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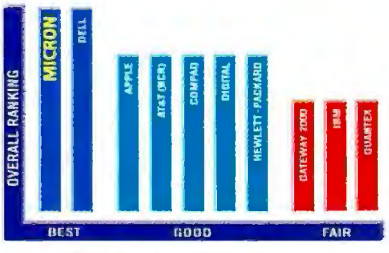

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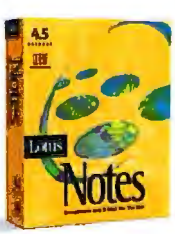

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editorial

RIP: Anonymous User

"Howdy, stranger" is being replaced by "Identify yourself" on the Net. Should we worry?

Face it: Digital IDs will mean the end of anonymity on the Internet. I've written before (December 1996) on how people hide behind that anonymity to lob bombs on e-mail. But they also depend on it to maintain a level of irreverence and outspokenness that's valuable, fun, and worth preserving in some form.

In the future, people who want privacy to air their views may still use nicknames, but remaining truly anonymous to someone who really wants to identify you (say, because you owe them money) will get harder and harder. If you want to buy or sell, or even just download information, you'll have to say who you are.

Without the basic elements of identity that we discuss in our cover story (page 70), the Internet won't realize its potential as a universal backbone of commerce and communications. Neither big corporations nor individuals will want to expose themselves in an environment where they can be attacked by people wearing electronic ski masks.

But will the end of anonymity also mean the end of personal freedom? What if a government could find "undesirables" instantly, correlate all their movements and purchases, and ensure that they're not able to hide behind aliases? Ultimately, computers will be able to do that. We should be worried about that kind of security. It's not needed for ordinary commerce and communications, and we shouldn't let governments hide behind the argument that it is.

That's just what the U.S. government is doing. The Clinton administration has consistently stood for an Internet where the government has the last word, whether on security or content. So far, U.S. courts don't seem inclined to agree on the content issue. And the international market is now making a sham of the U.S.'s stringent export restrictions on cryptography: The recent CeBIT show in Hannover, Germany, saw the debut of several Euro-grown 128-bit encryption products. If the U.S. couldn't keep the atomic bomb under wraps, it certainly can't make a secret of basic math.

So, security and freedom—how do we navigate these two sometimes contradictory goals?

First, let's not go overboard. The noncomputerized world we've lived in for millennia has never been 100 percent secure. If someone steals your credit card, the issuer makes good on its promise to protect you and the merchant. These relationships—not some foolproof system of identity—are why it all works.

Let's emulate these kinds of relationships on the Web. Digital IDs should give us enough certainty to support our traditional notions of trust, but in a form that also respects privacy and is as unobtrusive as it is appropriate. I happen to favor strict checks on people who buy rocket launchers; I certainly don't favor them for people who buy shirts on-line.

Which brings me to my second point: personal freedom. Governments should play a role in digital security; someone, for example, should validate certificate authorities (but not as an excuse to monopolize encryption, as British authorities are attempting to do). Governments might ultimately need to regulate what can be done by various parties with your digital ID. It's far from certain that we all won't cry "Uncle" after a few years under siege from "targeted" marketing efforts that presume we want to receive hundreds of offers for vacations in Mexico just because we charged a burrito at the local tacqueria.

But my fond hope is that governments can be kept as far away from core security mechanisms as possible. Clipper chips, government key servers—these spell trouble for individual liberty. The usual arguments of crime and terrorism don't bear scrutiny: They're just lazy attempts to pull the trigger on expanded intrusion into all our lives, a temptation nearly irresistible to bureaucrats.

My fond hope is that governments can be kept as far away from core security mechanisms as possible.

The libertarian idealism of the Internet is already strained. The end of anonymity is a reasonable price to pay for the expanded community that the Internet can bring. The end of liberty is not.

Mark Schlack

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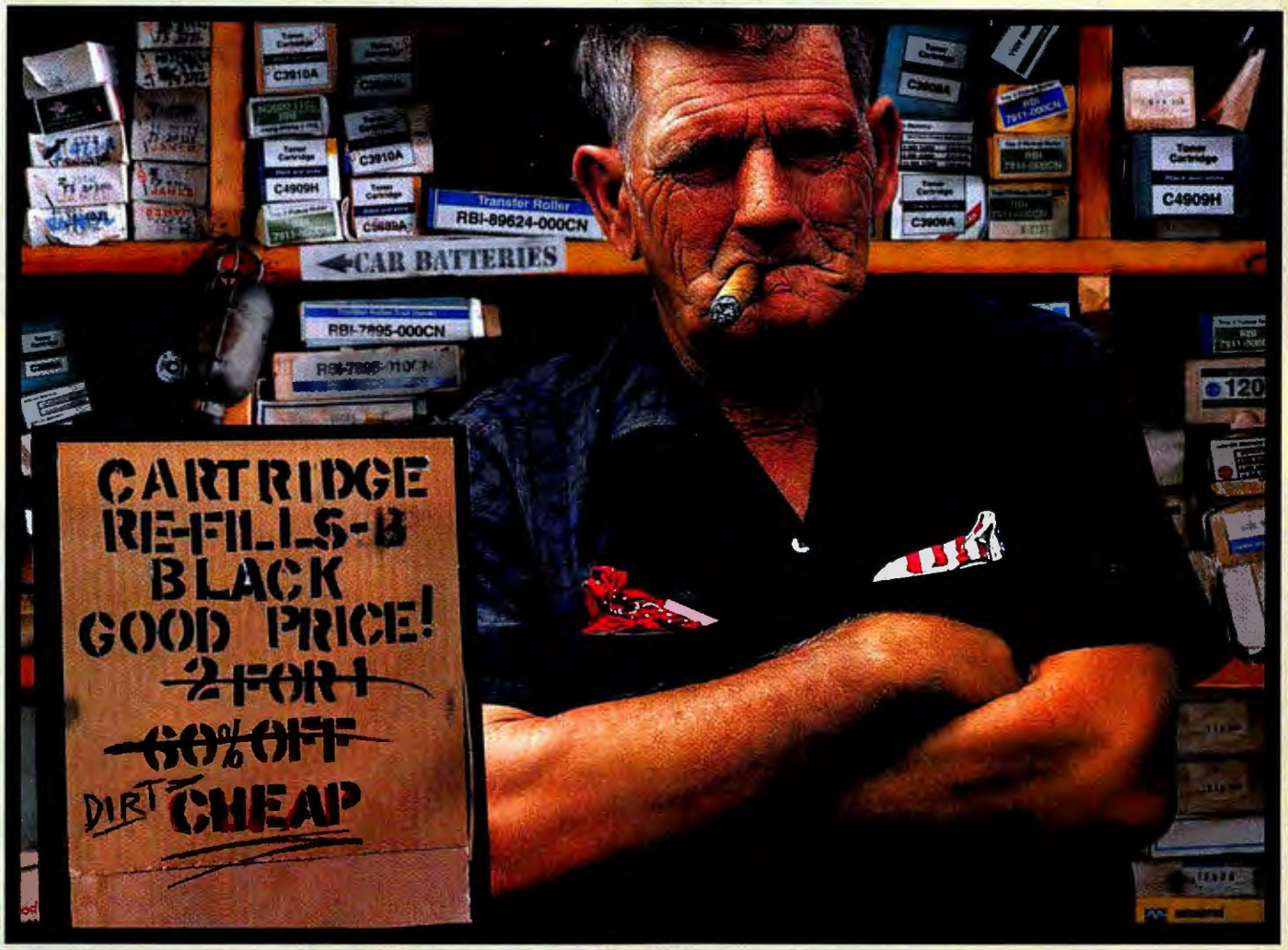

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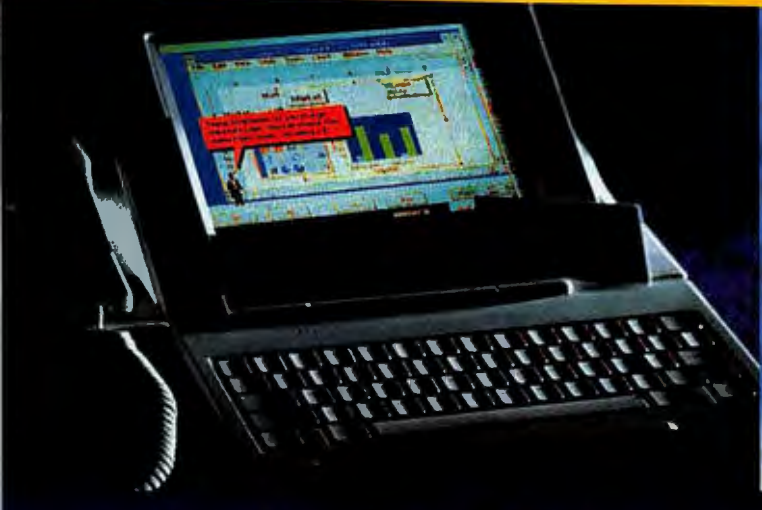

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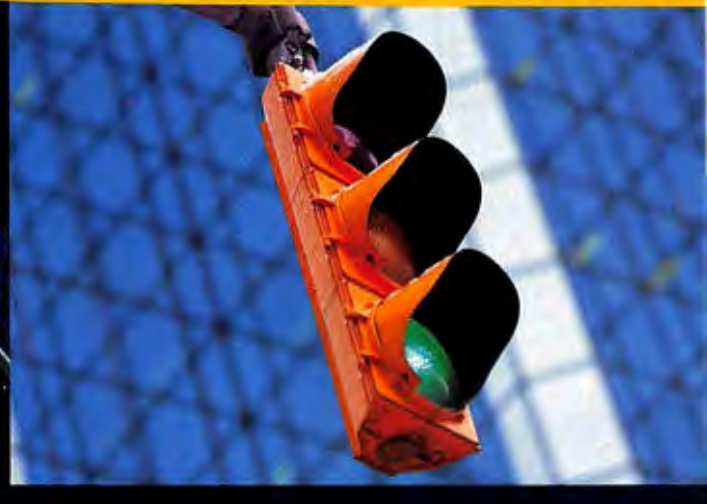

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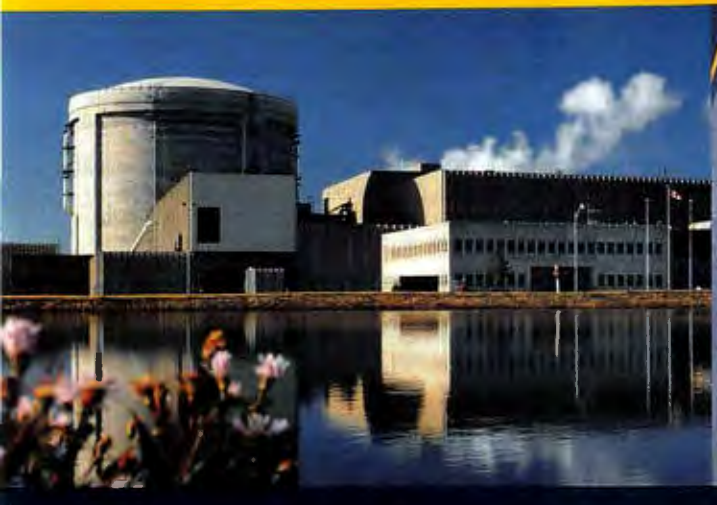

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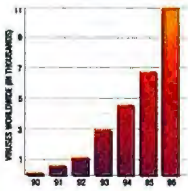

The worldwide computer virus count currently tops 11,000, but the virus threat gets worse every year. Hundreds of new viruses are created every month.

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POLYMORPHIC VIRUSES

SOURCE — Virus Bulletin, October 1996

Polymorphic viruses are the most difficult to detect because each infection looks different. Dr Solomon's detects polymorphic viruses better than all the rest.

MACRO VIRUS DETECTION RATE

SOURCE — Secure Computing, January 1997

Macro viruses represent the newest threat to your computer today, and they're easily shared via documents and email. No other product detects and removes them like Dr Solomon's.

DETECTION OF VIRUSES IN COMPRESSED AND ARCHIVED FILES

SOURCE — Secure Computing, January 1997

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inbox

The Blue Box

"Rhapsody with Blue" (April Bits) was clear, insightful, concise, and technologically literate. I gained the knowledge I wanted from one phrase ("...a single preemptive thread that executes the Mac OS and Mac applications"). While I had guessed that the "blue box" would be a single thread, I couldn't be sure because most other authors had not been able to parse what Apple was telling them—and Apple hadn't made public statements at that level of technical detail.

Steve Setzer
ssetzer@bix.com

What Might Have Been

I entirely disagree with the idea that Apple had to choose between acquiring Next and becoming a software company ("Apple's Opening Move," March Editorial). Apple's core products have always been computers, and Apple continues to produce excellent hardware designs. The best option—one Mark Schlack ignored—would have been for Apple to put all its efforts into hardware. Apple could have offered a PowerPC machine capable of running the Mac OS, with all its 68000-emulation baggage, as well as the native PowerPC version of Windows NT. Mac and Windows users would have been able to run their old applications along with new, native PowerPC/NT applications. That sounds like an ideal platform to me, and it would have allowed Apple to gracefully exit the OS business and retire the Mac OS while offering a clear upgrade path for its current users.

T. A. Stephens
tas@ricochet.net

Java Unveiled

Am I the only one thinking that the new emperor, Java, is wearing no clothes? Bytecode? CPU instructions, methinks. Virtual machine? Ho hum! Is the search for code reusability so compelling that we have all lost our programming senses? Let's just admit that all this open-mouthed slavering at Scott McNealy's trough is merely one more gladiator round at the Coliseum. We loved it when IBM got its comeuppance, and now we, and McNealy, want Gates & Co. to get theirs. And one day it will be Sun's turn when the next bright new thing comes along.

Roger Fedyk
iha@bellatlantic.net

Behind the Numbers

I was amazed to see the costs quoted for PC ownership in the text box "Thin Clients: Behind the Numbers" that ran with the April cover story. The five-year cost of owning a Windows PC is $44,250? Rubbish! No wonder network computer (NC) proponents are such easy

prey for the PC advocates. I run a small networked office with six PCs and a NetWare server; if the five-year cost were a tenth of that figure, I would feel derelict in the performance of my duties. In fact, I have had more problems with office calculators, fax machines, and copiers than with PCs. As for upgrades, no one would simultaneously upgrade all users when some clearly don't need it.

The NC has a place in the modern office, but I can't see anyone giving up the flexibility that PCs offer, especially after considering the validity of these studies.

Tom Farmer
Farmhaus@aol.com

Another View

Windows 95 is a black hole into which we throw support time. The system tempts us with no-brain automatic setup and then makes us pay with endless reinstallations of software components that can't be fixed in any other way. Then, just when we think we'll scream if we see another hourglass, we find that the system is so confused that there's no option but to scrap the entire installation and start again from scratch. And that, when it includes preservation of current data and reconfiguration of all reinstalled applications, means a full working day.

Peter Chandler
The Technology Partnership
pc@techprt.co.uk

No 40-bit PGP

In "Encryption for a Small Planet" (March), Thom Stark wrote that Pretty Good Privacy, Inc., is "producing 40-bit exportable and 128-bit domestic versions of its Viacrypt commercial PGP product line." This is not

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true. PGP keys are at least 128 bits long in all versions of the product. More than a factual error, this undermines the history and reputation of PGP.

Human-rights organizations use PGP to protect the identity of witnesses. Others use it to protect the privacy of everyday correspondence. In either case, no one wants to try to protect their communications with weak encryption. Forty-bit keys can be broken in less than a second by any major government.

My company doesn't do weak cryptography. We now have a strategy based on international agreements for strong cryptographic use worldwide that does not violate U.S. export law yet does not compromise the integrity, strength, or interoperability of PGP software. To learn more about our position, see our Web page at http://www.pgp.com.

Philip Zimmermann
Chairman and Chief Technology Officer
Pretty Good Privacy, Inc.
prz@pgp.com

We do regret the error. At press time, PGP, Inc., was working on international trademark agreements that would allow licensing of the PGP trademark for software that meets the company's standards for security and user control.—Eds.

Moore vs. Crypto

In "Encryption for a Small Planet" (March), Thom Stark neglects to mention the effect of Moore's law on data security. My corollary to Moore's law is this: To maintain the same level of data security, you must increase your key length by 1 bit every year. By Moore's law, processor performance doubles every 18 months; however, there are also advances in algorithms and mathematics, as well as an increasing number of computers available to a would-be cryptanalyst. Since a doubling of computer power is equivalent to shortening the key by 1 bit, a conservative estimate is that the key length should increase by 1 bit every year.

Stark's theoretical estimates for the maximum times needed to crack keys of different lengths are correct in today's terms, but incorrect in absolute terms. In his example, RC-4 with a 56-bit key takes 2691.49 years to crack. A 56-bit key in 16 years is equivalent to a 40-bit key today. Wait 16 years, and then start your cryptanalysis: The 56 bit-key would take 16 years and 15 days to crack. If the U.S. government insists on maintaining its current stance on the export of encryption technology, then it should at least frame future legislation to allow cryptography vendors to increase key lengths by 1 bit every year, with a review of the baseline, say, every 10 years.

Martin Budden
Richmond, Surrey, U.K.
martinjb@cix.compulink.co.uk

There's nothing absolute about Moore's law; it's an observation of a trend, and the trend will slam into the realities of minimum scale and maximum waste heat transfer before too many more microprocessor generations elapse. Your argument about advances in algorithms is a better one; there might be indefinite room for improvement there.

The ground on which the U.S. government maintains its limits on exportable encryption strength amounts to "we have to be able to decipher the bad guys' traffic." If you buy that, then there's no reason to ever increase the key-length limit. Of course, strong encryption is available from non-U.S. vendors, and further, if criminals and terrorists don't respect laws against crime and terror, why would anyone expect them to respect laws against exporting strong encryption?—Thom Stark

Lame Review?

Russell Kay's review of our CD-ROM, "Java Security: Managing the Risks" (April

Bits), accuses us of offering lame advice to Java users concerned about security. The review is a prime example of the sort of treatment that security experts can expect from Java bandwagoneers. Our bottom line is not, as the review implied, to turn Java off, but to manage your risks: Educate yourself about the dangers of executable content, determine what (if anything) you have to lose, and set up an appropriate security policy. Unfortunately, there's no magic solution to Java security. If you have nothing to lose, you can surf with impunity. But if information is the lifeblood of your business, you had better think twice about surfing to unknown sites with a Java-enabled browser on a mission-critical machine.

Security is rarely an all-or-nothing proposition. You must decide for yourself how much risk you're willing to live with.

Gary McGraw and Ed Felten
Authors, "Java Security: Managing the Risks"

I commend the authors' attitude about managing risks; I've been waving that flag in various IS camps for years. But the problem, in my view, is that the solutions they propose aren't workable in the real world. To "think twice about surfing to unknown sites with a Java-enabled browser" is fine as a philosophical perspective, but you can't get much work done that way. When did you last use a Web browser for more than a minute or so and not *visit an unknown Web site? To reap the advantages of Java, you have to understand and accept some security exposures, which the authors make clear. But what IS administrators need from security policy and security tools is more than an Off switch and a warning label. This isn't a bad CD-ROM publication. But I think there's a better one that could have been.—Russell Kay, technical editor*

No Transfer

Can you generate a certificate on one platform, send in the certificate request, and expect to be able to successfully install and use the certificate on a totally different platform? After reading "Digital IDs" (March Web Project), I wasn't certain whether the certificate is bound to be used on the platform on which it is generated.

David Milewich
drmilewich@tasc.com

Certificate use is not bound by the format of the request, but by the fact that the key

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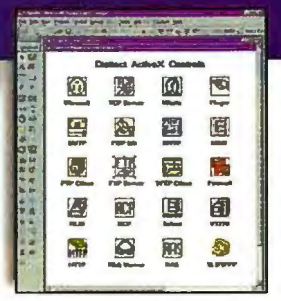

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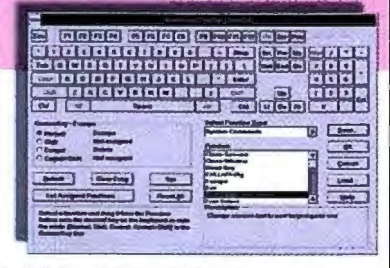

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Inbox

you send off to be signed lives in the key database of the system on which you generate the signing request.
—Jon Udell, executive editor

Thanks for the clarification. We should have pointed that out.—Eds.

POPped Pine

A letter in the March Inbox ("Pine Came First") states that Pine works with POP. As of version 3.95, PC-Pine cannot be used with a POP server, according to the University of Washington's Pine FAQ.
Alan Schunemann
schu@digex.net

FIX

In "Digital IDs" (March Web Project), we said that any Web server to which you connect can request cookies other than the ones it deposited. That is untrue: It's not that easy to steal cookies. For details, see news://dev4.byte.com/5e0o0t%241dm@dev4.byte.com.

COMING UP IN JULY

COVER STORY

The New User Interface

Microsoft's Windows 97 and Netscape's Constellation offer the first true network user interfaces for desktop computers. BYTE examines this fundamental shift in desktop UIs, particularly its impact on applications development.

MANAGING DATA

Beware the Year 2000

It's coming, and it's going to break some big applications. Estimates put the cost to U.S. businesses alone at $600 billion. We look at techniques and tools for finding the problems and fixing them.

NETWORK INTEGRATION

Virtual Private Networks

The Internet has ushered in the era of virtual private networks, which promise low-cost, highly configurable wide-area networking. We sort out the pros and cons of building your own versus renting one from an ISP.

HARDWARE LAB REPORT

MMX Desktop Systems

NSTL tests high-end desktop systems that take advantage of the new Pentium II chip's MMX multimedia-enhancement technology.

SOFTWARE LAB REPORT

Web Applications Servers

We examine three top server-based programs that address the challenge of distributing applications—and applets—over the Internet: Lotus Domino, Microsoft Internet Information Server, and Netscape Enterprise Server.

CORE

A CPU in the Hand

BYTE takes an inside look at the Hitachi SH-3, the low-power 32-bit processor at the heart of many hand-held personal computers.

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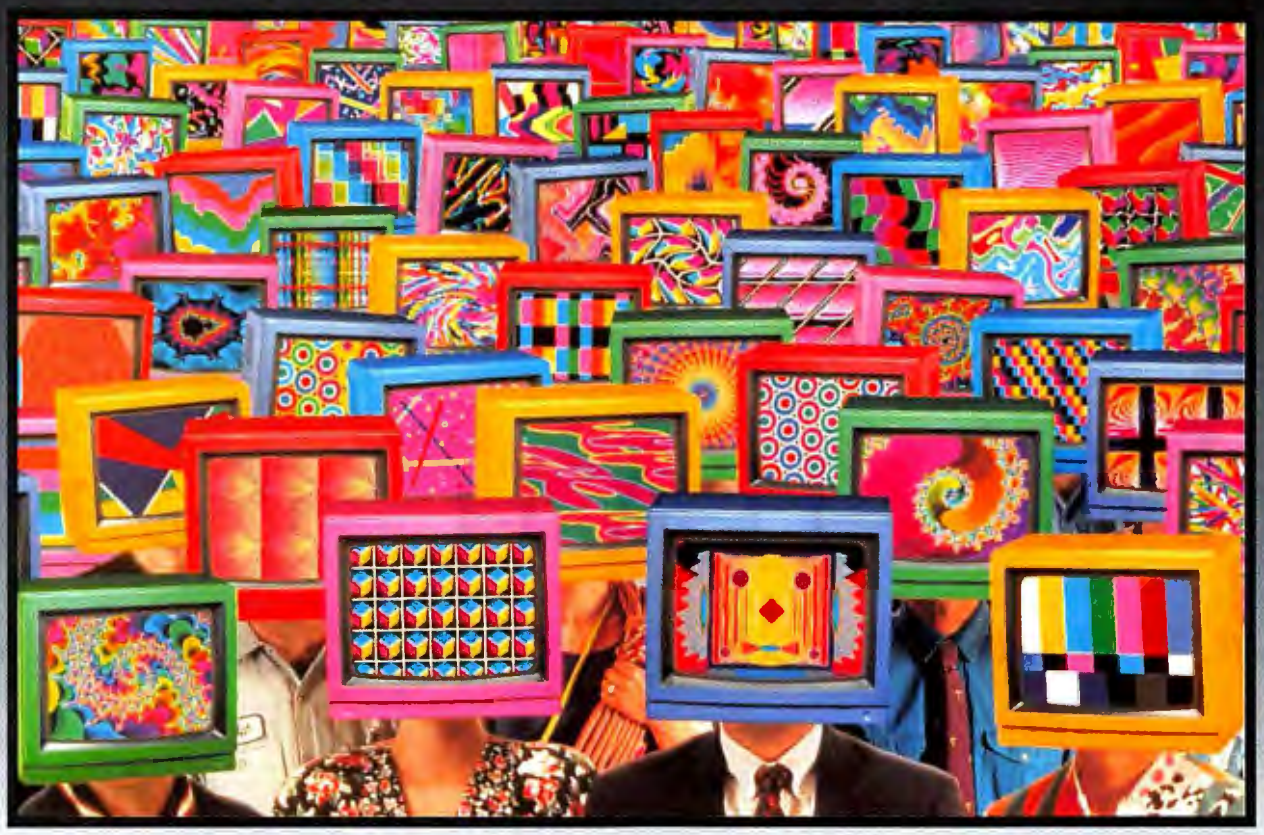

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Has It Changed Your Life Yet?

Pentium II: King of the x86 Hill

Intel's latest processor edges AMD's K6 in x86 performance, but it's a photo finish with the PowerPC.

The seesaw pursuit of desktop performance continues. Debuting at a top speed of 266 MHz, Intel's latest processor, the Pentium II (code-named Klamath), is king of the x86 hill. In recent tests, however, BYTE found that Pentium II–based systems run neck and neck with current high-end PowerPC-based computers. And tests on a noncommercial reference system that used the new 233-MHz K6 indicate that although AMD's latest processor lags slightly behind the fastest Pentium II in integer operations and further behind in floating-point-intensive tasks, it competes fairly well with Intel's current high-end CPUs.

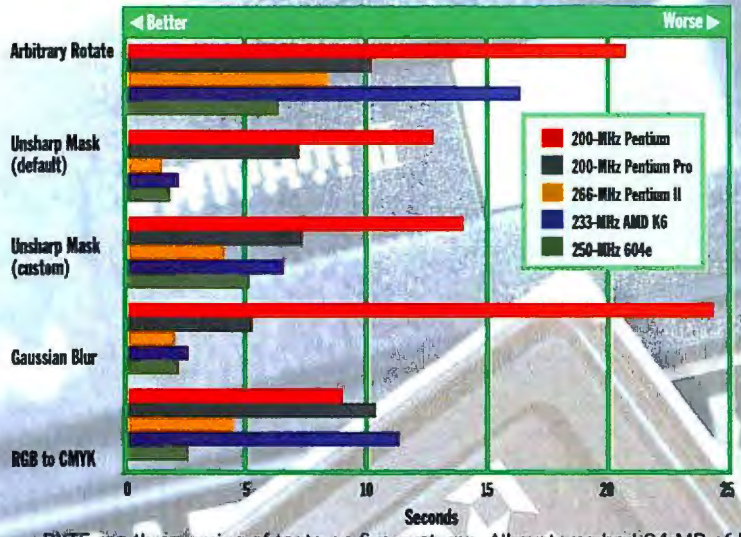
Discussions about these latest processors' performance are incomplete without considering total system architecture. For example, the latest offerings from Mac OS system vendors such as Umax (510-651-9488; http://www.umax.com) and Power Computing (512-246-7807; http://www.powercc.com) feature a 604e processor running at 250 MHz. However, until new motherboards for Mac clones become available, the 250-MHz 604e is constrained by a processor-to-main-memory (aka system) bus that runs at 50 MHz, compared to 66 MHz for the current Pentium II system bus. Faster system-bus speeds (and also faster L2-cache bus speeds) are expected from the Intel and PowerPC camps over the next two years.

With the Pentium II, Intel increased the L1 cache size from 16 to 32 KB, added multimedia extensions (MMX) support, and ratcheted up the speed to 266 MHz. The Pentium II has a 512-KB L2 cache, but Intel may later release Pentium IIs with different L2-cache sizes. The Pentium II system provided by Polywell (800-999-1278) was a screamer. But the Pentium II sacrifices performance in certain areas to allow a lower price and sets the stage for a battle over PC motherboard designs.

The Pentium II sports a new package, the Single Edge Contact (SEC) cartridge, which looks like a deck of playing cards painted black and mounted on edge. The new package allows the use of standard static RAM (SRAM), which is a major reason why Intel can offer the 266-MHz Pentium II at $775 and the 233-MHz Pentium II at $636. (The 512-KB Pentium Pro [200 MHz] cost $1035 at press time, in quantities of 1000.)

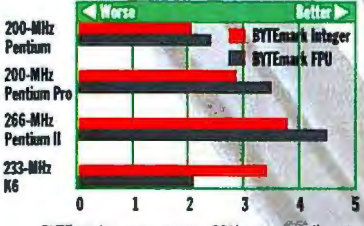
However, the Pentium Pro's custom cache ran at the same speed as the CPU, as high as 200 MHz, whereas the 266-MHz

Photo Finish in PowerPC vs. Pentium II



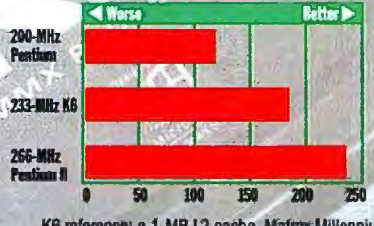
BYTE ran three series of tests on five systems. All systems had 64 MB of RAM. The Photoshop tests do not address disk access or video performance. The PowerPC (Power Computing's PowerTower Pro 250) and K6 systems each had a 1-MB L2 cache. All other systems had a 512-KB cache.

K6 Nips at Pentium II's Heels



BYTEmarks measure raw CPU, not overall system performance. A 90-MHz Pentium equals 1.

K6 Lags in NT Applications



K6 reference: a 1-MB L2 cache, Matrox Millennium, and Seagate ST34501W drive. Other systems: a 512-KB L2 cache, Diamond Stealth 3D 2000, and Maxtor 85120A EIDE drive.

Geek Mystique

State of the Internet

More interesting statistics reflecting the emergence of the Internet in today's everyday life, as provided by Win Treese of Open Market, a developer of Internet commerce software (http://www.openmarket.com/intindex):

Number of times President Clinton mentioned the Internet in the 1997 State of the Union address: 6

Number of times he mentioned it in the 1996 address: 0

Number of State of the Union addresses carried live on the Internet: 1

Percent change in Hambrecht & Quist's Internet stock index for 1996: −16

Rank of Ford among Web advertisers, in estimated dollars spent, August 1996: 18

Rank of Microsoft: 1

Number of people who worked on the NFL's Super Bowl Web site: 35

Number of Boston Public Library branches: 26

Percentage of branches connected to the Internet: 100

Pentium II's L2 cache bus runs at just 133 MHz. The SEC approach also needs a different socket than the Socket 7 used for the Pentium. Intel claims the SEC cards are needed to support higher clock speeds (greater than 300 MHz) in high volumes at commodity prices. Intel's competitors claim they can match or exceed Intel's performance by sticking with the Socket 7, while still beating Intel's prices.

AMD uses the Socket 7 for its K6 processor announced and released in April. AMD contends that system vendors can build relatively inexpensive systems by leveraging the existing low-cost infrastructure for Socket 7–compatible components. Motherboard vendors who want to support the K6 only need to upgrade the BIOS and clock speed to accommodate the new chip, which is also available at 166 and 200 MHz. The Socket 7 implementation is limited to a 66-MHz shared system and secondary cache bus, however, unlike the Pentium II, which has separate buses. Any motherboard that supports the P55C pin-out of the Pentium with MMX will probably support the K6, so expect a lively market in K6 upgrades for existing midspeed (120- to 166-MHz) Pentium systems.

The quantity-1000 price for the 233-MHz K6 is $469, or $167 less than the 233-MHz Pentium II. The K6 doesn't have an integrated L2 cache, but 512 KB of L2-cache memory costs only about $25.

The BYTEmark FPU test indicates that the K6's primary weakness is in floating-point operations. AMD says most business tasks do not rely heavily on floating-point performance and even contends that the SYSmark for Windows NT 4.0 test suite of five applications uses more floating-point operations than typical users would in using those applications. The K6's performance in the BYTEmark integer test suite showed that while the floating-point performance of the K6 fell slightly short of a 200-MHz Pentium, the K6's integer performance was almost equal to that of the Pentium II.

In our Photoshop tests, which do not emphasize hard drive or video adapter performance (for a full description, see "MMX: Better in Fits and Starts," February BYTE, page 26), the K6 was slower than the Pentium II in the MMX-intensive RGB-to-CMYK conversion, Unsharp Mask, and Gaussian Blur operations, in some cases by a wide margin. This suggests that AMD's MMX implementation is not quite as fast as Intel's.

As usual, chip and system vendors will continue to release faster products this year and next. Cyrix, another Intel rival, will soon announce its M2 chip, which will have its own MMX implementation. Intel already plans to release a 300-MHz Pentium II this summer. Intel also says that the Pentium II's dual-independent bus architecture supports the evolution of today's 66-MHz system bus to 100 MHz within a year. Meanwhile, in the PowerPC arena, sources say a 604e-like CPU code-named Arthur that will have separate secondary cache and system buses (with the cache bus running at up to the same speed as the CPU) will appear this summer. Exponential's x704 is slated to appear this summer running in the 400-MHz range (with systems possibly using an in-line-cache approach to deliver faster cache-bus performance).

In the meantime, if you want a relatively inexpensive but high-performing system, check out K6-based computers. For the fastest in x86 performance, go with a Pentium II–based system, though if you need workstations or servers with more than two CPUs, you'll have to go with Pentium Pro (greater than dual Pentium II–based systems won't be supported until early 1998, Intel says). As for Mac versus Wintel, our tests show that systems based on the fastest x86 and PowerPC processors are roughly comparable in raw performance. The debate over which OS—Windows or the Mac—is better is beyond the scope of this article.

