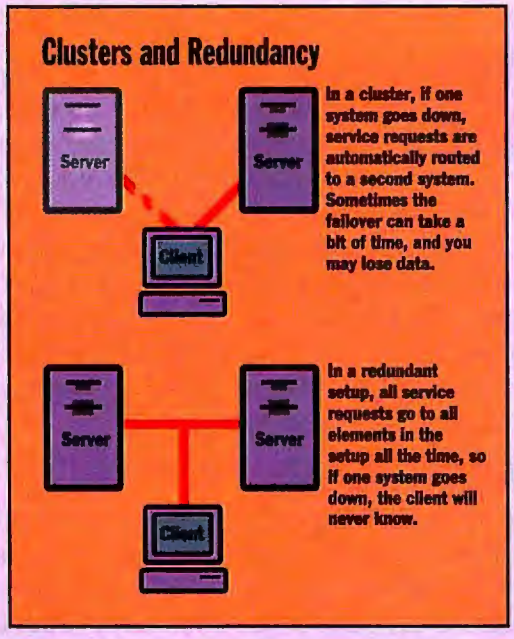
The strategy with fault tolerance is to prevent the mission-critical system from coming down at all costs. While HA systems are primarily software solutions with supporting hardware, FT solutions are the opposite: hardware solutions with supporting software. Tandem Computers, which is the market leader in FT systems, uses a shared-nothing system with dual processors carrying out every task simultaneously. When a fault is noted on one processor, it is reported to the other processor, where the task continues with no downtime.

Unlike FT systems, RR systems do not have dual processors running simultaneously. An RR system must switch over to a newly started second software process and recover data as quickly as possible.

John Oltsik, a server specialist at Forrester Research, thinks that RR technology has become good enough for the majority of mission-critical applications. "RR stops short of providing the zero-fault, 100 percent uptime of the FT system," says Oltsik. "But it is much more affordable for midrange to smaller companies and can offer uptime in the 99.999 percent range, with guaranteed data integrity."

Continuous operations is a peer branch with HA. It uses the strategy of avoiding any planned downtime, such as hardware maintenance, disk backup and replacement, CPU replacement, and so forth.

The star at the top of the tree is called continuous availability, the sum of HA and continuous operations.



Clustering and redundant arrays of systems are two approaches to HA and FT.

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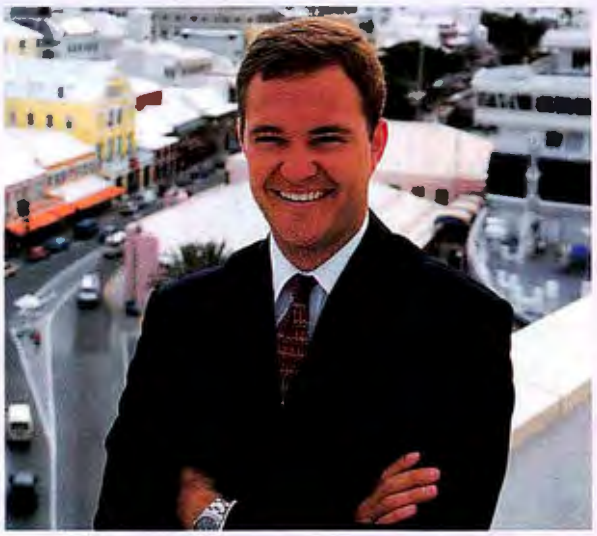
High Availability in Bermuda

Internet (Bermuda), Ltd. (IBL) grabbed an early lead in Bermuda's Internet market and remains the area's fastest-growing Internet service provider (ISP). "In the Internet arena, high-availability (HA) solutions are a requirement for doing business," says Peter Durhager, general manager of the firm.

The bedrock of IBL's Internet-access and consulting businesses is six Digital Equipment AlphaServer systems running the Digital Unix OS, four in Bermuda and two in the Bahamas. According to Durhager, "During nearly two years of continuous operation, we have experienced no downtime on any of these servers due to hardware or software faults. This represents 100 percent availability of services to IBL customers, a very impressive statistic for this length of time." The HA systems are now mission-critical components of the business, Durhager adds.

"Having solid, highly available systems positions us well to implement a variety of Internet-based business solutions," Durhager says.

Durhager says international business is now on par with tourism as Bermuda's largest foreign-currency earner. "Many international businesses are taking advantage of the financial and political benefits of doing business in an offshore domicile," he points out. "Our challenge is to maintain a competitive stance with companies who do business strictly in the U.S. or England. That means having outstanding technology for all facets of our operation."



"Dependence on independent servers is quickly becoming a thing of the past." —Peter Durhager

IBL recently installed an AlphaServer 4000 system, which will eventually be clustered with the existing AlphaServers using Digital's TruCluster technology. TruCluster software allows multiple AlphaServer systems to be clustered as a single computing resource via high-speed, memory-to-memory connections. It incorporates all the functionality of DECsafe Available Server, providing the clustered environment with almost 100 percent availability to mission-critical applications and data.

"We are growing at about 250 new e-mail users per month, so clustering is key to our growth-optimized architecture," says Neil Movold, who is the director of technology at IBL. "As soon as we reach saturation, the TruCluster design will allow us to simply snap on another AlphaServer 4000 or 5000 system, with no downtime whatsoever."

Technically, it's impressive, but Durhager tends to emphasize the business benefits that HA computing implies. "By using high-performance servers and clustering technology, we can build a highly available, reliable, and scalable architecture that will allow for continual growth in the ISP arena," he concludes. "Dependence on independent servers is quickly becoming a thing of the past."

Will the Twain Ever Meet?

As it stands today, HA and FT are two different technologies with two different levels of availability, but most experts agree that the distinction is growing smaller. HA is even cropping up on PCs, as Microsoft comes to market with its clustering solution for Intel-based processors. This will create yet another set of potential markets, driving HA solutions even further down the food chain.

In the near future, we will also see an intermarriage between HA and FT technologies, further blurring the distinction between them. Already, the level and kind of availability that can be created by either HA or FT solutions is approaching a difference of only a few decimal points. Tandem and Microsoft are working together to blend the two types of systems, incorporating Tandem's FT nonstop-kernel philosophy—hide the failure from the application—with Windows NT's HA-server philosophy—failover and restart the application.

But no matter how you slice up the market or define the terms, the driving need for HA systems remains the same. As people in all types of businesses come to depend on their computer systems almost as much as the electricity that powers them, they will be less and less tolerant of outages of any kind. "People won't tolerate the lights going out in their offices for an hour every week," Radzik concludes. "Why should they expect any less from their computer systems?" B

David Baum and Gregory Karpain are freelance business writers specializing in information-technology topics. You can contact them by e-mail at **dwbaum@silcom.com** *and* **gkarpain@silcom.com.**

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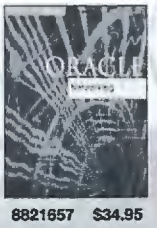

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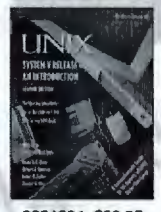

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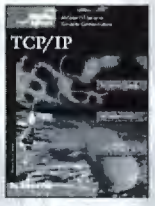

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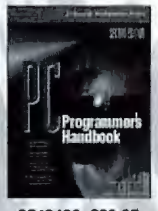

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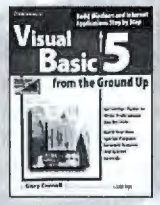

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The Object Is to Manage Data

When you're tracking large, complex data types, you need an object database management system like one of these three.

By Todd Zino

Data used to be neatly constrained into fixed-width fields of numbers and characters. We organized it with flat-file databases, navigated it with hierarchical pointer-based systems, and linked it with relational tables—connected by keys and indexes and programmed using so-called fourth-generation languages (4GLs), which were usually proprietary and different for each DBMS and each vendor.

But today's data is more diverse and more complicated and comes in much larger quantities than just a couple of years ago. Now we need to organize and query audio, video, animated 3-D graphics and textures, compound documents, geographic information, and ever more data types. We need to have large-scale data storage and retrieval across global networks on demand. To meet all these new challenges, the best answer, though not the easiest, seems to be represented by object-oriented database management systems (ODBMSes).

ODBMSes are not trivial packages. They're complex and expensive, and using them requires a change in procedures, habits, even attitude. But more and more organizations are choosing ODBMSes to help them do the jobs they need to get done. Some reasons include the growing presence of object-oriented programming models in the client/server realm, including COM, DCOM, and CORBA; the inability of traditional, SQL-based, relational database management systems (RDBMSes) to address complex data and multitiered architectures; and the semantic mismatch between SQL and more modern, component-based languages, such as Java, ActiveX, and C++.

For this report, BYTE looked at three of the major players: Object Design's ObjectStore, O2 Technology's ODMG, and Versant Object Technology's Versant. Each represents a somewhat different approach to building an ODBMS, but all are compliant with the Object Desktop Management Group (ODMG) standards. All are available for both Unix and Windows NT platforms, and all include full support for C++ and have either beta or shipping interfaces for Java.

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Object Design's ObjectStore
was a standout in tough competition, offering a strong architecture and effective development tools.

We installed these products on NT-based servers and exercised their capabilities, seeing what they were individually best suited for and evaluating the support available to the user and the network administrator. In our evaluations, we placed considerable emphasis on the ease of development and deployment, since these products are merely building blocks that you have to put together as efficiently as possible. We noted how well they serve up data for Web- and Internet-based applications, and what use they made of Java.

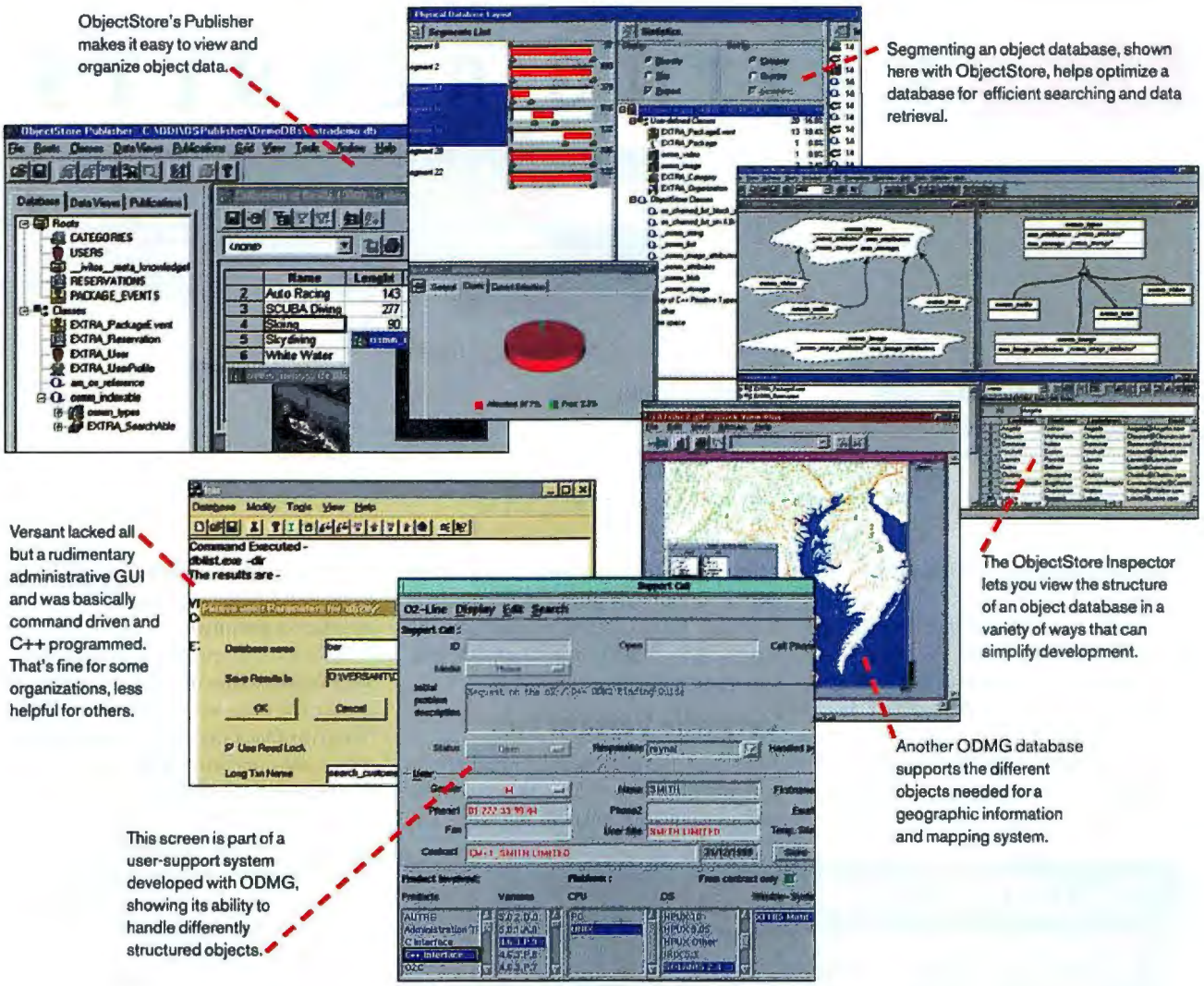
Our original plan included extensive performance testing, but we learned the hard way that this wasn't such a straightforward task. We were unable to create useful and comparable tests in the time that we had available (see "Missing the [Bench] Mark" on page 126).

I Object to This Relationship

Before getting into the specific products, let's review how ODBMSes differ from RDBMSes. The relational database model was built on the concepts of algebraic set theory, monolithic lookup tables, and a simple ad hoc query grammar, which was eventually standardized into the omnipresent SQL.

ODBMSes, in contrast, are centered around the concepts of persistent storage in object-oriented programming (OOP) languages. In essence, this means that classes, attributes, and instances of objects can be represented within a database in the same way that they're represented in OOP languages. Also, they can be stored and retrieved by applications as needed in their natural form without needing to be altered to fit into a relational table.

While the pure, theoretical RDBMS model is versatile enough to accommodate any object type, data structure, or distributed architecture, when it comes to practical implementations and real-time performance issues, the relational model starts breaking down and becoming less than optimal. Why? Because most modern client/server and other complex software packages are programmed in terms of objects, and objects just don't fit neatly into relational tables. More often than not, the only solution for this problem is to create a separate table for each distinct class that exists in the particular



To manage data objects of all types requires some programming, but most ODBMSes also provide helpful GUIs.

database model that's being developed.

Unfortunately, once you have a number of classes, you need to take data from many tables to complete most queries, and the overhead becomes significant. Doing a SQL JOIN to pool data from multiple tables can involve intensive algebraic computations when you're working with large amounts of data. The more complex, hierarchical, or interrelated object-oriented data becomes, the harder it is to coerce the relationships into rows and columns, and it becomes ever harder to read and update such data.

Object databases remove this layer of complexity and theoretical discrepancy, and, in fact, their architecture lends itself more readily to distributed computing and local caching than does the RDBMS model. It's often said that ODBMSes exhibit terrible performance on simple queries and don't support ad hoc queries. Indeed, straight queries in a relational database that only require pulling data from one table and a few columns might run faster than an equivalent ODBMS transaction. However, the latter have been observed to perform from 100 to 1000 times faster on complex queries where RDBMSes required a JOIN. (For more on the advantages and strengths of ODBMSes, see "Debunking Object-Database Myths" on page 101.)

The Development Process

While ODBMS products have proven their reliability at the enterprise level, they have yet to reach that maturity on the interface and development side. When developing a data model in an ODBMS, you must come to terms with many different data structures. Some of these constructs—array, set, cursor (a pointer used to scan through a grouping of objects), or bag—are familiar to the seasoned programmer and are also used in RDBMS development. Others are unique to ODBMSes and are useful for optimizing performance.

For instance, a *segment* is loosely defined as a physical grouping of objects as a unit of a larger database. It's useful when you have objects with a few large attributes (e.g., an employee object with an associated binary image). If you group the larger attributes of different objects together in a segment, the system can scan both large and small objects faster—the large ones because they're all in the same physical location in storage, and the small ones because the size of each object in storage has decreased.

continued

LAB RATING RESULTS

BEST OVERALL

Object Design's ObjectStore

A very well thought-out and easy-to-use interface and a rich feature set make this package a standout.