–G. Armour Van Horn

HyperWave Wins Best of CeBIT Award

HyperWave, an innovative information server that solves many of the problems associated with electronic publishing on the Internet and intranets, won BYTE's third annual Best of CeBIT award. (For contact information on CeBIT award winners, see page 28.). The HyperWave information server combines powerful search and navigation tools with remote authoring, full-text indexing, and security. HyperWave's ability to treat links as separate objects that are bidirectional and have a wide range of attributes eliminates many link management chores.

continued

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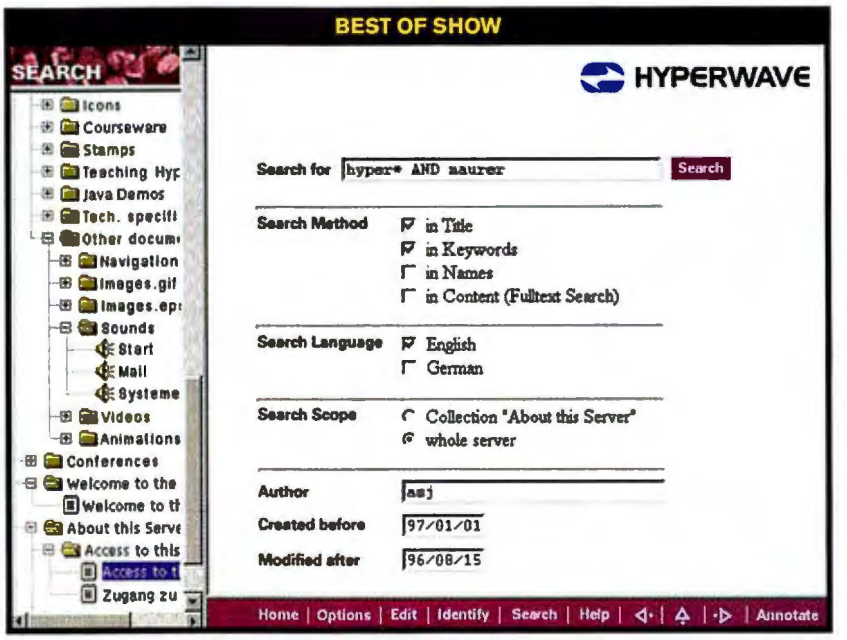
Speech technology from Lernout & Hauspie, which provides speech recognition, text-to-speech conversion, compression, translation in many languages, and other services, won as Best Technology. Best Technology finalist was a Java-based application from the Berlin Heinrich Hertz Institut of Communications Technology that shows how the forthcoming MPEG-4 video standard can turn video into a more interactive medium.

The C3 Messenger server, from Com:On, won the Best Communications Software award for its ability to integrate disparate mail systems with open Internet mail. Finalists were the DirectPC Network Edition satellite Internet service from Hughes Olivetti Telecom and Snapware desktop telephony software from telesnap GmbH. Orckit's Fast Internet xDSL Broadband Access System won the Best Communications Hardware award for its ability to ease the Internet bandwidth crunch. Finalists were 3Com's Fast IP switch and Vicas, a combination router, encrypter, PBX, and Ethernet card from BinTec Communications GmbH.

HyperWave also won in the Best Internet Product category, while Trusted Web intranet security software, from Siemens Nixdorf, and Inso's Dynabase Web Management System were finalists. Black Sun's Passport/Community Server, which is for building large on-line communities, won as Best Multimedia Software. Finalists in the category were a multimedia authoring tool from Pitango Multimedia called Clickworks 1.1 and Metatools' Soap, a video-editing tool that has an innovative user interface.



HyperWave's search engines dynamically index text and custom document attributes.

The award for Best Multimedia Hardware went to the Philips Trimedia TM-1000, a media processor that accelerates audio, video, graphics, and communications. DV Master, a digital video-editing board from Fast Multimedia, and TerraTec's AudioSystem EWS64 XL card, a professional solution for editing digital and analog sound, were finalists.

Quicktionary, a nifty pen-size scanner

Best of CeBIT Awards Contact Information

Best of Show: HyperWave (+49 89 9930740, 888-644-3100, or http://www.hyperwave.com).

Best Technology: Lernout & Hauspie (+32 57 228 888 or http://www.lhs.com). Finalist: Berlin Heinrich Hertz Institut of Communications Technology (+49 30 310 02 253 or http://www.hhi.de).

Best Communications Software: Com:On (+49 40 30 189 182 or http://www.com-on.de). Finalists: Hughes Olivetti Telecom (+44 1908 319101 or http://www.hoteu.com); telesnap GmbH (+49 711 90 66 80 or http://www.telesnap.de).

Best Communications Hardware: Orckit (+972 3 696 2121 or http://www.orckit.com). Finalists: 3Com (408-764-5000 or http://www.3com.com); BinTec Communications GmbH (+49 911 9673 0 or http://www.bintec.de).

Best Internet Product: HyperWave. Finalists: Siemens Nixdorf (+353 1 676 7551 or http://www.trustedweb.com); Inso (617-753-6500 or http://www.inso.com).

Best Multimedia Software: Black Sun Interactive (415-273-7000 or http://www.blacksun.com). Finalists: Pitango Multimedia, a division of Scitex (800-675-5666 or http://www.pitango.com); MetaTools (805-566-6200 or http://www.metatools.com).

Best Multimedia Hardware: Philips (408-991-3838 or http://www.trimedia-philips.com). Finalists: Fast Multimedia (+49 89 50206 0 or http://www.fast-multimedia.com); TerraTec (+49 2157 8179 0 or http://www.terratec.de).

Best Peripheral: WizCom (+975 2 532 8222). Finalists: Philips (+49 511 89 51095 or http://www.speech.be.philips.com); Toshiba (800-550-8674 or http://www.toshiba.com).

Best Portable: Apple (408-996-1010 or http://www.apple.com). Finalists: Toshiba (+49 2131 158 01 or http://www.toshiba-teg.com); Palm Computing (415-949-9300 or http://www.usr.com/palm).

Best Software Application: Silux (+41 52 3660330 or http://www.silux.com). Finalists: MultiStream (+49 89 890162 14 or http://www.multistream.com); Applix (+49 89 7485890 or http://www.applix.com).

Best Development Software: SoftLab (+49 89 99360 http://www.softlabna.com). Finalists: Quadratron Regie (+44 1344 57744 or http://www.qr-ag.com); Platinum Technology (800-442-6861 or http://www.platinum.com).

Best System: Umax Data Systems (+886 2 517 0055 or http://www.umax.com). Finalists: Data General (508-898-5000 or http://www.dg.com); Vobis (+49 2405 444 0 or http://www.vobis.de).

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Circle 130 on Inquiry Card (RESELLERS: 131).

Umax's high-end Mac OS system features a 250-MHz 604e CPU.

from WizCom that performs OCR and language translation, took top honors in the Best Peripheral category. One peripheral finalist was Philips' SpeechPad and SpeechMagic software-hardware combination for voice dictation and speech-to-text conversion. The second peripheral finalist was Toshiba's slim PDR-2 Digital Still Camera (it fits into and directly interfaces with a PC Card slot).

Best Portable winner was Apple, for its PowerBook 3400, a notebook that runs on a 240-MHz 603e PowerPC processor. The Toshiba Libretto 50, a 75-MHz Pentium-based PC subnotebook, and the new version of the PalmPilot hand-held PC, from U.S. Robotics' Palm Computing Division (see the What's New Preview on page 171), were finalists.

Silux Simulation, a tool that lets you dynamically interact with running simulations and enables stress and motion analysis, won as Best Software Application. Finalists were the multiple-platform, distributed-enterprise backup system for SAP R/3, from MultiStream, and Applix Anywhere Office, which is implemented in Java. The award for Best Development Software went to SoftLab's Visual Enabler, a workgroup configuration management and version-control tool set. Finalists were the enterprise-level software-integration system from Quadratron Regie called O3sis and Platinum Technology's Paradigm Plus 3.5 object-oriented repository and design-and-analysis tool.

The award for Best System went to Umax Data Systems for its high-end Mac OS computer based on a 250-MHz 604e PowerPC processor (you can upgrade the system by adding a second CPU), the SuperPulsar 2500. (No Pentium II or K6 systems were nominated. At the time of the show in mid-March, vendors staged only technology demonstrations of their forthcoming Pentium II or K6 systems and wouldn't publicly discuss features or performance.) Finalists were Data General's dual-server, Pentium Pro–based Cluster-in-a-Box and Vobis's surprisingly affordable (about US$3800) 500-MHz 21164-based Highscreen Alpha 500 system.

MMX OverDrive = Expensive Upgrade

Intel's latest OverDrive processor boosts your system's business applications performance while adding support for multimedia extensions (MMX) technology. However, if you're on a tight budget, you should investigate less expensive memory upgrades first.

Intel (800-538-3373 or 503-264-7000; http://www.intel.com/procs/overdrive) offers several versions of its Pentium OverDrive processor with MMX technology for upgrading older Pentium systems. An upgrade from 75 to 125 MHz or from 90 to 150 MHz costs $399. The upgrade from 100 to 166 MHz costs $499.

The OverDrive with MMX incorporates leading-edge Intel technology, such as 0.35-micron fabrication and 2.8-V operation. Both techniques allow Intel to produce faster processors that consume less power and produce less heat. So it can work in older 3.3-V systems, the OverDrive with MMX provides its own voltage converter, filters, and a fail-safe protection system.

All this intelligence fits on a tiny piggyback circuit board hidden inside the heat sink under the integrated fan. To ensure an adequate supply of instructions

Future Watch

Video Marries Hypertext

A new standard from MPEG will bring Web-like interactivity to sound and motion. The nascent MPEG-4 standard will combine sound and motion with hyperlinks, allowing for a new generation of interactive applications that let you point and click through a series of linked text, audio, and video objects.

Whereas today's Virtual Reality Modeling Language (VRML) is used to define interactive 2-D and 3-D environments, MPEG-4 adds video to the mix. With MPEG-4, you can click on part of a video (e.g., an engine part) and go to linked explanatory text for more information. MPEG-4 could be used for interactive training, education, virtual business meetings, and other types of interactive applications.

MPEG hopes to create an international draft standard and then final approval sometime in 1998. Beyond that time frame is MPEG-7, which will specify a standard for describing the information needed by multimedia search engines, so that Web surfers will be able to better search for audio and video content.

Bug of the Month

OverDrive in Reverse

Although upgrading an older Pentium system with the latest OverDrive processor is usually a fairly smooth process, it's not always without problems. When upgrading our first candidate, a Comtrade 90-MHz Pentium system built around a Wang motherboard, it took only a few minutes to unlock the zero insertion force (ZIF) socket, remove the old processor, and install the OverDrive unit.

When we turned the PC on, however, we discovered what Intel describes as a rare incompatibility. The OverDrive draws power for its built-in fan and other circuitry directly from the CPU socket. On some system boards, however, the three necessary CPU socket pins are left unconnected.

Without power for its fan, the OverDrive avoids burning up by shifting into what Intel calls "low-performance mode." Instead of soaring to 150 MHz, the effective processor speed dropped to about 25 MHz! No workaround is possible, according to Intel. Check the compatibility list at the OverDrive Web site (http://www.intel.com/procs/overdrive) before you buy. –Robert L. Hummel

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Prevents accidental shut-offs and conveniently controls power to the entire connected system.

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Power problems attack computers relentlessly. Did you know that you have a better chance of winning the lottery than of escaping power problems? They are the single largest cause of computer data loss and hardware damage.

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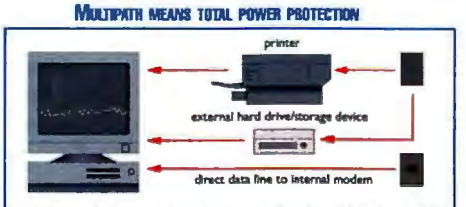
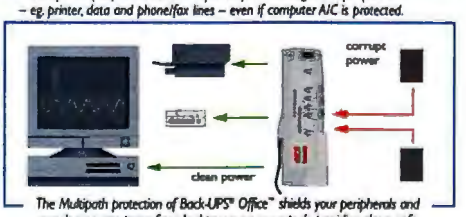
Unique multipath protection keeps your PC and data safe

Plugging phone lines or other peripherals into your computer increases your vulnerability to power problems. When a surge hits an unprotected peripheral, it can blaze down serial cables and datalines, and toast your expensive PC. Multiple peripherals and datalines to and from your system are vital, but dangerous. Without them you can't do your job. If a power sag locks your keyboard or reboots your computer before you've saved work, or while you are downloading from the Internet, you can lose data, time

MULTIPATH MEANS TOTAL POWER PROTECTION



Bad power (red) can enter a computer system through multiple paths – eg. printer, data and phone/fax lines – even if computer A/C is protected.



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Data			•
Phone			•
Total Outlets:	2	2	2
Number of Block Outlets			2
Protection from:			
Surges	•	•	•
Spikes	•	•	•
Blackouts		•	•
Brownouts		•	•
Overvoltages			•
Typical Runtime in Minutes:			
with Pentium 100 w/15" monitor		10	10
Battery backup for:			
PC		•	•
Monitor		•	•
Storage Devices/Zip Drives			•
Fax/Modem Surge protection for:			
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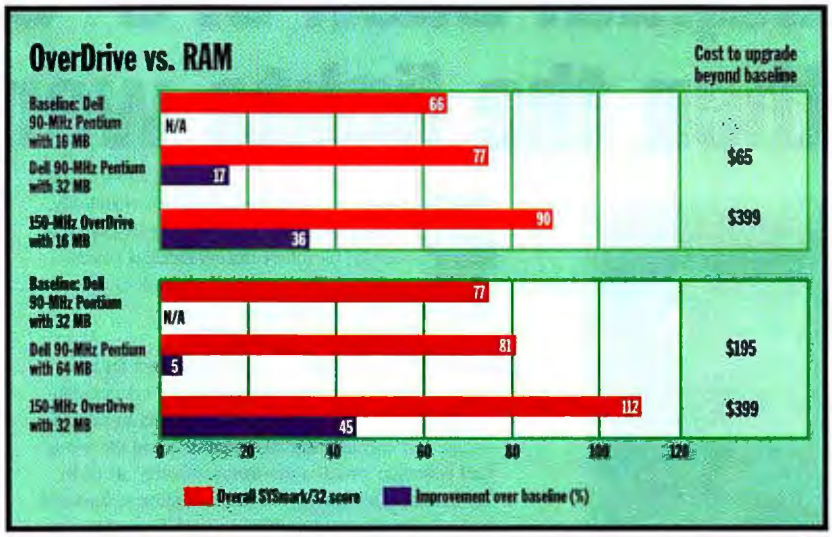
and data to feed the OverDrive's core, the OverDrive's on-chip cache is 32 KB, which is twice that of a non-MMX Pentium processor.

Is this OverDrive upgrade worth the price compared to a less expensive memory upgrade? Based on tests BYTE ran using the application-based SYSmark/32 suite of benchmarks from Business Applications Performance Group (BAPCo, http://www.bapco.com), many users will have trouble justifying the expense, given the modest performance increase.

BYTE tested a Dell 90-MHz Pentium system upgraded to a 150-MHz Pentium OverDrive with MMX. The upgrade went smoothly, though that may not always be the case (see this month's Bug of the Month on page 30). To gauge business applications performance improvement, we used SYSmark/32 under Windows 95 to evaluate the system before and after the upgrade.

To determine cost-effectiveness, we also compared the OverDrive's increase to a much cheaper upgrade: adding RAM. Plugging the OverDrive with MMX into our 16-MB system increased the SYSmark/32 score by 34 percent (see the chart). Leaving the original 90-MHz processor installed and increasing system RAM from 16 to 32 MB produced only half that increase. But at one-sixth the $399 price of the 150-MHz OverDrive, the 16-MB RAM upgrade (which cost about $65) represents a better upgrade value.



Upgrading to 32 MB of RAM delivered half the boost of an OverDrive, but at one-sixth the price.

However, adding memory goes only so far. If your system already has 32 MB of RAM, BYTE found that doubling it to 64 MB makes little difference in the SYSmark/32 scores. Some of the individual application scores actually decrease slightly! The highest performance increase comes from adding the OverDrive and 16 MB of RAM (for a total of 32 MB), which produces an increase of 70 percent compared to the baseline 90-MHz system with 16 MB.

What's the best choice? If your system is limping along with just 16 MB of RAM, spend the $65 to upgrade it to 32 MB and wait for OverDrive prices to drop. However, if you're attached to your current system and need that extra boost and those MMX instructions now, the OverDrive MMX will increase your throughput modestly while lightening your wallet substantially.

–Robert L. Hummel

Survey

Vendors Ready HTTP 1.1 Products

The first products that implement the HTTP 1.1 protocol that proponents say will help ease the current Internet bandwidth crunch are now shipping. More will appear this summer and fall. BYTE polled several leading software companies to gauge their support for HTTP 1.1. (For more information on version 1.1, see "Less Is More," May BYTE, page 40.)

Netscape (415-937-2555 or http://home.netscape.com): It already has released beta versions of Netscape Communicator, the company's e-mail, groupware, and browser suite, and Enterprise Server 3.0, the company's flagship Web server. Netscape hopes to release both products by the end of this month.

Microsoft (206-882-8080 or http://www.microsoft.com): A future version of the company's Internet Information Server (IIS) will support all the server-side requirements of HTTP 1.1. Internet Explorer release 4 (slated for release late this summer) will support the top client-side performance enhancements in HTTP.

IBM (http://www.ics.raleigh.ibm.com): It has already released its HTTP 1.1–compliant Internet Connection Secure Server 4.2 for AIX, OS/2, MVS/OE (under the version number 2.2), Windows NT, Sun-Solaris, and HP-UX.

The Apache Group (http://www.apache.org): Version 1.2 of the popular Web server supports HTTP and should be shipping by the time you read this.

Lotus (617-577-8500 or http://www.lotus.com): The company says the next version of its Domino Web server for Notes will support HTTP 1.1. The next version of Domino is slated for release sometime this summer.

–Kerry Hickox

Video Highway On-Ramps

Ever wish that all these videoconferencing codes and acronyms (ISDN, ITU, H.320, H.324, H.323, IETF) would just disappear? That videoconferencing products would interoperate, and real people could get on with the business of talking and seeing one another, like with a telephone, no matter what protocol or network a system happened to use? Well, all that is possible with an emerging class of devices called videoconferencing gateways.

Gateways are network protocol converters (and, in some cases, video "translating" devices) that make it possible for users on different networks to exchange information. Video network gateways

Introducing the MessagePad 2000, the only handheld computer you can actually use.

Of all the handheld computers, only the MessagePad 2000 offers sharp, crisp backlighting and a 16-level, high-resolution gray-scale screen that rotates on command. Which means you can always see your work in the best orientation – horizontal or vertical, even upside down. And in the best light. Bright. Or dim.

The MessagePad 2000 gives you more flexibility, thanks to its two PC slots (other handhelds have only one slot). So, for example, you can dedicate one to a wired or wireless modem and use the other for additional memory.

How much can you do in three to six weeks? That's how long a set of AA batteries lasts under normal usage. Note: normal usage here means a lot. Like having backlighting on, using the modem, crunching numbers, writing e-mail, drawing, doodling, whatever.

Built-in software lets you connect directly to a variety of serial, IrDA and LocalTalk® printers – unlike most Windows® CE devices, which have to be hooked up to a PC in order to print.

There's fast. And then there's fast. The MessagePad 2000 comes with a screaming 160 MHz RISC processor, which offers up to five times the performance of the 20-40 MHz processors you get with other handheld devices.

The usable area of the MessagePad 2000 screen is up to 56% larger than what you'll find on most Windows CE products. So, instead of having to decipher small sections at a time, you can read the entire width of a fax or Web page.

A built-in microphone and speaker let you record and play back voice dictation. And the MessagePad 2000 is the only handheld computer that lets you record and take notes simultaneously.

The MessagePad 2000 works easily with desktop computers. So you can create documents on the MessagePad 2000, then transfer them to and from Microsoft® Excel or Word on any Windows or Mac® OS-based system. Or you can keep your calendar and address book current by synchronizing them with desktop programs like Microsoft Schedule+ 7.0 or Claris Organizer™ 2.0. And it's easy: with Auto Dock, the MessagePad 2000 makes these transfers automatically.

Unlike Windows CE-based devices, MessagePad 2000 is the only handheld computer that lets you exchange data with both Windows and Mac OS-based computers.

The MessagePad 2000 handheld computer offers a real detachable keyboard (not a tiny, finger-cramping version). So you can quickly and easily type e-mail, business letters, project reports. Only your superb writing style – not your aching fingers – will determine the length of your documents.

Of all the handheld computers out there, only one makes it truly easy to be productive on the road. Introducing the MessagePad® 2000. Rather than just letting you view data, the MessagePad 2000 lets you carry out sophisticated tasks with the greatest of ease. For example: you can now write a full-length proposal, insert information downloaded from the Web – even include pricing from your company's Intranet – and then fax or e-mail it to a client. Try that with an ordinary handheld computer. The MessagePad 2000 has more power, more storage, more flexibility. All contained within the most innovative design, optimized for usefulness. Of course, there's only one real way to understand how incredible the new MessagePad 2000 is: try it yourself. For the name of a dealer near you, or to get more information, call 800-909-0260. Or visit us at www.newton.apple.com/useit.

Newton

Modem and ISP required for Internet access. Competitive specifications as of February 1997. ©1997 Apple Computer, Inc. All rights reserved. Apple, the Apple logo, the lightbulb logo, LocalTalk, Mac, Macintosh, MessagePad and Newton are registered trademarks of Apple Computer, Inc. Claris Organizer is a trademark of Claris Corporation. Microsoft and Windows are registered trademarks of Microsoft Corporation. All Macintosh® computers are designed to be accessible to individuals with disability. To learn more (U.S. only), call 800-600-7808 or TTY 800-755-0601.

add support for managing video and audio data streams over the intersection of two or more networks using different protocols.

"Video gateways aren't conceptually novel," says Ami Amir, president of RADVision (Tel Aviv, Israel, and Mahwah, NJ; 201-529-4300 or http://www.radvision.com). "We've been delivering H.320 LAN-to-LAN video gateways based on our proprietary middleware for over 18 months, but this new standards-compliant generation of video network gateways is exciting." H.320/H.323 gateways being developed by Lucent Technologies, RADVision, PictureTel, VideoServer, and others let people who have conferencing on their desks get the video/audio "on and off" ramps they need to pass between packet-switched and circuit-switched networks.

PictureTel's (Andover, MA; 508-292-5000 or http://www.picturetel.com) LiveGateway is a PC server add-on kit that not only provides bidirectional interoperability between LiveLAN 2.0 or 3.0 (H.323-compliant) clients and H.320 systems, but also enables Intranet LiveLAN conferencing across digital telephone lines (ISDN). The kit ($2995) consists of one LiveGateway full-length ISA/EISA card with an ISDN cable and software.

Similar in basic purpose, RADVision's L2W-323 Gateway/Gatekeeper for IP networks includes a built-in H.323 gatekeeper (providing H.323 call-control services) and allows up to four concurrent calls between IP-based H.323 terminals (with H.261 for video compression and decompression) and remote users connected to the switched public networks with H.320 videoconferencing systems, at speeds of up to 384 Kbps per call. Prices start at $5950.

VideoServer (Waltham, MA; 617-229-2000 or http://www.videoserver.com) and Cisco Systems (Mountain View, CA; http://www.cisco.com) have announced plans to collaborate on the development of gateways. Under the agreement, Cisco will OEM gateway modules from VideoServer to enable conferencing between LAN and WAN end points. VideoServer has been demonstrating its gateway technology at major venues ever since. Pricing and availability have not been announced as of this writing.

Murray Hill, NJ–based Lucent Technologies' (http://www.lucent.com or 888-458-2368) long and illustrious history on the PBX stage makes it a natural for the gateway business. Bruce Tillinger, market manager for Lucent's multipoint products, sees H.320/H.323 gateways as critical components of business environments. "Going forward, H.320 is going to continue, but H.323 will make its way later this year, and it is going to be critical for our customers to be able to have a seamless way to converse with people, regardless of the networks or the protocols in use at the various end points. Therefore, our solutions will include H.320/H.323 gateway functionality."

If you are evaluating potential gateway providers, besides examining the company's basic engineering and roots in networking, you should also closely examine the extent of their standards compliance (many product data sheets read "H.323-ready," but full H.323 is envisioned as an update), call-control and gatekeeper functionality, and expansion, especially in the number of connections the gateway can support simultaneously in its basic configuration. Also, verify that the LAN protocols as well as all the videoconferencing hardware and software in use are, in fact, fully supported in the gateway.

Checking on these features before you invest in a provider can save you from unpleasant surprises down the road.

–Christine Perey

Datapro Report

Users Give a Qualified Yes to NCs

Business users appear clearly receptive to network computers (NCs). Over 60 percent of end users surveyed early this year said they would consider giving up their PC for an NC, provided it reduced reliability and ease-of-use problems and still provided access to current PC applications. However, certain types of users are more open to the idea of NCs than others.

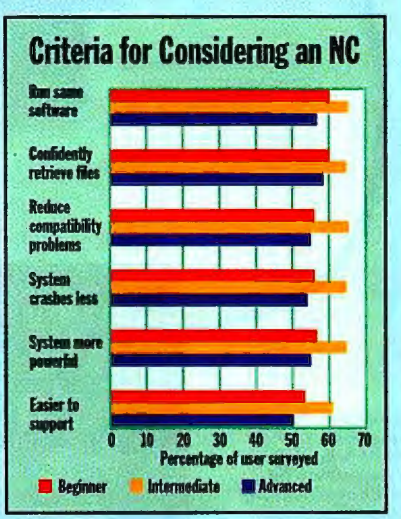
NCs come in different flavors. They can be PC-based (e.g., those that comply with the NetPC specification, from Microsoft, Intel, and others), X Window System–based (e.g., Wyse Technologies' WinTerm device), or Java-based (e.g., those offered by Sun Microsystems). The survey focused on Java-based NCs. These are OS-independent and don't contain an internal storage device or removable medium such as a floppy drive. They rely on a server or servers for system management, booting up, running applications, and storage.

Although most people like their PC, the majority said they would consider giving up their hard and floppy drives if the NC solved some of today's basic PC problems. Top complaints about PCs today are programs and files that aren't always compatible with others (35.9 percent of those surveyed complained about this), system crashes (31.3 percent), and notebook/desktop data-sharing hassles (31.3 percent).

As you can see from the chart, users who classified themselves as PC users with an intermediate level of experience are most receptive to exchanging PCs for NCs. Although their application usage patterns are similar to those of advanced users, intermediate users are less likely to spend much time using compute-intensive applications (e.g., programming, desktop publishing, and graphics design).

Advanced users who spend much time using compute-intensive applications are not necessarily well suited for the NC environment because of their intense local-resource requirements. However, over 50 percent of advanced users were receptive to NCs. Many PC users are frustrated and ready to listen to alternatives. It may not be too difficult for information technology (IT) managers to persuade end users to adopt an NC after all.

John MacGilvary, chief analyst, Worldwide PC Industry. For more information on Datapro reports, call 609-764-0100; fax: 609-764-2814; or http://www.datapro.com.



Intermediate users are most amenable to NCs.

"With the new 32-bit Windows version, it's making a strong bid for honors as the best all-around remote control program on the market."
PC World *March 1996*

"Its modular design shines in Microsoft's Windows 95's 32-bit multitasking enviorment. It is easy to use, and it also has features that make it easy for network administrators to manage."
LAN Times *Feb.19,1996*

"LapLink is the easiest program to use, and it's one of the fastest and steadiest."
Federal Computer Week *Feb. 6,1996*

"After hours of testing, a clear usability winner emerged-LapLink was far and away our testers top choice for fuss-free remote access to files, programs, or a network, and for remote training and technical support."
PC/Computing *Sept. 1996*

"LapLink consistently outperformed pcAnywhere on our network. With LapLink, we felt as though the remote system was performing tasks locally, but when we switched to pcAnywhere we still felt as though we were using a modem."
PC Magazine *March 26, 1996*

"LapLink is a powerhouse for, and the granddaddy of, remote computing."
Home Office Computing *May 1996*

"...if you haven't upgraded your LapLink in a while, it's time to do it again. LapLink for Windows 95 is good."
BYTE *May 1996*

"LapLink is a superior remote access client for telecommuters, remote offices and even local clients"
PC Week *April 1996*

"When we matched it up against Symantec's pcAnywhere32 in our labs, we found that LapLink is the product we'd want with us on the road."
PC/Computing *May 1996*

"LapLink is still the tool of choice for laptop users. It may be the only remote access product you need."
LAN Magazine *June 1996*

"...LapLink's speed and intuitive design make it the best choice in the market."
Info World *Jan.29,1996*

If you think file transfer is all we do, you need to catch up on your reading.

Computer industry experts aren't in the habit of agreeing with each other. When they do, it's definitely worth noting.

It's also worth noting that LapLink® has already racked up more prestigious industry awards (twenty-three of 'em, at last count) than every other remote access software package. Combined.

And now that LapLink is available for Windows NT, you have every reason in the world to request one of our free, fully-functional trial packs.

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We'd be delighted to bring you up to date.

TRAVELING SOFTWARE

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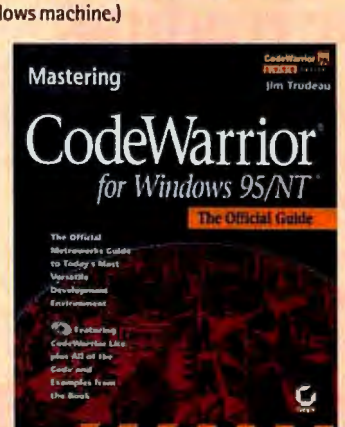
Book Reviews

CodeWarrior's Reach Gets Bigger

Long ago, in 1994, only Mac programmers knew about CodeWarrior. It is Metrowerks' integrated development environment (IDE), which consists of a tightly coupled editor, project manager, compiler, linker, and source code debugger. It cranked out PowerPC code for the Power Mac like mad. This book exemplifies CodeWarrior's platform diversity today. The CodeWarrior IDE cranks out code for a wide variety of systems, including the Mac OS (680x0 and PowerPC), Windows 95/NT (x86), Java, the BeOS, the PalmPilot, and a slew of embedded systems.

Jim Trudeau does a good job of explaining the CodeWarrior architecture and basic programming concepts. Note and tips text boxes provide valuable information—the description of an object-oriented programming (OOP) class is elegant—and they offer rest stops in the middle of a complex subject.

The CD-ROM that is included with *Mastering CodeWarrior for Windows 95/NT* contains a demonstration copy of the Windows version of the CodeWarrior IDE. Thus, you can experiment with some of the book's sample programs. Furthermore, one sample program lets you generate Java code, while another lets you compile and generate a Mac application. (That's right, with the proper settings, you can write and compile Mac programs on a Windows machine.)

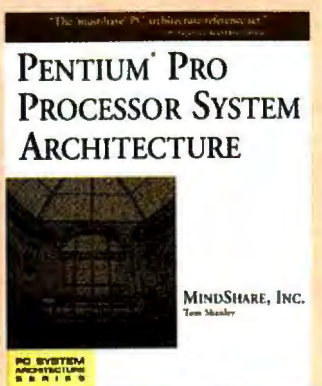


Of course, the emphasis is on Windows development, and here the book covers essential details in using the development tools, such as how to operate the source code debugger. It also provides code examples for making a DLL and a Windows application. If you're interested in trying a set of Windows development tools that can potentially extend your reach to other platforms, check it out.

–Tom Thompson

Insider's Guide to the Pentium Pro

You don't feel like reading Intel's Pentium Pro manuals? Try this book, instead. It's the latest in a well-respected series based on



Intel's system architecture. It covers all aspects of Pentium Pro design, including Intel chip sets (440FX, 450GX, and 450KX) and a somewhat speculative introduction to Intel's matrix math extensions, or as they're now termed, multimedia extensions (MMX) technology. The book assumes knowledge of earlier Intel processors and system architecture or familiarity with previous books in the "PC System Architecture Series." You must go to the Pentium book in this series, for example, to get serious details on the advanced programmable interrupt controller (APIC).

Using top-down organization, Tom Shanley tells you what he's going to tell you before doing it. The overview sections yield a fair understanding of Pentium Pro design. The rest provides the details—logically organized and clearly explained at a level appropriate for hardware and software engineers. It includes many tables and figures.

This book is not casual bedtime reading. It is essential information put in a palatable form for those who need it.

–Dave Rowell

Mastering CodeWarrior for Windows 95/NT by Jim Trudeau, Sybex, ISBN 0-7821-2057-1, $39.99

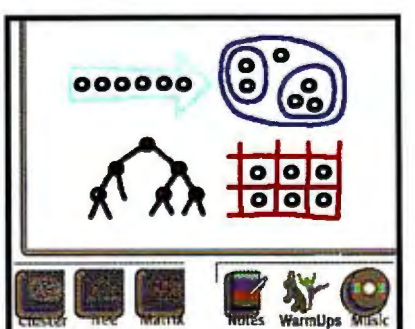
Pentium Pro Processor System Architecture by Tom Shanley, MindShare, Inc., Addison-Wesley Developer's Press, ISBN 0-201-47953-2, $34.95

What's the Point?

Good idea, bad execution.

The user's guide to VizAbility: Diagramming states that "diagrams are an incredibly flexible way to illustrate, communicate, and record your ideas." The concept of this CD-ROM is intriguing. Its developers claim that using it will help you communicate better, improve visualization skills, and incorporate these skills into your daily life. Unfortunately, I found no evidence to support this claim.

The program leads you through exercises involving symbols, structures, composition, and show-and-tell. Yet after spending considerable time trying to give this program the benefit of the doubt, I still don't understand what objective its developers set out to accomplish. For example, in the composition section, you are told to organize circles and



VizAbility: Diagramming, $29.95
PWS Publishing Co., 800-327-0325; fax: 408-373-0351; http://www.vizability.com/

squares into describing a sentence that is given. OK, maybe I will be a better Pictionary player after completing this exercise, but is it worth all the time and effort?