	PRICE (WINDOWS NT/UNIX)	WEB INTERFACE (PRICE)	TECHNOLOGY	FEATURES	USABILITY (EASE OF DEVELOPMENT)	OVERALL SCORE
ObjectStore 5.0	**$3300 / $6000**	**ObjectForms ($3200)**	★★★★	★★★★★	★★★★★	★★★★★
ODMG 5.0	$4000 / $6000	O2Web ($5000)	★★★★	★★★★	★★★	★★★★
Versant 5.0	$5500 / $9000	VersantWeb ($995)	★★★★	★★★	★★★★	★★★★

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

Vaguely similar is the cluster concept, another way to group like objects or attributes strategically. Clusters work more at the logical level, placing certain objects with stronger interrelations (for example, children in a tree) closer together. Each of the tested ODBMSes has these constructs in some form, although they're certainly not interchangeable. To some extent, a lot of these optimizations are automated implicitly upon the creation and population of a database (particularly in Versant). But to gain the finest control, especially for mission-critical applications, you must define them explicitly.

Versatile Versant 5.0

Versant gears itself toward the higher-end enterprise market, with emphasis on transaction granularity and fault-tolerance. Despite its strengths in these areas, it's quite lacking in development aids, and its user interface is primitive.

Unlike many commercial ODBMSes, Versant is based on the object-server model, not the page-server implementation found in ObjectStore (O2's ODMG, meanwhile, uses a hybrid). With a page server, the smallest unit of data is of a fixed size (usually about 4 KB), while an object server deals with logical objects, which are often smaller. When objects are small, this object-server architecture permits a maximum of concurrency for servers with a heavy transaction load.

Versant offers a fault-tolerant server, with industry-leading solutions for synchronous database replication and transparent master/slave mirroring. These features are deeply rooted in the ODBMS architecture, thus requiring a minimum of code-grappling to configure.

VersantWeb, a companion product aimed specifically at Web applications, is relatively less expensive than its two competitors while still offering vital functionality and interoperability with all major Web-server APIs.

Although Versant excels in versatility and reliability, it fails badly in terms of ease of learning and administration. The C++ API was easily the most complicated of the three we tested, and it also had perhaps the least readable documentation and reference. The graphical tools are restricted to a simple DBAdmin utility, which offers little beyond the most basic database-administration operations. And there are no RAD tools available.

We didn't test Versant's Java interface, which hadn't yet been released, but it's

The ODBMS Desktop

A key advantage of ODBMS technology is its ability to scale down to the desktop as well as up to the enterprise. The technology has many potential uses in software engineering, graphic design, and the development of applications that manage data.

Most software today requires some way to store and retrieve local data. Because the basic interfaces for this in C++ and Java, for example, are slow and unreliable, some type of database technology must be implemented and embedded into the product. But in these cases, a full-fledged database server, object or relational, would be expensive, excessive, and impractical. Instead, products such as NeoLogic's NeoAccess and Object Design's PSE Pro cater to a new paradigm known as "databases for the desktop."

NeoAccess 5.0 can be used as a storage back end within any C++ application framework. Because there's no additional licensing-fee structure, the NeoAccess back end can be integrated into commercial products without raising the issue of per-seat or per-copy royalties. The product supports popular C++ compilers and development environments on Windows, Unix, Mac, and BeOS platforms.

The NeoAccess technology is a component of many of today's popular software titles, including NetObjects Fusion (a Web-page editor), Netscape Communicator, and Corel's productivity software. No Java interface is yet available.

With PSE Pro, Object Design offers the core technology on which its larger enterprise system is built. PSE (which stands for Persistent Storage Engine) uses the same storage technology found in ObjectStore, but without the large memory footprint or multiuser architecture. PSE Pro provides a system of libraries and schemata that allow for the efficient and reliable serialization of data handled in an application.

Currently, PSE Pro has interfaces for Java, C++, and ActiveX. Object Design's implementation of ODBMS classes for Java has been an influential basis for the ODMG's upcoming standard for using object-database technology with Java. PSE Pro comes with a less-functional PSE product that can also be freely downloaded from Object Design's Web site.

reported to have all the functionality of Versant's standard C/C++ interface. We think it will probably provide an easier development environment.

Who's Minding the ObjectStore?

BYTE has already looked at Object Design's ObjectStore 5.0, a cutting-edge ODBMS that offers the best-case scenarios for development, architecture, and rapid time to market (see "What's in Store for the Web," August BYTE). ObjectStore is fundamentally different from the other two products, using virtual memory mapping rather than inheritance and unique IDs to regulate and manage each object.

Where Versant and ODMG require each newly created object to be a subclass of the generic base object class, ObjectStore does not. This saves an average of 64 bytes per object of overhead, a small gain that really adds up for enormous multigigabyte databases.

In addition, ObjectStore is the only ODBMS we tested that offers ActiveX support, clearly a big advantage for Windows NT distributed development. Perhaps the most impressive feature of ObjectStore is its suite of visual tools for developing applications and administering existing databases. Inspector 2.2 is an advanced utility that allowed us to edit data, rearrange a database's physical organization, and design queries. All this is contained in a user-friendly point-and-click environment, which uses a familiar spreadsheet-like layout to display data. You can also evaluate and debug the often-complicated database schema file using Inspector.

Another useful tool in the ObjectStore arsenal is the Performance Expert, an analytical utility that examines an ObjectStore application or architecture and suggests optimizations, as well as giving detailed performance information.

With ObjectStore, you can develop in both C++ and Java, and your Java code can access C++ objects and methods within the database. In terms of its C++ API, ObjectStore sported the most streamlined code with the least amount of required structures, macros, and cryptic class instantiations to construct a simple database and object model. Unlike the other two products, however, there's no Smalltalk interface.

Object Design's support for ObjectStore is very impressive. It's standard practice for an engineer to spend a day or two with a customer to help install the product and resolve any questions.

OBJECT-DATABASE SYSTEMS FEATURES

	ObjectStore	ODMG	Versant
Version	5.0	5.0	5.0
Price per Unix development seat	$6000	$6000	$9000
Price per NT development seat	$3300	$4000	$5500
Web interface and price	ObjectForms ($3200)	O2Web ($5000)	VersantWeb ($995)
PLATFORMS SUPPORTED			
Windows NT	✓	✓	✓
Windows 95	✓		✓
IBM OS/2			✓
Solaris SPARC	✓	✓	✓
Digital Unix	✓	✓	✓
SGI Irix	✓	✓	✓
IBM AIX	✓	✓	✓
HP-UX	✓	✓	✓
SCO Unix		✓	
Solaris x86		✓	
SunOS 4.x		✓	
DEVELOPMENT TOOLS			
Visual development tools	Inspector, Performance Expert	O2Look, O2Tools (Unix only)	
Visual administration tools	Inspector	O2Tools (Unix only)	DBA
LANGUAGES SUPPORTED			
Java	Included	Optional*	Optional* (beta)
C++	Included	Included	Included
Smalltalk		Optional*	Optional*
ActiveX	Included	N/A	N/A
ODMG COMPLIANCE			
ODL (Object Design Language)		✓	
OQL (Object Query Language)		✓	Subset (VQL)
SQL-92		✓	✓
Object schema	Virtual mapping	Base class	Base class
ARCHITECTURE			
Transaction architecture	Page server (physical)	Page server (physical)	Object server (logical)
Server-based method execution			✓
Client-based method execution	✓	✓	✓

* For Versant and ODMG, one language interface of choice comes with the development license. Additional language interfaces cost extra.

✓ = yes; N/A = not applicable.

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

The French Connection

For reasons that escape us, a surprisingly large number of ODBMS products originate in France, including O2 Technology's ODMG 5.0. For the developer, the ODMG 5.0 database server presents two different faces. On one side is a competitively priced server for Unix platforms, offering O2Look and O2Tools, nice rapid application development (RAD) tools, and graphical interfaces to its complex database system.

Alas, there's no visual interface whatsoever on the NT side of things. This is particularly unfortunate, given that a significant amount of advanced client/server development is performed on the Windows platform even when the target server might be a Unix machine.

On the positive side, O2 boasts the implementation of its own 4GL, called O2C,

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Missing the (Bench)Mark

To develop applications using a given ODBMS, you first have to learn its general architecture and application framework. No two products have the same characteristics, so preparing a benchmark to test performance requires developing a schema that will be representable across each vendor's ODBMS.

But that's the easy part. Each product has its own complex API, and some can be used with only a limited range of tools, such as C++, which itself is not fully standardized.

Each product tested for this review had entirely different C++ data structures to represent a basic object with string attributes of random length. Moreover, each product had its own C++ macros, which were needed to initialize the database, populate it with replicated objects, and begin and end a transaction. And, of course, these macros don't behave the same for each ODBMS product. For objects such as a database segment, a large pointer, a record cursor, and a static reference, there were often vastly different implementations of each for a given product. For these reasons and more, porting a generic pseudocode application with any degree of realistic complexity to each ODBMS could not guarantee a reasonable level of parity across these very different products.

Not only was the basic creation of databases and objects not consistent, the semantics of a transaction and the database's model of locks and privileges employed during a read or write were also inconsistent. To each vendor's credit, all the ODBMSes tested had a well-defined and highly flexible system of locks and transaction-behavior parameters. But, again, there was no easy way to equate a particular scheme that would be the same for each database. And while each product supports Object Query Language (OQL), that isn't always the best method for querying the database, and products allow you to not use OQL at all in performing reads and writes on the ODBMS.

Most of these benchmarking issues stem from the general complexity of databases. Even relational DBMSes tend to use proprietary language additions to maximize performance and efficiency in an enterprise application.

Thus, the bottom line is that NSTL could not, under any practical or realistic circumstances (and in the time available), obtain performance data with which to compare real-world implementations of the ODBMS products that are reviewed in this article. We concluded that to create tests that would fairly compare the three systems would require, at the very least, three separate development efforts, and even then we would have to make choices that would call some results into question. Ralph Waldo Emerson may have said that consistency is the hobgoblin of little minds, but BYTE simply can't make performance comparisons without it.

There's hope on the horizon, though. The ODMG has a better chance of working toward a Java common standard for the ODBMS world before vendors diverge in their various implementations of a Java API. If Java can be standardized here, its ease of development and strict object-oriented semantics relative to C++ will give it a good chance to become the premier language of choice for ODBMS development. Applications written in Java for a particular ODBMS are much more easily portable to another ODBMS than they are if they're written in C++. Moreover, Java melds very tightly with the ODBMS concepts—something SQL could never do. This will also be an important factor if ODBMSes are to gain widespread acceptance in the future of enterprise data handling.

which allows for advanced and simplified programming and dynamic memory and object management within a syntax and environment that are fully compatible with plain old ANSI C.

Furthermore, O2 Technology has been working with top CORBA developers to produce its own O2Corba add-on for ODMG 5.0, which gives a full interface to the popular CORBA implementation of distributed object architecture. In addition, O2 has recently developed a high-tech server model, called "adaptive locking," which permits a hybrid of page and object locking for concurrent transactions.

Objects stored in the O2 database are language neutral. This means that if a particular object is developed in Smalltalk, it can be accessed or manipulated by a Java application and vice versa.

PRODUCT INFORMATION

NeoAccess 5.0
$750
NeoLogic Systems
Berkeley, CA
510-524-5897
http://www.neologic.com
Enter 1097 on Inquiry Card.

ObjectStore 5.0
Unix, $6000; NT, $3300
Object Design, Inc.
Burlington, MA
800-962-9620
617-674-5000
http://www.odi.com
Enter 1095 on Inquiry Card.

ODMG 5.0
Unix, $6000; NT, $4000
O2 Technology, Inc.
Palo Alto, CA
800-798-5454
650-842-7000
fax: 415-842-7001
http://www.o2tech.com
Enter 1094 on Inquiry Card.

PSE Pro
$250
Object Design, Inc.
Burlington, MA
800-962-9620
617-674-5000
fax: 617-674-5010
http://www.odi.com
Enter 1096 on Inquiry Card.

Versant 5.0
Unix, $9000; NT, $5500
Versant Object Technology
Fremont, CA
800-837-7268
510-789-1500
fax: 510-789-1515
http://www.versant.com
Enter 1093 on Inquiry Card.

Good Support

One final word about deciding on a package like one of these: Help from the vendor when you need it is critical for enterprise software, including ODBMSes. All three products we tested offer outstanding support, which sometimes includes contract accounts and extensive on-site support and training. And this includes not only technical support, but also a future commitment to compatibility and standardization.

The vendors have come a long way in developing better front ends in which existing SQL queries can be executed and traditional relational concepts ported to an object framework. It's good to know that when you have to switch, you can rely on good tools that build on what you already have. B

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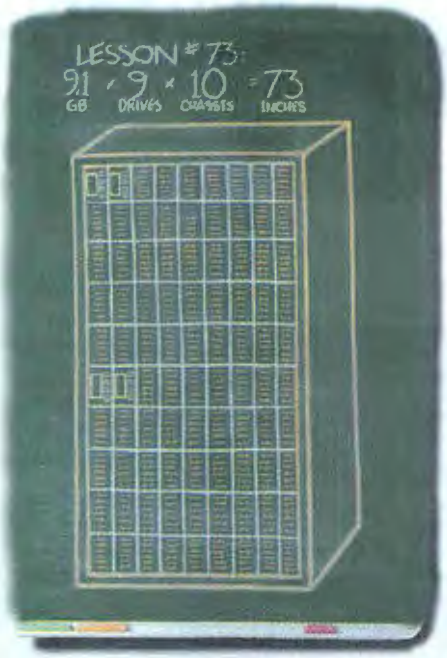
Evaluations in this report represent the judgment of BYTE editors, based in part on extensive tests conducted by NSTL, Inc., as documented in a recent issue of its monthly Software Digest. *To purchase a copy of that report, with NSTL's own evaluations and data, contact NSTL at 625 Ridge Pike, Conshohocken, PA 19428; 610-941-9600; fax 610-941-9950; on the Internet, editors@nstl.com. For a subscription, call 800-257-9402. BYTE magazine and NSTL are both operating units of The McGraw-Hill Companies, Inc.*

Artecon's New RAID Math



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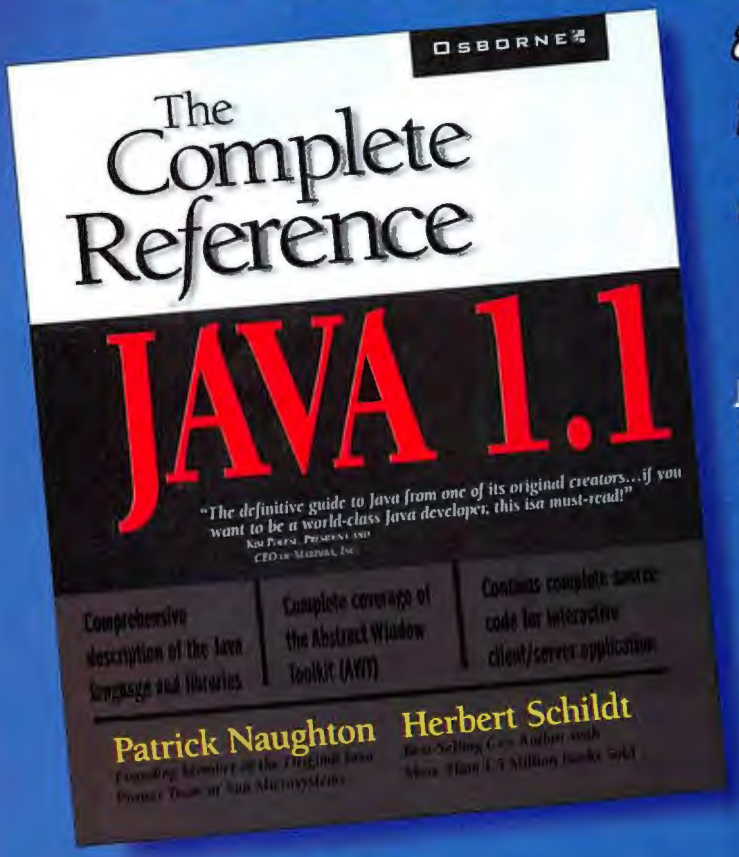

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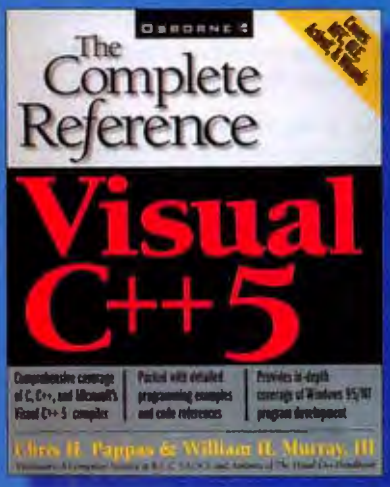

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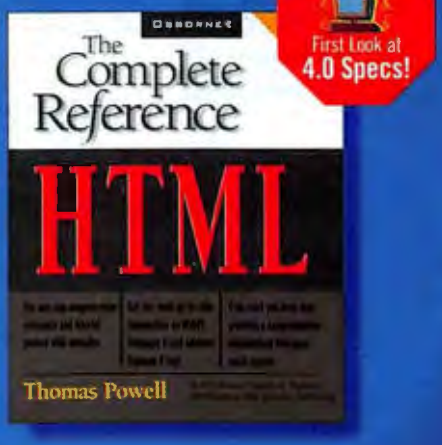

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Three tiny Web servers offer quick implementation and fewer administration headaches. By Michelle Campanale

Web Servers Get Skinny

For small companies or groups that need their own Web site, mini Web servers offer instant gratification. These dedicated turnkey systems are simple to set up and maintain, and they can be cheaper than using an Internet service provider (ISP) to host your site.