To be honest, I might have completely missed the point and objective of this CD-ROM. As a result, this review might be biased and incomplete, but without more assistance from the VizAbility: Diagramming makers, I am certain other users will feel as unsatisfied by this program as I was.

–Jesse Friedman

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Go on-line for less with this simple, fast, cost-effective, 128Kbps **ISDN Terminal Adapter**. Features Multilink PPP, Bandwidth-on-Demand, Call Bumping, Stac® Compression, up to 460Kbps DTE throughput, two Analog Ports, BRI S/T or U Interface, and Flash EPROM Firmware.

Omni TA128

This revolutionary **ISDN Terminal Adapter** allows two users to share one ISDN line. Features Multilink PPP, Stac® Compression, Bandwidth-on-Demand, Call Bumping, two Analog Ports, two Serial Ports, up to 460Kbps DTE throughput, BRI S/T or U Interface, and Flash EPROM Firmware.

Elite 2864I

The industry's first **ISDN Modem** to achieve backward compatibility with V.34 analog modems. Features built-in V.34 Modem, Multilink PPP, V.120, V.110 & X.75, Stac® Compression, Standalone Fax, Voice Digitization, Microphone and Speaker Jacks, Serial & Parallel DTE Interfaces, one Analog Port, up to 460Kbps DTE throughput, Password Protection, Embedded Protocol Analyzer, and Flash EPROM Firmware.

Everything You Need For ISDN Access Is Here

Prestige 100

This affordable new **Personal ISDN Router** is the perfect choice for SOHO Internet Access. Features include Single User IP Account (SUA™), IP Routing, PPP/MP, Stac® Compression, Dial-on-Demand, Bandwidth-on-Demand, two Analog Ports, four-user support via Ethernet LAN connection, PAP/CHAP, Telnet, and BRI S/T or U Interface.

Prestige 2864I

The first **ISDN Remote Access Router** to provide interoperability with V.34 analog modems. Features Single User IP Account (SUA™), IP/IPX Routing, Transparent Bridging, Dial-on-Demand, BOD, PPP/MP, V.120, X.75, Stac® Compression, one Analog Port, Menu-based Configuration via Telnet, Integrated SNMP, PAP/CHAP, and Firewall. AppleTalk® optional.

Prestige 128

This new Dial-on-Demand **ISDN Bridge/Router** provides a complete low-cost solution for wide area networking and corporate Internet access. Features Single User IP Account (SUA™), IP/IPX Routing, PPP/MP, V.120, X.75, Stac® Compression, BOD, Remote Configuration via Telnet, SNMP, PAP/CHAP, Firewall, and two Analog Ports. AppleTalk® optional.

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Circle 206 on Inquiry Card (RESELLERS: 207).

Blasts from the Past

5 Years ago in BYTE

"Managing Infoglut" discussed several text search-and-retrieval systems, electronic books, paperless documents, and SGML, the forerunner of the wildly popular HTML that is used on the Web today. And thanks to the Web, managing text is even more of an issue today.

10 Years ago in BYTE

Besides articles on CAD and IGES, BYTE covered IBM's new Personal System/2 line, which featured up to a 386 processor, the Micro Channel bus (neither electrically nor mechanically compatible with the old IBM PC bus), and a new OS from Microsoft called Operating System/2. Several big companies like Sharp, Toshiba, and IBM had large active-matrix LCD projects under way. Analysts predicted active-matrix would be the next step in display evolution.

15 Years ago in BYTE

Tutorials on developing, producing, and using videodiscs for mass-storage and educational applications advised us that soon we may be measuring mass storage in gigabytes (and today we do, of course).

20 Years ago in BYTE

We ran articles on designing multichannel analog interfaces and how to interface with the IBM Selectric office typewriter. The idea behind these articles was to use the typewriter as your printer to generate "suitable hard copy output."

INTERVIEW

Internet Gatekeeper

Gil Shwed, CEO, president, and founder of Check Point Software Technologies, discusses future trends in firewalls and Internet security.

BYTE: *Why have firewalls and other security products become important to companies?*
Shwed: Historically, a firewall was something like a door. When a company wants to connect to the Internet, it has to put in a door that opens up its network to the rest of the world. Firewalls served initially as those doors. In the last year or two, we've seen the firewall used increasingly to enable connectivity. Not just to close the door to attacks from the outside, but to enable people to connect to its network from the road in a secure way, for companies to start sharing information using the Internet as a Virtual Private Network (VPN).

BYTE: *How are companies' security needs changing?*
Shwed: Companies have discovered the possibilities of connectivity. They have more doors, they have more connection points, they use public networks, they have to secure them. Two things have happened. The first trend involves employees or other companies that are calling from the outside. The second trend is with the emergence of the Internet, people realize the security risks that they have. Later, they may realize that a major part of the risk actually resides within the corporation. Companies are using more network security inside the company for compartmentalization among different departments. Once the company is connected, you don't want the wrong people to get to the finance-department computers or for the software developers to test their software on the production machine by mistake.

BYTE: *How have new Internet "push" software and similar new services on the Internet changed firewalls?*
Shwed: A firewall has to support the policy [of the company], and part of the policy means that there are new services every day. Each one of these new services optionally needs to be supported or blocked. What we offer people is the ability to add these services themselves or through us and support for these changes. These changes happen every day, so it is critical to be able to support new services like BackWeb or Real Audio through the Internet.

BYTE: *What are the current and future dangers? We have seen a great deal of concern lately about Java and ActiveX security.*
Shwed: We have an open architecture with our FireWall-1 product, and it lets the user plug in whatever they want. It provides basic capabilities so that the user can choose where they want to allow Java applications or ActiveX applications. This lets administrators decide if they want to get ActiveX or not get ActiveX, and from which site. One of the customer demands we have found is that people are afraid of Java applets, but they also need them because they write enterprise applications that need them. Instead of forcing them to choose between screening Java out or screening it in, we allow administrators to enable Java when users are visiting sites on the Internet that are known and to disable Java when users are visiting sites that are unknown.

For more information on Check Point, see **http://www.checkpoint.com.**

Microsoft Internet Explorer 4.0 delivers Internet applications and desktop integration—and you can't beat the price. By Pete Loshin

Microsoft's Free-Lunch Browser

Internet Explorer 4.0, Microsoft's answer to the Communicator superbrowser from Netscape, proves the adage that competition benefits the consumer. A full Internet applications suite, IE 4.0 borrows some of Communicator's features and adds new ones at an unbeatable price—free. This shows how eager Microsoft is to get it on your desktop.

The preview release was stable enough to show off many of the new features. They include Outlook Express (an e-mail and newsgroup reader), NetMeeting (a collaboration tool), NetShow (a streaming multimedia client), and FrontPad (a Web editor). Those brave enough to install IE shell integration will be rewarded with what seems like an OS upgrade, enabling a uniform look and feel—and single-click document activation.

Desktop integration is apparent at every turn: You can now use IE for viewing and navigating disks, folders, networks, and computers. Active Desktop lets you drop HTML pages and ActiveX components anywhere on the desktop (see the screen), so now the Web is the desktop and the desktop is the Web.

Dynamic HTML, an open extension to HTML for Web-content interaction that bypasses the server, is also new. You can drag and drop "floating" images on a page or manipulate the results of a database query.

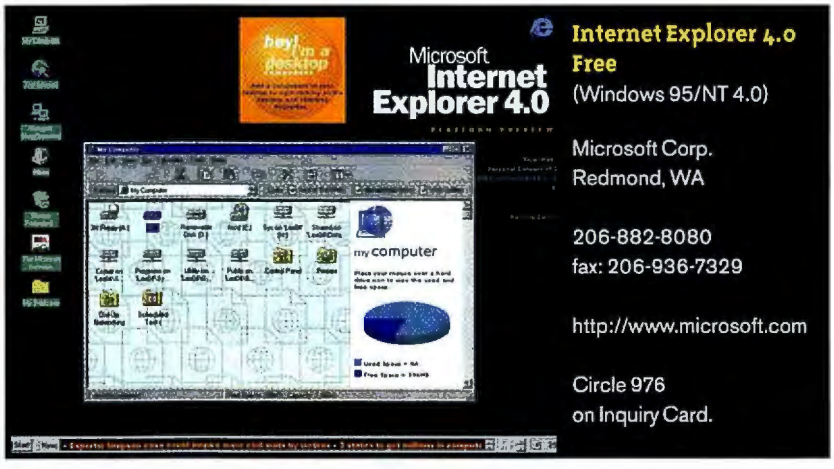
The Favorites function includes a site-subscription option, directing the browser to periodically check subscribed pages. It highlights updated links with a red "gleam" on each page's entry in the Favorites menu.

Also new is Microsoft Wallet, for managing shipping addresses and credit-card numbers for on-line shopping. The new configurable toolbar also shines. You can drag and drop the toolbar, toolbar links, and an address window next to, above, or below each other.

Microsoft may call Outlook Express a lightweight e-mail client and newsgroup reader, but it easily satisfies my needs, with IMAP4 support, HTML content editing and viewing, complex message-filtering rules, multiple mailbox support, and Secure Multipurpose Internet Mail Extensions (S/MIME) encryption and digital signatures.

NetMeeting 2.0 offers chats, digital whiteboards, application sharing, and both videoconferencing and audioconferencing, with broad support for open standards, multipoint conferencing, and LDAP directory access. A NetShow streaming-video demonstration showed a nice-looking but small video image. Personal Web Server takes advantage of Windows networking to let you easily publish content from your desktop with FrontPad, a decent little HTML editor.

There's barely room to list all the new features in the preview release I used, let alone those that didn't make the preview. There was plenty to convince me that Netscape's next offering had better be good to slow its loss of market share to Microsoft's Internet Explorer juggernaut. B



IE 4.0 meshes Web and desktop, with (for example) drag-and-drop installation of an ActiveX news ticker in the menu bar (bottom).

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

TECH FOCUS

Active Desktop Integration

Microsoft's Active Desktop combines live HTML objects with the Windows desktop for more direct integration of network resources (intranet and Internet) with local resources (files and programs). Active Desktop uses two layers: An HTML layer (for objects such as HTML frames or ActiveX controls) sits on top of the icon layer, where users typically keep folders, files, and programs (as represented by icons).

Pete Loshin is a technical editor for BYTE reviews and author of Extranet Design and Implementation *(Sybex, 1997). You can reach him at* **ploshin@mcgraw-hill.com.**

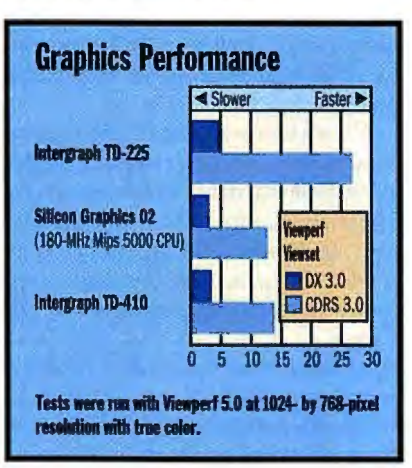
Intergraph's new TD-225 is one of the first Pentium II systems—and the best 3-D graphics buy we've seen. By David Essex

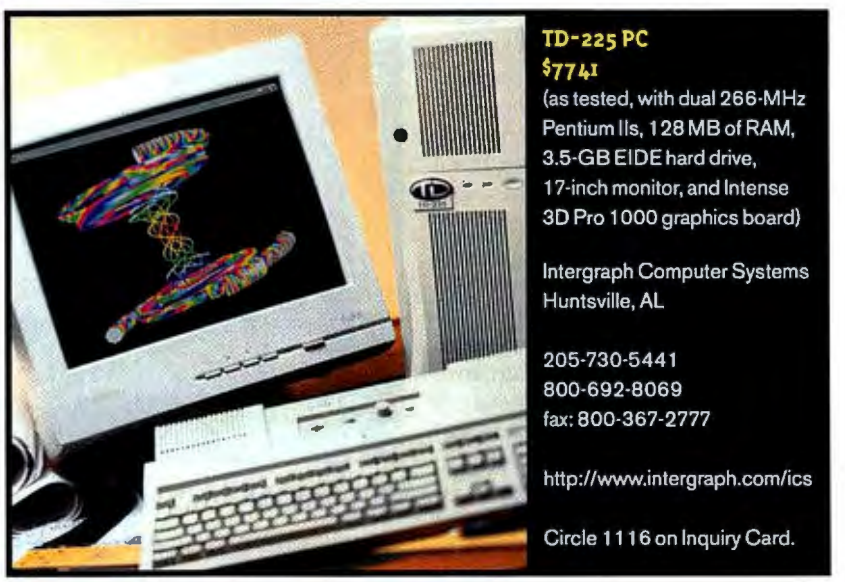
3-D Price Breakthrough

Long a leader in Windows NT–based 3-D graphics workstations, Intergraph is introducing its lowest-cost 3-D system ever. At the same time, it's becoming one of the first companies to use Intel's radically redesigned Klamath (rechristened the Pentium II) CPU.

Rather than plugging directly into the motherboard, the Pentium II is housed in a roughly half-size card, with its L2 cache now in a separate chip nearby and a heat sink for dissipating the considerable heat of the Pentium II. Intel plans to house all its future CPUs in such modules, which system vendors like for the flexibility in system design that they allow.

Intergraph's TD-225 PC comes with up to two 233- or 266-MHz Pentium II CPUs. For 3-D acceleration, you can choose either Intergraph's workstation-class Intense 3D Pro 1000 ($1999) or the Intense 3D 100 ($135), a slower card geared more toward 2-D applications. At 512 MB, the TD-225's memory capacity is huge (our test system came with 128 MB). Also included is a universal serial bus (USB), a fast bus based on an emerging standard for hot-pluggable peripherals. The system also has five PCI slots, one of which holds the graphics board.





TD-225 PC
$7741
(as tested, with dual 266-MHz Pentium IIs, 128 MB of RAM, 3.5-GB EIDE hard drive, 17-inch monitor, and Intense 3D Pro 1000 graphics board)

Intergraph Computer Systems
Huntsville, AL

205-730-5441
800-692-8069
fax: 800-367-2777

http://www.intergraph.com/ics

Circle 1116 on Inquiry Card.

The TD-225 represents a price breakthrough in NT-based 3-D PCs.

Our lab tester found the TD-225 to be well-designed inside. A single quiet fan provides all the cooling requirements for the PCI slots. A DC power plug on the back of the tower case provides power for the keyboard speakers, and a lockable hinged door closes access to the CD-ROM and floppy drives—both nice touches.

We ran two benchmark tests to judge the Intergraph's overall graphics performance and that of the spanking-new Intel Pentium II. We ran the CDRS Viewset test (based on Parametric Technology's modeling and rendering software) and the DX Viewset, which is based on IBM's Visualization Data Explorer. Both are part of Viewperf, an industry-standard OpenGL benchmark.

The TD-225's CDRS score of 26.64 easily beat that of Intergraph's own, higher-priced TD-410 workstation, which we reviewed in the December 1996 BYTE (see the graph); its DX score of 4.61 also beats other workstation-class machines we've tested by 42 percent or more. Our BYTEmark CPU benchmark came in at 3.8 for the integer index and 4.5 for the floating-point index. These scores easily beat those of a 200-MHz Pentium Pro and matched those of a 266-MHz Digital Equipment Alpha–based machine (see "Pentium Pro Makes NT Fly," February 1996 BYTE).

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

Our loaded test system (with dual 266-MHz Pentium IIs, 128 MB of RAM, a 3.5-GB hard drive, and a high-end Intense 3D board) cost just $7741. Less expensive configurations are available in the $3000-to-$5000 range. That makes the Intergraph TD-225 PC the most capable, professional-level 3-D machine we've seen at such an affordable price. B

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

PHOTOGRAPH: BRIAN WILDER © 1997

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

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SONY 17SEII	17" (16.0")	0.25 AG	NO
HITACHI ELITE 751	19"(18.0")	0.22 horiz.	YES (1672)
SONY 20SFII	20"(19.1")	0.30 AG	NO
VIEWSONIC GT800	20"(19.1")	0.30 AG	NO
MITSUBISHI 91TXM	21"(19.7")	0.28 AG	NO

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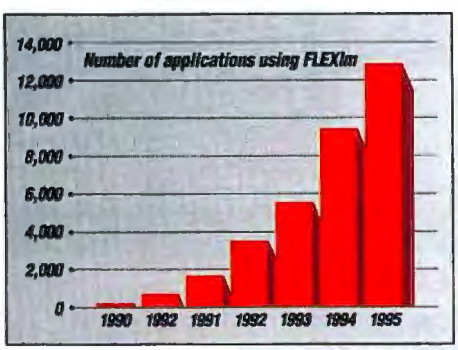

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Circle 166 on Inquiry Card.

A latecomer to the Windows CE hand-held PC ranks, Hewlett-Packard leapfrogs everyone with a standard 640-pixel-wide screen. By David Essex

Looking More Like Windows

Windows CE—Microsoft's scaled-down version of Windows for hand-held PCs—is single-handedly responsible for making these tiny computers a viable platform after years of disappointed expectations. Now, Hewlett-Packard, the company that led the first move toward desktop standards with its Lotus 1-2-3–equipped LX line, is finally offering its first Windows CE units, the 300LX and 320LX.

The 300LX series' breakthrough feature is an 80-column, 640- by 240-pixel screen, a first for Windows CE hand-held PCs. Even without the optional backlight, the screen is eminently readable once you angle it to avoid glare. With the bluish light on, the display is crisp—in fact, it's good enough to play solitaire in bed with the lights off.

I tested a 320LX prototype ($699) that lacked several features found in the final units that HP expected to ship by mid-spring—a CompactFlash backup card, a docking cradle, and a fax modem. The 300LX, which costs $499, has 2 MB of RAM instead of 4 MB and lacks the screen backlighting, fax modem, and CompactFlash.

Both units' connectivity options include any network or modem device that will fit in its Type II PC Card slot, a 115-Kbps IRDA-compliant (Infrared Device Association) port, and an RS-232 interface that requires an optional adapter. Bundled connectivity software includes a terminal emulator, remote networking, an e-mail inbox, and the Pocket Internet Explorer that come with Windows CE, and Microsoft's H/PC explorer for transferring files to and from your PC. Also included is bsquare development's bFax Pro. HP throws in a CD-ROM offering additional communications software.

RATINGS	
TECHNOLOGY	★ ★ ★ ★
IMPLEMENTATION	★ ★ ★ ★

HP 320LX
$699

Hewlett-Packard Co.
Cupertino, CA

800-443-1234
970-392-1001

http://www.hp.com/handheld

Circle 1100 on Inquiry Card.

The standard-width screen lets you view Windows without scrolling to the right, as on other CE hand-held PCs.

Though it comes with downsized versions of Microsoft Word and Excel, the 320LX—like its competitors—is still a glorified Day-Timer in many ways. Thus, it comes with tools for synchronizing contacts, schedules, and notes between hand-held and desktop machines. Special software lets you synchronize with the desktop version of Microsoft Schedule 7.0a. You can also synchronize to the Outlook personal information manager (PIM) in Microsoft Office 97 and print directly to a printer.

The keyboard is as cramped and stiff as that of any competing hand-held PC, though the unit is roughly a half-inch wider, at 7.2 inches. Windows CE hardware vendors have avoided using handwriting recognition for input, what with that technology's well-known failures.

The alternative—using the stylus to activate the mostly standard Windows mouse events, supplemented with minimal keyboard entry—is workable. This is especially true of Pocket Excel, which requires less user input than Pocket Word. Also, with faxes and e-mail now dowloadable in essentially desktop format, and with extensive data sharing between the desktop and hand-held PCs, the 320LX won't lack for useful input and output.

HP still has a way to go to top the classy Philips Velo 1 (see "This Hand-Held Stands Out," April BYTE), which has a built-in CPU-based modem and voice input. Still, the 320LX has one big, wide feature that no other hand-held PC can beat—for now. B

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

PHOTOGRAPH: BRIAN WILDER © 1997

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

Ricoh's multifunction MP6200S CD-RW drive handles CD-ROM, CD-R, and rewritable media. By Stan Miastkowski

A Readin', Rewritin' CD Drive

It's easy to get acronym fatigue when talking about CD drives. Besides CD-ROM, there's CD-R (recordable) and the new generation of DVD (digital versatile disc—formerly videodisc). DVD holds long-term promise, but technical and legal problems continue. In the meantime, CD-RW (rewritable), after a rocky start, is beginning to make inroads now that an industry group has agreed on a common format.

I took a look at one of the first "standard" CD-RW drives, the Ricoh MP6200S. Currently available only in an internal version, the drive looks exactly like any CD drive, and it shares many common features as well. The MP6200S has a SCSI-2 connection, is a 6X CD-ROM reader, and writes both CD-R and CD-RW media at 2X speed. But it's the quarternary phase-change RW technology—in which different media are handled by automatic modulation adjustment of the read/write laser—that sets the drive apart. According to the specifications, CD-RW media can be recorded and erased up to 1000 times and has a 30-year lifetime, making it an excellent choice for applications such as backup. It's also a great choice for CD mastering because, unlike CD-R, a mistake or buffer underrun won't ruin the disc. But at $25 per disc, CD-RW media is five times more expensive than CD-R.

You can use CD-RW two ways. For mastering or multiwrite sessions (adding data to the media sequentially, by tracks), CD-RW discs are completely backward- and forward-compatible with standard CDs; they can be read by any CD drive, including DVD. Testing the MP6200S with a prerelease version of Adaptec's Easy-CD Pro 2.1, I created both standard data (ISO 9660) and audio (Red Book) CDs. The only difference is an icon in Easy-CD Pro that erases CD-RW media.

The MP6200S can also do packet writing using the new standard Universal Data Format (UDF) that makes the CD-RW appear as just another drive letter. I used an early beta version of Adaptec DirectCD, which will be shipped with the drive. It formats CD-RW media into sectors and uses a Windows 95 virtual device driver (VxD) for accessing the files. A CD created with UDF needs a device driver to be recognized by a PC. There have been rumblings about UDF drivers being included in future operating systems. In the meantime, DirectCD makes UDF CD-RW media compatible with all PCs.

Unfortunately, the VxD didn't yet have full UDF capabilities. While I could drag and drop files onto the CD-RW, I could only erase the entire disc instead of deleting individual files. The shipping version of the drive will include full UDF capabilities, a Ricoh spokesperson said, so CD-RW discs can be used just like 650-MB removable media.

Although several manufacturers will ship CD-RW drives, it remains to be seen how successful the technology will be. CD-RW is definitely a transitional technology on the way toward a DVD future, but it offers distinct advantages now. Although the initial drive investment of $599 isn't inexpensive, the CD-RW media cost of 3 cents per MB is considerably below the 10 to 15 cents per meg of competing rewritable technologies such as magneto-optical and phase-change dual or removable-media drives such as the Iomega Jaz or SyQuest SyJet. And the MP6200S's ability to act as both a CD reader and a CD-R recorder makes it a true multifunction peripheral. B

MP6200S
$599
(read/write media, $25)

Ricoh Corp.
San Jose, CA

800-955-3453
408-432-8800
fax: 408-432-8372

http://www.ricoh.com

Circle 1033
on Inquiry Card.

Though CD-Rewritable may prove a halfway house to DVD, it already delivers the lowest per-megabyte cost in removable media.

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

Stan Miastkowski is a BYTE consulting editor. You can reach him at **stanm@bix.com.**

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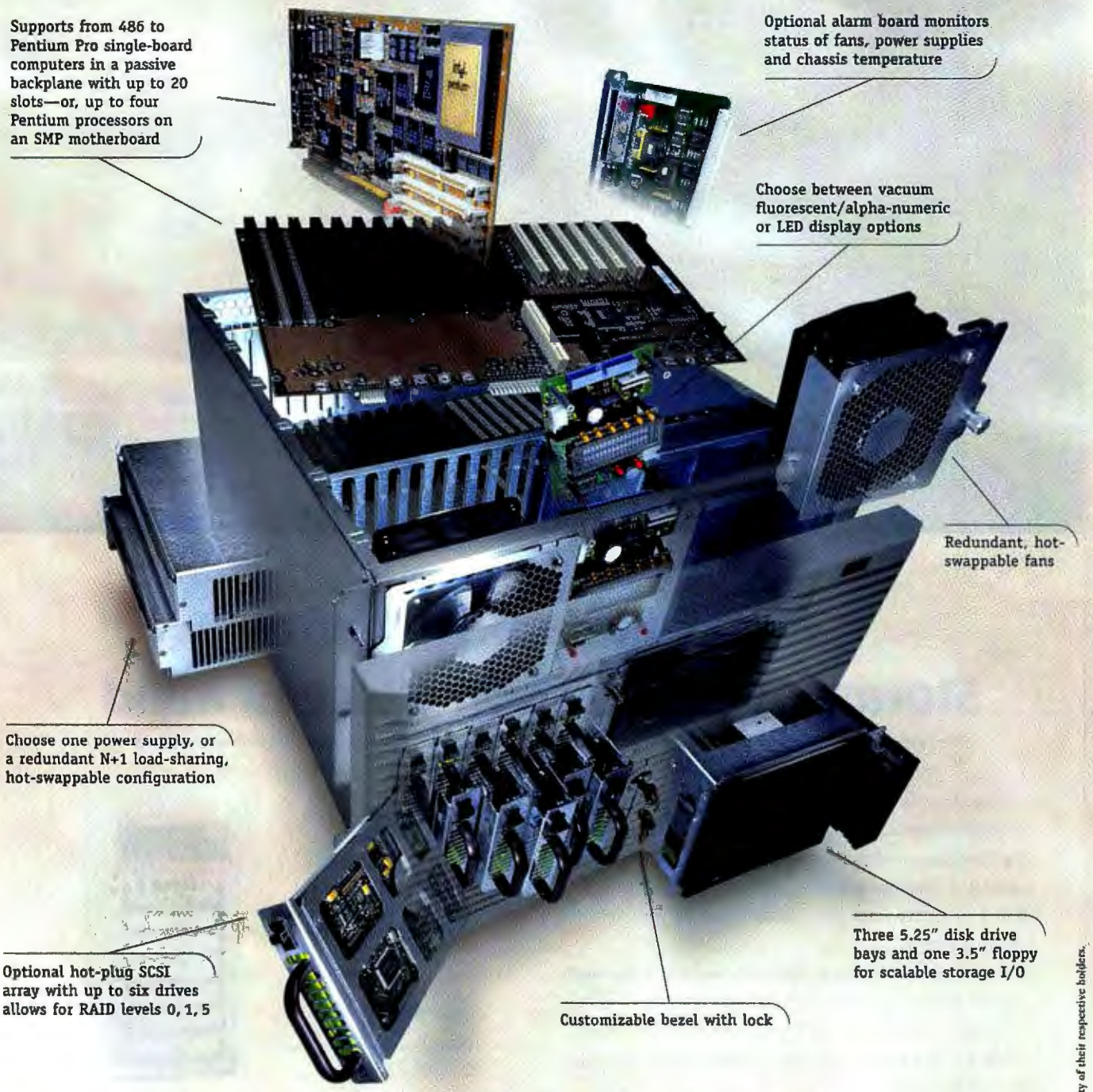

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When information links change constantly, Publish and Subscribe promises robust data delivery. By Dr. Richard Hackathorn

Data Delivery When You Want It

Despite the evolution of information technology, we are still searching for better mechanisms to deliver data from producers to consumers. An important emerging technology offers hope. It's a special type of data-delivery mechanism, called Publish and Subscribe (P&S), that is appearing in various IT architectures today.

The concept of P&S goes back hundreds of years to early newspapers and magazines. Someone generates content of a volatile nature; someone else is interested in that content on a continuing basis. P&S implies an ongoing relationship that links data producers with data consumers, more than just a fleeting transaction.

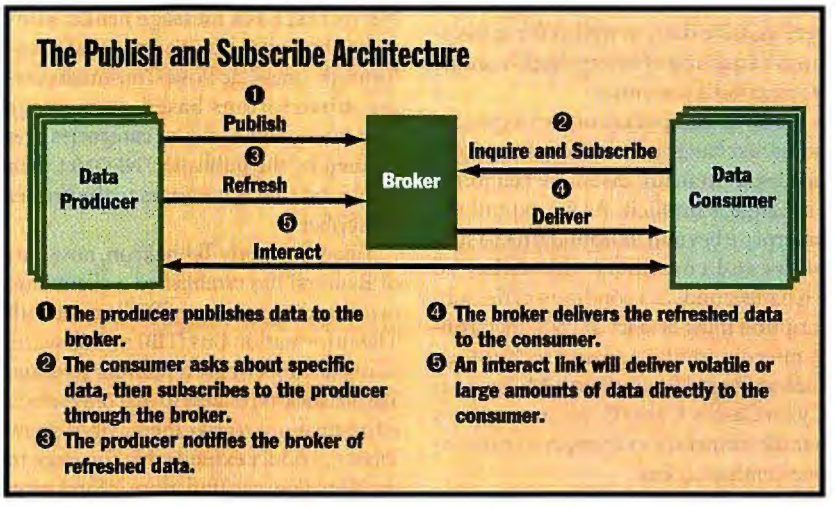
Now apply this concept to databases. The content of databases is ever-changing. Some application programs generate new or changed content, and other applications report that content on a continuing basis. The traditional way of linking data producers with data consumers was to design the system architecture so that those links are hard-wired into module linkages and procedural calls. The relationships are static because they are predefined, supporting the high performance necessary for certain on-line transactions, such as airline reservations.

As we move into increasingly dynamic and complex data environments, we no longer have the luxury of predefining and hard-wiring those links. Data producers and consumers might frequently appear and vanish. A mechanism is required within distributed systems to decouple this hard-wiring. That is the role that P&S attempts to fill.

P&S is a coordination mechanism that matches and links producers with consumers in a dynamic fashion. P&S requires a third party, called a *broker*, to match producers who want to publish specific data with consumers who want to subscribe to that data. Although the producer could act as the broker, this approach would not scale for larger, distributed systems. The broker establishes a relationship, called a *subscription*, between one producer and one consumer for specific data. The subscription is maintained by the broker as long as both the producer continues to publish and the consumer continues to subscribe. This duration could be a few seconds or a few years.

The purpose of the subscription is to relieve the burden on both the producer and the consumer for maintaining the currency of the data. As data changes, the producer should inform the broker of these changes; the producer should not have to maintain a subscriber list and send changes to each subscriber. Likewise, the consumer should be informed by the broker of any changes; the consumer should not have to poll each producer periodically to detect changes.

The term *data*, as used here, should be generalized to any type of business object, whether data-centric or procedure-centric. There should be little difference between subscribing to the latest data on weekly sales performance or the latest software module for financial applications. In addition, there should be little difference between subscribing to data or programs that are totally static or to those that change minute by minute. And there should be little difference between subscribing to business objects that workers might use and to objects that are invoked internally by an application program.



A broker ensures that the producer's data reaches the consumer.

Basic Interactions

The interactions of a typical P&S mechanism are shown in the figure "The Publish and Subscribe Architecture." In this case, a producer first publishes an object with the broker. Consumers can then inquire about objects that have been published. If a required object is available, the consumer can then subscribe to that object, and the broker delivers that object to the consumer. When an object changes, the producer refreshes that object with the broker, who in turn delivers the refreshed version to the consumer. (The reverse actions for unpublishing

by the producer and unsubscribing by the consumer are implied but not shown.)

By decoupling the producer/consumer relationship, the security of both parties can be enhanced, allowing either party to participate in an anonymous fashion. Producers could also share or transfer subscriptions to balance loads or to specialize in certain areas. Further, the P&S mechanism could form multilevel value-added chains, where a consumer adds value to the data and republishes the results for another group of consumers.

In actual implementation, the exchanged object is probably a reference (pointer), so the actual delivery of data or code happens directly between the producer and the consumer, as shown in the figure's *interact link*. In addition, an interact link to a centralized database would be required for highly volatile or very massive data, as well as for applications requiring efficient high-volume transactional semantics.

A critical component of P&S is the economic exchange between consumer and producer. In many cases, the economic exchange is implicit. As we extend the enterprise beyond its boundaries to suppliers and customers, the ability to exchange funds as a condition of the subscription must be part of P&S. Electronic microcommerce, using technology such as Digital Equipment's Millicent or CyberCash's CyberCoin, attempts to handle monetary exchanges as small as one-tenth of a cent.

P&S Products

The P&S mechanism is emerging in many diverse product categories, including:

Distributed Objects: The concept of a broker achieved industry visibility with the Object Management Group's specification for the Common Object Request Broker Architecture (CORBA), which extended the classic remote procedure call (RPC). Numerous vendors are commercializing CORBA. (For more information, see "Distributing Components," April BYTE, and "CORBA for the Masses," March BYTE.) Several products extend the event notification within CORBA to support P&S, such as Orbix, from Iona Technologies, DataBroker, from I-Kinetics, Entera, from Borland Open Environment, and Ambrosia, from Open Horizon.

Messaging Transports: Messaging transports (also called message-oriented middleware, or MOM) are extending their inherent store-and-forward mechanism into P&S. NEONet, from The New Era of Networks, has a message broker controlled by a rule-driven engine that transforms the message flow. Consumers create subscriptions based on message content, not on names or categories predefined by the publisher. NEONet then filters and routes messages to the proper subscribers.

Tibco (formerly Teknekron, now part of Reuters) has established a client base in the trading systems of Wall Street with The Information Bus (TIB) middleware. Using a subject-based naming scheme, TIB broadcasts packets so that only selected destinations receive them. Tibco's new Tibnet product extends this coverage to the Web. (You can find more information on middleware in "Will Netscape Set the Standard?," March BYTE, and "The Ultimate Middleware," April BYTE.)

Work-flow and Groupware: Newsstand, a set of tools from Lotus Development, extends Lotus Notes to the Web by publishing Notes templates and then managing the security and approval of subscriptions (see our review, "Notes Opens Up to the Web," October 1996 BYTE). Several publications, such as BNS's Banking Report, use Newsstand for electronic distribution.