I tested three thin Web servers that are targeted at two different audiences. Microtest's WebZerver and Compact Devices' Twister are aimed at companies that have little Internet experience but need a Web server for publishing content and hosting conference discussions. On the other side of the spectrum, the WebBox, from Webtronics, is a programmable tool for setting up customized remote services over the Internet, such as a Web camera or any Web device you can dream up.

I was impressed by how easy all these products are to use. But if you are comfortable installing and administering Internet services on full-fledged Linux or Windows 95 PCs, you will find the features of mini Web servers too limiting. In that case, you may be better off purchasing a similar, multipurpose product like the Whistle InterJet 200 or the i-Planet IPS 168, both of which offer Web, Internet, and e-mail functions. Another option—paying an ISP to host your Web site—can be expensive, but it helps you avoid the maintenance hassles.

The Same but Different

On my small network with two Windows 95 PCs and a 10Base-T hub, none of these three systems took more than 10 minutes to set up—from flipping on the power switch to getting a Web page on-line. All three are optimized to perform a single task or function; contain both hardware and software; employ a proprietary, stripped-down OS; and require only an HTTP-compliant Web browser. If you have a Remote Access Service (RAS) server, you can manage and update each of these systems over the Web.

TWISTER

RATINGS	
TECHNOLOGY	★★★
IMPLEMENTATION	★★★★★
PRICE	★★★★

WEBBOX

RATINGS	
TECHNOLOGY	★★★★
IMPLEMENTATION	★★★★★
PRICE	★★★★

WEBZERVER

RATINGS	
TECHNOLOGY	★★★★
IMPLEMENTATION	★★★★★
PRICE	★★★

Both WebZerver and Twister are simple, inexpensive, and easy to use. Both install quickly and provide design and setup templates. The WebBox offers the same level of convenience, but it goes beyond the other two by allowing you to write your own applications using the Tcl ("tickle") scripting language.

I like Webtronics' WebBox the best. This system has support for the HTTP 1.1 keepalive parameter, which allows access to multiple documents via one connection. Additionally, it has few moving parts and will be great for Web administrators or engineers who seek a small-form-factor system to link with their Web cameras, thermometers, or any other Web-worthy devices. This is not meant to denigrate WebZerver and Twister, both of which simplify content distribution and are friendly to Web users.

Cisco pioneered the category of mini Web server earlier this year with its Micro Webserver. Cisco, however, declined to participate in this review. Company officials said Cisco is planning to release a new line of slim servers optimized to work with network computers (NCs).

continued

Webtronics WebBox

ADVANTAGES:

+ No moving parts equals high reliability
+ Highly extensible with Tcl programming to support serial-programmable devices and CGI scripting
+ Supports HTTP 1.1 keepalive parameter

DISADVANTAGES:

– Lacks HTML editor, requires some HTML design knowledge
– Lacks SCSI port for adding storage space and expandability

What gives WebBox its edge are its two programmable 115.2-Kbps serial ports. Using Tcl, a small scripting language from Sun, you can program its one serial device to do a variety of things. For example, you might turn the system into a monitoring device by hooking up a Connectix camera and programming it to upload data to a Web page at certain intervals. You can also write CGI scripts using Tcl, and sample code is available in the help section.

Webtronics has put some nice touches on the box, such as extensive link lights. These LEDs indicate network traffic, such as packet errors and collisions; the ones on the WebZerver and the Twister are not as detailed. Like the Twister, the WebBox allows for out-of-band management via its external serial port. But unlike the other two, the WebBox has no moving parts, which adds to its reliability. Instead of a hard drive, it uses 4 to 20 MB of flash ROM, in addition to 512 KB of ROM. Its memory consists of 4 MB of DRAM.

All three mini Web servers have password ability at all levels. The WebBox, however, bests the others with a front-mounted switch that lets you set the system to "read only." I was also impressed by the depth of some of the other configuration features, like the ability to change the media access control (MAC) address by manually reinitializing the WebBox (i.e., erasing the flash memory) from another front-panel switch.

The one thing the WebBox lacks, however, is an HTML editor. Instead, you need to use a third-party HTML editor like FrontPage and import your premade pages, or know HTML and type in your own tags. To get my Web page up, I cut and pasted prefab HTML code into the WebBox's index.html directory.

Navigating the WebBox is easy. Its menus contain few graphic elements yet provide a lot of information. I found extensive help available on-line, including an operation FAQ, a problem-solving section, a reference manual, and sample code.

For the technically elite, WebBox is not only a fun toy but a quick and practical means of Web connectivity for a branch office or workgroup. It is scheduled to ship in late fall for $1299.

Microtest WebZerver

ADVANTAGES:

+ Highly expandable; allows seven read/write SCSI devices
+ Ships with group-discussion feature

DISADVANTAGES:

– Priciest of the bunch

The need for reduced administration and overhead and the desire to get on the Web quickly and inexpensively don't always go hand in hand. Both Microtest's WebZerver and Compact Devices' Twister eliminate the complexities of a traditional Web server. They also are excellent tools for workgroups that want to post pages to a corporate intranet.

I found WebZerver at least as easy to implement as the WebBox. As soon as I attached it to a hub linked to a few PCs, WebZerver tried to get an IP address automatically, using Dynamic Host Configuration Protocol (DHCP), BootP (a TCP/IP protocol used to enable diskless PCs to find their own logical IP addresses at start-up), and Reverse Address Resolution Protocol (RARP). During setup I noticed Easy Site Layout, a utility that lets you choose different Web templates for different groups. Engineering, corporate, and human resources were among the choices. At press time, WebZerver didn't offer much in the way of automatically customizing those pages, however. Microtest officials say the unit will ship with a 30-day trial version of NetObjects' Fusion HTML editor.

At $1595, WebZerver is the most pricey of the three. However, it's the only one with 10/100Base-T Ethernet support. This improves performance and extends the WebZerver's useful life as people move up to 100-Mbps networks. Its 133-MHz AMD 486 (P75-class) processor, 2.1-GB hard drive, and 8 MB of RAM make it the most powerfully configured system.

Because WebZerver was in early beta stage at press time, many of its capabilities, such as monitoring site activity and usage, creating users and groups, and backup and security functions, were not yet implemented. According to Microtest officials, when the product ships it will also allow seven read/write SCSI devices to connect to its SCSI port for further expandability.

Other features, like the Web page setup wizard and the context-sensitive file search tool, were very useful. In the administration menu, there is a pointer to download a demo copy of WS FTP. I used this utility to transfer premade HTML files to the hard drive.

Though they were not available when I tested the WebZerver, EasyPrint (which converts documents to HTML) and EasyTalk (a newsgroup feature) utilities are expected to ship with the product.

WebZerver will work well in a small office or workgroup, especially for those people who don't want to bother with programming. In terms of sheer speed in

TECH FOCUS

HTTP 1.1 Improves Net Efficiency

All Web servers, even small ones, need to have HTTP embedded in their core OS in order to function. HTTP 1.0, which works in conjunction with the TCP protocol in the IP family, is used for packetizing Web information such as HTML documents and file downloads.

One advantage of HTTP 1.0 is that it is very bursty; it's great for handling multiple tasks and switching from one thing to the other. But there's always room for improvement. HTTP 1.1, a reworking of its predecessor, is designed to ease network congestion by reducing the number of connections required between client and server.

The keepalive function of HTTP 1.1 is an example of this improved efficiency between HTTP and TCP. TCP reaches full data transfer efficiency only when the connection between the client and the server is kept open. HTTP 1.0 closes that connection after each request. Keepalive keeps a route or "tunnel" open all the way through the network, allows persistent connections, and remains open for multiple requests. The benefit to the Web server is capacity; many documents can be accessed with one connection.

Web Server Features

	Twister	WebBox	WebZerver
HTTP support	HTTP 1.0	HTTP 1.0 and 1.1 (keepalive)	HTTP 1.1
CGI support		✓, via Tcl	
Security	Programmable access controls; user/password on each directory	User/password on each directory; read-only capability	User/password on each directory, read/write or admin privileges
Hard drive	1.2-GB	512 KB of ROM, 4-20 MB Flash	2.1-GB
Processor	186 processor (40-MHz)	Motorola MC68EN 360 RISC-based (25-MHz)	AMD 486 (133-MHz) (P75-class)
RAM	1 MB	4 MB of DRAM (up to 16 MB)	8 MB
Platforms supported	Any client with TCP/IP and a browser	Netscape and MSIE	Any frames-capable browser
Expandability	Can't upgrade SIMM; SCSI port allows six external devices (one read/write and five read-only); software is upgradable	Can't upgrade SIMM; closed hardware; full programmability w/ Tcl; software is upgradable	Upgradable SIMM; up to seven external (read/write) SCSI devices; software is upgradable
Ports	SCSI port, serial port	Two serial ports (115-Kbps), can be programmed by Tcl	SCSI port, no external serial port
LAN technologies supported	10Base-T, 10Base-2	10Base-T	10Base-T, 100Base-T
Applications included	Setup wizard, directory wizard, development wizard, FileMover, Instant IP, FTP, Claris HomePage, Net It Now (demo)	Tcl interpreter, sample Tcl source code available from Web; scheduler, whiteboard, and phonebook	EasySite setup wizard, page-template wizard, EasyPrint, EasyTalk, WS FTP (demo)
Search	Search directory, file, HTML headers, file headers	Grep (text and words in files) and filename search	Context-sensitive search
User management	Via browser/access-control menu	Via browser/Web page menu, BoxHacker file manager application	N/A (in beta at press time)
Out-of-band management	✓	✓	
Downloadable upgrades	✓	✓	✓
On-line help/manual	Help	Manual, help, operation FAQ, problem-solving menu	Help, user guide, search help
Link lights (network, blocked, link, etc.)	Network activity, network status, HD status, system pulse	Operation, link, transmit on Ethernet, receive on Ethernet, collision on Ethernet	Status, network activity, network speed, disk activity
Manual configurations		Reset, read-only	Address reset switch

B = BYTE Best. ✓ = Yes

getting an internal Web site up and running, it is hard to beat.

Compact Devices Twister

ADVANTAGES:

+ Ships with full copy of Claris Home Page
+ Allows easy customization of content

DISADVANTAGES:

– Expandability limited to one read/write SCSI device and five read-only SCSI devices

Like WebZerver, Twister took little effort to install and use. After I entered the MAC address and assigned the unit an IP address, the Instant IP configuration utility got Twister up and running in minutes. I easily created user accounts with the setup wizard. With the development wizard, I created departmental and personal home pages from templates.

I was even able to customize my pages and add URL links, select basic decor and colors, and add pictures and icons using templates supplied with the system. With a copy of Claris HomePage (also included), I authored pages on-the-fly. Another bundled demo, Net It Now, converts documents to HTML. A Windows file-mover utility has an intuitive interface that proved extremely useful in transferring files.

The hardware comes equipped with a 1.2-GB hard drive and a SCSI connection, which can support one read/write and five read-only external SCSI devices for added expandability. Twister, priced at $1295, is ideal for a small company that needs an intranet Web site quickly.

At first glance, mini Web servers might seem like a bad idea. For a few hundred dollars more, you can buy a cheap Pentium PC and run free or shareware Web server software. But if you're like most people, you place a higher value on the time you save by using one of these turnkey systems. Web server appliances are much more practical and feature-rich than they were when they first appeared roughly a year ago. If you have a particular need, there's likely a small Web server to address it. B

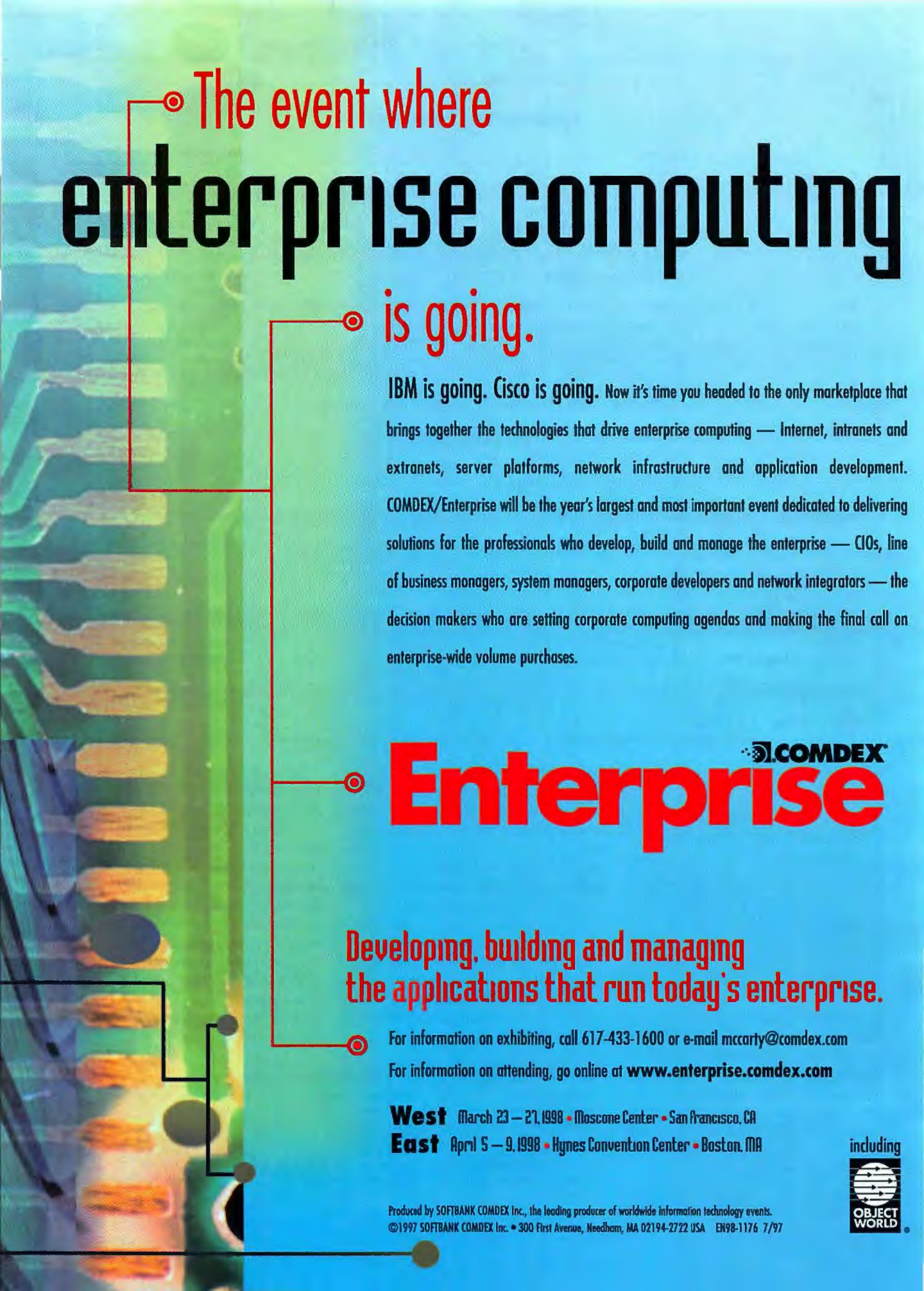
Michelle Campanale (**Michelle@dev5.byte.com**) *is a BYTE technical editor.*

PRODUCT INFORMATION

Twister $1295
Compact Devices
Campbell, CA
408-255-4200
fax: 408-253-4200
http://www.devices.com
Enter 1079 on Inquiry Card.

WebBox $1299
Webtronics
Laguna Hills, CA
714-582-1946
fax: 714-582-3706
http://www.wtnx.com
Enter 1080 on Inquiry Card.

WebZerver $1595
Microtest
Phoenix, AZ
800-526-9675
602-952-6400
fax: 602-952-6401
http://www.microtest.com
Enter 1081 on Inquiry Card.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A trio of loaded, high-megahertz PowerPC 603e–based systems offer great performance at low prices. ***By Tom Thompson***

Three for Speed

The pace at which processor speeds increase continues its relentless advance. Today, systems based on the low-cost PowerPC 603e are available at the peppy speeds of 280 and 300 MHz. Furthermore, three vendors, Umax, Motorola, and—surprise!—Apple, offer Mac OS systems in the $2500-to-$3000 price range.