Web Publishing: Web publishing has become an exploding marketplace. This is especially true with "push" broadcast products from PointCast, Marimba, BackWeb, I-Fusion, and others. Even Microsoft has recognized its importance with its effort to standardize Internet channels. (For more information on this technology, see "Push Me, Pull You," September 1996 BYTE.)

Data Marts: P&S has big potential for use in delivering data from data warehouses. Tapestry, D2K's tool suite for building and managing data marts, has a subscriber interface with which users can examine the metacatalog and then place subscriptions via the Web. Information can be delivered in a variety of formats, such as Excel, Word, or Lotus 1-2-3. Aclue, from Decision-ism, focuses on the Arbor Essbase community, using P&S to distribute dimensional data cubes consistently throughout an enterprise.

Future Flexibility

As the distribution categories show, the landscape of data delivery is radically changing, giving us diverse alternatives for tapping into databases. Yet having the right data at the right time continues to be an elusive goal. Using P&S, we can create large-scale electronic markets that organize the dynamic relationships between data producers and data consumers—for the extended enterprise and beyond.

The complexity of our business environments today does not afford us the luxury of predesigning and hard-wiring our distributed systems. By reconfiguring rapidly in response to changing business conditions, P&S can become the basic fabric of our enterprise systems of the future, putting a different twist on business process reengineering. B

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Dr. Richard Hackathorn is president of Bolder Technology, Inc. (Boulder, CO), a company specializing in enterprise connectivity and data warehousing. You can reach him by sending e-mail to **richardh@bolder.com** *or at his company's site,* **http://www.bolder.com/.**

Inferno is an abstract, scalable OS suitable for everything from hand-held devices to servers. ***By Larry Rau***

Inferno: One Hot OS

Inferno is a distributed, architecture-independent, network OS (NOS) that is now commercially available from Lucent Technologies. Researchers at Lucent's Bell Laboratories designed and implemented Inferno to solve many of the problems encountered in the communications and computer industries.

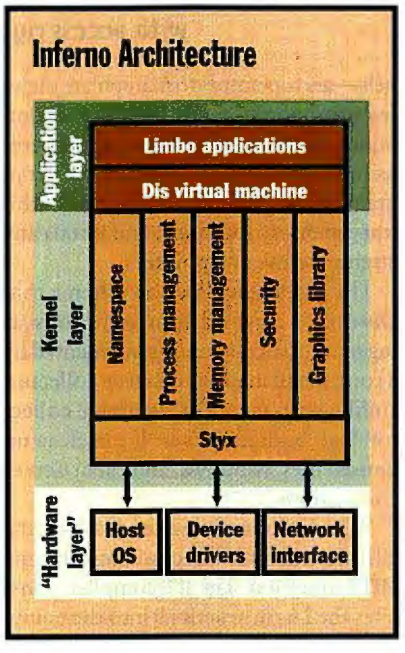
The impetus behind creating Inferno was to reduce the cost and complexity of creating and deploying software systems. Inferno offers a number of features that together help achieve this goal. One such feature is that Inferno is highly scalable. The complete OS and basic applications run in only 1 MB of RAM, making it suitable for embedded systems, such as network computers (NCs), set-top boxes, and PDAs.

However, the system's hardware-abstraction architecture (described below) makes it an ideal interface for high-performance server applications. For example, it allows an Internet service provider (ISP) to write mission-critical software that runs on a server farm using different hardware and host OSes.

The Inferno OS was designed to support a "write once, run many" model for software developers. That is, a compiled Inferno program can run on a variety of existing and emerging hardware systems. The Inferno system employs several layers of abstraction to achieve this ubiquity. Inferno provides a virtual machine (VM) to hide hardware architectural differences so that software isn't tied to any specific processor. So far, this sounds a lot like Java, but Inferno goes further than this single layer of abstraction by providing a virtual OS (VOS) and a virtual network (VN).

The Abstract OS

The idea of a VOS is analogous to a VM. Inferno's VOS defines a common interface for system services. Support for this common interface is achieved in two different ways. First, the VOS can reside, or be hosted, on top of an existing OS (as in the server-farm example above). In this case, the interface maps VOS services to the native OS services. Alternatively, the VOS can be made "real" through a kernel that implements the VOS interfaces directly on the hardware, as shown in the figure "Inferno Architecture" above.



Inferno offers a common OS interface, a VM, and a virtual network interface.

The VN is the next layer of abstraction. Currently, many properties of the type and topology of a network are embedded in applications. For instance, many programs that use the sockets-communications library contain information that ties the software to the IP protocol.

Inferno provides a single abstract view of the network. Network nodes are accessed generically via a symbolic machine and service name. The Inferno system then takes care of the specifics of the underlying network—for example, TCP or asynchronous transfer mode (ATM). All the virtual components work together to make the applications software independent of the underlying network infrastructure. You could upgrade a network to, say, Gigabit Ethernet without rewriting the applications software, thereby increasing its useful lifetime and reducing support costs.

File System and Namespaces

Inferno has many of the features you would expect to find in a modern OS, as well as some unique features. Conventional features found in Inferno include threads, device access, and a networking file system. Among Inferno's unique features, two stand out: First, all resources are represented as file systems. Second, local and remote file systems can be placed in a dynamically configurable, hierarchical namespace.

Inferno file systems contain entries that represent actual disk files. These systems also contain entries representing resources, which appear as files. For example, hardware resources, such as a display or a network device, appear as files to an application. This abstraction is powerful because of its simplicity and familiarity. You access resources through familiar function calls, such as `open()`, `read()`, and `write()`. Furthermore, all resources can be assigned access permissions and ownership.

This interface is both simple to use and simple for the system to support. A network interface allows any Inferno file system (i.e., resource) to be exported to other Inferno nodes on a network. Therefore, when an application performs file-access operations, it does not require the file to be local or remote (see the fig-

ure "Inferno Resources" at right).

Each thread in Inferno inherits a namespace, which can be dynamically configured and subsequently passed on to its siblings. A *namespace* is a hierarchical collection of files on both local and remote file systems that are available to a program. An application can require a particular namespace or construct one on its own. How that namespace is constructed—that is, where it is or what resources are actually present—can be unknown to the application. Furthermore, namespaces can change from one invocation to the next, or even during execution. This allows resources to be configured, reconfigured, and modified without disturbing the application code.

The Styx Protocol

Inferno relies on a number of underlying technologies to operate. In compliance with Inferno's mythological underworld theme, its key component for distributed nature is called Styx. Styx uses a simple message-oriented protocol that resides on top of a reliable, in-order, networking protocol, such as TCP. It implements the basic operations, such as open, read, write, and close, necessary to operate on files. Thus, Inferno makes local procedure calls if the file system being accessed is local. Otherwise, the Inferno kernel automatically converts the file-system calls into appropriate Styx messages and sends them to the remote host.

Each Styx message can optionally contain a cryptographic signature and/or be encrypted. This fundamental integration of security within Inferno satisfies the commercial requirements of networking systems. Inferno nodes connecting to one another are authenticated using public-key-encryption schemes, thus creating a trusted network environment.

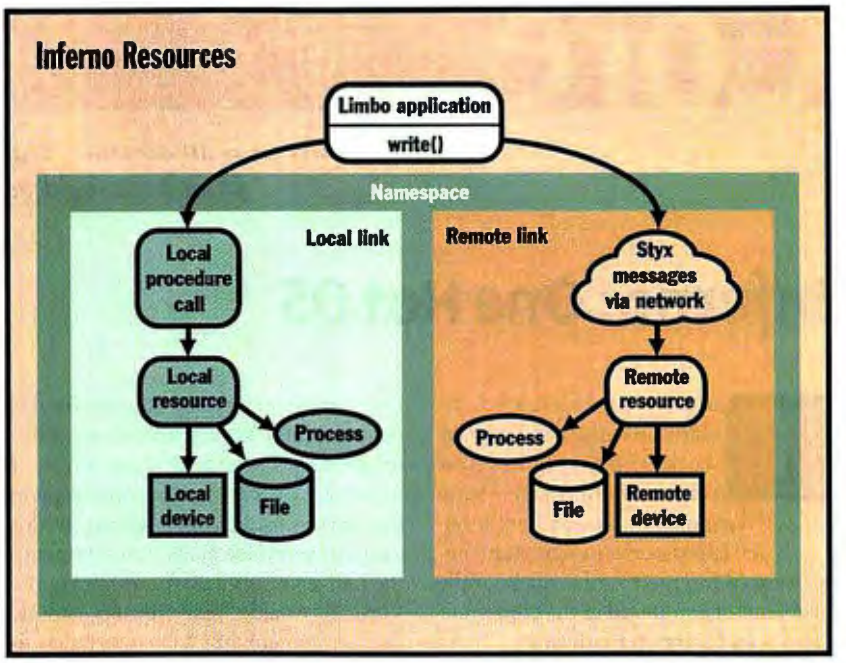
The Dis VM

The Dis VM implements a software processor for the Inferno system. This provides applications with a common target instruction set and architecture. The instruction set for Dis is not specific to any language. Each instruction consists of one byte that identifies the instruction operation, and another that identifies the addressing mode. The instruction is followed by three optional operands ranging in size from 1 to 4 bytes each.

Dis supports several high-level data types—strings, arrays, lists, and channels—and operators to manipulate them. It also supports threads, interthread communication, and automatic garbage collection. Like Java, Dis prevents you from manipulating pointers or accessing arbitrary memory locations, and it foils any attempt to use null pointers.

The garbage-collection scheme that Dis uses is a hybrid approach, consisting of reference-counting augmented by a concurrent mark-and-sweep collector. Unlike with Java, Dis's garbage collector deals with resources: It can clean up unused files, windows, and client/server connections.

When a Dis module is loaded, it can be either interpreted directly or just-in-time (JIT) compiled. The JIT compiler translates the Dis instructions into the equivalent native code of the underlying architecture. JIT compilers are relatively small and easy to write because they were conceived before the Dis instruction set was formulated.



Resources represent local and remote files and even devices, with access rights and attributes.

Developing for Inferno

The Inferno system also includes Limbo, a new general-purpose, concurrent programming language. Limbo is a strongly typed dynamic language designed to take advantage of Inferno's features. Developers familiar with the C language will be very comfortable with the syntax and semantics of Limbo.

Along with the Limbo language comes a large set of application-level services, which include the Tk graphics library, file manipulation, math functions, linear algebra, encryption, string-parsing, and more. The Inferno distribution also contains a set of applications and numerous sample programs. The bundled applications include an editor, a debugger, and a compiler.

Inferno Resources

Additional information on Inferno can be obtained from Lucent Technologies' Inferno Web site (http://www.lucent.com/inferno). This site contains the Inferno evaluation release 1.0 package for downloading.

The package contains the *hosted* Inferno system, which is available for Windows 95 and NT, Solaris (x86, SPARC), Irix, HP-UX, and Linux (x86). The distribution contains the Inferno OS, support for the TCP and UDP network protocols, the Dis VM, the Limbo programming language, a GUI window manager, a collection of sample applications, and reference material for programming the Inferno environment. B

Larry Rau (Whitehouse Station, NJ) is a member of the Inferno development team. You can contact him by sending e-mail to **larryr@lucent.com.**

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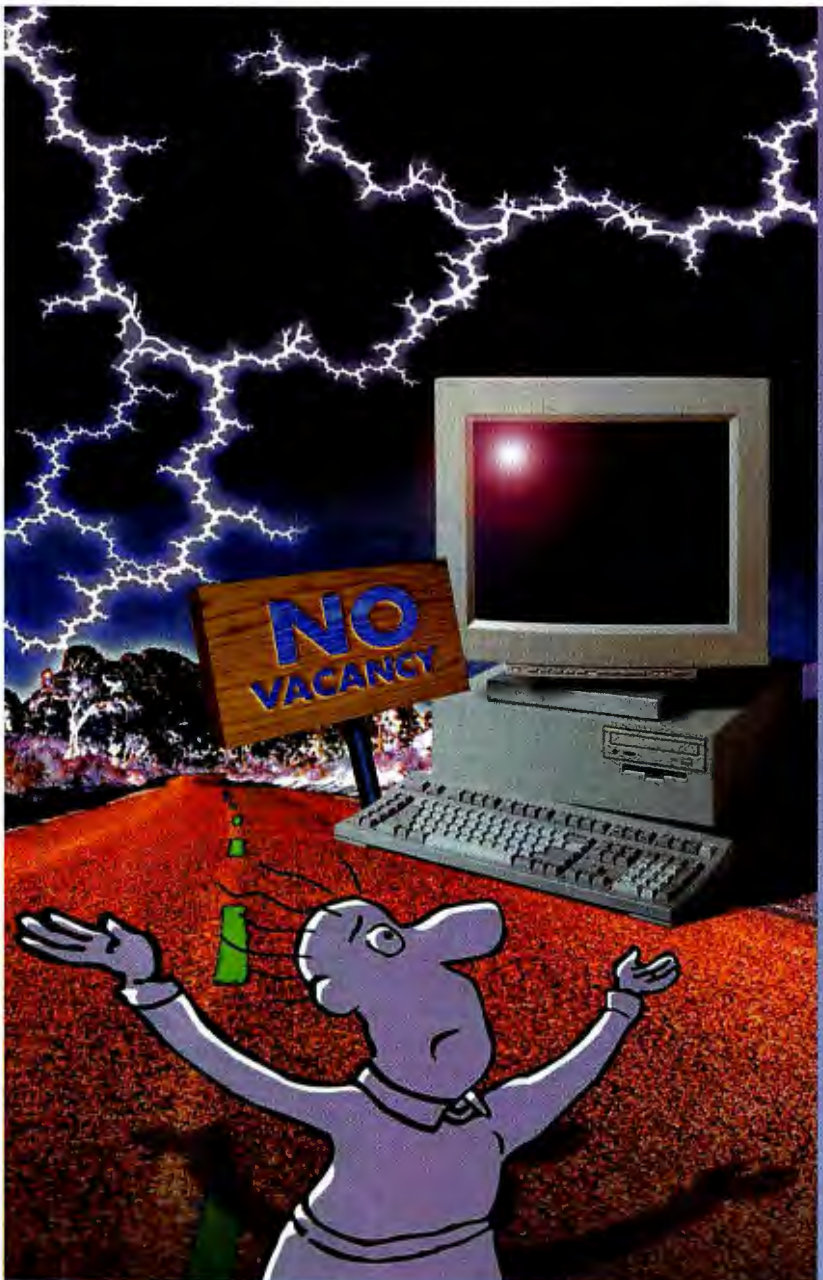

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Circle 154 on Inquiry Card.

ATM's topology doesn't offer built-in redundancy, but the smart network manager can build it in the network. By Jeffrey Fritz

Bulletproofing ATM: Part I

These days, network reliability is as important as—or maybe even more important than—network performance. A high-bandwidth network backbone means little to its users if the network itself proves unreliable. Financial institutions, government agencies, airlines, and other critical industries simply cannot afford network failures—although, ironically, such failures are inevitable over time.

Therefore, it is absolutely necessary to take steps to ensure that the network is as bulletproof as possible. The most critical failure point in most networks is the backbone.

Asynchronous transfer mode (ATM) has been getting more than a little notice recently as a network backbone. This is understandable because it offers high bandwidths of 155 Mbps and up, and supports a large variety of services. ATM also offers built-in support for constant bit rate (CBR) services such as voice and video. Furthermore, it offers quality of service (QoS) capabilities that let voice, video, and data coexist over a common network fabric.

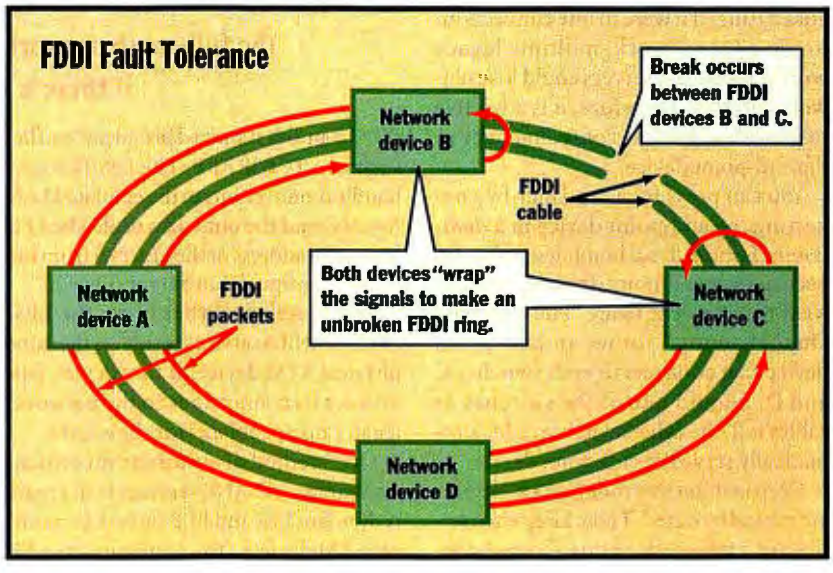
For all its advantages, however, ATM does not offer built-in redundancy. This is strange, particularly because other backbone networks support redundancy in their topology. For example, Fiber Distributed Data Interface (FDDI) has dual concentric, counter-rotating rings. As the figure "FDDI Fault Tolerance" illustrates, should a fiber in the FDDI backbone break, or a device on the FDDI link fail, the devices on either side of the break sense this and automatically wrap network signals, leaving one contiguous ring. This means that network services are usually unaffected. Similarly, connectionless networks, such as TCP/IP over Ethernet, can retransmit and redirect packets that go astray across the network.

When it comes to redundancy, ATM is different. Unlike Ethernet or FDDI, ATM is connection-oriented, not connectionless. It is usually configured in a point-to-point or point-to-multipoint fashion. Failures result in lost cells, lost packets, and dropped connections. This can mean lost services to a single switch, multiple switches, or even the entire network. The severity of the loss depends on which cables and switches the outage affects.

Therefore, fault-tolerance design should be foremost in our minds when planning or implementing ATM networks. Fault tolerance means that the network can survive the loss of one or more connections, the loss of one or more switches, and the loss of a source of LAN emulation (LANE) services. Each one of these cases requires some special attention during the design phase if you desire fault-tolerant network operation.

Cable Redundancy and Switch Failures

The effect of a lost cable or a failed switch is somewhat similar. In each case, the network loses necessary services. The ATM network configuration shown in the figure "Full Mesh and Dual Homing" on page 60 has designed-in redundancy that helps overcome the loss of a switch or a cable. In doing so, it provides decent fault tolerance for ATM networks.



Unlike ATM, FDDI devices use a mechanism that establishes a backup route when a line fails.

Notice that every ATM switch in the figure directly connects to every other switch. This is a *full-mesh* configuration. If an interswitch cable fails or a switch crashes, calls to and from the affected switch are automatically rerouted. Suppose that a construction worker cuts fiber B. Suddenly, switch A becomes disconnected from switch D. The route from switches A to D can be reestablished through either switch C (fibers D and F)

or switch B (fibers A and E). Which route the device chooses is determined by either preconfiguration or whichever switch is heard from first after the outage. Most ATM devices can handle this kind of call rerouting in a few seconds.

Once the primary link returns to service, ATM devices typically place new calls on the restored link. Calls that the device reroutes after the failure aren't restored to the primary link, because doing so would disrupt them again.

End-Point Redundancy

ATM end-point devices can also take advantage of redundant connections. An ATM end-point device is an ATM client or device such as a workstation, server, switch, or router. Often, the end-point device supports the interconnection of legacy networks such as Ethernet or Token Ring. If it were to lose connections to the ATM network, multiple legacy workstations and servers could lose network services. Therefore, it is advisable to provide some form of redundancy to the end-point device.

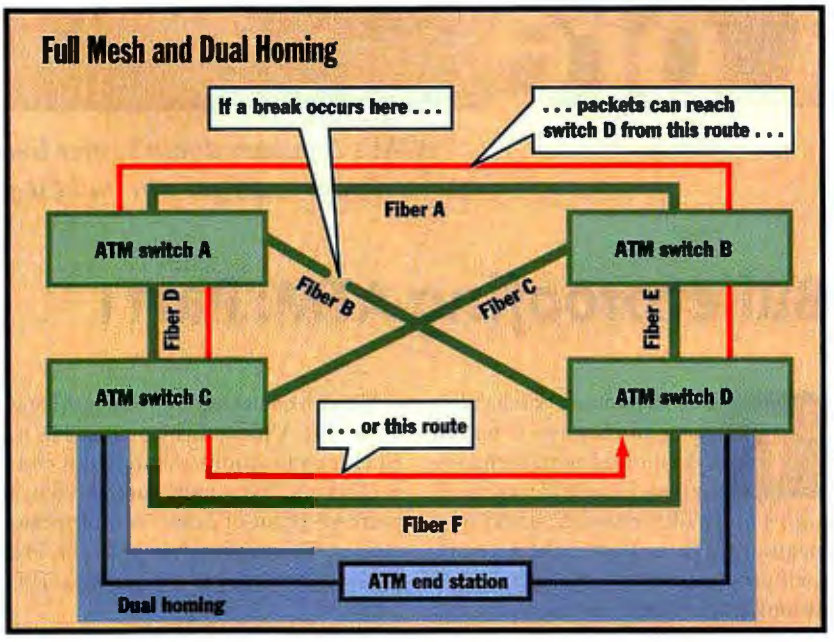
You can provide redundancy by connecting the end-point device in a *dual-homed* fashion. Dual homing simply connects a single end-point device to multiple ATM switches. The figure "Full Mesh and Dual Homing" shows an end-point device that connects to both switches C and D. Should one of the switches or cables fail, the other switch would automatically serve the end-point device.

Keep in mind that today's ATM devices are statically routed. Therefore, when setting up a full-mesh or dual-homed configuration, you often must manually provide each switch with the static routes to every adjacent switch. You do this by entering the Network Services Access Point (NSAP) ATM address of each adjacent switch or by defining multiple default routes.

Cooperating LES/BUS Services

There is more to bulletproofing an ATM network than simply providing full-mesh or dual-homed configurations. ATM legacy networks often depend on LANE, which supports transmission of unicast and broadcast packets using a LANE client (LEC). The LEC learns the ATM NSAP addresses of the other stations by consulting the LANE Server (LES).

The Broadcast and Unknown Server (BUS) handles standard broadcast traffic, such as a TCP/IP ARP. The LES/BUS pair handles connections to the emulated LAN (e-LAN) and the outside world. The LEC learns the address of the LES/BUS from the LANE Configuration Server (LECS).



The full-mesh network provides multiple routes if there is a line failure.

The problem is that often the LES, LECS, and BUS services reside on the same physical ATM device. If that device fails or loses its connections to the network, it can cause problems for the e-LAN.

One method of ensuring the constant availability of LANE services is to create redundant LES and BUS servers in multiple ATM devices. You configure the LES/BUS servers to operate as mirror images of each other in the same e-LAN. Should one fail, the other LES/BUS can take over and supply LANE services to the clients. (For more information on how you can do this, see "Reliable ATM Networking" in the April BYTE.)

Failures happening in the LECS are usually less of a concern. The only time the LECS is contacted is when a LANE client is looking for the NSAP address of the LES/BUS. This generally occurs during power-up or initial connection of the client. Once the LEC knows the LES/BUS address, it does not need to access or consult the LECS further.

If the LECS fails or is cut off from the network, it will affect only new client connections. Already-established clients will continue to operate as before, because they have obtained the LES/BUS NSAP address. Therefore, while a LECS failure can prevent a new client from joining the e-LAN, it will not adversely affect stations currently participating on the e-LAN. Additionally, you can preconfigure the NSAP address of the LES/BUS directly into some clients, negating the need for the LECS entirely.

Redundancy can offer an additional benefit to the ATM network as well. You can configure redundant BUS and LES services to provide load sharing along with reliability. Each cooperating LES/BUS operates in a round-robin fashion: LES/BUS pair one serves client A, LES/BUS pair two serves client B, and so forth. This shares the load relatively equally. Load sharing is particularly valuable to the BUS, because it can become extremely busy handling broadcast traffic in the e-LAN.

This covers some of the basic issues regarding how to provide ATM network redundancy. Next month, I'll describe in more detail how to provide redundant LES/BUS services. I will also consider fault-recovery times and show some disadvantages to providing redundancy. B

Jeffrey Fritz is responsible for advanced network technology development for West Virginia University. He is the author of Remote LAN Access: A Guide for Networkers and the Rest of Us *(Manning Publications/Prentice-Hall PTR). You can contact him at* **jfritz@wvu.edu**.

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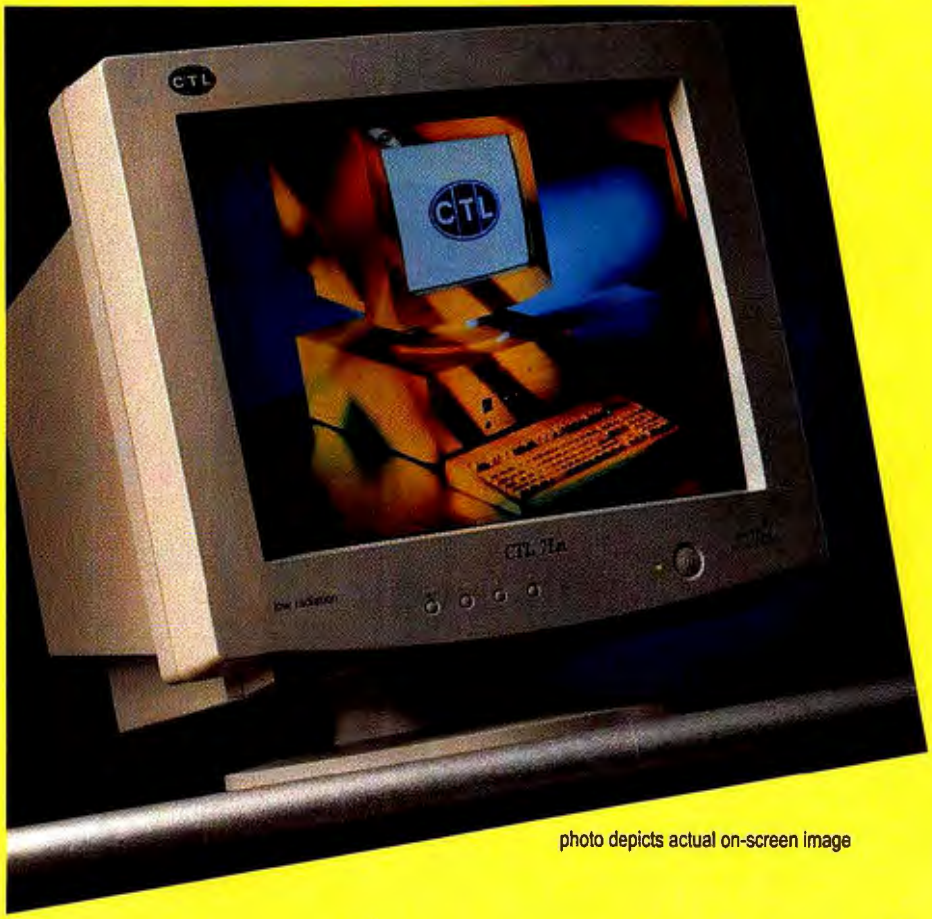

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The new ST19 IC offers low-power logic for smartcards, plus mechanisms to safeguard their data. By Ian Blythe

Smarter, More Secure Smartcards

Take an early personal computer from the '80s, some memory, and squeeze it all into a single chip that's only 25 square millimeters (about 0.04 square inches) in size. This is a smartcard IC, which itself is embedded in a plastic blank the size of a credit card. This card then acts as an intelligent memory device that stores and transfers its contents securely, even under potential attacks.

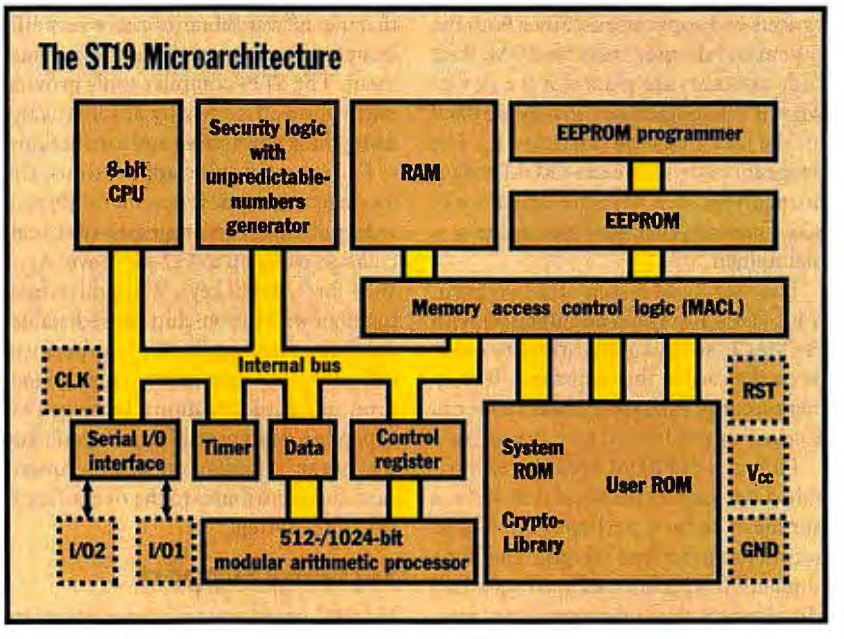
Applications currently using smartcards include telephone cards, health cards, pay TV, banking, loyalty schemes, GSM (Global System for Mobile communications) and other cellular telephones, network log-in/authentication, and data security. The increasing added value within these applications brings new threats of fraud and loss. SGS-Thomson's ST19 is a new family of smartcard ICs that addresses this need for higher security. The ST19 series builds on the experience and security aspects of the ST16 smartcard IC family.

Smartcard IC Basics

While a smartcard IC must be capable of sophisticated computations in order to encrypt crucial data, it must do so under conditions unlike those of desktop systems. The IC must be very reliable and robust, since it's carried on one's person. It must consume little power so that transactions can be carried out with battery-powered card readers.

For reliability, the basic communications interface between the smartcard IC and the card reader is starkly simple: It uses just three lines (serial I/O, clock, and a reset synchronization signal). This interface is defined by the International Standards Organization (ISO 7816). With two more lines for power and ground, a smartcard IC must make do with just five connections to the outside world (the ST19 has an extra I/O line). However, this makes for a secure interface: Any information access goes only through these lines and requires that the smartcard IC approve it and process the transaction.

The smartcard IC must be a flexible device. A card vendor will configure it for different customers who have varying security requirements. Such configurations might range from a single-application card that runs only a single program to multiapplication cards that have specialized, segregated programs in ROM. A single-program card might act as a bank card, while a multiapplication card could act as an electronic purse (credit/debit) with a loyalty scheme, or as an insurance card that holds medical files.



The ST19 smartcard IC has on-chip security functions and protected memory areas.

ST19 Road Map

The ST19 is initially made using a 0.6-micron CMOS process technology. This provides two capabilities of the smartcard IC: a fast 5- to 10-MHz clock and low-voltage (3-V) operation that allows it to be used with battery-based card readers. This technology also provides high reliability and the high-memory-density EEPROM required for today's multifunction smartcard applications.

The ST19 IC is constructed from predefined logic modules. Together these modules make up the various subsystems of the smartcard IC, as shown in the figure "The ST19 Microarchitecture." Each module has been qualified for its inputs, outputs, operation, and security capability.

The major part of any smartcard IC device is its on-chip memory. The ST19's memory is divided into three distinct areas: system ROM, user ROM, and user EEPROM. Various members of the ST19 have different amounts of RAM and ROM

to handle different applications, as shown in the table at right. Each memory area has a user-defined memory-access control logic (MACL), which provides full separation between on-chip application code and the data. Like a memory management unit, the MACL handles the read/write access permissions to the RAM partitions and read/execute/program /erase access to the EEPROM partitions, and it defines whether the EEPROM attributes can or cannot be modified. Thus the security level can easily be set to suit a single application card or a multifunction card.

ST19 Family Configurations

	ST19600	ST19SF5x	ST19CF68
RAM	128 bytes	>=512 bytes	960 bytes
System ROM	1 KB	2 KB	8 KB
User ROM	6 KB	10–32 KB	24 KB
User EEPROM	256 bytes	1–16 KB	8 KB
Cryptoprocessor with Crypto-Library	No	Optional	Optional
Secure OS with interpreter	No	Optional	Optional
Potential application	Loyalty cards	Stored-value cards, wireless communications, health cards	Stored-value cards, health cards, pay TV, Internet access

The system ROM holds basic I/O, test, and security functions. These functions are based on a firmware library that maximizes security. The user ROM holds the operating system code. This code will differ depending upon the requirements of various end applications. Since both the system and the user areas are ROM, their code contents are placed in the device when it is manufactured, so they are fixed for the lifetime of the smartcard IC. The program code in the user ROM area is normally written with the assistance of SGS-Thomson to ensure that security is maintained.

The user ROM is split into two partitions. This allows, in conjunction with the MACL, several applications to coexist on the card at the same time. To augment security, each application's code can access only predefined memory areas.

The user EEPROM area stores variable data, such as personal data keys, a purchase history, perhaps your Social Security number, and favorite telephone numbers. It is partitioned into four areas. However, for this user-programmed area, memory access is set by attribute bytes in EEPROM, allowing the access control to be dynamically defined and changed. The address isolation provided by the MACL gives a high security level. In addition, depending on the application's needs, confidentiality of the data can be ensured by encryption.

The on-chip CPU needs its own RAM in order to operate. This again is partitioned into four areas. The card vendor defines these areas during the IC manufacturing stage, and to enhance security, the designer can prohibit code execution from RAM.

The ST19's 8-bit CPU core is object-code-compatible with the ST16 family. This allows the ST19 to use a ready-made library of secure functions. The ST19 core also features extended addressing modes and an instruction set that is especially designed for writing high-security applications. These instructions give optimum trade-off between complexity and size so that the software libraries can be very efficient for access control and file management. The ST19 compiler tools provide extra code efficiency by automatically using these new modes and instructions.

For cryptographic applications, the modular arithmetic processor (MAP) provides public-key cryptography (PKC) calculation using up to 512-bit (Level A) or 1024-bit (Level B) keys. When this is used together with the on-chip unpredictable-number generator, the ST19 can perform full public-key generation, digital signatures, and authentication internally. This capability guarantees that the secret key will never be known outside the smartcard and contributes to the overall security of the system.

Software Support

No CPU-based system is ever complete without a firmware development system. This, too, is provided, both as a complete development system and as Crypto-Library support routines. The Crypto-Library can be provided in the system ROM area, leaving 6 to 24 KB (depending on the ST19 family member) of user ROM available for the application software. The library spares the card OS designer from having to write low-level hardware driver functions and be able to concentrate on security algorithms.

The cryptographic library provides firmware functions for:

- Basic math, including modular squaring and multiplication for various-length digits
- Generating long random numbers
- Calculating Montgomery constants, which are required for long-number modular arithmetic
- Modular exponentiation with or without using the Chinese Remainder Theorem, a proven theorem that gives faster calculation of modular exponentiation
- More elaborate functions such as RSA signatures and authentications for any modulo length up to 1024 or 2048 bits (depending on the required security level), or Digital Signature Algorithm signatures and authentications
- Full internal key generation for signatures and authentications

Toward a Secure Future

As the smartcard market grows globally and the stored value on smartcards increases, attempts at fraud will rise. How secure can a smartcard be? Formal certification schemes, such as the European Information Technology Security Evaluation Criteria (ITSEC), can give the user a high level of confidence in a particular application's security. For example, an ITSEC Certification to Level E3 High, which covers application, chip design, manufacturing, and delivery, has shown the ST16 smartcard ICs to be suited for a banking application. The ST19 builds on this track record using a reliable and proven nonvolatile memory technology. The ST19 also has a configurable architecture that allows flexible designs, and its firmware supports many adaptable security mechanisms. B

Ian Blythe is a senior technical writer at SGS-Thomson Microelectronics. You can reach him at **ian.blythe@st.com.**

While similar to C++, this programming language has differences that make OOP easier. ***By Justin Morgan***

An Introduction to Objective-C

Since its acquisition by Apple, Next's OpenStep cross-platform environment has become a critical part of the company's OS strategy. The Rhapsody OS uses OpenStep's cross-platform development tool suite and several object frameworks (i.e., libraries).

For anyone who's used a GUI builder and an integrated development environment (IDE), the developer tools will be a snap to use. However, to leverage their full power, it's necessary to learn an uncommon object-oriented (OO) variety of C called Objective-C. This has become a source of angst for Macintosh C++ developers who must learn a new programming language.

This article offers a gentle introduction to Objective-C that C++ programmers can easily understand. It assumes familiarity with common OO concepts, such as class, inheritance, and method (known as *member function* in C++).

Objective-C is not as large and complex as C++, yet it's fully OO and supports inheritance, encapsulation, and polymorphism. Like C++, Objective-C is a "hybrid" language; in other words, it's an ANSI C superset that supports standard C scalar types, such as `int`, in addition to object types, such as `NSArray`.

Objective-C's run-time system allows for the creation of dynamic, extensible programs. The run-time facilitates the building of bundles, which consist of one or more compiled classes that can be dynamically loaded or linked into a running program. The language's dynamic typing and binding go hand-in-hand with dynamic loading. Objective-C allows instance-variable objects to be a generic type, `id`, which means the variable's class is not known until the program is running (i.e., the variable's class is not fixed at compile time). Once an object has been typed, the run-time automatically binds the appropriate class methods to the instance while the program is running.

The Class Interface

By convention, the source code for an Objective-C class is divided into a public interface and a private implementation. The public-interface declarations can be found in an appropriately named file suffixed with `.h`. Here I'll investigate the structure of an interface file by declaring a simple class called Pet. The listing "Pet-Class Interface (Pet.h)" above contains the public interface for this class.

Pet-Class Interface (Pet.h)

```
#import <Foundation/NSObject.h>  // Must import my superclass
#import <Foundation/NSString.h>  // Required for 'name' variable
@interface Pet : NSObject        // Start of class declaration
{                                // Start of instance-variable block
   NSString *name;               // Object instance variable
   int      age;                 // Scalar instance variable
}                                // End of instance-variable block
// Accessors for 'name'          // Start of method declarations
- (void)setName:(NSString *)newName;
- (NSString *)name;
// Accessors for 'age'
- (void)setAge:(int)newAge;
- (int)age;
@end                             // End of class declaration
```

A colon separates the class name from the superclass name. In this case, `Pet`'s superclass is `NSObject`—the root class—which is declared in the Foundation Kit. `NSObject` is the only class without a superclass. (Apple prefixes Rhapsody class names with `NS` to prevent namespace collisions with classes.)

In C++, an object is simply a glorified structure. In Objective-C, each object is a pointer to a structure. This distinction is important when declaring instance variables, as you'll see below.

The first declared variable is the pet's `name`. This variable's type is statically declared as `NSString`, which is a Foundation Kit object that encapsulates a Unicode-compliant string. Remember that objects are pointers to structures, so the asterisk is required in front of `name`. If you didn't know `name`'s class type at compile time, you could dynamically type it to `id`, but you would lose some compile-time error checking. The second instance variable, `age`, is declared in standard ANSI C fashion.

Declaring Methods

In almost every OO language, methods come in two flavors: instance methods and class methods. In this regard, Objective-C follows the same conventions as C++. But Objective-C methods can override any inherited method. In C++ jargon, it can be said that all Objective-C member functions are "virtual."

A method's return type and its argument types can be ANSI C scalars or Objective-C objects. Arguments and return values that are objects can be statically declared (e.g., `NSArray`) or dynamically declared (e.g., `id`). Unlike ANSI C, Objective-C's default type is `id`, not `int`.

When you write interface declarations, instance methods are preceded with a minus sign, and class methods are preceded by a plus sign. (It so happens that the `Pet` class consists only of instance methods.) Each method name is separated into one or more key words, each

suffixed with a colon to separate it from the argument name. The colons are considered part of the method's unique name.

The class-implementation file is shown in the listing "Pet-Class Implementation (Pet.m)" at right. This is where the Objective-C methods are defined for your class. Note how the instance methods provide external access to the `name` and `age` instance variables. Rhapsody uses this convention extensively; almost every publicly accessible instance variable should have a set method (e.g., `setAge:`) and a get method (e.g., `age`).

Structurally, Objective-C methods are defined similarly to ANSI C functions. When defining a method, you first state the method name (from the interface) and then follow it with a code block that contains the algorithms you want to perform. The code block looks just like a C function block with one important difference: You can mix Objective-C messages with regular ANSI C code.

Pet-Class Implementation (Pet.m)

```
#import "Pet.h"                 // Must import my interface
@implementation Pet             // Start of class definition
- (void)setName:(NSString *)newName
{
   [name autorelease];          // Decrement reference count of old name
   name = [newName retain];     // Increase new name's count and
                                // assign newName to 'name' variable
}

- (NSString *)name
{
   return name;
}
- (void)setAge:(int)newAge
{
   age = newAge;
}
- (int)age
{
   return age;
}
@end                            // End of class definition
```

Using Messages

Defining classes, creating instances, and sending messages are the essence of object-oriented programming (OOP). Once you define a class, you need to send messages to objects. Below are a couple of sample message expressions.

```
[myDog setName:@"Rover"];
[myDog setAge:3];
```

Here you're using the class methods `setName` and `setAge` in actual message expressions. Square brackets must be placed around the receiver and the message. The message's receiver is an instance of the `Pet` class (note how the receiver is always placed before the message). The message arguments are an `NSString` instance (the unusual @" construct begins a literal `NSString` containing "Rover") and a literal integer (3).

You can put an Objective-C message expression anywhere you'd put an ANSI C function call. Objective-C also allows you to nest messages. When nesting, the return value for the innermost message expression is used as the receiver for the next expression, and so on.

The listing "A Simple Objective-C Program (PetTest.m)" below is basically an ANSI C `main()` function that contains some Objective-C messages. Since the program uses Objective-C, you suffix the filename with `.m` rather than with `.c`.

The first line of code,

```
myDog = [[Pet alloc] init];
```

warrants further explanation. This is an example of a nested message expression. Whenever you create a new Objective-C object, you must first allocate memory for its instance variables and then initialize the object. By convention, rather than doing this on two separate lines, you ask the `Pet` class to allocate space for a new instance and then initialize the allocated instance—all in one line of code.

Since the `Pet` class inherits the methods `alloc` and `init` from `NSObject`, it already has the necessary machinery to create instances of itself. The return value from the outermost expression is a new `Pet` instance, which is assigned to the `myDog` local variable. The last line in the program uses a standard `printf()` function to display the contents of `myDog`.

A Simple Objective-C Program (PetTest.m)

```
#import "Pet.h"                 // Required for 'myDog' variable
main ()
{
   Pet *myDog;                  // Local object variable

   myDog = [[Pet alloc] init]; // Allocate memory and initialize
   [myDog setName:@"Rover"];   // @"Rover" is a literal NSString
   [myDog setAge:3];

   printf("My dog's name is '%s' and he is %d years old.\n",
     [[myDog name] cString],   // cString gets a char* from an NSString
     [myDog age]);
}
```

The World of Objective-C

Objective-C is a simple language that's easy to learn and use. C++ programmers who have already switched to Objective-C often rave about the clear syntax and vast flexibility that it provides. Although Java is more flexible than C++, it still retains C++'s obscure messaging syntax, and most developers agree that Java is just not ready for the creation of industrial-strength applications.

You can obtain further information about Objective-C development from Apple's developer site (http://devworld.apple.com), from NeXT Computer's Web site (http://www.next.com), and from Metrowerks' Web site (http://www.metrowerks.com). B

Justin Morgan has been programming OpenStep/NextStep since it was available only in a black cube. He is a contractor at AT&T Wireless Services (Kirkland, WA). You can reach him at **jmorgan@objectronics.com**.

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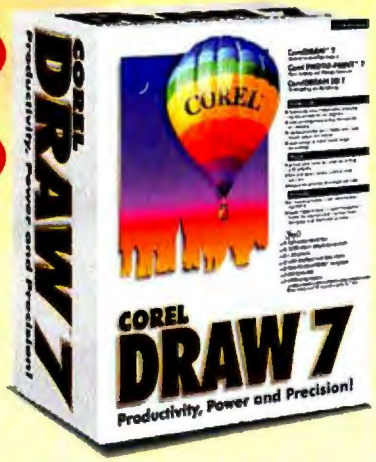

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WHO GOES THERE?

Before you can trust your business to the Internet, you must have reliable authentication.

By Peter Wayner

Think of the Internet as the Wild West minus the dust, complete with barroom brawls, larger-than-life personalities, and generally scurrilous behavior. And just as the Wild West became California, with its penchant for tofu and half-caf-half-decaf-nonfat lattes, the Internet is becoming more socially acceptable, too, thanks to something as simple as a signature.

Part of the problem with the Internet has been that nobody really knows who you are. And while anonymity can be useful, it tends to drive banks and credit card companies a little nuts. After all, how do they know if you're really allowed to withdraw $50,000 from Bill Gates' checking account? So banks, credit card companies, and major corporations are actively developing the tools that will allow people to apply digital signatures and to ensure that those signatures will hold up in a court of law.

Banks and money lenders aren't the only ones interested in signatures. Many companies are experimenting with signing everything from e-mail to Word documents. Signatures can provide a level of integrity and nonrepudiation that appeals to anybody worried about data forgery and tampering.

So how does it work? What are the big projects? Who's going to use it? How do you get a signature? And how do you implement signatures for your company?

What's My Sign?

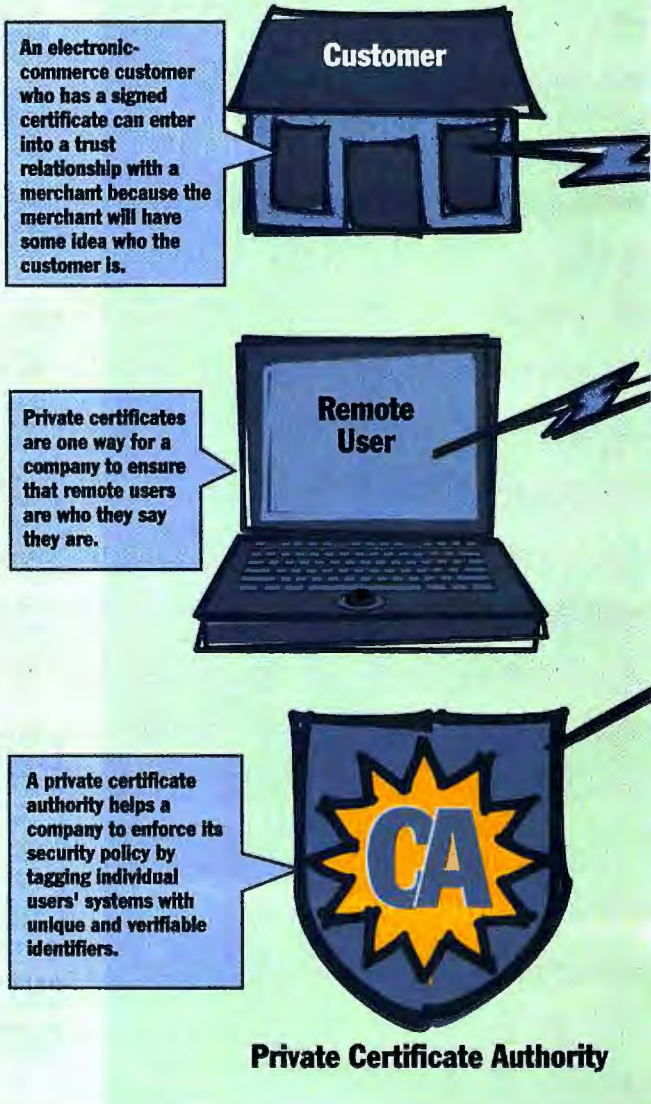
There are many digital signature algorithms described in academic literature. In practice, three major ones stand out: the hash-based signature, the U.S. government's Digital Signature Standard (DSS), and the RSA signature created using the classic algorithm developed by Ron Rivest, Adi Shamir, and Len

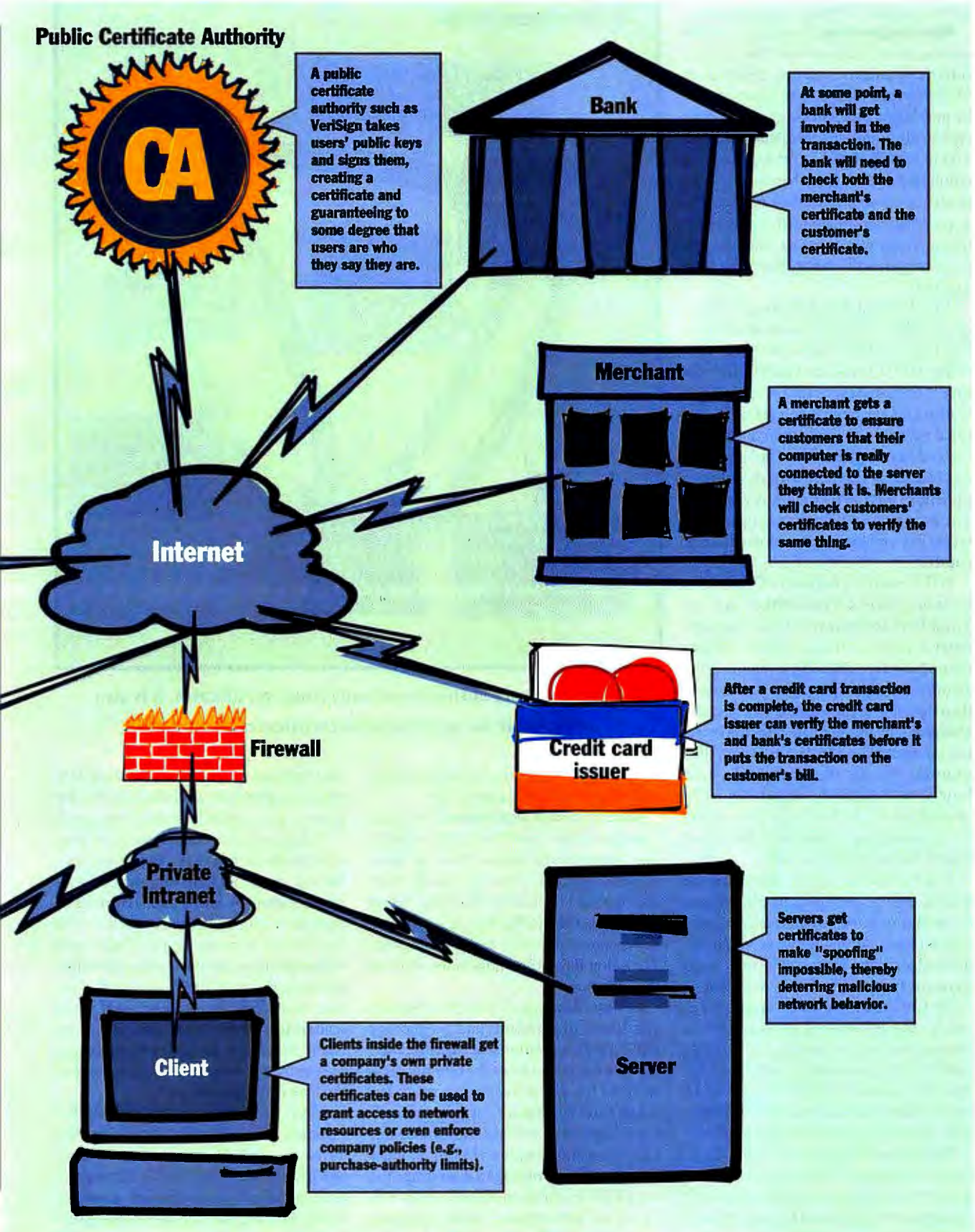
The New Security Infrastructure

Data privacy, data integrity, and nonrepudiation. These are the buzzwords to listen for in any discussion of on-line business. Without them, your transactions are not secure.

A digital certificate is a way to ensure that you are who you say you are. You get one by telling a certificate authority (CA) who you are. For low security, the CA may require only your e-mail. For high security, you have to prove who you are.

Once you have a certificate, you can authenticate yourself with others by exchanging your certificates. And once you're authenticated, you can begin secure, encrypted sessions easily.




Public Certificate Authority
CA
A public certificate authority such as VeriSign takes users' public keys and signs them, creating a certificate and guaranteeing to some degree that users are who they say they are.
Bank
At some point, a bank will get involved in the transaction. The bank will need to check both the merchant's certificate and the customer's certificate.
Merchant
A merchant gets a certificate to ensure customers that their computer is really connected to the server they think it is. Merchants will check customers' certificates to verify the same thing.
Internet
Firewall
Credit card issuer
After a credit card transaction is complete, the credit card issuer can verify the merchant's and bank's certificates before it puts the transaction on the customer's bill.
Private Intranet
Client
Clients inside the firewall get a company's own private certificates. These certificates can be used to grant access to network resources or even enforce company policies (e.g., purchase-authority limits).
Server
Servers get certificates to make "spoofing" impossible, thereby deterring malicious network behavior.

Adleman. All three algorithms have different uses and different requirements.

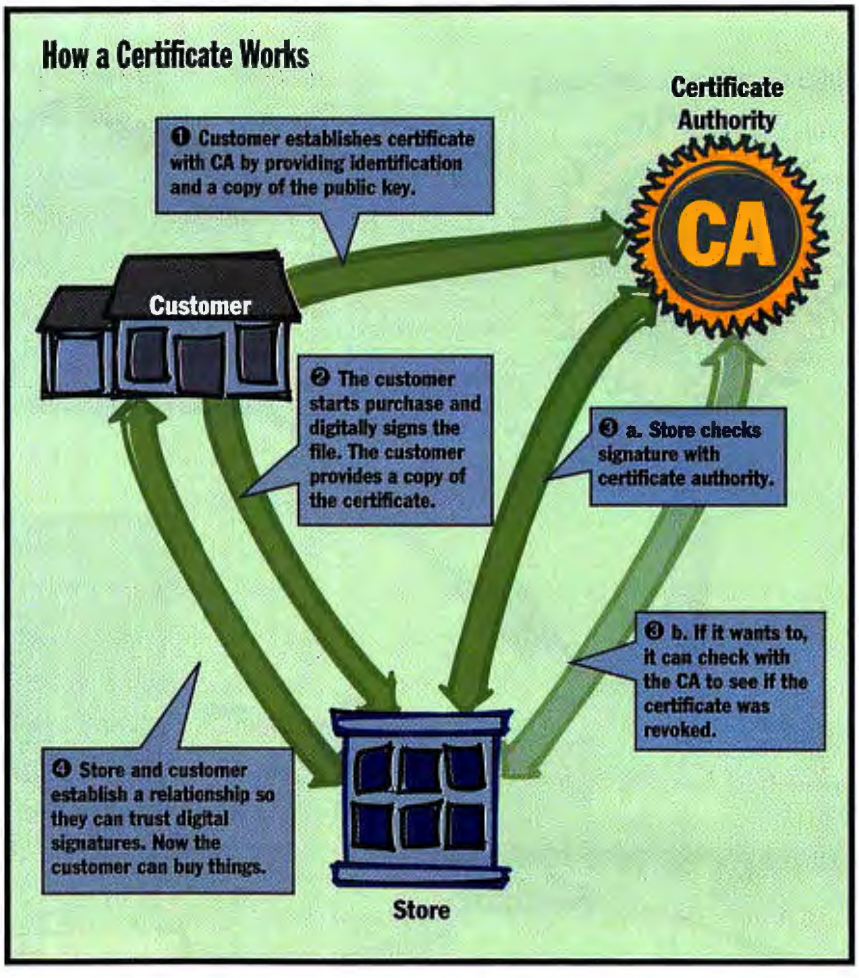
Hash signatures. Hash functions are similar to encryption functions; in fact, some hash functions are just slightly modified encryption functions. Most operate by grabbing a block of data at a time and repeatedly using a simple scrambling function to modify the bits. If this scrambling is done repeatedly, then there is no known practical way to predict the outcome. It is not practical for someone to modify a document in any way and make sure that the same output will emerge from the hash function.

A hash-based signature uses a cryptographically secure hash function like Message Digest 5 (MD-5) or Secure Hash Algorithm (SHA) to produce a hash value from a file. The hashing procedure concatenates your secret key (which you get through a third party) to the file, then hashes the file and key combination. The result, the *hash value*, is shipped with the file as a signature, but the secret key is withheld. The receiving end also has a copy of the secret key and uses it to evaluate the signature.

In the case of CyberCash's CyberCoin, users get secret keys when they sign up. Those keys are known only to their computer and the central computer. When a transaction is ready, a file containing the amount and the details is put together and then signed with the secret key. (The client assembles the file, concatenates the secret key, computes the hash function, and then ships the file and the result of the hash function without the secret key.) The central bank can check this transaction by repeating the computation because it knows the secret value as well.

The hash-based signature may be the least known of the signature algorithms. It's becoming more popular lately because it's less computationally intensive than the other algorithms. Many of the microcash payment systems like DEC's Millicent or CyberCoin use hash-based signatures to reduce the processing costs and make smaller transactions feasible. Each of these systems requires a central server to check every transaction; using faster algorithms means using less computer server power and reducing the central server load.

The major limitation of these hash-based signatures is that the receiver must also have a copy of your secret key to check the signature. This could allow the receiver to forge a signature. Maintaining these secret keys is also bothersome, and many use a shared secret infrastructure.



The certificate authority not only issues certificates, it is also responsible for verifying that certificates are still valid.

DSS and RSA signatures. The other two signature algorithms, DSS and RSA, don't have this limitation. They are *public-key* algorithms—in other words, there are two keys for each person (see "How Public-Key Crypto Works," page 73). One key creates a signature and is kept secret. The other key—the public one—verifies the signature.

DSS was developed by the U.S. National Institute of Standards and Technology (NIST) with the National Security Agency. Only those companies that do business with the U.S. government are required to use it, and many prefer not to because it's a signature-only system. NIST chose this crippled solution because the United States government is working to discourage the use of any encryption software that will curtail the government's ability to eavesdrop. Software that provides authentication only, like DSS, is openly exportable in products, while software that uses RSA for general encryption is heavily restricted.

RSA signatures are clearly the most popular, thanks in part to the aggressive marketing, patenting, and long-term development done by RSA Data Security. The company controls many of the most important patents in the field, and although there has been substantial litigation in the area, RSA has used its position to successfully establish itself as the leader. Its software and libraries can be found in the core of many products, and the company continues to employ some of the best cryptographers.

RSA Data Security was responsible, for instance, for integrating digital signature software with the Macintosh OS long before the Web took off. The company added drag-and-drop signature applets to PowerTalk (Apple's collaboration software) that would allow someone to embed

How Public-Key Crypto Works

Public-key algorithms such as RSA (for developers Rivest, Shamir, and Adleman) encryption seem mind-bending to many people because they defy the conventions for how two-key systems should work. Everyone knows that bank safe-deposit boxes require two keys to be opened (although the one owned by the bank is a bit redundant if the vault is any good). But the two keys in public-key algorithms work differently. The secret one is used to create a digital signature; the public one is used to verify it.

The easiest way to understand RSA encryption is to remember two facts from basic algebra: First, numbers have multiplicative inverses, and second, {e^a}^b = e^{ab}. The multiplicative inverse of a number, a, is the number b where a*b=1. So the inverse of 4 is .25 in regular arithmetic.

RSA uses modular arithmetic that operates only on the integers between 0 and a certain number n. It is often compared with the remainder from division. The equation a*b mod n could be translated to mean "multiply a and b, then divide the result by n and return the remainder." Surprisingly enough, much of standard arithmetic rules still hold for this domain. Numbers can be added, subtracted, multiplied, and usually divided and the equations will obey the usual rules of commutation, associativity, and transitivity.

To construct a pair of keys for RSA, find two prime numbers p and q. The product is n. The two keys, e and d, are random numbers chosen so that e*d mod ((p-1)(q-1)) = 1. That is, d is e's multiplicative inverse. (Additional details about the choice of p, q, d, and e are beyond the scope of this piece.)

The algorithm works because m^de= m mod n. (The reason this works is also beyond the scope of this explanation.) To encrypt a message, convert it into a number m and compute m^e mod n. Only the person who knows d can decrypt it by computing (m^e mod n)^d mod n = m^de mod n = m.

You can think of the public-key process like a string of n pearls. Let one pearl be the message. The public key is some number a, less than n, and the corresponding private key is n-a=b. A message is encrypted by counting along a pearls and decrypted by counting b pearls, which brings everything back to the beginning. This approach is just a metaphor and is obviously insecure. Anyone who knows a and n can figure out b. But this is not the case with RSA or Digital Signature Algorithm. With those algorithms, it is impossible to determine the private key from the public key.

a digital signature in an electronic form by merely dragging it to the icon. The firm has licensing agreements with all the major OS companies including Microsoft, IBM, Sun, and Digital, and each of these companies has added similar features to its product line, but without the same level of integration. Unlike DSS, RSA can also be used to encrypt data and provide security as well as authenticity.

Both hash-based and public-key algorithms can be adjusted to be secure by making sure that the secrets and the keys use a sufficient number of bits to resist all known attacks. Hash-based signatures are inherently easier to attack because the secret used to create the signature is known to both sides. A break-in at either the central computer or the user's house could compromise a hash-based signature. The signature-generating key used in public-key systems, on the other hand, is stored only in the owner's computer, significantly reducing the security risk.

Whom Do You Trust?

After withstanding scrutiny for almost 20 years, the public-key digital signature algorithms themselves are quite solid. That said, they require a great deal of support and infrastructure. The problem is that it's impossible to be sure that a particular person's public key is really that person's public key and not a forgery. After all, the key is just a number—it bears no resemblance to a person, nor does it carry personal data about its owner.

The popular solution to this problem is to wrap the key in a digital *certificate*, a small block of data (maybe several thousand bytes long) that contains the public key and an endorsement made by someone else's digital signature. That "someone else" is called a *certificate authority*, or CA. The certificate shifts the burden of trust to this new signature. If it checks out correctly, then you have more reason to trust the public key.

Unless you don't trust the certificate authority. Then you have to check the certificate on *its* digital signature, and so on and so on. All the certificate does is shift the trust up the chain. The biggest challenge right now is to develop this *hierarchy of trust* for digital certificates.

At this point, most users' computers will investigate only one level into a certificate hierarchy. If your Web browser connects to a server that's enabled with Secure Sockets Layer (SSL), the server will establish its identity by shipping a copy of its public key encased in a certificate. That certificate was probably produced by VeriSign, one of the major certificate providers for Web servers that use SSL to encrypt the data traveling between the server and the browser. The browser validates the VeriSign certificate by checking VeriSign's signature.

But again, how does the browser know that *VeriSign's* signature is valid? Does it keep going up some hierarchy? No. In this case, it stops at VeriSign because VeriSign's is a *root* certificate. In the future, we could have a deeper hierarchy. For instance, governments might choose to sign certificates for each other. Or the United Nations might sign the certificate of the United States, which might sign the certificates of the 50 states. And these hierarchies could coexist. The credit card companies' Secure Electronic Transactions (SET) protocol, for instance, makes provisions for both corporate certificate authorities and geopolitical certificate authorities.

But hierarchies are not the only solution. Pretty Good Privacy (PGP), the popular free encryption solution, uses a network of signatures to guarantee each public key. This is called a *web of trust*. Your key might be signed by your parents, spouse, boss, and a few good friends. People who will want to verify your signature might know someone from this group and have a copy of his or her public key. If not, they might know someone who knows someone else who is once removed from the group. And so on and so on.

Existing webs of trust are too small to offer a practical solution to Internet commerce. Many credit card companies or banks are going to set up their own hierarchical networks because they need specific guarantees of identity that satisfy their models of risk. They may decide, for instance, that they'll be satisfied if a certificate is mailed to a new customer's house on a floppy disk. Banks understand the problems involved in distributing credit cards and can use their experience to ensure that certificates are safely placed in the right hands.

But while simple certificates from bank-run hierarchies may be good short-term solutions, a strong web-like approach

might serve the most people. Pindar Wang, chairman of the Hong Kong-based certificate authority VeriFi, says simple hierarchical structures won't work in Asia. "They are not practical," he stresses, "because the trust relationships which CAs attempt to represent are by no means static or clearly delineated outside of well-defined power structures. There is no clearly defined hierarchy—not even a static web of trust! Instead, we find a highly dynamic gray area where spheres of influence and lines of power are constantly forming and dissolving."

U.S. certificate authorities may come to discover the same fact about the market. Cross-company alliances are already becoming more common. Corporate restructuring often takes people from project to project, making it difficult to rely on simple hierarchical certificates to provide more than just an identity (see "Extending Certificates," page 78).

As if the hierarchy problems aren't enough, CAs must maintain two databases: a complete list of certificates and a list of revoked certificates. After all, if when

Secure Electronic Transactions Protocol

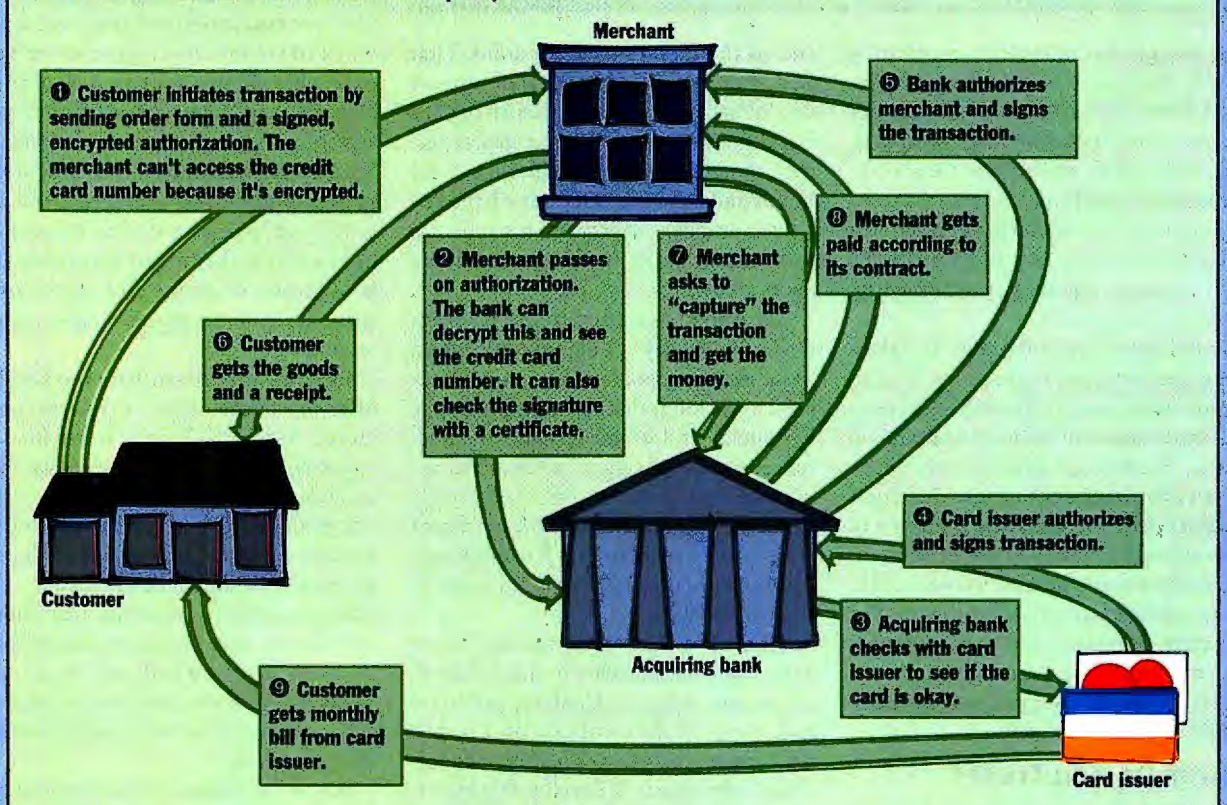
The Secure Electronic Transactions (SET) protocol mimics the current structure of the credit card processing system and replaces every phone call or transaction slip of paper with an electronic version. This can involve a surprisingly large number of data packets because the credit card system evolved to allow a wide range of transactions. Restaurants, for instance, frequently submit the bill twice. The first time processes the basic bill, and the second time adds on the tip. Hotels, on the other hand, often reserve a large block of extra credit to account for extra charges like room service. This is released when the client checks out.