These are not bare-bones boxes. The systems (Umax's SuperMac C600/280, Motorola's StarMax 5000/300, and Apple's Power Mac 6500) have at least 32 MB of RAM, a fast CD-ROM drive, 16-bit stereo sound, and a hard drive that's 3 GB or larger. Some offer dual monitor support, a 10Base-T Ethernet interface or a 33.6-Kbps modem, and an Iomega Zip drive. All come with lots of bundled software.

System Overview

All three systems come in a mini-tower design and achieve their low price in several ways. The most obvious is the PowerPC 603e's low cost, as well as low RAM prices. All three also use an internal Enhanced IDE (EIDE) hard drive rather than a higher-priced SCSI drive.

The SuperMac C600 and Power Mac 6500 use a set of ASICs (code-named Alchemy) that are based on Apple's Performa 6000 series and target the cost-sensitive SOHO market. However, flaws in system design contribute to a hardware/software glitch in System 7.6.1 that disables the L2 cache, hammering system performance. But this and other difficulties have been resolved through patches or workarounds.

The Motorola StarMax 5000 series uses the Tanzania II main logic board, which was jointly developed by Apple and Motorola. This architecture is a lightweight Common Hardware Reference Platform (CHRP), which uses some mainstream PC parts to reduce system costs.

All three systems use PCI slots for hardware expansion. Depending on the vendor, the number of PCI slots varies from as few as two to as many as five. PCs typically stuff one expansion slot with a SCSI connector card, another with a Sound Blaster card, and perhaps a third with a graphics accelerator. On a Mac OS system, however, 16-bit stereo sound, a SCSI connector, and accelerated video are integral to the system. Thus, the dearth of slots on these Mac OS systems isn't as bad as it might appear to a PC user. In a last vestige of Apple's go-its-own-way mentality, the Performa 6500 design sports a proprietary communications slot, which may or may not be occupied with a fax/modem card.

Software compatibility among these systems was excellent. In my tests, using Microsoft Office; Adobe Photoshop, Acrobat, and Illustrator; Netscape's Communicator; Qualcomm's Eudora Light Internet E-mail program; and a slew of utilities, I encountered no problems. All my favorite extensions and Control Panels worked as well, such as NOW Utilities and Adobe Type Manager (ATM).

At these systems' clock rates, typical operations, such as image editing in Photoshop, flew by quickly. Playback of video CDs through Apple's software QuickTime MPEG decoder was smooth and reliable.

continued

APPLE POWER MAC 6500

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

B MOTOROLA STARMAX

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

UMAX SUPERMAC

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

Apple Power Mac 6500

This system has a 300-MHz 603e processor, a 50-MHz system bus, and 512 KB of L2 cache clocked at 50 MHz. Its 64 MB of RAM is expandable to 128 MB. For storage, it has a 4-GB hard drive, a 12X SCSI CD-ROM drive, and a 100-MB Iomega Zip drive. The communications slot has a 33.6-Kbps Express modem. The built-in video uses the ATI 3D Rage II+ graphics-acceleration chip.

The Power Mac 6500's other expansion features seem rather sparse, particularly since it's the most expensive of the three systems. It doesn't include an Ethernet interface or a second display board. It also sports the fewest PCI slots (two). However, adding a PCI expansion card is a snap: You undo three screws, pull on two tabs, and drag out the drawer that houses the slots. Then you simply plug in the card and slide the drawer back into the system.

Umax SuperMac C600/280

This system has the slowest processor speed of the three, at 280 MHz. The processor sits on a plug-in board, which allows for future upgrades. The 280-MHz speed is partially offset by a 1-MB in-line cache that's clocked at 80 MHz, twice the system-bus speed. This also means that the SuperMac's system bus is the slowest of the trio, running at 40 MHz. In terms of BYTEmark performance, the SuperMac C600 placed last in integer computations, but it actually edged out the faster systems on floating-point computations.

At $2395, it comes loaded with a 12X CD-ROM drive, a 4-GB hard drive, 32 MB of RAM (expandable to 144 MB), an Asante 10Base-T Ethernet card, a second display board with accelerated 2-D and 3-D graphics for dual-monitor support, and a 33.6-Kbps Global Village fax/modem card in the communications slot. It also has a slew of extras, such as a pair of miniature stereo speakers and a JABRA Ear Phone for use with the telephony functions.

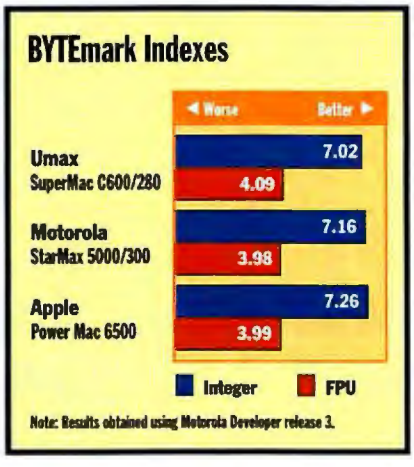
To add a PCI card to the SuperMac, you must first loosen some screws, slide the case off, and remove a support strut. I managed to figure this out without consulting a manual, but the process could be daunting for some people. MPEG playback of the video CD didn't work, but a quick download of a patch from the SuperMac Web site solved the problem. The system doesn't come with a Zip drive, but there are plenty of bays for one.

TECH FOCUS

Power Video

While Microsoft touts the Memphis OS's support for four monitors once it's released, for 10 years the Mac OS has supported up to six monitors. When the Mac II was introduced, Color QuickDraw, the Mac's imaging engine, was designed to support multiple monitors with different pixel depths and resolutions. When you plugged a NuBus video board into the system, the Slot Manager automatically fetched the board's driver and hardware characteristics from its firmware. The Slot Manager passed this information to Color QuickDraw. The user didn't do anything other than arrange how the monitors displayed the desktop. The limitation of six monitors was due to the number of NuBus slots in the Mac II.

For PCI Macs, an Expansion Manager obtains board information for Color QuickDraw. The different bus interface necessitates this new Manager. Open Firmware obtains the board's driver, initializes it, and passes board characteristics back to the Mac OS. As before, no user intervention is necessary: You simply plug in the board and start the system. You use the Monitors and Sound Control Panel to arrange the orientation of the monitor screens.



Motorola StarMax 5000/300

On the outside, this box looks almost as smart as the Apple unit. There's a lot to like on the inside, too: a 300-MHz 603e processor, 512 KB of L2 cache (expandable to 1 MB) on a 50-MHz bus, 32 MB of RAM (expandable to 160 MB), ATI 3D Rage II+ accelerated graphics for the built-in video, a 16X CD-ROM drive, a 4.3-GB hard drive, 10Base-T Ethernet, an IMS Twin Turbo graphics card for dual-monitor support, and an internal 100-MB Zip drive—all for a price of $2899.

While the StarMax placed last in both the BYTEmark integer and floating-point calculations, the difference among the three systems was so small that it was unnoticeable. With the unit's Ethernet interface, accelerated graphics, and large hard drive, I found myself using it a lot.

The one dark side to the StarMax is adding a PCI card. Of the three systems, this was the hardest to do this on. I had to consult the manual to figure it out. And the procedure involves some disassembly—again, a bad thing for the average user.

A Close Race

Of the three systems, I prefer the StarMax because it's well built and about as fast as the other two. The mix of extras, such as the Ethernet interface, Zip drive, and second display card, make it attractive. Plus, it has no problems with MPEG playback. In addition, the Tanzania II design means that you can use a spare PC mouse and keyboard on the system.

The SuperMac C600 places a close second, with nearly the same goodies and a price of just under $2400. Despite its good performance, the Power Mac's high price and lack of a second display and Ethernet interface means I can't recommend it over the Motorola and Umax systems. B

Tom Thompson is a BYTE senior technical editor at large. You can reach him by sending e-mail to **tom_thompson@bix.com.**

PRODUCT INFORMATION

Apple Power Mac 6500
$3000
Apple Computer, Inc.
Cupertino, CA
408-996-1010
fax: 800-505-0171
http://www.apple.com/
Enter 1084 on Inquiry Card.

Motorola StarMax 5000/300
$2899
Motorola Computer Group
Tempe, AZ
512-434-1526
fax: 602-438-4636
http://www.mot.com/computer/starmax/
Enter 1082 on Inquiry Card.

Umax SuperMac C600/280
$2395
Umax Computer Corp.
Fremont, CA
510-226-6886
fax: 510-623-7350
http://www.supermac.com
Enter 1083 on Inquiry Card.

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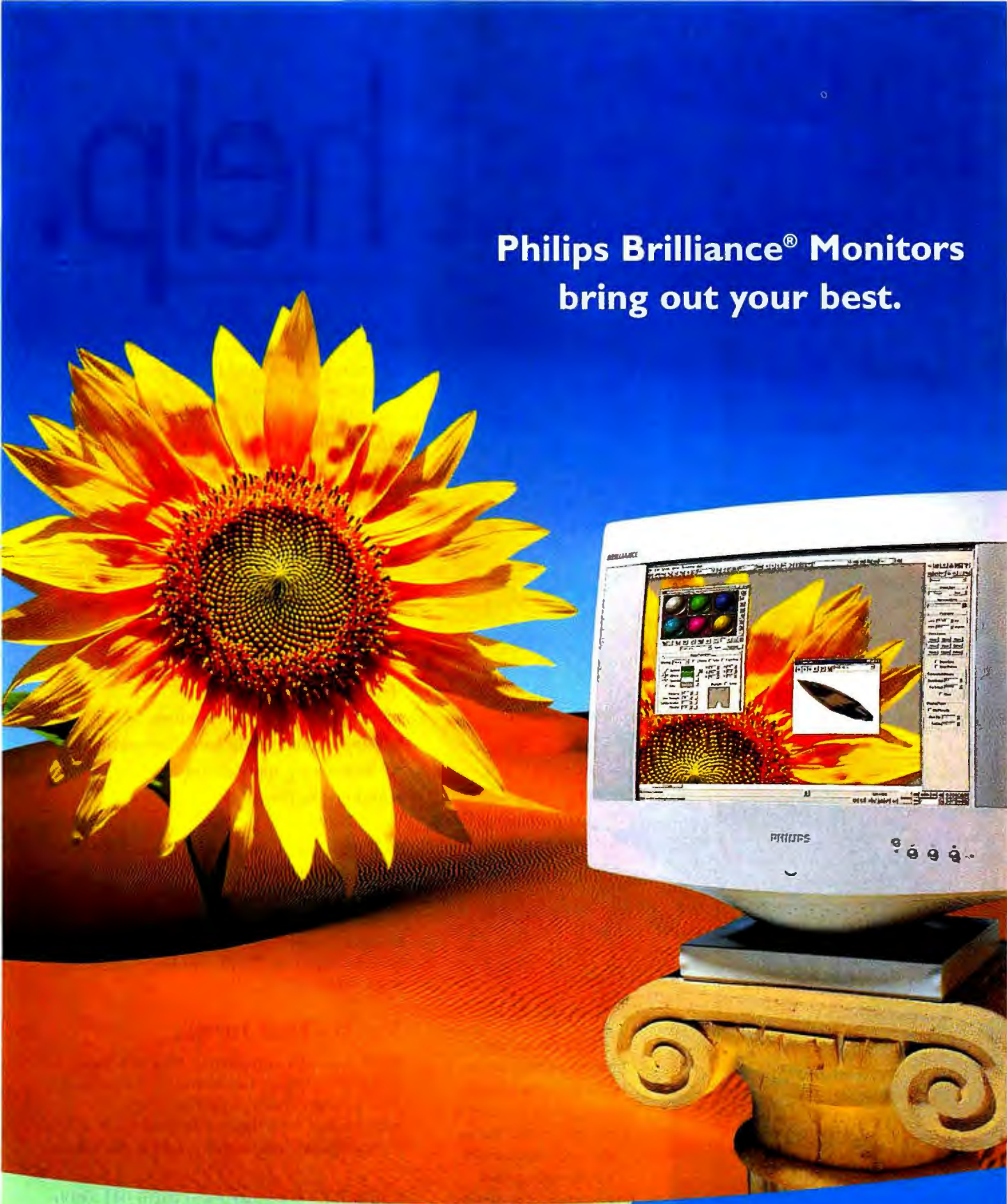

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Manager of Technology and Development Support,
Discovery Channel Multimedia

Jerry Pournelle

Chaos Manor

Virtual Publishing—and Virtual Travel

Jerry takes to the skies with a new laptop—and muses on some virtual possibilities.

Microcomputers went to Mars. That's appropriate. Single-chip computers were developed for on-board guidance of ICBMs. One cause of war is competition for scarce resources. Ninety percent of the resources available to humanity are not on the Earth. Now, microcomputers help explore the solar system and help make ICBMs obsolete.

At the 1986 meeting of the Citizens Advisory Council on National Space Policy, we recommended that the U.S. abandon enormous missions in favor of smaller and more focused missions making use of the latest off-the-shelf technologies. That was first done by the Air Force with projects like Clementine. It took NASA longer than I thought it would, but, in fact, the change from expensive missions to the "smaller, faster, cheaper" missions epitomized by Pathfinder came at blinding speed for a big government agency. I can claim a little credit for getting NASA thinking in that direction (not so much me as the council I chair), but most of the credit goes to Dan Goldin, the best administrator NASA has had since Apollo. Congratulations all around.

Not only did we get images from Mars, but they were distributed over the Web. NASA's Web site—that's http://www.nasa.gov; nasa.com is a private-joke site featuring some mild sex ads—got over 100 million hits in less than a week. Who says the American people aren't interested in space?

Now all we need is for Digital Equipment to perfect the Millicent cash-transfer system I wrote about in the July Web Exclusive column. This is a method for collecting small—less than a dollar—fees over the Internet with transaction costs of a fraction of a cent. I doubt that a dime a hit would have deterred many people from looking at the Mars pictures, and 100 million dimes would pay for 5 percent of the mission's cost. The 100 million rate wouldn't be sustained for 20 weeks, but even so, this could be the beginning of a new era in space-mission financing. After all, some movies have cost more than Pathfinder did. I'd rather pay 10 bucks to see more Mars experiments than to see *Waterworld*.

THIS HAS BEEN A BUSY MONTH at Chaos Manor. We had to tent the house to get rid of termites, there have been several trips, Larry Niven and I are hard at work finishing *The Burning City*, and there were a couple of medical emergencies, not serious, but time-consuming. There's a lot here this month, but I suspect the column will definitely live up to its name.

Who says the American people aren't interested in space?

I'm writing this part of the column in the Denver airport and later on a United Airlines flight; which is to say, in the anteroom to purgatory. I can recall when I looked forward to a few hours on an airplane. No telephones, and I could get some work done. Now the seats are so close together that you can't open your laptop if the passenger in front of you leans the seat all the way back.

I don't know what happened to America, but suddenly the only thing anyone cares about is money. So many people are willing to endure acute misery to save a few bucks that there aren't any reasonable choices for people who would pay, say, 10 percent more in fares to get 10 percent more space. Since airline operation costs are driven by fuel costs, and fuel costs are driven by weight carried, it wouldn't cut much into profitability to have such a section for long flights.

I am no great fan of regulations, but I do wonder if the nation can keep its sanity when travel is both stressful and time-wasting, and our businesspeople and government executives are stuffed into seats 17 inches wide with no legroom and no way to open a laptop. Surely there's a better way than this!

One thing is certain: the misery of modern air travel (at least in tourist class) will hasten the development of tools for letting us avoid the travel altogether. Virtual reality, here we come.

I'm carrying a Compaq Armada 4160T, which I've named Armadillo. In case you're wondering, I like armadillos. This is about the best laptop I've ever had. It works extremely well, provided you can get the screen at the right vertical angle. Unfortunately I can't, because the chap in front of me has his seat back as far as it will go; so it's very hard to see the Word '95 menu items and toolbar icons. I've set Word to the Pournelle option: white letters on a blue background. (Chris Peters, who used to own Word at Microsoft, put it in at my request.) Thus, my text is visible; it's the menu bar I can't see too well. I can live with that; now if the kid behind me will stop pounding on my seat.

This is my second Armada. The first was an early model that had problems with the power management software. This one doesn't have that difficulty. There's

an item in the Shutdown menu that says "eject PC"; execute that, wait a moment, and undock. It trundles for a bit and then you can either shut down entirely or put the machine to sleep.

You can "suspend" the machine either by software or with a hardware button. For some reason, the button is more prominent than the power button. It works well, once you remember that you get back in control not by pressing the suspend button again, but by a single press of the power button. Pressing the suspend button wakes the system up just long enough for it to realize that the suspend button was pressed, after which it goes back to sleep. This can be disconcerting until you figure out what's going on.

It wakes up right where you left it, for instance at the point where I left off typing this; and it comes on instantly. The suspend operation doesn't use much power, less than 10 percent for several hours.