The SET protocol offers packets of data for all these transactions, and each transaction is signed with a digital signature. This makes SET the largest consumer of certificates, and it makes banks by default one of the major distributors of certificates. IBM, GTE, and VeriSign have announced plans to help banks offer certificates to their customers; this promises to be a big market for developers of these large databases.

One of the most active debates in the SET community is about who will pay for the SET certificate-revocation list. The SET protocol forces a transaction processor to check the lists regularly to catch transactions that might be generated by a lost or stolen certificate. In order to simplify the process of keeping the lists current and synchronized, the protocol defines a fingerprint to be a hash of the latest revocation list. The transaction processors can compare fingerprints to ensure that their copy of the list matches the latest master list.

The credit card issuers will probably become the ones that are responsible for maintaining these lists of revoked certificates. The structure of the marketplace virtually assures this. But this may mean that the SET certificates will not become easily useful for other uses of encryption, like sending private letters, because the card companies may see the certificates as their own property. Or they may decide to open up this feature as a gimmick to draw customers. Only the marketplace will tell.

How Secure Electronic Transactions (SET) Works



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Circle 150 on Inquiry Card (RESELLERS: 151).

a certificate becomes compromised (e.g., an employee leaves the company or someone's computer is stolen), there must be a way to call up the CA and request that the certificate be disavowed. As you can imagine, this mechanism could be somewhat unwieldy. As time goes by, revoked certificates would pile up, demand more space, and slow down verification. Certificates based on the X.509 standard (the standard virtually everyone uses) come with an expiration date to ensure that old, retired certificates can be removed from on-line. Similarly, Nortel's Entrust system uses two types of certificates with different expiration limits (see "Certificate Systems," page 80). The certificates for encrypting the message data often last a much shorter time than the certificates for signing documents. Either one can be revoked independently of the other.

Shadow of a Doubt

One of the biggest questions about certificates is how much assurance they really provide. Some, such as VeriSign's Class 1 certificates, are passed out to anyone who can fill in a form on a Web page. They are good only for establishing a consistent presence, not for guaranteeing that someone is a real person.

VeriSign's Class 2 certificates, on the other hand, are issued after a check of some consumer databases. If you have a credit rating, then you can have a certificate. It's unclear, however, whether VeriSign or anyone else has the tools available to prevent identity theft by someone who knows enough information about you. Nor is it clear what it means to have an entry in these databases. (One person received a credit card application for his dog, filled it out, and got the card. The dog pays his bill each month.)

VeriSign also offers a Class 3 license that requires someone to personally take their application to a notary, who will check identification before endorsing it. This adds an additional layer of credibility to the certificate.

Thawte, a South Africa-based certificate authority, plans to offer an even higher grade of certificate. Thawte's plan requires that the certificate holder meet personally with a representative of the company. At this time, the company has only one U.S. representative (in North Carolina). Clearly the company will need to expand its operations if it intends to enter this high-grade business seriously.

Are Smartcards a Certificate Solution?

Personal computers have flourished because they are versatile and easy to program. Good for games, bad for security. The same facility that makes it easy to hack into the keyboard device drivers makes it easy to grab a password's keystrokes.

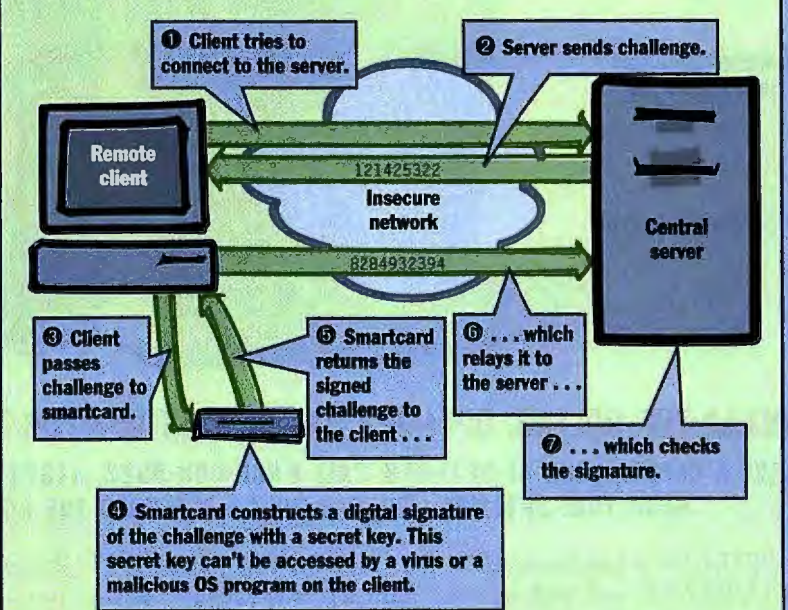
Hardware tokens (also known as smartcards or dongles) are one solution. These devices are built around a chip dedicated to creating digital signatures. A smartcard log-in session begins with the host sending a challenge string. The smartcard signs the challenge and returns it. The challenge string (and therefore the response) changes each time to prevent replay attacks.

Dallas Semiconductor recently released the iButton, a round metal tag with a diameter of about 16 mm. The company also manufactures a small interface that plugs into the parallel port of a computer and can be added for less than $20. A user can touch the button to this interface and the computer can pass messages back and forth to the button, which creates digital signatures on the fly. The buttons are quite useful for people who must log in to a central computer remotely because they remove the threat that a password sniffer will record the password.

Many smartcard manufacturers, like Dallas Semiconductor and Security Dynamics, are attempting to make a tamper-resistant package to protect the certificate. While the degree of necessary tamper-resistance is debated, developers and hackers play cat and mouse.

It may not be long before PCs standardize upon a smartcard interface. Oracle is already strongly recommending that a smartcard interface be available on any network computer (NC). Smartcards are an important part of letting people carry their information and identities with them if they switch between NCs. WebTV has the electronics built into its design.

How a Smartcard Works



Defining the limits of certainty is also a difficult legal problem. The various certificate authorities are trying to draw limits that are both attractive to customers and financially feasible. The *Guidelines on Digital Signatures* issued by the American Bar Association states that "a certification authority must have sufficient financial resources to (1) maintain its operations in conformity with its duties, and (2) to be reasonably able to bear its risk of liability to subscribers and persons relying on certificates issued by the certification authority."

Satisfying the first requirement is straightforward. Database servers, network connections, and adequate security are well-defined problems. The second

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requirement, however, is very open-ended. Understanding the risks of a server failure is one thing, but defining the risks of a certificate causing grief is another.

In time, the certificate authorities may adopt a structure similar to the bonding used by locksmiths or couriers. If a certificate is misused and someone ends up with a loss, some insurance fund will actually offer compensation. The CAs will need to investigate peoples' backgrounds before offering these higher-grade certificates.

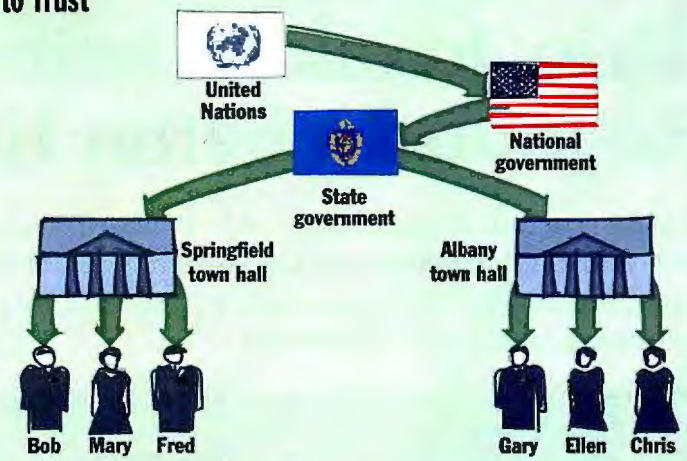
Personal Responsibility

Of course it's not just up to the certificate authorities. VeriSign requires that you keep your certificate on a "trustworthy" system. What's trustworthy? According to VeriSign, it's "computer hardware, software, and procedures that are reasonably secure from intrusion and misuse; provide a reasonable level of availability, reliability, and correct operation; are reasonably suited to performing their intended functions; and enforce the applicable security policy."

The word "reasonable" is not precise, and its definition may change over time. It could, for instance, mean a Windows 95 client today and something completely different tomorrow if a gross insecurity appeared in Windows 95. For instance, if malicious ActiveX components proliferate, then it might be considered reasonable for security-conscious owners not to run ActiveX modules on their machines.

Users will have a responsibility to maintain their certificates on a system and pay attention to ensure that they take all "reasonable" measures to keep it secure. This responsibility will be the most onerous and

How to Trust



In this hierarchical certificate world, a line with an arrow represents the process of certification. The entity at the arrow end has its public key endorsed by the arrowless end. All authority comes from a big pyramid that may imitate the order imposed by governments.

A "web of trust" version of certificate authority allows multiple people to certify the authenticity of a person's public key. In this case, some pairs of people certify each other (Mary & Gary, Bank & Plant). In others, the certification is only one-directional.

Extending Certificates

Certificates were invented to guarantee public keys, but they can do much more. That's because each certificate consists of an extendible set of fields. Some fields are predefined. But you can add as many as you want. Corporations might want to create strong certificate structures that carry additional information about the privileges given to the holder. For example, a certificate could set a limit on the size of a contract that an employee can guarantee. The corporate treasurer, for instance, might have a certificate that backs up a digital signature applied to any contract, no matter how large. A new, entry-level employee, on the other hand, might get a certificate that can spend only small amounts (say $100).

There are no limits to the fields that can be added to a certificate. It's easy to imagine certificates that specify the level of travel allowed (first class versus coach), the type of parking, the access to particular financial documents, or even the key to the executive washroom. Each corporation can choose to implement these fields differently.

IBM is planning on helping companies add certificate-level security to their personnel data. This is the type of all-encompassing job that certificate-minting software companies need to justify a large installation at a company. This type of system would allow people to check information about their benefits, 401(k) plans, and other personal business that an employer is obligated to keep private.

Corporate certificate structures could also be moved to a web structure. The entry-level employee might get only a general signature, issued like an ID by the security department, while top management's certificates would be guaranteed by the personal digital signatures of the board of directors. Access to financial documents might require a certificate guaranteed by the comptroller's office, and in the case of special projects, compartmentalized security could be insured by requiring that someone's certificate bears the signature of the project manager.

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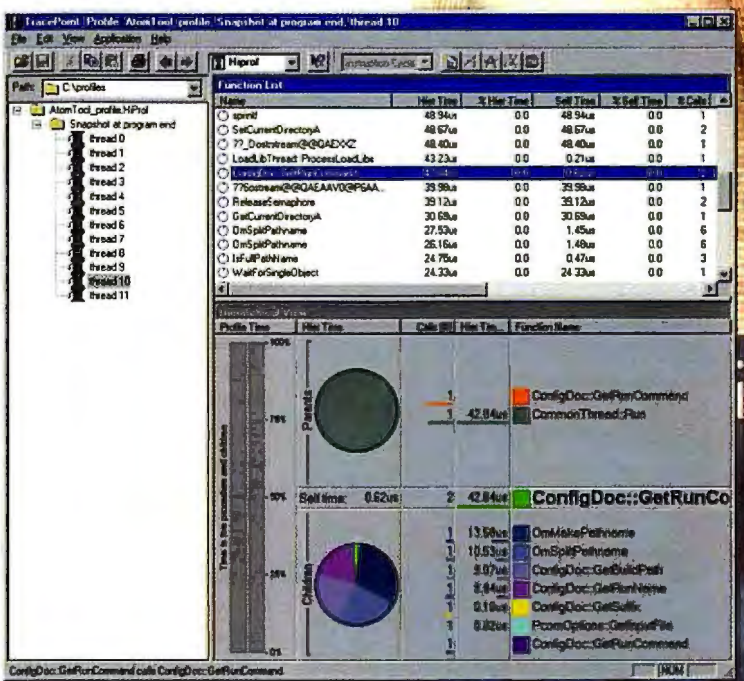

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difficult one for average users because the majority of people are not that conscious of computer security.

It may be impossible to determine exactly what would happen if someone lost a fair amount of money because a certificate was compromised. In most cases, the certificate holder would probably be responsible. Only the holder's computer holds the private key necessary for signing files, so that computer would be the only likely source for the key. But the authority could also be liable if someone were able to register a different key in that person's name. VeriSign takes some precautions to ensure that the certificates are revoked only by the rightful owner. Only time and some test cases will determine whether VeriSign, Thawte, or any of the other certificate authorities are charging enough to discharge their responsibilities when things go wrong.

What's Going to Happen?

Most of the tools for creating and checking digital signatures are still in the lab. At this point, Web browsers using SSL to set up secure links are the only ones that use digital signatures very often. Others, however, have bigger dreams.

The leaders are the banks. They recognize that Internet commerce demands a way for people to check the authenticity of documents like checks or credit card authorizations. The SET protocol endorsed by Visa and MasterCard is one of the most sophisticated uses of digital signatures, and these companies intend to make it a standard part of electronic commerce. According to Visa and MasterCard, the date for the finalization of SET was just moved from April 14 to May 31, so details were not available by the time this issue went to press.

Many corporations recognize that they have very little power to corral their employees and regulate what they do over the Net. It's not hard to imagine a low-level clerk committing a company to expensive contracts. Many companies like IBM, Apple, Xcert, GTE, and VeriSign are actively trying to find ways to build a corporation-wide structure for supporting digital signatures.

The lawyers are also closing in. Utah was the first to draft legislation recognizing digital signatures, and many other states are following. Unfortunately, the laws do vary slightly from state to state. Eventually, the U.S. government will issue its own laws that will smooth out the differences between the states. The American Bar Association has an active committee drafting recommendations for the use of digital signatures in commerce.

These forces see that the infrastructure to support digital signatures is the next necessary step for the Web. Although it's impossible to predict what the final shape will be, it's easy to see that the final environment will be largely defined by the two forces with major amounts of cash on the line: banks and lawyers.

The overall effect will be a widening network of trust. At the beginning, people may hold only certificates that are good for one organization at a time. Your hard disk will begin to look like your wallet as it becomes filled with certificates for work, health club, drivers license, scout troop, or practically any other part of life. In time, the organizations will begin to cross-link their databases and countersign certificates as people grow more and more used to the structure.

"People believed that the certificate world would just be a big pyramid," says Scott Dueweke, IBM's marketing manager for electronic payment and certification. "I don't think many people who are involved in this in a deep way believe that anymore. I think you're going to see islands of trust that are corporations, associations, or governments. As the islands grow, gradually we'll have a complete network of trust." B

Peter Wayner is a BYTE consulting editor who lives in Baltimore. He is the author of Digital Cash *(AP Professional Press, 1997). You can find him on the Web at* **http://www.access.digex.net/~pcw/pcwpage.html**.

Certificate Systems

The relatively new world of certificates is peppered with some unfamiliar names. Until recently, even VeriSign was a relative unknown. But some really big companies are moving forward with complete solutions of their own.

IBM's World Registry. IBM is taking a serious lead in delivering certification software known as the IBM Registry. The IBM Registry uses certificates and public-key digital signatures as the basis for a wide range of offerings, such as personal vaults, business archives, directory services, and time stamping. A business could build up a library of its important documents and arrange the access privileges of the staff to ensure that information is properly restricted. The certificates would control access and allow the archive to ensure that requests are authentic.

IBM plans to offer this technology on a larger scale to the public by renting space on Big Blue's servers. The company plans to run the software in two different geographical locations in order to defend against any physical damage and to ensure that the data is always available if a network connection drops. IBM even uses the term "hardened" to describe the security around the computer as if it were a nuclear missile silo.

GTE's CyberTrust. This is the system that MasterCard chose to maintain the top level in its Secure Electronic Transactions (SET) system. Banks with credit card divisions that want to support MasterCard's SET system will get certificates from GTE. And individual banks that want to maintain their customers' certificate authority can license SETSign from GTE.

GTE also plans to help corporations maintain their own certificate infrastructures. CyberSign will serve all the functions on a local corporate machine. If you don't want the problems and security implications of running it locally, you can contract out with GTE. VirtualCA will do the work remotely.

Nortel's Entrust. One of the most established products on the market is the Nortel Entrust encryption, certificate, and signature system. (See "Don't Lose Your Crypto Keys," May 1996 BYTE.) The Entrust central database issues two public-key pairs to each person. One, used for signatures, is longer to add more security. The other, for encrypting messages, is somewhat shorter because it's more likely to be changed. Entrust also distributes an API that would allow companies to develop custom applications that run on their local systems.

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Balance the Load with Transaction Server

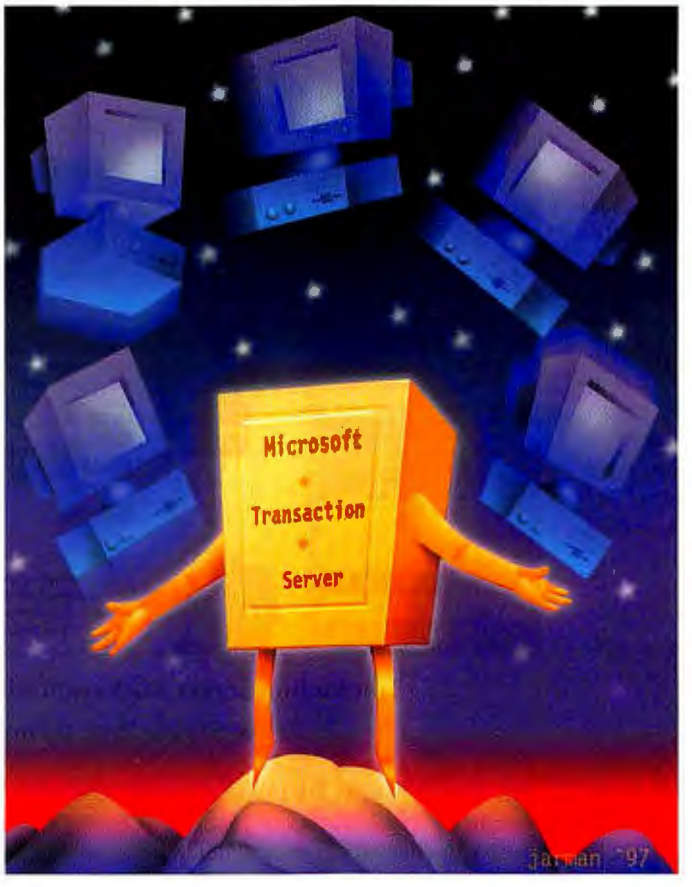
You can't see it, and it doesn't store data or calculate results. Can you live without it? Perhaps not.

By Barry Nance

After a long day at work and a quick dinner, you finally get a chance to sit down and look at your mail. The bill for your car insurance arrived today, and it seems too high. Since it's early evening, your agent isn't available to give you a quote from a different insurance company. You don't want to wait until tomorrow because you're afraid you'll forget by then. Perhaps the Internet can help.

Visiting the Web site of the Car and Home Insurance company (CHI), you click on the Car Insurance Quote button and enter some basic information about yourself and your car. In a short time, you see that you can indeed save some money. You click on the Yes button, follow the instructions on the screen about where to send a check, and then fax a note to your agent, saying that you've switched your coverage.

You weren't the only visitor to CHI's Web site at that moment. In fact, 1000 other people concurrently strained the capacities of CHI's 20 Web servers and 10 database servers as they looked for a way to save money. You all saw quick response times because CHI used a transaction-processing (TP) monitor—specifically, Microsoft's Transaction Server—when it designed its Web-based insurance-quoting application.



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Transaction Server is software that doesn't help you enter data, nor does it store any data or calculate results. And yet you would be hard-pressed to implement a large, complex client/server application without using a product like it. Middleware—the category of software that includes Transaction Server—ensures transaction integrity, balances application work loads across multiple servers, and enforces appropriate, secure access at the application and transaction levels.

To explore Transaction Server fully, I developed a hypothetical car-insurance-quoting application and exercised it in an intranet environment. The application has all the essential ingredients for use with a TP monitor: three-tier architecture, the need to synchronize database updates, a thin-client presentation layer, and the potential for high-volume access.

In general, the experience taught me that multiple-server distributed applications absolutely require middleware—without it, developing large-scale applications is a horror show. I also discovered what makes Transaction Server in particular a worthwhile package and also stumbled across a few of its shortcomings. For example, before you can use Transaction Server, you must first render your application's business logic as an ActiveX component. Once you switch to (and learn) ActiveX, however, declaring transactions within Transaction Server and then at run time—letting it manage those transactions—is painless.

Requiring NT Server 4.0 and only 32 MB of RAM, Transaction Server integrates nicely into organizations that have already decided to use Microsoft products. Mixed-platform environments, such as those using Oracle's database manager, have more work to do or must wait until Microsoft makes Transaction Server work with more database managers, languages, and platforms.

Why Bother with Middleware?

Middleware helps you build high-volume business applications that can run on several applications servers and update multiple database servers. Thousands of clients, through a battery of Web servers, might use such applications simultaneously. Busi-

ness-logic analysts and programmers have neither the time nor the expertise to create the transaction-oriented, network-based architecture these applications require for everyday use—they have enough work to do automating business procedures and rules.

Middleware, and TP monitors in particular, give programmers the plumbing—the intra-application network linkages and services—that enables a distributed application to service a large number of clients. A three-tier application (with separate presentation, business-logic, and data storage) is a prime candidate for the sort of control and coordination that middleware provides.

As it manages interactions among the three tiers, middleware balances the work load among the servers, enforces transaction-level security, dynamically routes messages, and ensures transaction integrity across multiple databases. Because you configure your middleware with information about which database servers are equivalent copies of each other, it can monitor server activity and send transaction requests to less-busy servers. If a database server fails, the middleware queues the SQL request and delivers it when that server returns to the network.

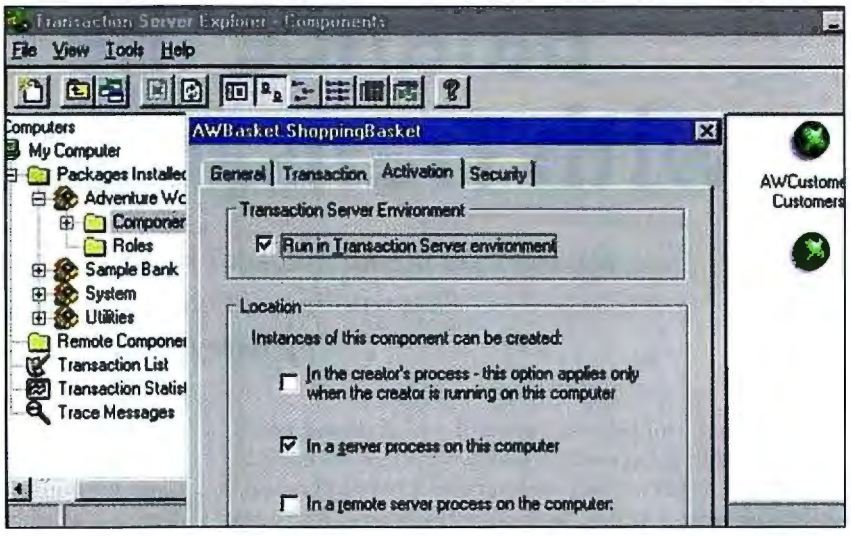
Alternatively, middleware can reroute a message to a different database server that (as you've designed) is a replicated copy of the failed server. Without skipping a beat, the system continues to process transactions that don't need access to the failed server. Some middleware products can even route HTML and other Web traffic to less-busy servers, thus making response times even shorter.

The Field

Middleware categories include, in addition to TP monitors, DCE/RPC environments, messaging, database-access tools, and object-oriented approaches. A TP monitor brackets developer-defined application operations (i.e., transactions) with implied BEGIN TRANSACTION and END TRANSACTION SQL statements. By using TP-monitor services, applications do not have to specifically provide for transaction integrity. Besides Microsoft's Transaction Server, TP-monitor products include BEA's Tuxedo, IBM's Transaction Server (formerly CICS for OS/2, CICS for NT, and CICS for AIX), Kiva's Enterprise Server, and Visigenic's VisiBroker.

BEA offers Java programmers transaction services with its Jolt product, a collection of class libraries and functions that complement the Tuxedo middleware product. Jolt also replaces HTTP with its own Jolt Transaction Protocol, which gives Jolt-based Java programs extra capabilities beyond the limited, document-presentation-oriented HTTP. Visigenic's VisiBroker is a CORBA 2.0 object request broker (ORB). It uses the IIOP protocol for interprocess communications between network nodes and supplies an IDL–to–Java code generator. Kiva's product is specially designed for the Web, while IBM's middleware products connect more computers and applications in more diverse ways than any others on the market.

Microsoft Transaction Server, like most other TP monitors, has a proprietary API. While other vendors plan to implement the new X/Open standard APIs in the future, Microsoft intends to stick with its ActiveX component model and simple calling conventions. Transaction Server



You set up transactions with Transaction Server in the Transaction Server Explorer.

Transaction Server works well with Microsoft's Active Server Page technology.

adds just two new APIs, `GetObjectContext()` and `SafeRef()`.

The Middle of the Road

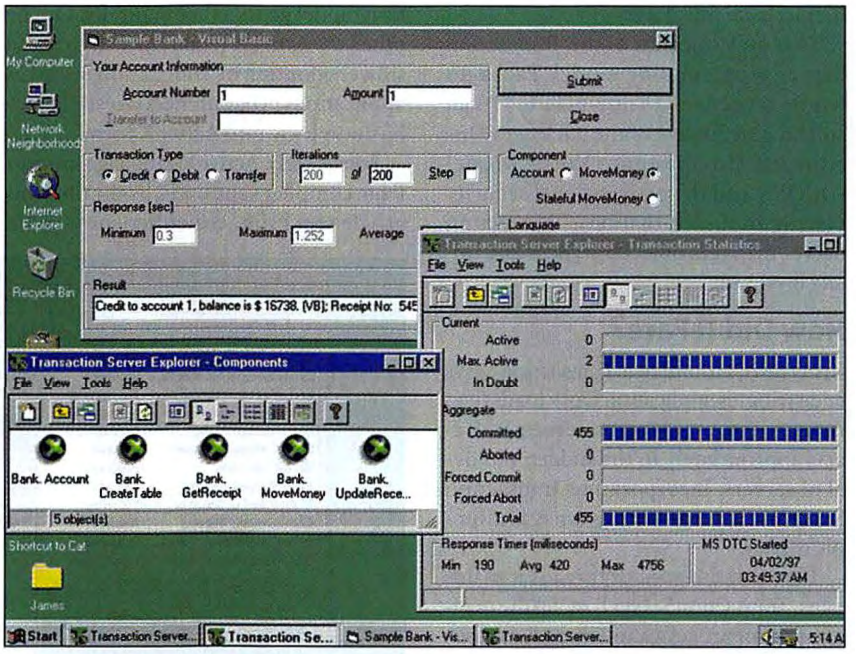
My hypothetical car-insurance-quoting application is a J++ ActiveX server component. It collects data from a prospective customer through a series of Web pages, retrieves and updates a series of database tables, and calculates the price of the car insurance. Note that the rates are not actual insurance rates, and, for the sake of simplicity, I didn't code a function to communicate automatically with individual states' motor-vehicle departments to verify driving records.

An Active Server Page VBScript entry in the HTML code of the data-entry Web page invokes the J++ program, which I defined as a "transaction" using the graphical Transaction Server Explorer. The three database tables I designed hold fictional insurance rates for each of the 50 states, adjustment factors for the make and model of the car being insured, and driver (i.e., customer) information. I replicated the database tables across all the servers in one test. In another, I distributed the tables unevenly among the servers, forcing Transaction Server to decide which updates completed successfully and which did not as I altered the availability of database servers.

In the lab, I set up a LAN consisting of 25 desktop computers connected via 10-Mbps Ethernet. I used 15 Windows 95 clients and 10 NT 4.0 servers to exercise Transaction Server. The servers acted as Web servers (using Internet Information Server [IIS] 3.0) and as database servers (using SQL Server 6.5). Not a stress test, this nonetheless gave me a good idea of what Transaction Server can do.

How It Works

The Transaction Server environment consists of base processes (client programs, such as the Netscape Navigator and Microsoft Internet Explorer [MSIE] browsers); application components (implementations of business logic, which have to be rendered as ActiveX components); the Transaction Server Executive (which manages transactions and provides services to application components); resource dispensers (distributors and controllers of the shared resources, such as database connections); and a resource manager (the database manager itself). With its support for ODBC, Transaction Server should be able to work with any resource manager that offers ODBC connectivity, and Microsoft plans to add Extended Architecture (XA) support in a future version of Transaction Server. It will provide this support in the form of an XA-to-ODBC mapping layer that exposes ODBC functions and procedures through the XA interface.



Microsoft Transaction Server Explorer monitors ActiveX controls and provides useful statistics about the transaction load on them.

Functionally, Transaction Server acts as a transaction clearinghouse on busy, complex networks. It manages low-level OS resources (e.g., processes and threads), thus allowing concurrently running clients to access server applications. Transaction Server synchronizes the access to multiple databases, lessening the effect of busy SQL message traffic as it routes transactions to applications servers and database servers.

Transaction Server supports (and requires) ActiveX, has a simple programming interface for hooking into your application, and offers just-in-time instantiation of object components. *Just-in-time instantiation* refers to Transaction Server's delaying the removal of an object's methods from memory for a short while, in case another subsequent transaction might happen to use that same object.

Transaction Server manages a pool of ODBC connections that clients can draw from, and it can act as a repository for shared data variables that multiple, concurrently executing processes can access. This repository lets programs share global variables among themselves as if they were a single process. The application components that Transaction Server manages are location-transparent, so they can reside virtually anywhere on a network; the application doesn't have to keep track of which server, drive letter, or directory structure contains them. Transaction Server hides these messy details from the business-logic programmer.

Transaction Server Explorer, a management tool with the look and feel of the file-and-folder-oriented Windows 95 Explorer, is the tool that programmers use for declaring packages, inserting components into each package, and giving the packages and components the appropriate attributes. Through the Transaction Server Explorer user interface, programmers can easily monitor activity levels, manage transactions, configure transaction support, establish security, and create transaction packages.

Transaction Server controls security at both the process level and the component level. By simply right-clicking on an object and then selecting Properties in the object's pop-up menu, you can assign process-level security and enable interface-authorization checking (as you insert a component into a package) with Transaction Server Explorer's point-and-click

hierarchical interface.

TP is only one part of the Transaction Server programming model. Packages whose objectives do not include TP can still take advantage of the package's Distributed Component Object Model (DCOM) and the process-level security system. In these situations, Transaction Server manages object instances and object lifetimes.

How Did It Fare?

In my tests, I found that Transaction Server distributes application work loads (i.e., transactions) evenly across servers and reacts appropriately to the sudden removal of servers. Incorporating Transaction Server into the J++ program was a simple matter.

Through the pool of threads it maintains, Transaction Server handles the management of processes and threads and isolates them from one another. In contrast to classic intra-application thread management (in which a programmer hand-codes the creation, allocation, and termination of threads), Transaction Server's automatic thread pool keeps application components from having to be thread-aware, and programmers no longer have to program thread management into the business logic.

But you cannot mix threading models in the same package: If one component in a package is single-threaded, they all must be single-threaded. Components with different threading models cannot be part of the same transaction within a single applications-server process. I discovered this restriction when I tried to mix Visual Basic and Visual C++ components in the same package. I had to declare the Visual C++ components as single-threaded (or put them into a separate package, which is easy to do).

One View

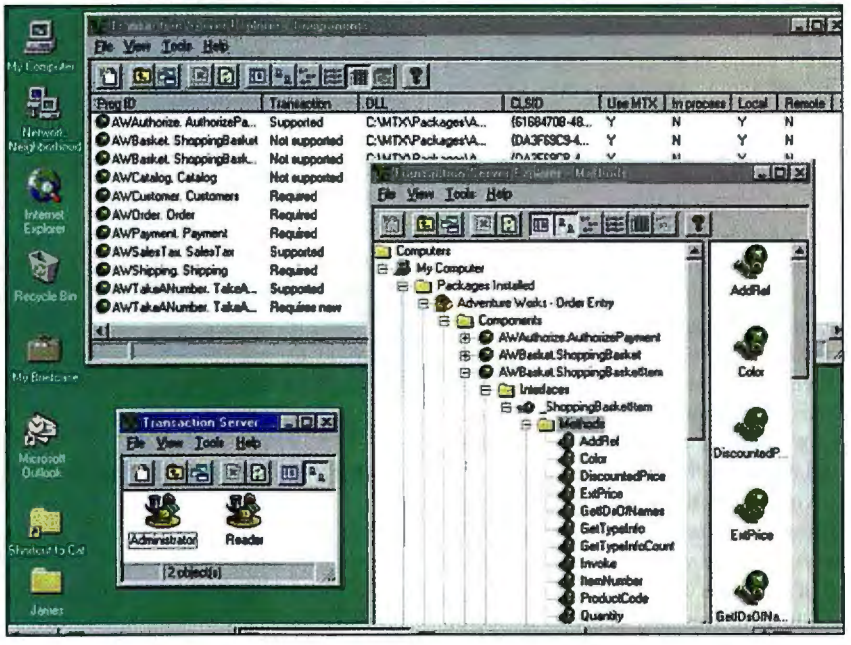
Distributing transaction work load and ensuring transaction integrity are the two biggest problems applications designers face as they work to scale applications for high-volume use. Microsoft's Transaction Server addresses precisely these problems, and it does so in an easy-to-configure, easy-to-manage, point-and-click manner.