Screen brightness noticeably changes when you go to battery power; it's still bright enough to see in broad daylight (from the correct viewing angle), although it's not as bright as the Nimantics Orion's screen. On the other hand, the batteries last a lot longer. If you're not using the CD-ROM drive, you can get nearly 4 hours of Word with the Armada, as opposed to a good bit less than an hour with the Orion. I also managed nearly 3 hours of battery life playing Interplay Productions' Conquest of the New World, a game that regularly uses the CD-ROM drive.

Conquest is a DOS program, and the Armada's power management didn't give much warning before it dumped me to the Windows 95 control screen; there's far more warning in Win 95 programs. On the other hand, an instant press of the suspend button preserved everything until I was able to bring up the system under outside power. I lost no data, not even the last move I made in the game. The bottom line is that I have got as much useful battery life out of the Armada as I have from any portable I ever had—and a lot more than I got from most of them.

The Armada comes apart. The top half is a neat portable using the main battery as a handle—a feature I like a lot. It's a bit heavier than the Gateway 2000 Liberty, but still small enough to carry to meetings. The bottom half contains the CD-ROM drive, better sound, the docking port, and another battery bay. You can wrap it up in pajamas and ship it in checked luggage, but I've found it no great hardship to take the entire machine on an airplane. However, I do appreciate the take-apart feature when I want to take notes in a meeting.

My son Richard runs his business from an IBM ThinkPad. I could do the same with Armadillo, and I like its mushpad better than the eraserhead pointing device on the IBM systems. This Armada has a 166-MHz Pentium MMX, and I haven't found a game (or anything else, but games are a strenuous test) it doesn't run well. At 800- by 600-pixel resolution, text in Word looks all right (the higher the resolution, the better a good font such as Times Roman looks).

It's fast: Norton System Information reports a 26. By contrast, the Cyrix P-166 gets a 43. Benchmarks don't mean a lot: systems are either good enough or they aren't, and this one definitely is. For example, I can save this entire column, with Word set to make a backup—don't *ever* trust fast save—in a second or less, and all 100,000 words of *The Burning City* are saved in under 2 seconds. Even for someone who saves as often as I do, there's not much room for improvement with more speed. What more do I need?

Benchmarks don't mean a lot: systems are either good enough or they aren't.

The keyboard is small, but it's more than adequate. Back at the airport, I got some real work done with this machine, and if I had any room, I'd be able to do some work now instead of playing Conquest of the New World. I was also able to do some Visual Basic programming while waiting in the doctor's office the other day. All told, this is a great portable.

A couple of complaints, neither exclusive to the Armada. First, the Caps Lock key. I've become used to the idea of Ctrl being on the row with the space bar, and given that the convention for select all is Ctrl-a, I even prefer Ctrl down there. It's all too easy to hit Ctrl-a on a portable with its smaller keys, and if you do hit Ctrl-a and then another key, you can lose all your work. Word has an undo feature, but some of the communications editors I have don't; so I am not only resigned to Ctrl being away from the *A* key, I welcome it. I realize that's a shock to some readers.

Alas, it was replaced by the Caps Lock key, and that one is also all too easy to hit; this doesn't result in a disaster, but it's very annoying. If left to me, Caps Lock could be up with the numbers, or above them, or even on the back side of the machine, or require a key switch. I don't use it a lot, and when I do, I certainly don't need it instantly accessible. If they can't move Caps Lock, I wish they would give me the option of changing it so that I'd have to do Shift Caps Lock to turn it on.

My only real complaint is that the screen could be just a little brighter under battery power; but, of course, that would come at the expense of battery life, and it's not as if this isn't good enough for real work. I could also wish it were a bit lighter, but I've never had a portable I didn't wish that of. Faced with a trade-off between weight and features, I tend to take features every time and carry a roll-on travel case that leaves ruts in the Tarmac; and with the Armada, I can take the top half to meetings.

Incidentally, redocking is incredibly easy: just push the machine into the docking port. It realizes instantly that things have changed, trundles a second, restores the network, and Bob's your uncle. I love it. If you're looking for a full-featured laptop, either as a second machine or your only one, look at the Armada. Highly recommended.

I MENTIONED ABOVE THAT WHITE on blue was a feature added to Word at my request. It's one reason I use Word, although the chief reason we switched was the document-comparison/revision-detection capability. Anyway, I have another request, this time for a feature Symantec added to Q&A Write when I asked for it.

I need a better word count.

Q&A Write had this neat feature: Ctrl-F3 brought up a small box that showed the number of words, the number of lines, and the number of paragraphs before the cursor, after the cursor, and in the entire document. The product manager said it was an easy feature to add.

This was wonderful for writers. I could set line lengths and then write the exact number of lines needed. For some assignments, that can be critical. Moreover, I could keep a bunch of notes at the bottom of a text file, start at the top writing finished text, put the cursor at the end of the actual text, and find out instantly

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how much real text I had as opposed to notes. This is a valuable feature. Of course, you can sort of do it with Word by cutting and pasting and getting word counts for different windows, but that takes excessive effort; it's much nicer to simply hit Ctrl-F3. Please, fellows?

THE OTHER NIGHT, I DOWNloaded Netscape Communicator, which is a step up from the last version of Netscape Navigator Gold. It works pretty well and has some nifty new features. It's not hard to install, and it's fairly easy to use. Alas, it has some instabilities. I don't remember the last time Navigator Gold crashed, but I've had three crashes with Communicator. None of them were serious: the program shut down without terminating my Internet connection and didn't seem to affect Win 95.

ERIC POBIRS, THE CHAOS MANOR intern, has been testing ATI's All-In-Wonder board and has this to say:

"At $329, the ATI All-In-Wonder (AIW) video board deserves the title. In a single slot, ATI provides 2-D and 3-D video acceleration, MPEG-1 decoding with full-screen scaling, video still capture, motion-video capture, NTSC output (via composite and S-Video), NTSC input from direct and cable (up to 125 channels), close-caption display and capture, and channel scheduling. While some competitors offer comparable feature sets by adding daughterboards, ATI's approach is more compact, more convenient, and less expensive.

"Installation gave some problems. RacingCow, the Gateway P-133 I installed the AIW into, also has a recently installed digital videodisc (DVD) kit. The first generation of DVD drives cannot read CD Recordable (CD-R) discs. One guess what format the ATI software came on.

"We installed the software over the network. Note that the default for CD-ROM (and all other) drives is not shared. Once we set sharing on the remote machine, we could install the AIW software.

"A full installation of the ATI software is more difficult than it should be. To enable all the features (and why buy the board otherwise?) requires invoking the installer several times. Common off-the-shelf tools such as InstallShield allow for complex installations and should be able to deal with the multistage operation called for here. At least the installation is covered in the printed documentation. Little else is. Mastering the interface is a bit confusing at first. I expect it's covered in on-line form somewhere, but a dozen pages added to the manual would have been appreciated.

"That aside, the software is good. The tabs added to the Display control panel allow more adjustments than most other video boards. The video capture/playback is well designed once you understand the

Every now and then, the Internet delivers rewards great enough to keep you trying.

I say seem to because hours later I did have some problems, applications running unusually slow, that sort of thing, which were cured by shutting down and bringing the system back up. That sort of thing used to be fairly common but hasn't been for weeks now, and since the only unusual event in the last hours was the Communicator crash, I have my suspicions.

For all that, I'll keep using Communicator, which has a nicer interface and works well indeed when it's working.

I consider the Internet a form of black magic anyway. Half the time on the Internet is spent waiting for something—anything—to happen, and half the remaining time, what is happening isn't interesting. On the other hand, it's a bit like fishing for steelhead trout. Most of your time is spent being miserable, waist-deep in freezing water; but catching one is rewarding enough that you will try again. Every now and then, the Internet delivers rewards great enough to make you keep trying.

MEANWHILE, I'VE ALSO BEEN improving my Web site. Go to http://www.earthlink.net/~jerryp/ to have a look—and while you're on the Web, drop by the BYTE site and read the Web Exclusive part of this column for much more on some of the problems I've encountered.

I've added some photographs taken with my wonderful Olympus D300-L digital camera, and mind you, that wasn't one of the problems. Olympus sent me a parallel-port version of the software; it works, and so does what they have up on the Web now. It may not be simple enough for unsophisticated users yet, but BYTE readers won't have any trouble with it.

basics. Video scaling is excellent. Playing Twister from DVD looked as good as any TV, even though the system was set at 1024- by 768-pixel resolution. Most inexpensive NTSC-over-SVGA products I've seen either produced a highly distorted playback or could fill only a small window.

"In full-screen mode, an optional row of icons provides access to the capture functions. Grabbing a perfect still from Twister was as simple as clicking on the mouse. While not as portable as Play's Snappy, the AIW fills the same role and adds motion capture for a much lower price.

"In addition to displaying full-screen NTSC video, the AIW also handles close-caption display. The intelligence of the PC lets users do things they wouldn't dream of using a TV. You can specify key words or phrases to activate an alert if they appear in a broadcast. You can save captions as a text file to create free transcripts. By using the scheduler, you can produce a transcript automatically. Often, this may be more convenient than a videotape.

"One place the AIW falls short is in 3-D performance. Diamond Multimedia's 3Dfx leads in direct support by game developers. Support for the ATI Rage II+ chip is mostly in the form of Microsoft's Direct 3-D API, which currently doesn't support as many advanced features.

"Normally, this wouldn't be much of a handicap, since the add-on nature of 3Dfx boards lets them supplement a serious gamer's primary video device. But one of the most appealing features of the AIW is its output to TVs. None of the 3Dfx boards (or Power VR for that matter) can be used simultaneously with the TV output, thus putting a major dent in the AIW's value to gamers. ATI claims its new generation of 3-D chips will put it on an even footing with the leaders in 3-D, but for now, you can't have it all. If an AIW using the new chips could also decode MPEG-2, it would be an excellent DVD solution."

When the Diamond Multimedia Monster Sound card arrived, Eric, who's more enamored of computer games than anyone I know, was eager to get at it. He set it up with six speakers—four tweeters and two woofers—and soon I was listening to helicopters flying around the room. The 3-D sound effect is very good indeed, and the audio realism (we're using Altec-Lansing speakers) is awesome.

Eric's report is in the Web Exclusive part of the column. There are some drawbacks to the Monster Sound card, but there are definite advantages. Recommended, but read the report.

The 3-D sound effect is very good indeed, and the audio realism is awesome.

GARRETT COMMUNICATIONS has done it again. A few years ago, I got an H-80 Micro Ethernet Hub. This is a small box that has one thin-net and six twisted-pair Ethernet jacks. One of the twisted-pair sockets has a switch that lets you use it to chain the hub to another. It runs at

10 Mb, never needs attention, and is indispensable for my system.

Now they have the Magnum 600ES Personal Hub Plus. This has six 10Base-T sockets and runs at 100 Mb. You can switch one of the sockets to connect to a 10-Mb hub such as the H-80, so the device serves as a bridge. You can switch another socket to plug into another 100-Mb hub, so you can daisy chain these.

Most of my Ethernet is 10 Mb, because I haven't made any serious effort to collect 100-Mb Ethernet cards. However, both Armadillo and Princess, the dual-processor Compaq Professional Workstation 5000, have 100-Mb Ethernet, and I make no doubt I'll get other 100-Mb machines soon. I plugged the 100-Mb systems into the 600ES, left the 10-Mb systems plugged into the H-80, connected the two Garrett devices, and whammo! Garrett is to Ethernet hubs and bridges as Granite is to SCSI cables: rugged, reliable, and worry-free. Highly recommended.

THE COMPUTER BOOK OF THE month is Edward Yourdon's *Death March: Managing "Mission Impossible" Projects* (Prentice-Hall, ISBN 0-13-748310-4). This is a manual on how to manage projects "doomed to failure" and turn them into successes. That sounds like pretentious nonsense, and coming from anyone but Yourdon, it probably would be; but this book is well worth your time and money. Yourdon's been there, and he can write; if you manage software projects and you're not the pointy-haired guy in "Dilbert," you will want this book.

The book of the month is a good novel by Victor Koman called *Kings of the High Frontier*. Unfortunately, it's intertwined with a bad novel and at least two dull political tracts. The book is about getting to space despite NASA and the government, and I kept reading it, but I have to say, I skimmed a fair amount. Mr. Heinlein said that he never saw a book that couldn't be improved by cutting from 10 percent to 50 percent; this one is no exception. It also suffers from putting characters in funny hats (literally in one case). In fairness, it covers a lot of territory, and big multiviewpoint novels can get away from more experienced novelists than Koman.

Many years ago, I postulated "information utilities": places where you might put intellectual work, such as a novel. Those who want to read your work would pay a small fee direct to you. "Where," I

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asked rhetorically, "is the need for that bloodsucking publisher?" In those days, I didn't realize that the physical production of books was one of the least of the tasks of the publisher. That gets contracted out anyway: few publishers own printing presses. What publishers do is edit books, arrange for publicity, and distribute them.

In Koman's case, distribution is electronic; visit http://www.pulpless.com for instructions. You can download the book in Adobe Acrobat or other formats. You can also arrange to have a copy printed and mailed if you don't want to read it on-screen. Pulpless pays the author something like half the money received. I read the book on the airplane. I probably wouldn't have if I hadn't had a paper copy; reading it on-screen in an airplane seat would have been pretty grim.

Within a few years, however, I suspect we'll have small, portable "book machines" about the size and weight of a paperback and capable of reading discs off smaller versions of a CD-ROM drive. The book machines will be as easy to read and as convenient to carry as a book. When they become widely available, they will completely change the publishing industry. It's not that books, especially hardbound books, will go away; but much of the mass paperback publishing will be displaced by personal book machines.

When that happens, there will still be the need for editors; and there will be so many books available that there will be an even greater need for reviewers.

It's late, and I'm out of time and space. Next month, more of same. Stay well. B

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BYTE

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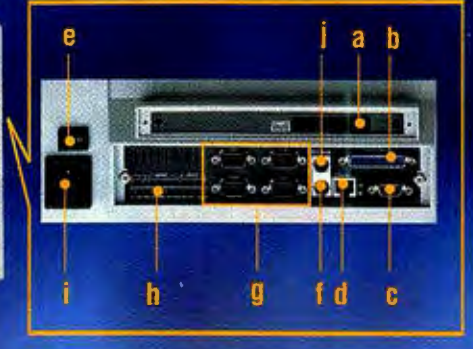

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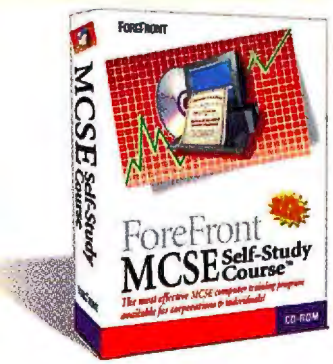

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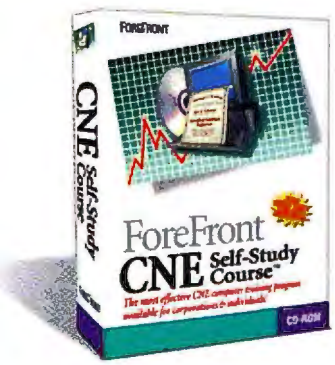

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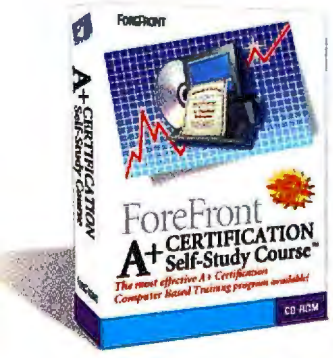

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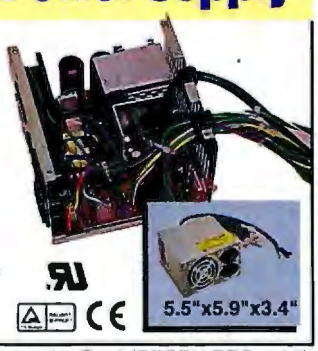

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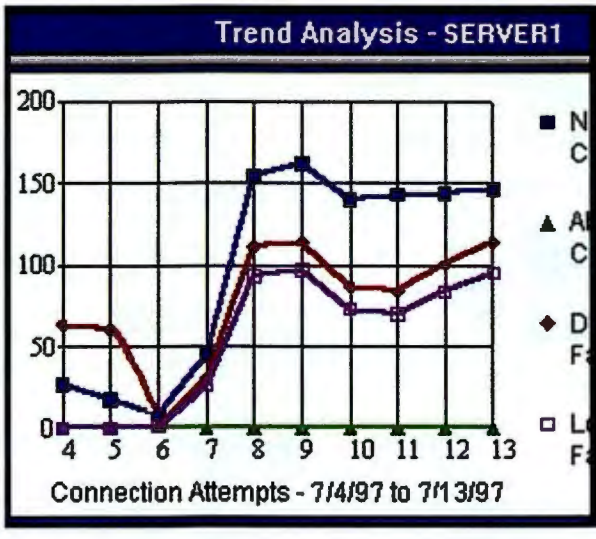
BorderManager links Internet and IntranetWare, but it doesn't go far enough. By William Wong

Novell's Internet/IntranetWare Connection

Novell's new BorderManager weds NetWare/IntranetWare networks with the Internet in an interesting marriage of technologies. The late beta I evaluated had something old, something new, and something borrowed.