I had ambivalent feelings about Transaction Server's requirement that business logic be rendered as ActiveX components. On the one hand, Microsoft's Transaction Server architecture and its OLE Automation model go together naturally. On the other, the ActiveX requirement may mean slower adoption of Transaction Server as applications programmers wrestle legacy business logic into ActiveX form.

Fortunately, ActiveX-language support from compiler vendors is, by the time this article sees print, either here now or on the near horizon. Microsoft's own language products (C++, Visual Basic, and J++), of course, can be used to create ActiveX components, and Microsoft even includes Wizards to help you get started. Other vendors—notably Borland (Delphi, C++ Builder), Powersoft (PowerBuilder, Optima++), and both Microfocus and Fujitsu (COBOL)—are currently working on similar Wizards and verifying that their compiler products work well with Transaction Server.

The future of Transaction Server holds more in store than an XA interface for database access. Microsoft plans to embed Transaction Server into NT Server 5.0, and the company says it will rearchitect IIS to be transaction-oriented. For example, you will someday be able to mark a Web page that uses Active Server Page technology as a "transaction" and have IIS automatically manage the resulting database accesses in an atomic fashion.

Especially with respect to object-orientation and components, Microsoft believes it's jumped in front of the TP-monitor marketplace with Transaction Server.



You can also use Microsoft Transaction Server Explorer to easily determine a component's methods and properties.

BEA, IBM, Oracle, and other middleware vendors disagree with this assessment. For my part, I think Microsoft has taken a big step toward supporting enterprise-level, run-your-business-on-it vertical applications, an arena in which Microsoft does not have much experience.

As it gains experience with enterprise-level business automation, I expect Microsoft will release other products it hopes that major companies will incorporate into their core data-processing efforts. However, I doubt Microsoft will see the benefit of producing a Transaction Server product for non-NT platforms. B

EDITOR'S NOTE: *You can download our sample program code from The BYTE site (***http://www.byte.com***).*

WHERE TO FIND

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Barry Nance is a BYTE consulting editor and the author of Introduction to Networking, 4th Edition *(Que, 1997),* Using OS/2 Warp *(Que, 1994), and* Client/Server LAN Programming *(Que, 1994). You can reach him at* **barryn@bix.com.**

Smarter Stuff

Embedded processors are waking up, and they're increasingly accessible and controllable by networks and the Internet.

By Bob Margolin

They're everywhere! Embedded programmable microprocessors are in consumer-electronics devices, kitchen appliances, automobiles, networking equipment, and industrial control systems in one form or another—from 8-bit microcontrollers to 32-bit digital signal processors (DSPs) and 64-bit RISC chips. Though they're most often associated with desktop computers, the most pervasive use of microprocessors today is by far in embedded systems.

Early embedded systems operated in a stand-alone mode using an 8-bit microprocessor and a bare-bones, homegrown OS—a real-time OS (RTOS) or kernel. Embedded systems are increasingly based on networks of distributed microprocessors that run many off-the-shelf OSes and communicate through wired and wireless buses, LANs, and WANs. They are remotely monitored, configured, and controlled using standard network management protocols.

The proliferation of programmable processors in embedded systems has happened largely because of the availability of powerful, inexpensive processors and high-density, low-cost memory. However, three factors are accelerating this trend and may transform the embedded industry altogether. First is the emergence of standard run-time platforms such as Windows CE and Java that simplify systems programming and foster interoperability. Second is the emergence of integrated software development environments such as Green Hills Software's Multi and Wind River Systems' Tornado, which simplify applications development. Third is the marriage of embedded systems with the Internet, which will simplify the development, networking, and management of distributed embedded systems.

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Under the Covers of an Embedded System

The term *embedded system* is a nebulous one that encompasses just about everything except desktop PCs. An embedded system is one that is preprogrammed to perform a dedicated or narrow range of functions as part of a larger system, usually with minimal end-user or operator intervention.

For example, a V.34 modem typically uses two preprogrammed processors. One, an 8-bit microcontroller, implements the Hayes-AT command set and provides overall control for the modem. The other, a 16-bit fixed-point DSP, implements the core data-pump function. Similarly, an automobile might use a network of chips to handle such functions as active suspension, ABS braking, and engine control.

On a larger scale, a factory or power plant might use a network of VMEbus chassis to control manufacturing and such processes as heating, ventilation, and air-conditioning. You can even consider a PC to be an embedded system—when it's packaged in a rack-mount configuration or ruggedized format and used to perform a dedicated function (e.g., telephone switching or machine control). In all these applications, embedded processors implement the bulk of the functionality by executing dedicated programs autonomously with minimal operator intervention.

Software

You write desktop applications—and debug, compile, and execute them—natively on PCs. You also develop the software for embedded systems on PCs and workstations. However, you must then cross-compile that software for the target processor, download it to the target platform, and debug it remotely from the PC or workstation.

Until a few years ago, the tools available for developing embedded software lagged far behind those available for producing native desktop PC applications. Native PC tools still hold an edge overall, but integrated embedded-software development environments have closed the gap considerably.

Green Hills' Windows NT–based Multi, for example, automates all aspects of embedded-software development, including

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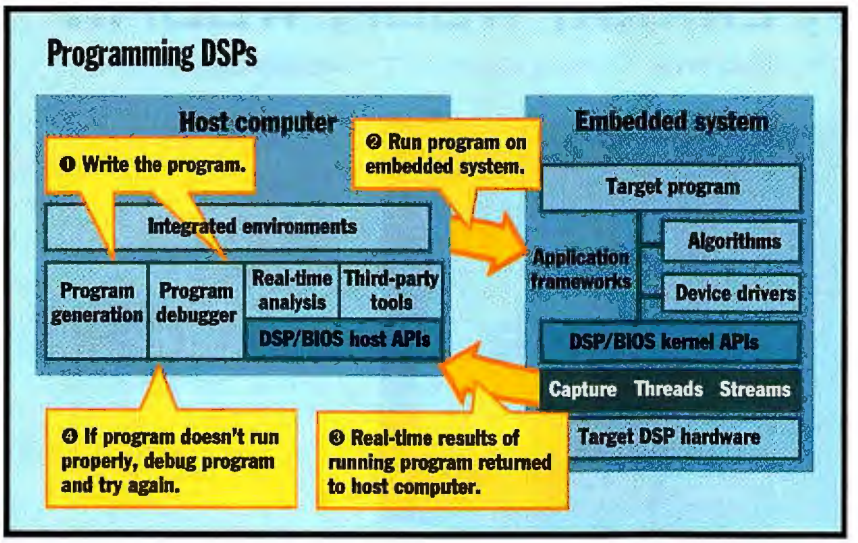

Texas Instruments' DSP/BIOS API, codeveloped with Spectron Microsystems, simplifies programming DSPs by real-time testing.

editing, source-level debugging, program building, execution profiling, run-time error checking, and project/version control. Moreover, tools such as Multi are available for most major embedded RISC and CISC CPUs and are compatible with major proprietary RTOSes, such as pSOS, VxWorks, Chorus, and Green Hills' own VelOSity and Integrity kernels.

In the DSP world, software methodologies still lag far behind. Assembly language coding is still common, and most designers opt for either a custom RTOS or no RTOS at all. An exception is Go DSP's Code Composer, which provides a window-oriented development environment for Texas Instruments' DSPs. Working in conjunction with TI's XDS-510-compatible emulators and Spectron Microsystems' Spox RTOS, Code Composer provides RTOS-aware source-level debugging, DSP project management, incremental compilation, and on-line help.

Embedded OSes

While Windows and Unix have established themselves as the dominant OSes on PCs and workstations, the embedded-systems market remains highly fragmented. Despite numerous attempts (e.g., Posix) by hardware and RTOS suppliers, the embedded market has failed to establish a standard run-time environment. DOS, real-time versions of Unix, and a handful of proprietary RTOSes own most of the off-the-shelf market. But more than two dozen smaller players have established a beachhead, with most designers still choosing to roll their own kernels.

The DSP market is even more wide open. Fresh from their transition from assembly language to C, DSP developers are surprisingly still reluctant to absorb the overhead of even the most efficient RTOSes. Still, growing DSP application complexity and substantial gains in performance are beginning to put programmer productivity on the radar screen. DSP designers are also beginning to warm to the idea of using RTOS services in their applications. Probably the best known off-the-shelf RTOS for DSPs is Spox. However, vendors of mainstream RTOSes, such as Green Hills, are also beginning to port their products to DSPs. A handful of small European vendors have also done so. These products have their origins in the transputer market.

An encouraging development in the push to establish a standard DSP platform is TI's recent decision to create a standard BIOS for its fixed-point DSPs. The new DSP/BIOS, codeveloped with Spectron, provides standard multitasking, I/O, and real-time data-capture services (see the figure "Programming DSPs" above). These not only simplify DSP programming, they also lay the groundwork for more advanced debugging, manufacturing test, and field diagnostics tools. The hope is that the industry will adopt this BIOS as a standard platform for DSPs from all vendors.

Proprietary RTOS vendors have been struggling for more than a decade to carve a niche in the embedded market. During that time, Microsoft has essentially sat on

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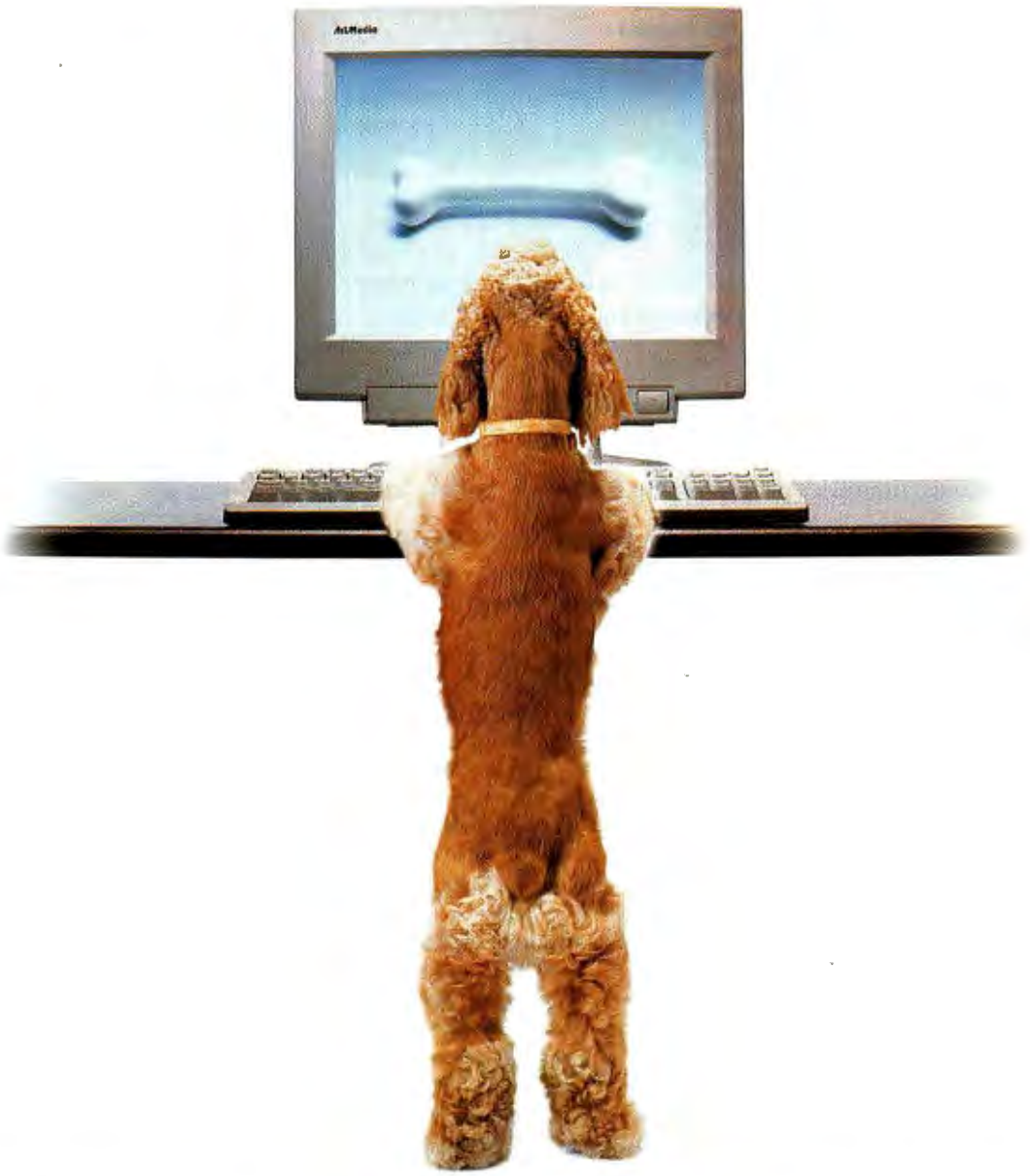

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the sidelines. Even so, DOS and Windows have always had a strong following in the embedded market.

However, the nonexistence of a small-footprint DOS or Windows has limited their use in deeply embedded systems. At the same time, the lack of deterministic, preemptive multitasking has limited their use in mission-critical applications with hard real-time requirements.

The availability of Windows CE may well shift the balance of power in the embedded-RTOS market. Fully ROMable, Windows CE features preemptive multitasking and a Windows-like GUI. Windows CE also contains a standard communications protocol that facilitates Internet access and information sharing with other Windows-based applications. Windows CE's modular implementation makes it scalable, thereby enabling its use in a broad range of resource-constrained embedded environments.

Soon, Microsoft will upgrade Windows CE with a deterministic scheduler that makes it better suited for real-time applications. Even with these improvements, Windows CE won't be able to match the miniature footprint, nimble context switching, and high-speed interrupt response of such RTOSes as VxWorks and pSOS. But for embedded systems that can tolerate 10-millisecond context switching and spare 256 KB of RAM and 512 KB of flash memory, the standard development and operating environment offered by Windows CE (not to mention third-party hardware and software support) may make Windows CE a serious contender.

So far, Microsoft is primarily targeting the high-volume hand-held PC market with Windows CE. However, the company is also making Windows CE available to the embedded community at large through distributors and systems integrators such as Annasoft Systems.

Another embedded platform that is gaining momentum in the embedded market is Java, an OS-independent platform originally developed for set-top boxes. The Java platform has two main components. One, the Java API, provides basic language, utility, I/O network, GUI, and applet services. The other, the Java virtual machine,

Fun with Internet Appliances

Internet appliances come in two flavors. The first is dumb appliances such as Web TV, which provide Internet access but with little or no processing capability. The second flavor is smart appliances that use embedded processors to perform some function in response to directives from a remote controller or management station. A smart lawn-care appliance, for example, might use sensors to collect soil-moisture reading and a camera to record grass size and color. You could relay this information to a remote-control station over the Internet, which would decide whether to turn the sprinklers on or off.

You could also use a smart Internet appliance to provide remote control over a home-security system. For example, you could program the system to beep you via e-mail in response to a visitor knocking on your door or ringing the doorbell. It could then prompt you to activate a discretely mounted camera, which uses the Internet to transmit video to your PC. If the visitor is out of view, embedded controllers inside the camera could be directed via the Internet to swivel down and zoom in to give you a look at the visitor. You could then use the Internet to speak with the individual.

Home heating, ventilation, air-conditioning, and appliances are also tailor-made for remote control over the Internet. Most of the hardware and technology needed to remotely control these devices are built in. Lucent Technologies, for example, offers a control system known as Homestar Wiring. It uses Category 5 twisted-pair wiring to electronically link and control a diverse network of smart appliances, security systems, entertainment devices, and telephone systems for one computerized location. Making the devices and the central controller Internet-ready is an incremental step forward.

Many experimental Web sites let users control remote devices over the Internet from their browser. Most are trivial, including a remarkable number of Internet-linked Coke machines, weather sensors, and hundreds of telescopes and video cameras. One of the best is a pair of smart video cameras located at Rockefeller Center. Using your browser, you can select a camera, move it sideways or up and down, and even zoom in.

Another interesting Web site lets you operate a model train and guide it around the track. At the USC robotic telegarden, you can use your browser to water a petunia. To have even more fun on the Internet, go to the Yahoo search area and look in "computers and Internet/entertainment/internet devices connected to the net."

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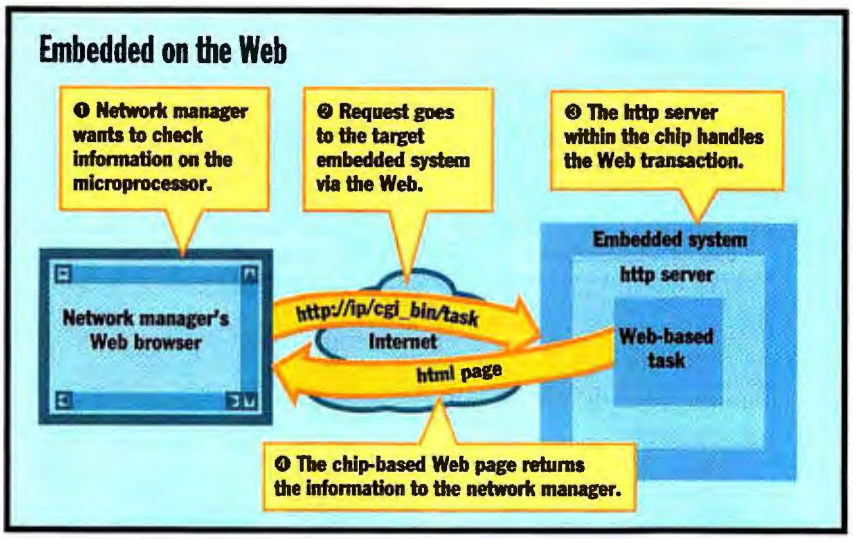

Web-page-on-a-chip lets network managers use a standard Web browser to perform diagnostics on the embedded systems.

separates Java applications from the details of the underlying browser, OS, or processor. You can compile Java applications directly for native execution on a particular processor. You can also compile them to produce an intermediate processor-independent byte code. You then convert this to processor-specific code by a Java interpreter and Java-compatible OS that reside on the target hardware.

Networking Embedded Systems

The processors in an embedded system can be connected via any number of proprietary or standard buses, LANs, and WANs. When the form factor is small, the processors are typically hard-wired together via a shared memory bus or other I/O port. Within a particular chassis, such as a hub, multiple processing boards might also be linked via a custom backplane or standard system bus such as VMEbus. Under the hood of an automobile, multiple processors may be linked via a custom bus built into the wiring harness or a separate high-speed serial bus such as the Controller Area Network (CAN) bus that supports data rates of up to 1 Mbps.

A myriad of wired and wireless standard network solutions exist to link multiple embedded systems that are dispersed throughout an office, home, or factory. These include low-cost consumer networks such as Consumer Electronics Bus (CEBus) and LonWorks, which use existing telephone and power wiring; mid-range LANs such as Ethernet and token ring, which use twisted-pair wiring, coaxial cable, and wireless media; high-end LANs such as Fiber Distributed Data Interface (FDDI) and Hiper Channel that use fiber optics; and market-specific LANs such as Mil-Std-1553, which are used in military applications.

While physical LAN-connection alternatives abound, the network protocol used most often in embedded systems for LAN communications is TCP/IP. In fact, most RTOSes are available with built-in TCP/IP support.

During the software-development phase, you use TCP/IP to support program downloading and remote debugging. After you deploy the system in the field, you use TCP/IP to support communications with other embedded systems, supervisory computers, and management stations on the network.

The principal network management protocol used for remote monitoring, configuration, diagnostics, and management of embedded systems is SNMP, which runs on top of TCP/IP. Individual embedded systems incorporate SNMP agents, whose Management Information Bases (MIBs) store data, such as network statistics and configuration information. This data is accessed by remote SNMP stations such as Hewlett-Packard's OpenView and Sun's SunNet over the network. RMON, a MIB extension to SNMP, enhances remote management capabilities by enabling the SNMP agent to store more comprehensive information (e.g., statistics, history, alarms, events, and filtered packets).

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Embedded on the Internet

High-level protocols such as TCP/IP and SNMP that span multiple physical networks are important because they help lay the groundwork for industrywide connectivity. The ideal scenario, of course, would be a single worldwide network encompassing all LAN and WAN communications for factories, offices, military installations, and consumer-electronics devices.

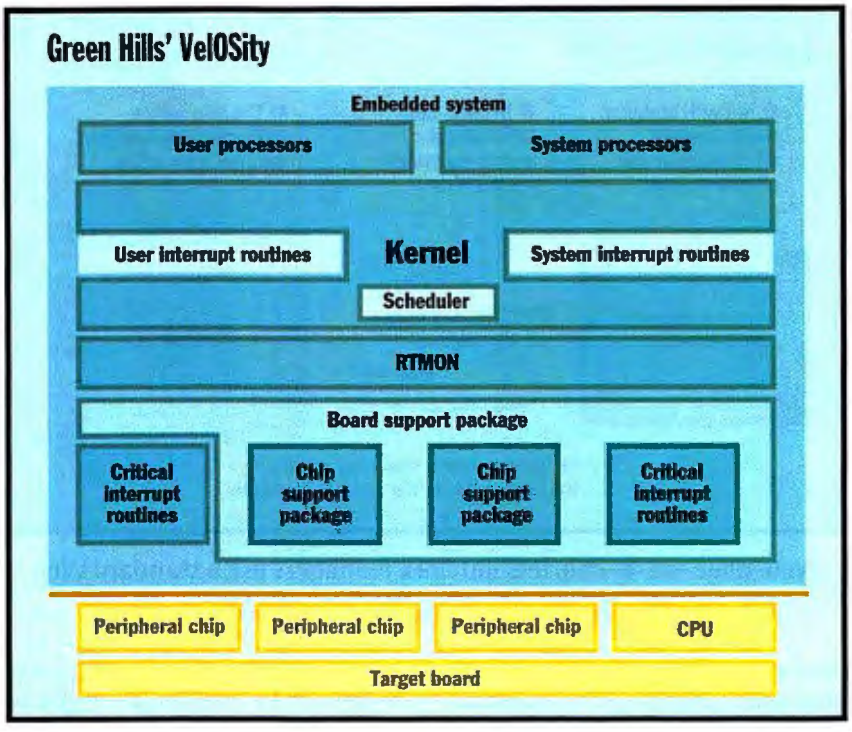
Given the massive installed base of proprietary and standard LANs, and the breadth of specialized communications requirements associated with each application area, such a network is not likely anytime soon. However, the Internet is emerging as the glue for such a network. Independent of the underlying physical network, we can use the Internet for LAN and WAN communications. The Internet can accommodate voice, video, and data traffic, and is already in widespread use.

Currently, desktop computer users employ the Internet primarily to send e-mail, transfer data files, and access information repositories. However, you can also use the Internet to network embedded systems and even individual processors in an embedded system.

From a practical standpoint, the Internet currently lacks the performance required to support real-time communications between embedded systems. Even in an intranet environment that circumvents Internet bottlenecks, IP lacks the capability needed to allocate dedicated bandwidth, which is essential for real-time communications.

Even so, the Internet and intranets are still ideal for performing such functions as remote configuration, diagnostics, and management that do not require real-time response. Improvements in the Internet's infrastructure, such as the deployment of high-performance asynchronous transfer mode (ATM) networks that can allocate dedicated bandwidth, will greatly extend the scope of the Internet in embedded-systems applications.

A number of companies are beginning to exploit the Internet to simplify remote management. Network hardware manufacturers such as Cisco Systems, HP, and Tivoli Systems, for example, are adding HTML interfaces to their hubs, routers, and switches that simplify the use of SNMP. The HTML interface makes the device's MIB look like a Web page (see the figure "Embedded on the Web" on page 91), enabling it to be remotely queried, configured, and managed via standard Web browsers such as Microsoft Internet Explorer and Netscape Navigator, either via the Internet or the corporate intranet. RTOS vendors are taking a similar approach, adding browsers and HTML interfaces that enable embedded systems based on their RTOSes to manage or be managed by other Internet-ready systems.



The core of VelOSity is a small, fast multitasking kernel. It handles user processes and system interrupt routines.

Java in Embedded Systems

As interest in creating Internet-accessible embedded systems increases, developers of embedded-systems software will gravitate toward development tools that simplify the creation of Internet-enabled applications. The Java language is tailor-made for developing such applications. The reason is that you can compile Java applications to a processor-independent format that can be downloaded over the network to any processor running the Java virtual machine and a Java interpreter.

Interpreted Java code is much slower than compiled C. However, this approach greatly enhances embedded systems' flexibility by enabling the system to be reprogrammed to perform new functions on the fly. The ability to download programs over the network is also ideal for resource-constrained embedded systems such as set-top boxes that don't have sufficient nonvolatile memory to store programs locally.

Many are predicting that Java will displace C and C++ as the language of choice for embedded-systems programming. Certainly, Java's processor independence will make it attractive for Web-based applications that require programs to be downloaded over the Internet. On the other hand, the overhead associated with interpreting downloaded Java programs on the fly makes it unattractive for applications in which programs are stored and executed locally on a particular processor.

As with C, you can also compile Java programs in advance to run native on a given processor. However, you then lose portability, and Java must compete with C on the merits of the language itself. Java may also have some advantages in this regard, but probably not enough to overcome the tremendous installed base and momentum enjoyed by C.

With embedded systems gaining network, Web, and Java capabilities, they are getting smarter, more communicative, and more controllable. This can only result in more of them, in more applications, doing more clever chores. B

Bob Margolin writes on a variety of technical issues in Wheatland, Wyoming. You can reach him at **margolin@wyoming.com**.

The Searchable Kingdom

Search engines crawl and index to make sense of corporate intranets.

By Edmund X. DeJesus

It's in your intranet somewhere: that engineer's report on the C-130 component prototype. Which you need in the next 30 seconds. To appear halfway knowledgeable at the meeting you just got dragged into. With the vice president, no less. Is it filed under *Products*? No, it's not a product yet. *Press Releases*? Not likely. *Company Policies*? Grrrr. What's this intranet for, anyway, if you can't find what you need?

What indeed? Once you've got your company-wide intranet up and running, it's off to Disney World, right? Don't pack your bags quite yet. An intranet is not much use unless it is searchable. Like a book without an index or a library without a catalog, an intranet without search capabilities is just a pile of information, no good for the people it's intended to serve.

That goes double if part of your intranet is visible to the public. If potential customers can't find what they want on your site—and find it fast—they will quickly click away to some site that's more hospitable, like your competition's, for example.

The brain behind making your intranet searchable is its search engine, which has two main jobs. First, the search engine must read all the parts of your intranet that you want to be searchable. These might include within-company Web sites, outside-company Web sites, networks, servers, and even desktop hard drives. Second, the search engine must handle queries from users, interpreting what the user is looking for, comparing that to the index, and presenting the most likely hits.

From speaking to the human brains behind many of the most widely used search engines, it is clear that there are many strategies for creating such engines for intranets. Engine designers may emphasize any of a host of features including speed, compactness of index, and ability to distribute index or query functions, handle multiple languages, understand linguistic nuances, and manage gargantuan amounts of data. To choose the right search engine for your intranet, it is crucial to understand your searching needs and then match them to the engine features. And note that many search engines tout the number of formats they can handle. Take this number with a grain of salt because you can count formats in a number of ways, and you can be sure that engine vendors are counting them in the way that makes their product sound better.

ILLUSTRATION: JOHN UELAND © 1997

Verity Knowledge Base Networks

Verity licenses from Xerox PARC the linguistic prowess of LinguistX as part of its Search'97 engine (see page 92NA 6). But this is not the only search tool Verity uses, notes product manager Nick Arnette. Many algorithms, including Boolean search, proximity search, fuzzy logic, Soundex (to handle homonyms or misspelled words), thesauri, and stemming tools, all work on input text. Matches on multiple engines lift that hit higher in the list of likeliness. A bonus: Verity can plug in new algorithms as they come along.

Verity differs from other search engines with its Knowledge Base Network. It captures *evidence* in the engine and gets smarter as it goes along. After a while, "Bill Gates" and "Windows 95" become associated with "Microsoft," so searches on one bring up the other as a possible hit. Verity also uses what it calls an open gateway approach to input: Its engine will look on the Web, in databases, and on networks to feed the search.

Text does not live by HTML alone. To handle non-Web documents that live in databases and on networks, Verity uses a variety of filters to handle the multiplicity of popular formats. These filters are licensed from Inso, the big Gorgonzola of filters (especially after its acquisitions of Systems Compatibility Corporation, ImageMark Software Labs, and Electronic Book Technologies), and they also make use of technology licensed from

MasterSoft. You can write your own custom filters for unsupported formats.

One common-sense feature is that location of a word influences its weight. A word in a title is a bigger hit than a word in a paragraph (meaning, for example, that this article would receive a pretty low hit score if you did a search for the term "intranet searching").

Besides the indexing itself, a search engine needs a *spider*, a program that traverses Web links efficiently to feed text to the search engine. Verity's spider is centralized and offers many controls. For example, you can control its speed, whether or not to respect the robots.txt file at each site (which allows, disallows, or controls spider access), ignore certain formats, search only certain domains, and search by fields. It also offers agents: subprograms that will watch info as it gets indexed (even from live news feeds) and route it to satisfy a query.

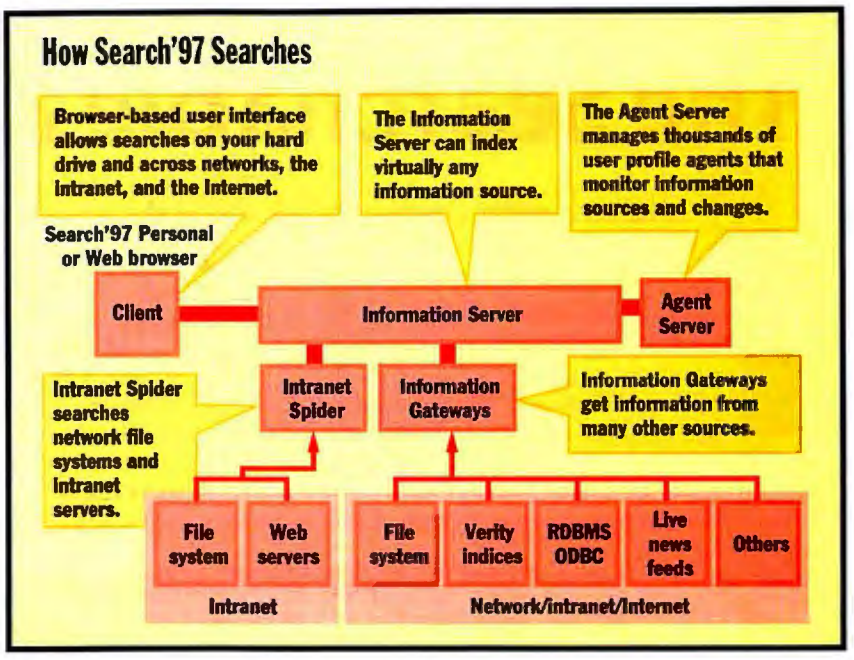
Verity's Search'97 is a very scalable engine, handling 20 GB of text with excellent performance, according to Arnette. That scalability extends to the hardware platforms it runs on, from desktops (costing less than $100) to servers ($20,000-$30,000 range). Verity works on 18 operating systems, including the Windows family, Macintosh, and Unix flavors.

With its low per-seat cost, Search'97 offers a lot, especially for the smaller intranet or those just getting their feet wet. With its ability to search documents in many formats, availability on many platforms, and talented spider, Verity's engine could match your intranet search needs.

Livelink Intranet: Corporate Choice

Open Text's Livelink Intranet squarely targets intranets, especially on the large corporate level, according to product manager Kevin Weatherston. A customer list that includes Ford and Siemens-Nixdorf backs that up.

Livelink Intranet is a Web-based product with several parts (see the figure on page 92NA 7). Livelink Spider crawls the Web from a central server for text to process. You can control which sites to crawl. It's a gentle spider that conforms to robots.txt protocols and doesn't beat relentlessly on servers but waits between accesses. It also pays attention to when Web pages change and rescans a page only when it changes: That saves time and processing.



Search'97 uses a three-tiered architecture, enabling distributed search processing based on an organization's requirements.

Livelink Index is a phrase-based engine that actually recognizes and returns full phrases—don't worry, individual words count as phrases, too. It is also aware of Web-file structure, so you can search in a headline only rather than in all the text. Location within the structure influences relevance ranking, as do number of occurrences and other factors. Filters handle documents in other typical formats like Word, WordPerfect, PDF, and Excel, although not yet with awareness of internal structure. With a simple change of its "language definition," you can perform searches in many different languages, including English, German, French, Korean, and some versions of Japanese. Naturally, this simplifies matters for multinational organizations.

Livelink Search handles queries from users. Ordinary Web browsers access Search, which queries the index and formats and returns hits.

Livelink Intranet is built to take advantage of the speed of 64-bit UltraSparc chips. That's especially useful when wrangling multigigabyte databases. Supported platforms include Sun with Solaris, Hewlett-Packard with HP/UX, and Intel x86 with Windows NT. A stand-alone search system will cost in the $12,000 range, but prices generally depend on special company needs.

Open Text's Livelink Intranet is suited for large corporations that don't mind heavy hardware demands. Its multilanguage and distributed capabilities make it especially useful for multinationals.

CyberSearch and Secure Searching

Frontier Technologies' CyberSearch searches the Web, newsgroups, local hard drives, LANs, or the Internet for Web pages, documents, spreadsheets, and ordinary files that may be in different locations. It also uses the latest security technology based on public-key certificates, according to Ray Langford, engineering manager for advanced products.

CyberSearch can keep track of when things change and update its index. It also does metasearching: setting up indexes of indexes so that instead of searching for the item itself, it checks the index where that item should be indexed. It can even metasearch one or more of the major online search engines (AltaVista, Excite, Infoseek, Lycos, WebCrawler, Yahoo).