BorderManager bundles technologies previously available only as part of other Novell products; Novell's multiprotocol router and IPX-to-IP gateway are something old. Something new includes virtual private network (VPN) support, a firewall, and caching. Novell even borrowed a 45-day evaluation version of Microsystems Software's URL-filtering software, CyberPatrol.

Though Novell would have you believe BorderManager works for everyone, the same tight integration with Novell products and standards that's a turn-on for NetWare administrators will be a turn-off for practically everyone else. BorderManager uses the Novell Directory Services (NDS) to provide a centralized solution for dealing with network security and management for all components, even for networks with multiple BorderManager servers. The firewall supports packet filtering, circuit gateways, and application proxies, with access controls for packet, host, application, and content. BorderManager uses the Internet Caching Protocol (ICP) to cache pages from multiple local Web servers hierarchically for distribution to the Internet.



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ClearView provides a central Windows-based tool for monitoring and controlling current links to the dial-up communication server.

BorderManager's VPN support works only between BorderManager servers, though support for VPN remote client connection to IntranetWare networks is in the works. Novell Internet Access Server (NIAS) includes multiprotocol routing support for IPX and IP and IP-to-IP network address translation (NAT). NAT reduces security exposure by essentially "stealthing" internal network structures; attackers can't hack systems they can't see.

Novell has added snappy Windows GUIs to centralized management, monitoring, and reporting tools, although the server-based configuration and administration tools still sport dreary character-based UIs. ConnectView, a GUI management tool, centrally monitors and controls dial-in network connections with real-time graphical displays, but Novell old-timers might prefer BorderManager's NetWare loadable modules (NLMs), which can overwhelm the uninitiated.

BorderManager's IPX support lets you integrate IPX and IP networks with minimal client reconfiguration. Ultimately, this software is not for casual network managers; it requires patience, planning, and a strong background in data communications, NDS, and IntranetWare to make BorderManager hum. It does provide some of the services needed to boost IntranetWare into TCP/IP internetworking, but non-NetWare administrators have little compelling reason to consider it, and harried techs at smaller NetWare shops may find it too complex. B

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

*William Wong (**bwong@voicenet.com**) is a computer consultant and author.*

TECH FOCUS

BorderManager and NDS

Novell's IntranetWare has had communication support and Internet access from a variety of sources, including Novell, but BorderManager is the first product that ties all the comm services together under one roof, the Novell Directory Services (NDS). BorderManager uses NDS for all security and management tasks as well as to support remote access, Internet connections, and virtual private networks (VPNs).

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What's New

Hardware

High-end notebooks from Digital and NEC, processor upgrades, portable Active Server Pages, a math tool, and crypto accelerators.

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Bigger, Better, and Still Fits in Your Lap

Laptop screens keep getting bigger, but the latest notebook from Digital, the HiNote Ultra 2000, has a 14.1-inch XGA 1024- by 768-pixel active-matrix display that may define the best size of all. This laptop has all the features you'd expect in a $6000 state-of-the-art system, including a 166-MHz MMX Pentium, 32 MB of RAM, a 2-GB user-replaceable hard drive, a 20X CD-ROM, a built-in modem, a touchpad, and a lithium-ion battery. Weighing under 5 pounds and measuring 1.4 inches thick, it's easily transportable. A built-in, replaceable USR Sportster Winmodem attaches to a back-panel phone jack (with room for the to-come LAN adapter's RJ-45 jack).

The screen captures your attention right off. Tests with Sonera's DisplayMate for Windows test patterns showed a lack of geometric distortion, which characterizes all flat-panel screens. Digital has managed to package all this into an amazingly small space, with the edge of the display only ⅜ inch from the case edge. Do the math, and you'll see that this has more than double the display area of a 12-inch panel, and the XGA resolution lets you take good advantage of the extra real estate. (But the weight of the display in the lid tests the holding ability of the hinges.)

In addition, the ½-inch-thick multimedia base adds another drive bay, more ports (including a USB connection), full wave-table sound with stereo speakers, and a subwoofer.

I almost fell in love with this machine, but I had some trouble adapting to its very flat keyboard. It's also expensive, although Digital offers a model with a 12.1-inch screen for a kilobuck less. Of course, the real attraction is the 14-inch display, which, frankly, redefines the term "desktop replacement." **—Russell Kay**

PHOTOGRAPH: SHAFFER/SMITH PHOTOGRAPHY © 1997

Notebooks

New Features in a Notebook

NEC'S VERSA 6200 FAMILY ($5199 TO $5999, built to order) brings new features and options to the high-end laptop market. The Versa line is among the first to feature the LS-120 drive for 120-MB floppies as well as an optional 24X CD-ROM drive. The LS-120 fits into the same bay as the CD-ROM or standard disk drive unit, and it can be used simultaneously with external CD-ROM drives. The NEC 6230 laptop comes loaded with the recently announced 233-MHz Pentium. All systems in the family have two PC Card adapters, one USB port, serial and parallel ports, and a connector for the Docking Station 6000. The basic configuration has a 13.3-inch XGA display with 1024 by 768 lines of resolution, a 10X CD-ROM drive, a 166-MHz Pentium with MMX, 32 MB of RAM, and a 2.1-GB hard drive.

Contact: NEC Computer Systems Division, Mountain View, CA, 800-632-8377; http://www.nec-computers.com.

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Processors

Beat Processor Obsolescence

RATHER THAN RETIRE A CREAKY OLD SYSTEM, you can simply pull the existing processor from a desktop PC or 486-based laptop and plug in an Evergreen processor for more computing power. Evergreen's 586 upgrade ($129) increases the processing output of most brand-name 486DX, 486DX2, and 486SX notebooks to the power of the 133-MHz AMD 5x86 processor. Plug in the Evergreen PR166 ($259) to upgrade 75-MHz systems to 166-MHz performance, or add the Evergreen MxPro to upgrade select 75-MHz systems to 200 or 233 MHz with MMX technology. The 200-MHz AMD K6 upgrade with MMX costs $349; the 233-MHz AMD K6 with MMX is $499.

Contact: Evergreen Technologies, Inc., Corvallis, OR, 541-757-0934; http://www.evertech.com.

Enter 1051 on Inquiry Card.

Systems

Home Entertainment on a PC

TOSHIBA'S NEW INFINIA LINE BRINGS NEW options and easy Internet access to the home PC. All four systems include a 200-MHz or faster Pentium with MMX. The Infinia 7231 ($2699) features a 9X-compatible DVD-ROM drive, hardware-accelerated MPEG-2, and bundled movie-controller software. The high-

end Infinia 7260 ($2899) has a 266-MHz Pentium II processor, a 6.4-GB hard drive, and 64 MB of EDO DRAM. All systems offer one-touch Internet access: A button mounted on the monitor gives you access to e-mail and special-interest Web sites through a Web service that Toshiba provides.
Contact: Toshiba America Information Systems, Inc., Irvine, CA, 800-457-7777; http://www.computers.toshiba.com.
Enter 1049 on Inquiry Card.

More-Powerful 3-D Workstations

INTERGRAPH'S TDZ 2000 3-D GRAPHICS workstations (from $10,495) come with a 300-MHz Pentium II processor, a RealiZm II 3-D graphics accelerator, 64 MB of RAM, a 4-GB hard drive, a 24X CD-ROM drive, and a floppy drive. The TDZs, powered by single and dual 300-MHz Pentium II processors, feature Intergraph's RealiZm II OpenGL 3D graphics and DirectBurst technology. Offering up to 63.2 GB of disk storage, they support up to 11 PCI slots, 3-D graphics enhancements, peripherals, and disk subsystems.
Contact: Intergraph Computer Systems, Huntsville, AL, 800-763-0242; http://www.intergraph.com.
Enter 1087 on Inquiry Card.

New Pentium II Systems

THE PENTIUM II DELL DIMENSION XPS "D" line comes with 233- or 266-MHz Pentium II processors and uses Intel's new 440LX chip set. The sys-

tems range in price from $2399 to $3799 and offer such features as an 8.4-GB hard drive, 4 MB of video memory, an optional 19-inch monitor, and a 24X Max Variable CD-ROM drive.
Contact: Dell Computer Corp., Austin, TX, 512-728-4100; http://www.dell.com.
Enter 1050 on Inquiry Card.

Multifunction

One-Stop Shopping

CANON'S MULTIPASS C3000 ($549) CAN handle all your printing, scanning, faxing, and copying needs for the home or small-office environment. The MultiPass is a four-color ink-jet printer with 400-dpi capability and a built-in scanner with 256 gray scales. It can receive and print plain-paper faxes or send PC faxes directly from most Windows applications.

The unit measures 15.75 inches wide, 14.2 inches deep, and 7.75 inches high, and it weighs 13.2 pounds.
Contact: Canon Computer Systems, Inc., Costa Mesa, CA, 800-848-4123; http://www.ccsi.canon.com.
Enter 1056 on Inquiry Card.

Videoconferencing

Videoconference on the Road

THE WINNOV VIDEUMCAM DESKTOP ($299) and Traveler ($299) videoconferencing cameras provide 352- by 240-pixel resolution and 16.7 million colors for portable or desktop computers. About the size of a computer mouse, the PC version has an ISO card for installation on a desktop PC, and the portable version has a Type II PC Card adapter for connecting to a laptop. The cameras support all industry videoconferencing protocols and work with Microsoft NetMeeting, White Pine's CU-SeeMe, VDOnet VDOPhone, and other videoconferencing software. The units have a 90-MHz Pentium and 16 MB of RAM and run with Windows 95 or NT 4.0.
Contact: Winnov, Sunnyvale, CA, 408-733-9500; http://www.winnov.com.
Enter 1058 on Inquiry Card.

Cards

Quick on the Draw

THE POWERSTORM 4D30T ($2999) FROM Digital is a new midrange graphics accelerator for high-performance 2-D and 3-D graphics in the desktop/workstation environment. This single-slot board is based on a chip from Evans & Sutherland that provides a 16-MB frame buffer and 1280 by 1024 resolution. The PowerStorm can draw 2 million triangles per second and perform most texture-mapping jobs, limited only by the amount of memory loaded on your system.
Contact: Digital Equipment Corp., Maynard, MA, 800-344-4825; http://www.workstation.digital.com.
Enter 1053 on Inquiry Card.

Copiers

Color Copiers

HEWLETT-PACKARD HAS USED ITS INK-JET and scanner technologies to create two series of color copiers. The Color Copier 200 series ($999) copies black-and-white documents at up to 10 copies per minute and prints at 600 by 600 dpi in both color and monochrome. The Color Copier 100 series ($699) has 600- by 300-dpi printing capabilities in color and 600 by 600 in monochrome. Print speeds are up to 7 cpm in monochrome and 3 cpm in color. An automatic multicopy document feeder with 40-sheet capacity is available for the 200 series.
Contact: Hewlett-Packard Co., Palo Alto, CA, 800-752-0900; http://www.hp.com.
Enter 1086 on Inquiry Card.

Storage

New Disk Drive Technology

THE LS-120 DISKETTE HAS THE SAME shape and size as a standard 1.44-MB 3½-inch diskette, but it has a formatted storage capacity of 120 MB. The Imation SuperDisk Drive ($199) is an external parallel-port drive for LS-120 disks. The technology places optical reference tracks on the diskette that are written and read by a laser system. The optical sensor in the drive allows the read/write head to be precisely positioned over the magnetic data tracks, enabling track densities of 2490 data tracks per inch, versus 135 tpi for a 1.44-MB diskette.
Contact: Imation, Oakdale, MN, 888-466-3456 or 612-704-4000; http://www.imation.com.
Enter 1057 on Inquiry Card.

Printer

A Small, Colorful Ink-Jet Printer

THE LEXMARK 1000 OFFERS 600- BY 600-dpi color printing for a mere $139. Measuring 14.2 inches wide, 6.3 inches deep, and 6 inches high, the unit weighs 8½ pounds. Its paper-

handling tray holds 30 sheets, it can print 3.5 ppm in black ink and 1.5 ppm in color, and it handles banner printing, manually fed envelopes, and transparencies. It works with Windows 95, 3.1, and 3.11.
Contact: Lexmark International, Inc., Lexington, KY,

606-232-2220;
http://www.lexmark.com.
Enter 1060 on Inquiry Card.

Scanners

Import Real Objects into 3-D Programs

THE ROLAND PICZA SCANNER ($1195) uses a needle to physically map the surface of small objects, such as Matchbox cars or dolls, for im-

porting into 3-D drawing programs as DXF or IGES files. The tool also works with the Modela 3-D plotter ($1195) to reverse-engineer an object. The Modela plotter can carve small models into balsa, Styrofoam, wax, or other materials to create models of your 3-D files or copies of objects it has scanned.
Contact: Roland Digital Group, Irvine, CA, 800-542-2307 or 714-727-2100; http://www.rolanddga.com.
Enter 1055 on Inquiry Card.

Networking

No-Hassle ISDN

ARESCOM'S APEX 1100 ISDN ACCESS router ($679) comes bundled with the Apex Wizard application to simplify configuration. The Wizard automatically configures most of the information needed for ISDN access, including phone and SPID numbers, and supports remote dial-in access for resetting the router in the event of a crash. An unlimited number of Ethernet LAN users can access the ISDN line simply by plugging into the IP network.
Contact: Arescom, Inc., Fremont, CA, 510-445-3638; http://www.arescom.com.
Enter 1054 on Inquiry Card.

Servers

Hot-Pluggable Server Technology

NETFRAME'S CLUSTERSYSTEM 9008 ($9995), a quad-processor Pentium Pro platform designed for remote-office, application-server, and mid-size business environments, offers hot-pluggable PCI technology, allowing users to add and replace individual PCI cards and device drivers without shutting down the system. When a new PCI card is added or replaced in the server, the OS software is notified; it then reconfigures the system to recognize the new resource without disrupting on-line users. A hinged top door provides access to PCI slots on the I/O board, enabling users to easily swap or add standard PCI cards to the system. The ClusterSystem 9008 has room for up to eight internal Hot Plug drives, three N+1 redundant Hot Plug power supplies, and three independent cooling zones.
Contact: NetFrame, Milpitas, CA, 408-474-1000; http://www.netframe.com.
Enter 1062 on Inquiry Card.

Clustered Servers in One Box

TANDEM COMPUTERS' CS150 ($15,000) is a clustered Windows NT server with two Pentium Pro–based servers in a single cabinet. Each processor node has its own copy of the OS, up to 1 GB of memory, optional MSCS or other cluster-management software, a SCSI disk controller, and a power supply for failover recovery in the event of server failure. Interprocessor communications are carried on ServerNet interconnect failover software, which is mirrored for communications fault-tolerance. Together, the servers can support 310 GB of data storage, which can be mirrored or RAID-protected.
Contact: Tandem Computers, Inc., Cupertino, CA, 408-285-6000; http://www.tandem.com.
Enter 1085 on Inquiry Card.

SOFTWARE
Lab Software

Automate Your Computer Lab

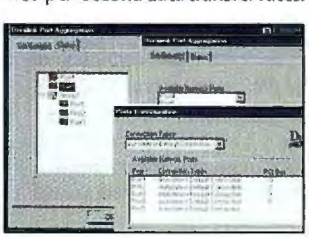
KEYLABS' LABEXPERT 2.0 ($1804 FOR 25 seats) automates time-consuming or boring tasks that otherwise need to be done manually by lab technicians or computer-classroom monitors. LabExpert simplifies testing systems by performing time-trig-

gered tasks during off-hours. It can also switch a computer's OS from Windows 95 to NT for benchmarking purposes. LabExpert loads and updates software on multiple, networked machines remotely, manages boot sequences and Windows registries, and erases and cleans disk drives. It's server- and NIC-independent; the file-system manager works with FAT, FAT 32, NTFS, HPFS, and NetWare.
Contact: KeyLabs, Inc., Provo, UT, 801-377-5484; http://www.keylabs.com.
Enter 1068 on Inquiry Card.

Networking

Faster Fast Ethernet

IF FAST ETHERNET DOESN'T PROVIDE enough throughput for you, Adaptec's Duralink Aggregation software ($199) combines the bandwidth of standard Fast Ethernet NIC ports into one single network port with multiple Gigabit-Ethernet-per-second data transfer rates.



The software, which works with Adaptec's Fast Ethernet PCI NIC, provides gigabit transfer rates on Fast Ethernet infrastructures with standards-based trunking to increase the throughput to users. It also maintains a single MAC address, simplifying server architecture. When Gigabit Ethernet standards are ratified, the software can be used to provide multi-Gigabit performance from Gigabit Ethernet adapters.
Contact: Adaptec, Milpitas, CA, 408-945-4800; http://www.adaptec.com.
Enter 1064 on Inquiry Card.

Engineering

Making Math for Engineers Easy

GRAFICALC ($295) MAKES IT POSSIBLE TO interactively solve geometry-related design problems on any palmtop, PC, or laptop running Windows 3.1 or higher. Geometric behavior can be defined with a point-and-click interface, and a formula task bar facilitates the creation of automated computations. GrafiCalc includes 100 built-in functions for geometric, trigonometric, logical, Boolean, and algebraic calculations, and the program links to such software as Excel, Mathematica, and MathCAD for performing analysis-of-design variables.
Contact: GeoMate Corp., San Jose, CA, 408-371-6095; http://www.geomate.com.
Enter 1070 on Inquiry Card.

Cryptography

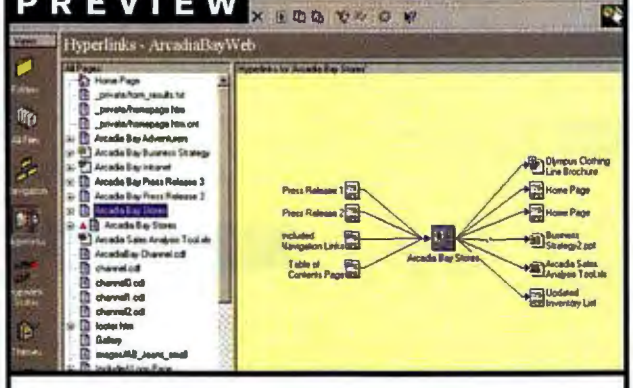
Encryption Made Easy

CRYPTOGRAPHIC TECHNIQUES CAN BE A burden on the processing power of a server. nFast ($3000–$10,000) downloads encrypted on-line transactions to an array of high-speed dedicated processors to relieve this burden. The company claims ten-fold-to-100-fold performance improvements in secure server transaction throughput. This peripheral

fits into a drive bay on a server and connects through a SCSI adapter. Up to seven units can be supported on a single SCSI chain. nCipher works with general-purpose RISC processors, using custom and standard logic to speed the encryption process for on-line commerce. SET and SSL are the protocols that nFast uses for electronic commerce; the program also provides support for standard algorithms, including RSA and DES.

Contact: nCipher Corp, Ltd., Cambridge, U.K., +44 1223 723 600; http://www.ncipher.com.
Enter 1074 on Inquiry Card.

PREVIEW



FrontPage 98
$149 ($40 rebate for registered Office users; upgrade from FrontPage 1.1 or higher, $54.95)

Microsoft Corp.
Redmond, WA
800-426-9400
206-882-8080
fax: 206-936-7329
http://www.microsoft.com

Enter 1063 on Inquiry Card.

Frontpage 98 Adds Refinement to Web Publishing

Microsoft's FrontPage 98 improves on a product that's already hugely popular with hobbyists, novices, and professional Webmasters alike. FrontPage 98 adds support for more of the latest Web features, including Cascading Style Sheets (CSS) and Dynamic HTML (DHTML), and it makes publishing your content easy with Microsoft's channel definition format (CDF).

The package can also be used to create top-notch interactive and animated Web pages for publication on any Web server, although you lose some functionality on servers that don't support FrontPage extensions.

Microsoft improves site design by including over 50 different schemes, with looks ranging from funky retro-fifties to button-down corporate. Each scheme can be modified to mute or blast colors or to use hefty animated graphics or lightweight but stationary images for quicker downloads. Background schemes are easily customizable. FrontPage simplifies the task of building Web forms and lets you e-mail yourself any data collected on-line or store it locally in either ASCII tab-delimited or HTML format.

The pain of table building is eased as FrontPage makes the task totally graphical, replacing hit-or-miss manual entry scripting of table, row, and cell dimensions with a pencil tool for graphical table creation. You can now edit a Web page locally, without the server running, which lessens dependence on a local Web server during production. In all, FrontPage 98 is a more functional update to a product that's already nearly an industry standard. **—Pete Loshin**

E-Mail

Safeguard Your E-Mail Attachments

HILGRAEVE'S DROPCHUTE+ ($50) AIMS to ease the delivery of large e-mail attachments. This software verifies the delivery of e-mail attachments and has a drag-and-drop interface for DropChute+ users to exchange files in real time. The Internet Rendezvous feature makes it possible to send e-mail anytime without having to schedule time on the Internet, and it also saves users long-distance phone charges. This feature works by sending a 2-second message to another PC running DropChute+ software and tells it when and where to rendezvous on-line. It then hangs up the phone, and the two PCs connect automatically through the Internet. DropChute+ detects and blocks viruses in received data, and users can deploy Microsoft Cryptography APIs or any third-party security product for encryption.

Contact: Hilgraeve, Inc., Monroe, MI, 313-243-0576; http://www.hilgraeve.com.
Enter 1075 on Inquiry Card.

Video E-Mail for Eudora

EUDORA E-MAIL USERS NOW HAVE A TOOL for compressing, decompressing, and recording e-mail video messages. CVideo-Mail ($200) includes a bundled video-capture board and has a file-management system for storing, saving, and deleting video

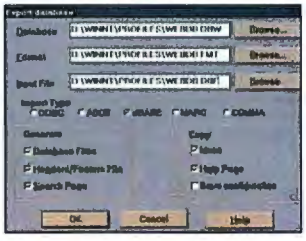
e-mail messages. It's EMSAPI-compliant, works with most desktop video cameras, and is integrated into Eudora with an icon that activates the CVideo-Mail application.

Contact: Cubic VideoComm, San Diego, CA, 619-505-2030; http://www.cvideonow.com.
Enter 1071 on Inquiry Card.

Database

Instant HTML

THE SHOWBASE EXTRA 2.0 PROGRAM ($1499 to $4499, depending on platform) converts dBase, ODBC-compliant, MARC, ASCII, and comma-delimited database files into



Internet-ready pages without requiring HTML coding. A Wizard interface facilitates the point-and-click conversion of files into Web-ready documents, and ShowBase Extra refreshes documents periodically from a database, eliminating the need to manually update Web pages created with this program. ShowBase Extra has a search engine that supports seven languages, and it supports 40 database packages, including Oracle, Sybase, Informix, and DB2. With bundled Java APIs, users can build custom front-end interfaces.

Contact: ShowBase, Inc., Aylmer, Quebec, Canada, 819-685-2273; http://www.ShowBase.com.
Enter 1072 on Inquiry Card.

Programming

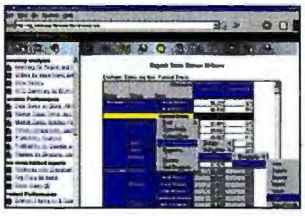
Control the Development Process

CYRANO CLIENTPACK FOR WINDOWS ($2250) lets you plan, manage, and analyze your testing procedures. Once you specify a project's standards, you can use ClientPack to automate compliance with such things as file-naming conventions for contracted programmers. Cyrano DBPack ($10,000) helps you tune

your Oracle, Microsoft, and Sybase databases, and Cyrano ServerPack ($37,500) enables you to perform multiuser load and stress testing. Cyrano VTPack ($25,000) enables you to test legacy-database performance. The suite supports a wide variety of platforms, including Windows, Sun Solaris, HP-UX, SunOS, Digital Unix, AIX, Open VMS, all versions of PowerBuilder, Sybase, SQL Server, Oracle, and ODBC.
Contact: Cyrano, Inc., Newburyport, MA, 508-462-0737; http://www.cyrano.com.
Enter 1065 on Inquiry Card.

Roll Out OLAP—Anywhere

DSS WEB 5.0 ($17,500) FROM MICROSTRATEGY works with the company's DSS Agent 5.0 product ($37,500) to provide a common interface for standard data-warehousing/data-analysis applications. This server-based application has a Web-enabled interface, which allows you to access information regardless of the platform on which an OLAP database is running. A wizard interface provides step-by-step instructions for building reports and saving work on a central server. DSS Web resides on a Web server and has a familiar Windows-based interface for data analysis. The software runs on Windows 95, 3.1, and NT; OS/2; Unix; and on the Macintosh. It supports Microsoft IIs, Netscape Enterprise, and O'Reilly WebSite Web servers.



Contact: MicroStrategy, Inc., Vienna, VA, 703-848-8600; http://www.strategy.com/.
Enter 1073 on Inquiry Card.

Portable Active Server Pages

DEVELOPMENT OF ACTIVE SERVER PAGES is code-independent with Chili ASP ($995 for unlimited users). This package lets developers build Active Server Intranet applications for non-Microsoft Web servers using Active Server Pages and Components. You can build an Active Server application once and copy it into ChiliASP, which ports it to different Web servers. ChiliASP runs on Lotus's Domino, Oracle Web Server, O'Reilly's WebSite, and Netscape's FastTrack and Enterprise servers. Active Server Pages, which are part of Microsoft's Internet Information Server 3.0 Web server, are for developing HTML code, ActiveX components, and CGI scripts for server-based applications.
Contact: ChiliSoft, Lancaster, PA, 717-290-8346; http://www.chilisoft.net.
Enter 1067 on Inquiry Card.

New Development Tools for C and C++

ELEMENTS 2.1 FOR C AND C++ ($3100 to $15,995) includes four new components. The development package focuses on better integration of distributed object middleware with the Elements Messenger module, which integrates most middleware for distributed applications into your development project. The Elements Versioner module provides file-level integration with Intersolv's PVCS Version Manager, a popular version-manager tool. A new testing tool supports Mercury Interactive's WinRunner and Xrunner application quality-assurance testing tools, and a converter module makes for easy turnaround from C or C++ code to Java.
Contact: Neuron Data, Mountain View, CA, 650-528-3450; http://www.neurondata.com.
Enter 1069 on Inquiry Card.

A Haht Development Environment

HAHTSITE 3.0 SUPPORTS SERVER-SIDE JAVA and JavaBeans, client-side JavaScript and Java applets, a Java editor, and JDBC while providing project management for Java applets. A new distributed application server enables separate processors and servers to form application-server clusters for higher-capacity Web applications. (Before, you needed to have the Web server and Haht's application server running on the same computer.) Other features included in the package are a two-pass report writer and application wizards. Haht's application server runs on Windows NT 3.51 or higher, Solaris for SPARC 2.4 or higher, IBM AIX 4.1 or higher, and HP-UX 10 or higher. The Hahtsite IDE costs $1995 per user; the application server costs $4995 per server CPU for Windows NT and $6995 per server CPU for Unix.
Contact: Haht Software, Inc., Raleigh, NC, 888-438-4248 or 919-786-5100; http://www.haht.com.
Enter 1066 on Inquiry Card.

Software Updates

Netscape is expanding its SuiteSpot software suite in release 3.1 with a larger version, called **SuiteSpot Professional** ($3495 for 50 users), as well as an updated standard suite. New to the suite is the Calendar Server 3.0 scheduling and synchronization software. Netscape has integrated LDAP into all mail, news, and calendaring products that are now shipping. LDAP supports user authentication and the sharing of calendars on the Internet. Included in the expanded suite are Netscape's Mission Control for centralized management, the Proxy Server for replicating and filtering Web content, and the Certificate Server for on-line security.
Contact: Netscape Communications Corp., Mountain View, CA, 650-937-3777; http://home.netscape.com.
Enter 1076 on Inquiry Card.

Visio has updated its line of business and technical-drawing tools. **Professional 5.0** ($349; upgrade, $149), for visualizing an information system's infrastructure, gives IT managers more vendor-specific networking shapes, supports the Unified Modeling Language (UML), and makes all stencils, wizards, and drawing pages easy to find. **Visio Standard 5.0** ($149; upgrade, $99) visualizes distributed database and spreadsheet information and includes new shapes for marketing presentations, a tool for creating project schedules, and a search tool for shapes, symbols, and templates. **Visio Technical 5.0** ($349; upgrade, $149), a 2-D drawing tool, offers new management features and new controls for the automated building of shapes. It also supports the integration of AutoCAD files.
Contact: Visio Corp., Seattle, WA, 800-248-4746; http://home.visio.com.
Enter 1077 on Inquiry Card.

Symantec's **pcAnywhere32 8.0** ($149; upgrade, $79) adds new security and remote-access functions to give road warriors or home-office workers greater access to network resources. The pcAnywhere32 package supports file transfer and general communications with modem, cable, and network connections for remote users, and it's now fully integrated with Windows NT's administration capabilities. Version 8.0 integrates White Pine's CU-SeeMe videoconferencing, caller authentication for Windows NT's User Manager controls, Microsoft's Crypto API for low-level security, voice- and data-switching support, ASVD and DSVD modem support, and new remote-management control for host-service administration.
Contact: Symantec Corp., Cupertino, CA, 408-253-9600; http://www.symantec.com.
Enter 1078 on Inquiry Card.

improbable

Advances and Retreats in Computing

The green screen, like certain rock bands that won't stay away, makes a comeback.

Retro Racket

eight-tracks bell-bottoms green screens

In computing, the old days never really go away. Software vendors (such as Wall Data) now offer programs that let you use the newest of the new (the World Wide Web) to access the oldest of the old (thousands and thousands of clunky IBM mainframes and other "legacy systems" that run poorly written, but important, programs and keep generations of COBOL and FORTRAN coders in dull but lucrative employment). Now hardware manufacturers, with some prodding from the Calvin Klein crowd, are about to bring back the green screen.

To use the correct terminology, as described in the glow-in-the-dark-phosphorescent-paint-encrusted press packet that is clogging up one of our desks: Get ready for "the GreenScreen!" The manufacturer, the imaginatively named GreenScreen! Company, is insistent on that exclamation point. The GreenScreen! terminals retail for $4.95 (that's right—four dollars and 95 cents). The low price is possible because these are literally old terminals, salvaged in bulk from crumbling warehouses and dumpsters across America. Most of them don't work, but, as you'll see in a moment, that's beside the point.

The terminals are described as "fashion accessories for the home, office, or salon." What is GreenScreen! Company *really* selling? GreenScreen! software tools, that's what. The theory is that people crave, absolutely crave, the feel of the '50s and '60s. And '70s. And '80s. "Eagle" rock stations play songs we didn't like too much the first time around but that we listen to now because they remind us of better songs that were played at the time. Bell-bottoms are back, and supposedly Elvis keeps coming back—so why not, the thinking goes, bring back green screens?

GreenScreen!'s new Web Access GreenProgram! lets you return to the '70s (and beyond) with what the manufacturer calls "lovably horrible green-screen terminal access." You can have the quietly utter thrill of viewing anything on the Web as if it were really an old-fashioned clunky green screen. It's a subtle delight, perhaps, but for some people, presumably, a very real one.

GreenScreen! plans to release other '70s, '60s, and '50s throwback products, too—everything from hand-soldered circuit boards to magnetic cores. Yes, truly, old memory can be yours forever.

A CONTEST WITH HOLES IN IT

We, too, are developing a catalog's worth of retro-computing KitschWare™, beginning with a line of tradable punchcard products. If you are under the age of 40 and have never seen a genuine computer punchcard, you are in for a treat.

To kick off the enterprise: a contest. Whose signature would *you* like to see on a collectible punchcard? Johnny Von Neumann? An Wang? Grace Hopper? Alan Turing? Ken Olsen? Guglielmo Marconi? And what kinds of statistics should be printed on the back? Send your nominations to marca@improb.com. The winners, if any, will receive a 360K floppy autographed (right on the working surface) by the editors of BYTE.

We are also creating a line of autographed punchcard chaff.

Marc Abrahams is director of the Ig Nobel Prize ceremony, which will be telecast live on http://www.improb.com on Oct. 9, 7:30 p.m. EST.

ILLUSTRATIONS: VICTOR GAD © 1997

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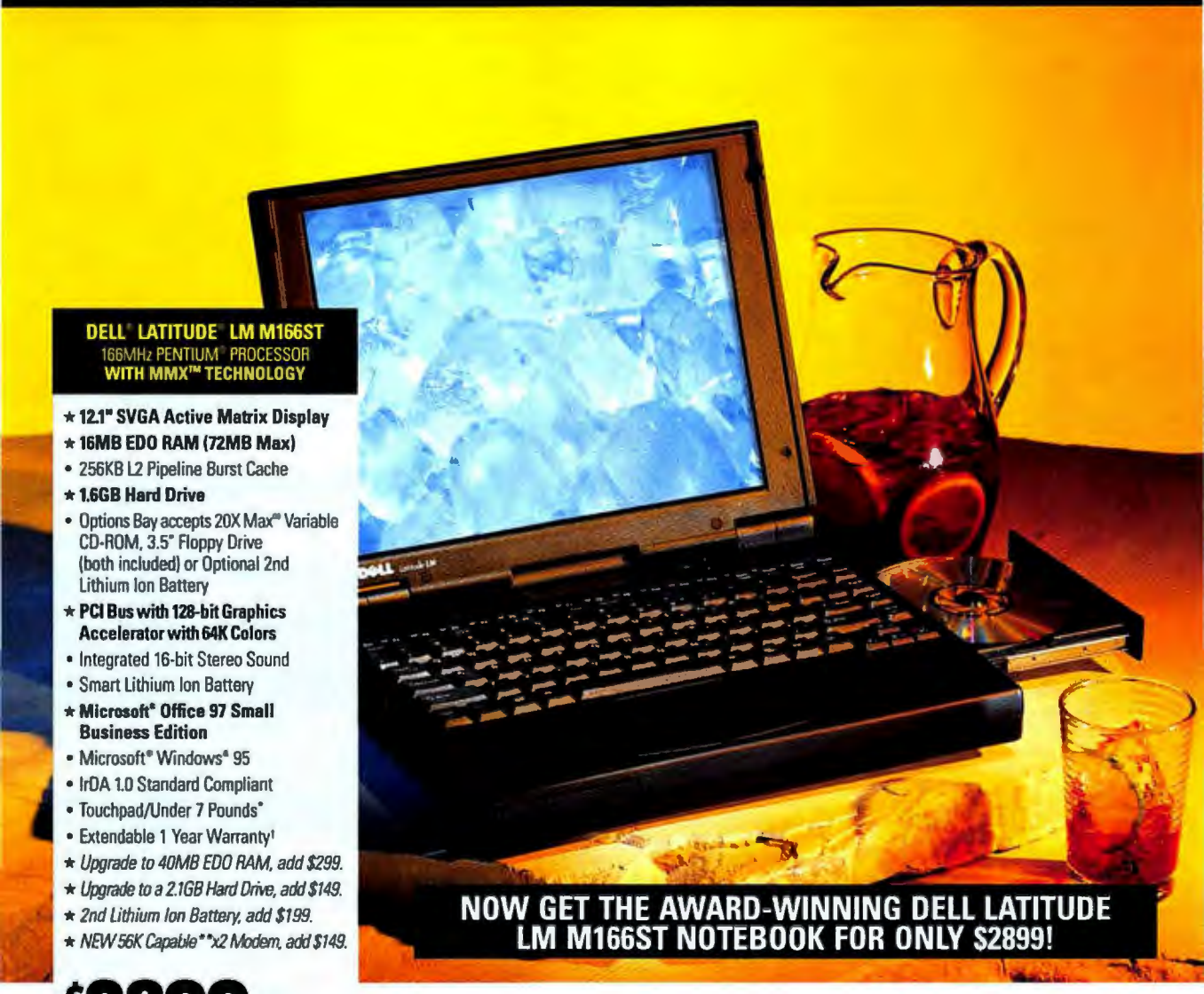

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- *NEW* Matrox Millennium II 8MB WRAM Video Card^
- Integrated Yamaha Wavetable Sound
- Altec Lansing ACS-290 Speakers with Subwoofer
- Iomega Zip 100MB Internal Drive with One Cartridge

$2999

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- 4.3GB Ultra ATA Hard Drive (9.5ms)
- 1000LS Monitor (15.9" v.i.s.)
- *NEW* STB Velocity 4MB AGP Video Card*
- Integrated Yamaha Wavetable Sound
- Altec Lansing ACS-90 Speakers

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★ *Upgrade to Altec Lansing ACS-290 Speakers with Subwoofer, add $75.*
★ *Upgrade to 1000TX Trinitron Monitor (15.9" v.i.s., .26dp), add $99.*

$2399

***NEW* Personal Lease: $107/Mo.°‡**
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200MHz PENTIUM PROCESSOR **WITH MMX TECHNOLOGY**

Common features listed above plus:
- 32MB SDRAM Memory
- 4.3GB Hard Drive (9.5ms)
- 1000LS Monitor (15.9" v.i.s.)
- *NEW* STB Nitro 4MB EDO PCI Video Card
- Sound Blaster 16 WaveSynth Wavetable Sound
- Altec Lansing ACS-90 Speakers

★ *Upgrade to a 64MB SDRAM, add $199.*
★ *Upgrade to 6.4GB Ultra ATA Hard Drive with 512KB Cache (9.5ms), add $79.*

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***NEW* Personal Lease: $89/Mo.°‡**
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MMX™ intel inside pentium® II processor

‡Pricing is not discountable †For a complete copy of our Guarantees or Limited Warranties, please write Dell USA LP Attn: Warranty, One Dell Way Round Rock, TX 78682 °Leases arranged by third-party leasing companies to qualified customers. ^System weight with floppy drive or CD-ROM in options bay. ^On-site service provided by an independent third-party provider. May not be available in certain remote areas. *20X Max./13X Min. ◊12X Max./6X Min. ◊◊24 Max./12X Min. **x2 products are capable of 56Kbps downloads. Due to FCC rules that restrict power output, however, current download speeds are limited to 53Kbps. Upload speeds are limited to 33.6 Kbps. Actual speeds may vary depending on line conditions. ††Advertised configuration varies from tested configuration. ^4MB Baseboard with a 4MB Upgrade Module. *Prices and specifications valid in the U.S. only and subject to change without notice. Intel, the Intel Inside logo, LANDesk and Pentium are registered trademarks and MMX and EtherExpress are trademarks of Intel Corporation. MS, Microsoft, Windows and Windows NT are registered trademarks of Microsoft Corporation. 3Com and EtherLink are registered trademarks of 3Com Corporation. Trinitron is a registered trademark of Sony Corporation. DirectLine is a service mark of Dell Computer Corporation. ©1997 Dell Computer Corporation. All rights reserved.

°Amount of monthly lease payment, based on 24-month lease from Dell Financial Services L.P., an independent entity; amount due prior to delivery: °$338; ‡$268; ◊◊$214; ^$178 (amounts exclude taxes which may vary; for example, Hartford City, IN fees °$8.45); no security deposit required, subject to credit approval and availability. Lease terms subject to change.

* Service
ce, add $99.

DELL DIMENSION M200a
200MHz PENTIUM PROCESSOR
WITH MMX TECHNOLOGY

Common features listed above plus:
- 16MB SDRAM Memory
- 3.2GB Hard Drive (12ms)
- 800HS Trinitron Monitor (13.7" v.i.s., .26dp)
- 2MB EDO ViRGE 3D Video
- 3Com 3C509B EtherLink III 10Mbit ISA Combo Card
- Iomega Zip 100MB Internal Drive with One Cartridge

★ *Upgrade to 32MB SDRAM, add $99.*
★ *Sound Blaster 16 PnP and Altec Lansing ACS-90 Speakers, add $89.*

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- Excel 97
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DELL® POWEREDGE® 2200 SERVER
266MHz PENTIUM II PROCESSOR
Dual Processor Capable, RAID Capable

Common features listed above plus:
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- 4GB Ultra-Wide SCSI-3 Hard Drive (27GB Max)
- 8X SCSI CD-ROM Drive
- 3Com Office Connect Hub 8-Port/TPC
- MS Windows NT® Server 4.0 (10 Client Access Licenses)
- 6 Drive Bays: 3 Hard Drive, 3 Removable Media
- 6 Expansion Slots: 3 PCI, 3 EISA

$4749
Business Lease: $166/Mo.
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DELL POWEREDGE 2200 SERVER
233MHz PENTIUM II PROCESSOR
Dual Processor Capable, RAID Capable

Common features listed above plus:
- 32MB ECC EDO Memory (512MB Max)
- 2GB Ultra-Wide SCSI-3 Hard Drive (27GB Max)
- 8X SCSI CD-ROM Drive
- MS Windows NT Server 4.0 (10 Client Access Licenses)
- 6 Drive Bays: 3 Hard Drive, 3 Removable Media
- 6 Expansion Slots: 3 PCI, 3 EISA

★ *APC Smart-UPS 700w Power Supply, add $399.*

$3749
Business Lease: $134/Mo.
Order Code #250085

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DELL LATITUDE NOTEBOOKS

Common features: ◆ 256KB L2 Pipeline Burst Cache ◆ Options Bay accepts CD-ROM (20X Max** Variable on LM M166ST or 12X Max** Variable on LM M133ST), 3.5" Floppy Drive (both included), or Optional 2nd Li-Ion Battery ◆ PCI Bus with 128-bit Graphics Accelerator with 64K Colors ◆ Integrated 16-bit Stereo Sound ◆ Smart Lithium Ion Battery ◆ Microsoft Windows 95 ◆ IrDA 1.0 Standard Compliant ◆ Touchpad ◆ Under 7 Pounds* ◆ Extendable 1 Year Warranty†

DELL LATITUDE® LM M166ST
166MHz PENTIUM PROCESSOR W/MMX

Common features listed above plus:
- 12.1" SVGA Active Matrix Display
- 72MB EDO RAM
- *NEW* 4GB Hard Drive
- MS Office 97 Small Business Edition

★ *2nd Lithium Ion Battery, add $199.*
★ *Leather Carrying Case, add $99.*
★ *3Com Lan+ 33.6 Modem PC Card, add $299.*
★ *Dell Latitude LM Port Replicator, add $159.*

$3999‡
Business Lease: $141/Mo.
Order Code #800168

DELL LATITUDE LM M166ST
166MHz PENTIUM PROCESSOR W/MMX

Common features listed above plus:
- 12.1" SVGA Active Matrix Display
- 40MB EDO RAM (72MB Max)
- 2.1GB Hard Drive
- Motorola 33.6 Fax Modem
- MS Office 97 Small Business Edition

★ *Upgrade to 72MB EDO RAM, add $299.*
★ *Upgrade to a NEW 4GB Hard Drive, add $349.*
★ *2nd Lithium Ion Battery, add $199.*
★ *Leather Carrying Case, add $99.*

$3499‡
Business Lease: $123/Mo.
Order Code #800169

DELL LATITUDE LM M166ST
166MHz PENTIUM PROCESSOR W/MMX

Common features listed above plus:
- 12.1" SVGA Active Matrix Display
- 16MB EDO RAM (72MB Max)
- 1.6GB Hard Drive
- MS Office 97 Small Business Edition

★ *Upgrade to 40MB EDO RAM, add $299.*
★ *Upgrade to a 2.1GB Hard Drive, add $149.*
★ *2nd Lithium Ion Battery, add $199.*
★ *NEW 56K Capable** x2 Modem, add $149.*
★ *Dell Latitude LM Port Replicator, add $159.*

$2899‡
Business Lease: $105/Mo.
Order Code #800140

***NEW* DELL LATITUDE LM M133ST**
133MHz PENTIUM PROCESSOR W/MMX

Common features listed above plus:
- 12.1" SVGA Active Matrix Display
- 16MB EDO RAM (72MB Max)
- 1.6GB Hard Drive
- MS Office 97 Small Business Edition

★ *Upgrade to 24MB EDO RAM, add $99.*
★ *Upgrade to a 2.1GB Hard Drive, add $149.*
★ *2nd Lithium Ion Battery, add $199.*
★ *Nylon Carrying Case, add $69.*
★ *Dell Latitude LM Port Replicator, add $159.*
★ *3Com 10Base-T Network Card, add $129.*

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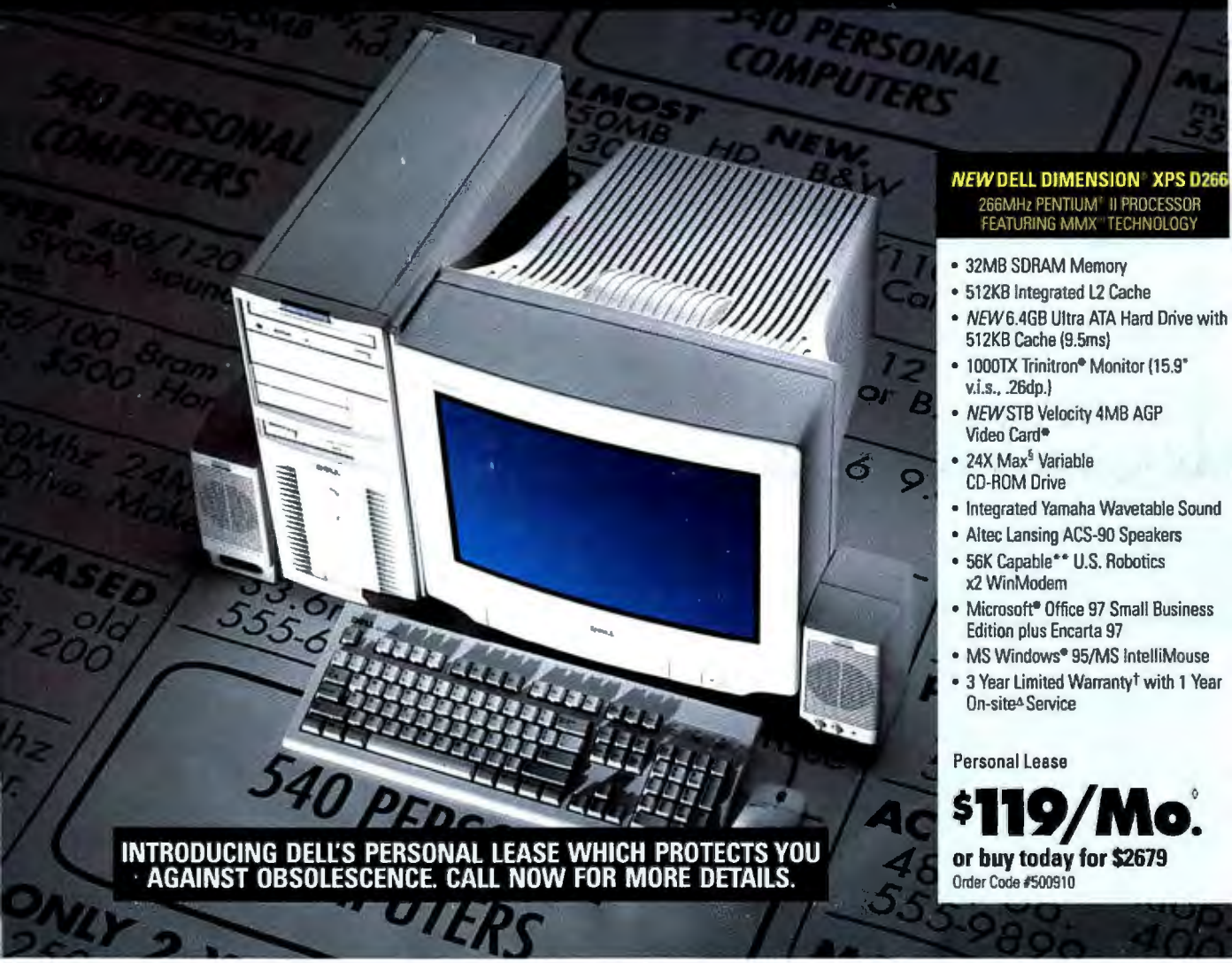

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- 512KB Integrated L2 Cache
- *NEW* 6.4GB Ultra ATA Hard Drive with 512KB Cache (9.5ms)
- 1000TX Trinitron® Monitor (15.9" v.i.s., .26dp.)
- *NEW* STB Velocity 4MB AGP Video Card®
- 24X Max[§] Variable CD-ROM Drive
- Integrated Yamaha Wavetable Sound
- Altec Lansing ACS-90 Speakers
- 56K Capable** U.S. Robotics x2 WinModem
- Microsoft® Office 97 Small Business Edition plus Encarta 97
- MS Windows® 95/MS IntelliMouse
- 3 Year Limited Warranty† with 1 Year On-site[Δ] Service

Personal Lease

$119/Mo.[◊]

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A little overwhelmed by the rate of technology change? Suffering from the "fear of computer commitment?" Well, you can breathe easier now. Because in addition to our business lease program, Dell is now offering computer leasing directly to consumers on all our Dell Dimension and Latitude LM systems. With an over-the-phone approval process that typically takes just minutes and low monthly payments, you can get the latest technology on your desk in a snap.

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[◊] Amount of monthly lease payment, based on 24-month lease from Dell Financial Services L.P., an independent entity; amount due prior to delivery: $238 (amounts exclude taxes which may vary; for example, Hartford City, IN fees $5.95); no security deposit required; subject to credit approval and availability. Lease terms subject to change. [†] Some conditions apply.

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