CyberSearch uses multiple indexing algorithms, such as proximity, dictionary and thesaurus, position, stemming, field, and concept. The usual filters let CyberSearch handle HTML, Word, Excel, Access, 1-2-3, WordPerfect, Quattro Pro, and even news feeds (if using Frontier's News Server). Plus, it can use the internal structures of documents to score hits. It

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All kidding aside, if you own a small business, the Dell PowerEdge 2100 really is a beautiful server. Just look at what *Network Magazine* had to say about it. "The Dell PowerEdge 2100 is designed specifically for small business environments and offers outstanding functionality, performance and customer support at the right price." Need more? The editors also went on to report that its advanced features like a 200MHz Pentium® Pro Processor, ultra-wide hard drives and a PCI Ultra/Wide SCSI-3 Controller will, in their words, "add at least a couple of years to the server's active lifecycle." And the fact that integrated server management and Intel®'s LANDesk® Manager software both come standard to give you an easy interface to the server's hardware monitoring functions. And now the PowerEdge 2100 is available with an expandable RAID controller, offering your business redundant data security. Plus there's next-business-day on-site service and a 24 x 7 toll-free support line with new "getting started" support. Speaking of getting started, shouldn't you?

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orders what it finds by relevancy and can abstract documents by relevant keywords.

Assistants automate searching with user-defined sets of query terms and locations to search. CyberSearch works in the background—periodically or on command—to return hits, whether Internet or intranet. CyberSearch also provides document monitoring to notify the user when a link or an item changes.

CyberSearch's client/server architecture is scalable. You can use CyberSearch at an individual PC or install the NT server component on your Web server to tap its power for maximum efficacy: Clients can share their indexed collections. A step-by-step wizard walks you through the setup process.

Although strictly for Windows platforms (Windows 3.x, 95, or NT client, Windows NT server), CyberSearch can get its information from non-Windows servers. Its low price of $99 per client makes it especially attractive to small and midsize operations.

Frontier Technologies' CyberSearch has a low price and Windows orientation going for it. Its security features and automation capabilities may also satisfy your intranet search requirements.

Ultraseek Server and Keeping Track of Content

Infoseek's Ultraseek Server is a by-product of Infoseek, the Web search service. As might be expected, it shares much of its big sibling's prowess, scaled down to intranet size.

Its spider is particularly shrewd. It can run in either a centralized or decentralized environment. Also, it keeps track of when items change and rescans them only then, as do some other spiders. But it goes one step further by keeping track of how often each item changes and anticipating when it should check the item next. Since many Web pages are in fact updated by their owners on a scheduled basis, Ultraseek Server catches on to the pattern and does not waste time updating when it's unnecessary. That's smart, and it saves processing time.

The Ultraseek spidering process is very polite, obeys all protocols, and does not swamp servers with inquiries. Patient, too: If the server is busy, the spider will wait an hour before trying again, notes Andy Feit, director of intranet product marketing. The spider can configure on a host basis or by URL, specify a user agent, and even handle password-protected sites.

Steven Kirsch, CEO, points out that Ultraseek Server was designed to handle large collections fast—no surprise when you're used to handling the entire Web. The search engine is statistically based and employs a variety of tools including natural language, Boolean, proximity, document structure, and fields. Like some other search engines, it should incorporate Inso technology for handling items in non-Web formats by the time you read this.

The index itself is centralized, but the spider can be either centralized or decentralized. With automatic operation as a primary goal, including the automatic updating mentioned earlier, Ultraseek Server requires no full-time administrator (see the screen on page 92NA 10). It runs on Solaris systems, but the NT version should be out by now.

Again, considering its heritage, it's no surprise that Ultraseek Server is highly scalable. Infoseek claims to be the only vendor capable of handling Microsoft's collection of a million documents. Pricing is also scalable, essentially by the number of documents, ranging from $995 for 1000 documents to $35,000 for 100,000 documents and so on.

Infoseek's Ultraseek Server is a complete package; it is suitable for big sites, and it has low overhead.

HotBot and the NOW Generation

Inktomi's HotBot powers the HotWired Internet search site and its own site search service. Its architecture is unique in that it uses "network of workstations" (NOW) parallel computing technology that Inktomi developed. NOW uses clusters of commodity workstations (like Intel Pentium Pro-based servers) and high-speed LANs to achieve supercomputer-class performance. There are several advantages to this type of architecture. First, it is highly scalable since you choose how many

Linguist X and Computational Morphology

Sure, Xerox PARC invented the mouse, windows, and the graphical user interface, but what has it done for you lately? Taught the computer how natural languages work, for one thing. This research has culminated in LinguistX, a search tool (not a commercial product itself) that search engines can incorporate for understanding languages.

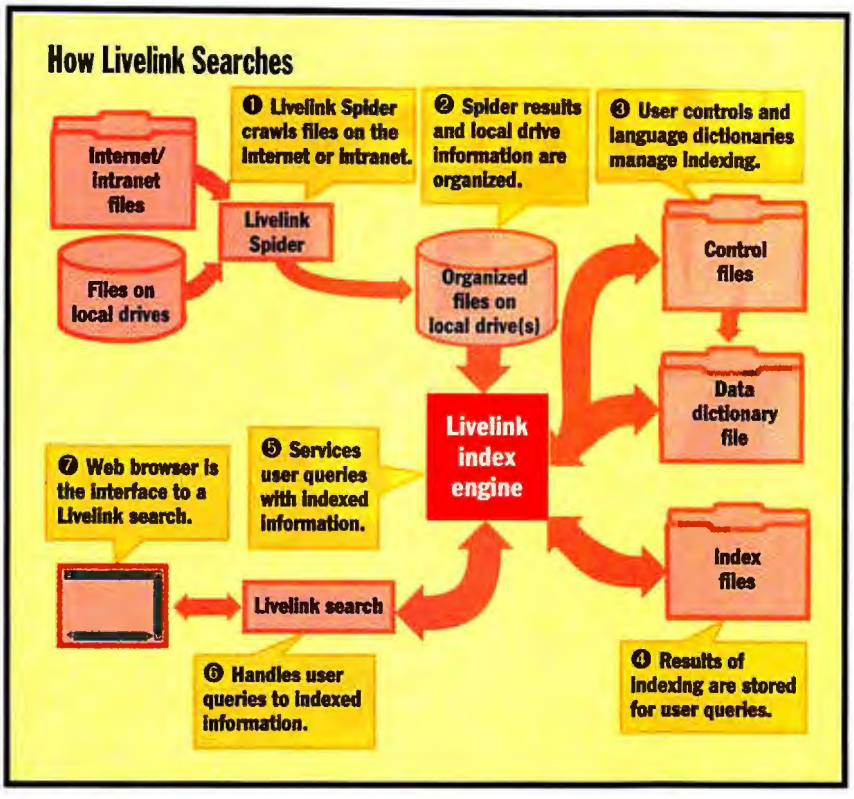
Ramana Rao, chief technology officer and director of engineering for InXight (a Xerox subsidiary), explains that LinguistX employs computational morphology to plow through text and use its linguistic understanding of how words and phrases work, which enables highly sophisticated queries. Its tokenizer picks words out of text, dealing with commas and hyphens correctly. This tokenizer is also language-independent, since all human languages share universal linguistic properties. (Thank you, Noam Chomsky.) All you have to do is select the specific dictionary you want LinguistX to use.

Its stemmer can tell that "survived" is related to "survive," is a verb, and is past tense. So when indexing, it can thus arrange similar words together, making a smaller index that is faster to search; astonishingly, LinguistX can represent up to eight English words with a single bit. This also helps you make more precise queries and find what you're looking for through a word's deep meaning, not just its surface form. On a higher level, the LinguistX thesauri find words with similar meaning: That can broaden a search, but it can also lead to serendipitous connections.

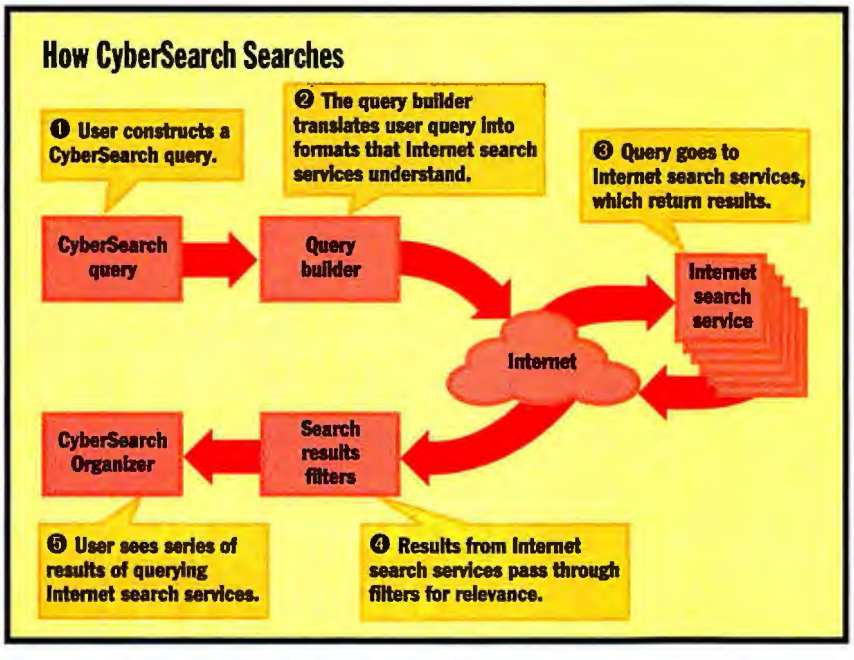
Taggers decide parts of speech. If you're looking for a saw, LinguistX knows a hand tool from the past tense of the verb "see." This is in stark contrast to search engines that treat words as mere strings of ASCII and would make no distinction between the tool and the verb. To tag a word properly means examining its context a little in the surrounding text. Obviously the extent of context examination must be as small as possible to preserve speed but wide enough to do the job.

LinguistX especially shines in handling phrases. If you search for "home run records" on most search services, you'll get a lot of dross about building a house, athletic footwear, and music albums. But LinguistX can tell that you are looking for exceptional batting performances in baseball.

All this has come out of years of linguistic research, turned into practical software. The result is a collection of ANSI C libraries that are platform-agnostic and eminently portable. For implementors, LinguistX saves time and space and delivers sharper query results. If this seems good to you, be sure to inquire whether commercial search engines incorporate LinguistX.



Livelink Spider forwards updated Web pages to Livelink Index, which prepares the index for later queries through Livelink Search.



A CyberSearch metasearch sends a query to some popular Internet search engines and returns the results.

workstations or disk drives, or how much memory, you want to use. Second, it is economical since the workstations don't cost as much as supercomputers. Further, you don't have to constantly upgrade your servers to keep up with growth. Finally, it is fast, thanks to some proprietary Inktomi software.

This software implements advanced multithreading across the NOW cluster. This is a parallel-processing technology that allows each processor to optimize and manage over a thousand network operations simultaneously. In a network-centric environment, this provides extreme performance. It also protects the system from delays or outages caused by individual portions of the network by balancing the load across the cluster. This cluster of parallel workstations thus has advantages over the symmetric multiprocessing architectures that other search products use. The cost-effectiveness is especially attractive to the bean counters, and the scalability should keep the administrator's back user-free.

The architecture has a downside, namely complexity. Besides routinely operating a horde of workstations, network switches, and disks, it must also monitor—and bypass—any failed components. Luckily, the complexity is nothing the user has to face. What HotBot needs, it has: It's in there.

The HotBot spider (the company name derives from a mythological spider of the Plains Indians) uses Inktomi's SmartCrawl technology to intelligently refresh its index. As usual, it crawls by visiting pages and following links from each page, but it is very efficient. Its networked architecture allows it to maintain enough simultaneous links to the Web to crawl up to 10 million Web documents per day (see the figure on page 92NA 10).

The spider is courteous to sites that don't want to be crawled. Nor does it index pages that require passwords to access them. But as long as the site has not requested that robots not crawl it, HotBot will index the site's pages on all servers. HotBot also does not burden any one site with its attention. It may index up to a few hundred pages of any one site within the first 24 hours. The next day it will revisit the site for any remaining pages, and so forth.

The HotBot technology is currently a centralized function, which is no surprise given the clustered network approach inherent in the architecture. There are plans to decentralize the technology: a "divide and conquer" approach that other engines have used to advantage.

Currently, HotBot is not capable of searching for non-Web documents, so

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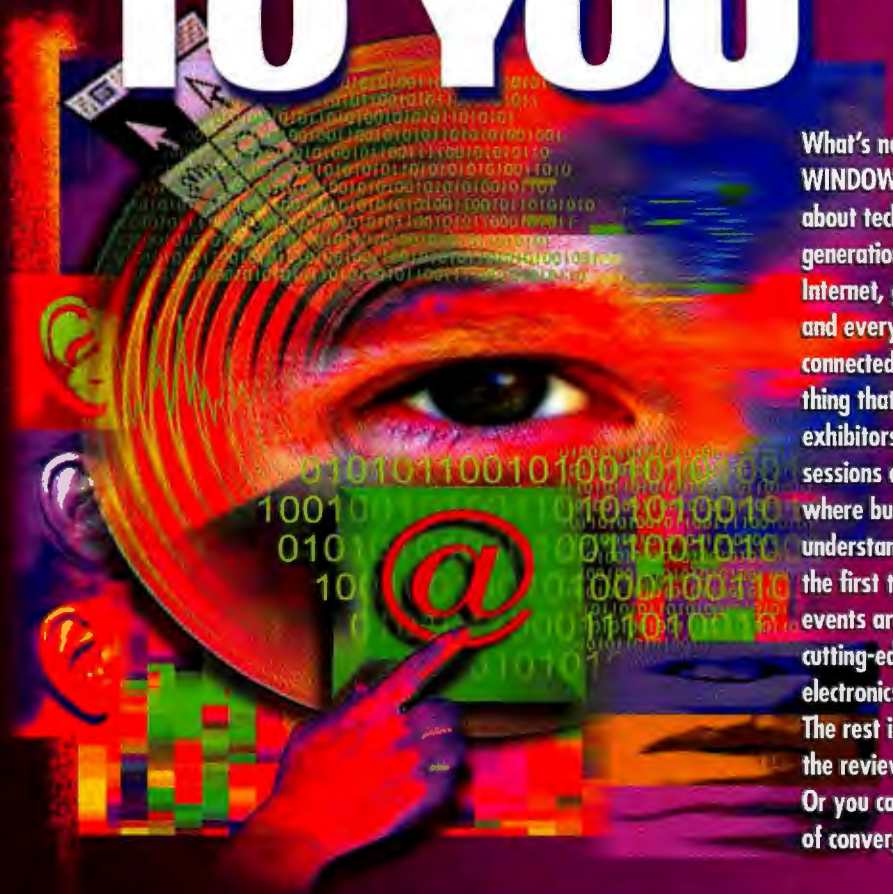

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	Atlanta Hilton & Towers (Main/Tower)	$179/$229	$199/$249
	Atlanta Marriott Marquis (1)	$185	$185
	Atlanta Marriott Suites Midtown	$171	$186
	Best Western American	$120	$140
	Best Western Inn at the Peachtrees	$122	$132
	Biltmore Suites Hotel	$125	$155
	Comfort Inn Downtown Atlanta	$138	$148
	Courtyard By Marriott Atlanta Airport North	$100	$110
	Courtyard By Marriott Atlanta Midtown	$129	$139
	Courtyard By Marriott Executive Park	$118	$133
	Days Inn Atlanta Downtown	$125	$135
	Embassy Suites Atlanta Buckhead	$175	$175
	Fairfield Inn By Marriott Midtown	$85	$85
	Holiday Inn Airport South	$102	$112
	Holiday Inn Atlanta Central	$89	$99
	Holiday Inn Buckhead	$109	$119
	Holiday Inn Midtown North	$67	$67
	Holiday Inn Select Decatur	$98	$108
	Holiday Inn Select Peachtree Corners (5)	$110	$120
	Hotel Nikko Atlanta	$189	$189
	Howard Johnson Downtown	$132	$142
	Hyatt Regency Atlanta (2)	$174	$184
	J.W. Marriott at Lenox	$169	$179
	Marriott Courtyard Downtown	$109	$129
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	Northeast Atlanta Hilton	$119	$119
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	Quality Inn Midtown	$88	$92
	Radisson Hotel Atlanta	$114	$124
	Ramada Downtown Atlanta	$92	$102
	Ramada Inn Atlanta Airport North	$102	$112
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	Renaissance Atlanta Hotel	$169	$189
	Ritz Carlton Atlanta	$200	$220
	Ritz Carlton Buckhead	$189	$189
	Sheraton Colony Square	$135	$135
	Sheraton Gateway Hotel	$145	$155
	Sheraton Inn Atlanta Airport	$99	$109
	Suite Hotel Underground	$149	$159
	Summerfield Suites Hotel Buckhead	$179	N/A
	Summerfield Suites Hotel Perimeter Center	$159	N/A
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❑ Single ❑ Double Arrival Date Departure Date Share With Comments

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4 REGISTRANT INFORMATION

You must circle one in each category (unless otherwise indicated) to receive an admission badge.

1. TYPE OF ORGANIZATION

Industry Organizations
- AH Computer Manufacturer
- AP Software Developer/Publisher
- KI Internet Services
- AZ Communications/Network Vendor

Channel Organizations
- AB Computer Retailer/Dealer
- AC OEM/Components
- AF Systems Integrator
- AG Mass Merchandiser
- AM Computer Distributor/Wholesaler
- AV Computer Consultant
- AW Other Computer-Related Services
- AX VAR/VAD
- AY Computer Superstore
- KE Other Computer Retail
- AE Database Services
- KG Bookstore

Corporate Organizations
- KP Government
- KS Publishing/Broadcasting
- KY Telecommunications
- KA Public Relations/Advertising
- AJ Consumer Electronics
- AN Multimedia Products/Services
- AK Non-Computer Manufacturer
- KB Engineering/Architecture/R&D
- KC Insurance/Real Estate
- KD Aerospace
- KF Non-Computer Consultant
- KH Education
- KL Finance/Accounting/Banking
- KM Healthcare/Medical
- KR Transportation/Utilities
- KW Non-Computer Retailer/Distributor/Wholesaler
- KZ Other

2. JOB FUNCTION

- FB Engineering
- FF Systems Programmer/Analyst
- FH Software Development
- FQ R&D
- FR Systems/Software Support/Maintenance
- FS Sales/Marketing
- FX Management
- FN PR/Publishing/Advertising
- FP Purchasing/Buyer
- FG Network Operations
- FE MIS/DP/IS
- FW Product Management
- FM Support Staff
- FC Finance/Accounting
- FK Press/Editorial
- FT Other

3. TITLE

- AA CEO/President/Owner
- BB Vice President
- LL Director
- CC Corporate Management
- EE CIO/CTO
- GG Sales/Marketing Staff
- JJ Support Staff
- SS Technical Staff
- PP Technical Management
- KK Other

4. COMPANY SIZE

- YA Under 50
- YB 50 – 99
- YC 100 – 499
- YD 500 – 999
- YE 1,000 – 4,999
- YF 5,000 – 9,999
- YG 10,000 or more

5. ENVIRONMENT

- TH Windows NT
- TN Windows 95
- TA Windows 3.x
- TB OS/2
- TC UNIX
- TD Macintosh
- TE Network
- TG DOS
- TM Novell NetWare
- TF Other

6. PRODUCT INTEREST (Circle ALL that apply)

- SA Communications and Networking
- SB Multimedia
- SC Development Tools
- SO Spreadsheet/Financial Analysis
- SF Office Systems/Imaging
- SG OEM Components
- SH Desktop Publishing
- SJ Mass Storage Devices
- SK DBMS
- SN Printers/Faxes/Copiers
- SR Accessories
- SS Peripherals
- ST Desktop Computers
- SX Mobile Computing
- SY Enterprise Computing
- SI Internet Products
- NP Internet Services
- NH Computer Telephony
- NA Software
- NE E-Mail Messaging/EDI
- SM Open Systems/UNIX
- SP Client/Server Computing
- SU Telecommunications
- SV Multi-Platform Environments
- SW Object-Oriented Programming
- SZ Parallel Processing
- SQ Other

7. HOW DO YOU BUY?

- QA Distributors
- QB Direct from Manufacturer
- QC Computer Retail Stores
- QD VAR/VAD
- QF Catalogs
- QG Superstores
- QH Mass Merchandiser
- QJ Systems Integrator
- QK Other

8. PURCHASE ROLE

- RA Final
- RB Specify
- RC Recommend
- RD No Role

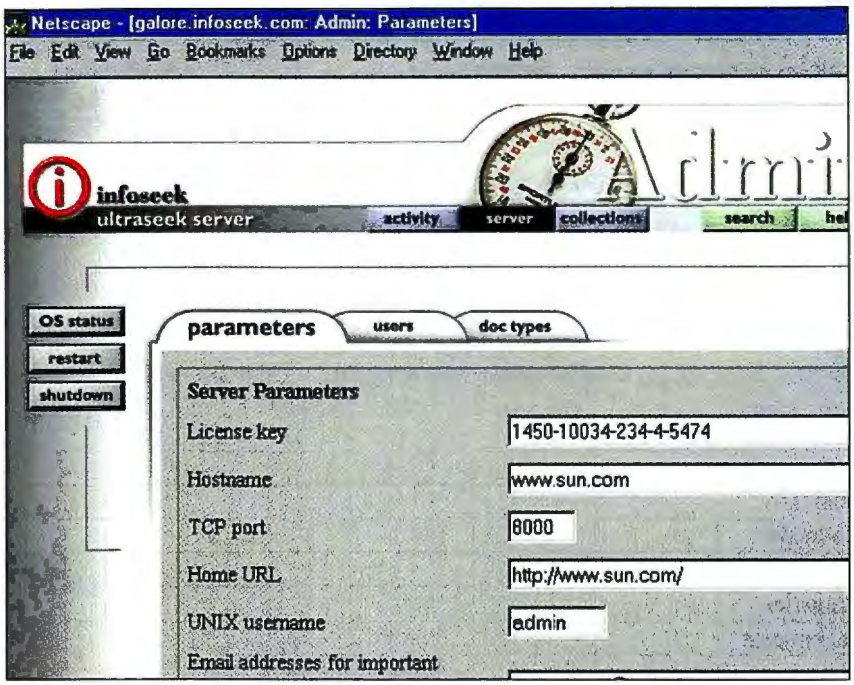
access to ordinary documents on networks and individual machines is out. But if the information is on a Web page, HotBot can find it because it gulps the entire Web document. HotBot deals with words and phrases handily. And just because it is limited to Web documents, don't misconstrue that it speaks only HTML. Besides text, HotBot can also search for various media types, including images, Java applets, any file extension (e.g., GIF, JPG), Shockwave, Virtual Reality Modeling Language (VRML), audio, and video.

If your needs require searching non-Web documents, or items on networks or individual machines, you'll have to look elsewhere. But for fast and scalable searching with conventional equipment (used in conventional ways), HotBot is a good choice at a good price.

Lycos and Mega Queries

Originally developed at Carnegie Mellon University, Lycos is one of the top search services on the Web. Now you can use it as the search engine for your intranet.

The Lycos spider knows some clever tricks. First, it can crawl either Web sites or file systems. You have many choices of crawl modes, and it respects the robots.txt protocol. As Sangam Pant, Lycos vice president of engineering, notes, the spider also performs link analysis as it crawls. This helps it crawl the most popular pages first: If many pages point to one page, that page seems more important, and the spider will crawl that one sooner. The spider also downloads the context of the page, which aids in building the index.



Ultraseek's Admin gives an overview of system status and control over parameters, how queries are served, and how the spider crawls.

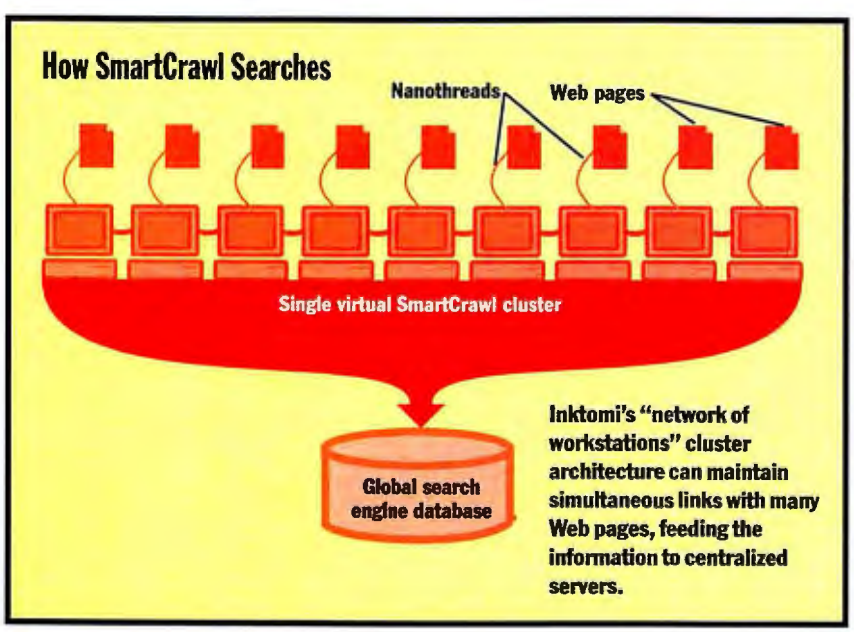
The index can span multiple servers and files. It can also replicate indices to improve safety (in case one copy gets clobbered) and speed (to support searches on multiple copies). The indexer looks for keywords within a page, which improves the relevance score. It also keeps track of statistical properties like frequency of occurrence: If "HTML" appears in *every* document, it might not be so important. The indexer keeps track of phrases, as well as the location of a word on a page; words in titles, beginnings, and endings are more important.

Surprisingly, the indexer can also index sound and graphics. How? No, not by listening to or viewing the items but by analyzing the text (captions, titles, lyrics) surrounding the items. This text, analyzed statistically, gives important clues about the sound and graphics content and a hook to hang a multimedia search on.

The indexer can handle 20 to 30 GB of information without problems. Then the indexer turns it over to the search engine, which essentially turns things inside out for searching. As you'd expect from its big sibling, the search engine is tuned for speed, managing vast amounts of data and handling huge numbers of queries without breaking a sweat.

Lycos licenses parts of its technology on an OEM basis. For example, the Lycos spider is part of several Inmagic (Woburn, MA) products. With Lycos components, a vendor can create products to address special needs and niches.

Some people might think having their own Lycos is overkill. But Pant points out that "most intranets start small—you could just grep 100 documents—but then grow rapidly" in the number of documents, the complexity of documents, and



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the number of queries. Lycos can handle the speed, relevancy of returns, and complexity.

Lycos runs on high-end Sun workstations and Alpha Unix systems, at prices that depend on the components included. But Lycos, for a flat price, also runs on small to midlevel systems running NT and some flavors of Unix.

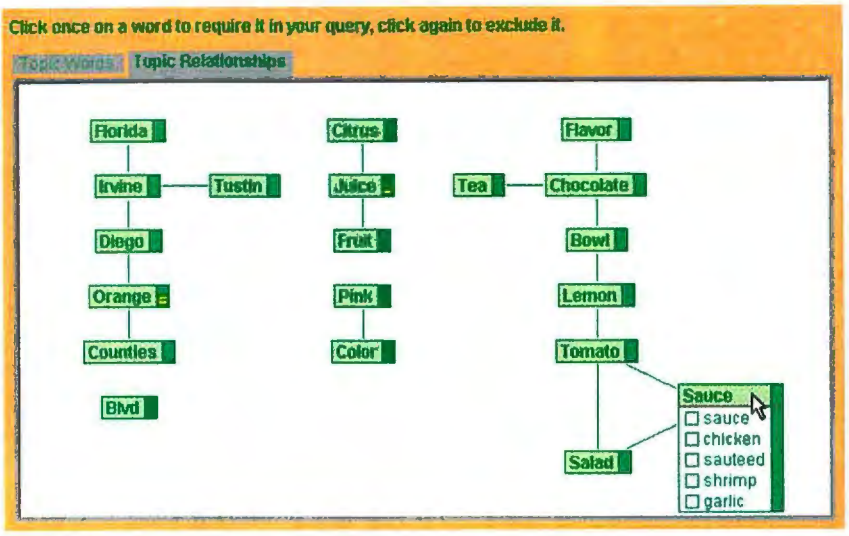
Lycos's prowess is based on its ability to handle large collections of data and to do high-speed searching. Add multimedia capabilities and you have an impressive package.

AltaVista: Your Search, Your Way

As with Lycos, the AltaVista Web search service is now available for searching your intranet. AltaVista Search Intranet Private Extension (no one ever accused Digital marketing of cutesy names) offers a set of C libraries that extends AltaVista's speed and capacity to intranets. There are also optional developer's kits for integrating standard databases like Ingres, Oracle, and Sybase.

Given its speed and power, the AltaVista crawler is designed primarily to not bring down the server it's crawling. You can give it multiple pages to start crawling from. It follows rules you establish for its dealings with sites (including the all-important robots.txt protocol), and it can run in automatic mode.

Its indexing engine can plow through data at about a gigabyte an hour, according to Bob Lehmenkuler, AltaVista Search marketing manager. It indexes every word and number from the crawler, creating a statistical model of the content. It throws nothing away, yet its "inverted text index" occupies only 10 to 30 percent of the original content. Its indexing handles fields, like host name or URL, and it is language-independent.



Visual LiveTopics lets you direct intranet searches graphically by selecting branches that will take you where you want to hunt.

The indexer eschews thesauri to broaden searches on the grounds that a thesaurus necessarily depends on some other person's associations with a word, not yours. Instead, AltaVista is readying Visual LiveTopics, a tool that lets you perform user-directed querying: on-line analytical processing on your Intranet (see the screen above). Suppose, for example, you perform a query on "orange." AltaVista has noticed "orange" in various contexts and presents each one as a graphical tree or text list for further searching. Were you thinking of Orange County? The fruit? The color? The flavor? By selecting which context you meant, you direct the path of the search and can drill down to deeper levels of detail. Currently in beta testing, Visual LiveTopics should be available soon.

Also available should be support for searching common office document formats. HTML is not yet the basis for all business communication.

Given its pedigree, it's no surprise that AltaVista handles tremendous amounts of data rapidly. It can be configured for centralized search services or distributed. It runs on Windows NT on Intel platforms and Digital Unix on Alpha machines, with Solaris support expected real soon now.

Cost depends on server platform and number of users. List price (if anyone still pays that) for the ground-floor NT model is $16,000, which covers 250 users. License for unlimited users would range from $34,000 to $100,000. On the largest Alpha box (whose 2 GB of RAM hints that this is not a desktop machine), the cost is $66,000.

Who buys AltaVista? Digital's Lehmenkuler claims the best customers are those who have tried other intranet search solutions first and not been satisfied. AltaVista is pricey yet powerful. You can't ask for more than the ability to handle practically anything, and do it fast.

Many of the search engines we've discussed have been tested on the toughest possible network: the Internet. They've proven capable of indexing millions of documents and serving millions of customers a day. Considering the features and capabilities of these engines, maybe adding search tools to your intranet won't be such a chore after all. B

Edmund X. DeJesus **(edejesus@bix.com)** *is a BYTE senior technical editor.*

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Multicast to the Masses

The IP Multicast standard is ready, but the infrastructure isn't. Yet.

By Mike Hurwicz

Bob Ordemann, senior principal scientist at Boeing, lived through the classic IS nightmare. Boeing needed to upgrade the software on its engineers' workstations. So, on a Saturday morning, the IS department fired up its software distribution system and began the download of the 20-MB upgrade. On Tuesday, it finished. Oops. Hundreds of engineers got a two-day furlough. The IS department got in trouble.

The problem was: The server that held the upgrade was establishing many one-to-one connections with the workstations. There just was not enough bandwidth on the network to handle so many connections at once, so downloading ground to a halt. IP Multicast could have avoided this problem. Instead of doing it one-to-one, the server could have established a one-to-many relationship—a multicast—using the bandwidth much more efficiently.

IP Multicast is an Internet Engineering Task Force (IETF) recommended standard, RFC 1112, that defines extensions to the Internet Protocol. The extensions are designed to keep corporate and public IP networks from drowning in traffic generated by certain types of applications. Specifically, IP Multicast works its magic where there are multiple receivers for a single transmission. For these kinds of network traffic, in a best-case scenario, IP Multicast reduces the network load in proportion to the number of receivers. If there are 10 receivers all receiving the same transmission, instead of each one having its own data stream, you could get as little as one-tenth the traffic.

But organizations have some good excuses for not getting around to IP Multicast. For one thing, IP itself has only recently gained popularity in commercial environments. In addition, IP Multicast has faced a daunting array of obstacles, from lack of applications to insufficient support in routers and other network equipment. These problems continue to hold back deployment.

That may change. The IP Multicast Initiative (IPMI) aims to ensure that the technology will firm up during 1997, preparing the way for a surge of deployment in 1998. Never heard of IPMI? Well, you've heard of some of its members: AT&T, Bay Networks, BBN Planet, Boeing, Cisco Systems, Hewlett-Packard, IBM, Intel, Lawrence Berkeley Laboratories, MCI, Microsoft, NASA, Netscape, Sun, and 3Com. Even with such heavy backers, IP Multicast deployment won't enter all at once. It will come first on corporate intranets. Widespread deployment on the Internet will take longer.

A Happy Medium

There are three basic ways for a sender to transmit identical data to multiple receivers: broadcast, multiple unicast, and multicast.

A broadcast is a single data stream intended for every station on the network. In forwarding broadcasts, routers (and switches) have no way to intelligently determine, on a case-by-case basis, whether any stations on a particular network actually need or want the data. Routers are usually configured to just pass or block broadcasts on any particular route. Routers are often set up to block broadcast traffic because of the potential for "broadcast storms," in which packets are broadcast and rebroadcast, severely degrading network performance. When they are blocked by all routers, broadcasts are limited to one LAN segment.

To get past routers and yet avoid flooding innocent bystanders (networks where there are no stations that need the data), the sender can transmit multiple unicasts. Each unicast is directed at a particular end station; the data is not forwarded to networks where there are no recipients. However, generating a separate, identical data stream for each receiver is inefficient. It gobbles up network bandwidth, particularly with data-intensive applications. In addition, it's a lot of work for the sender, requiring extra processing power and memory.

continued

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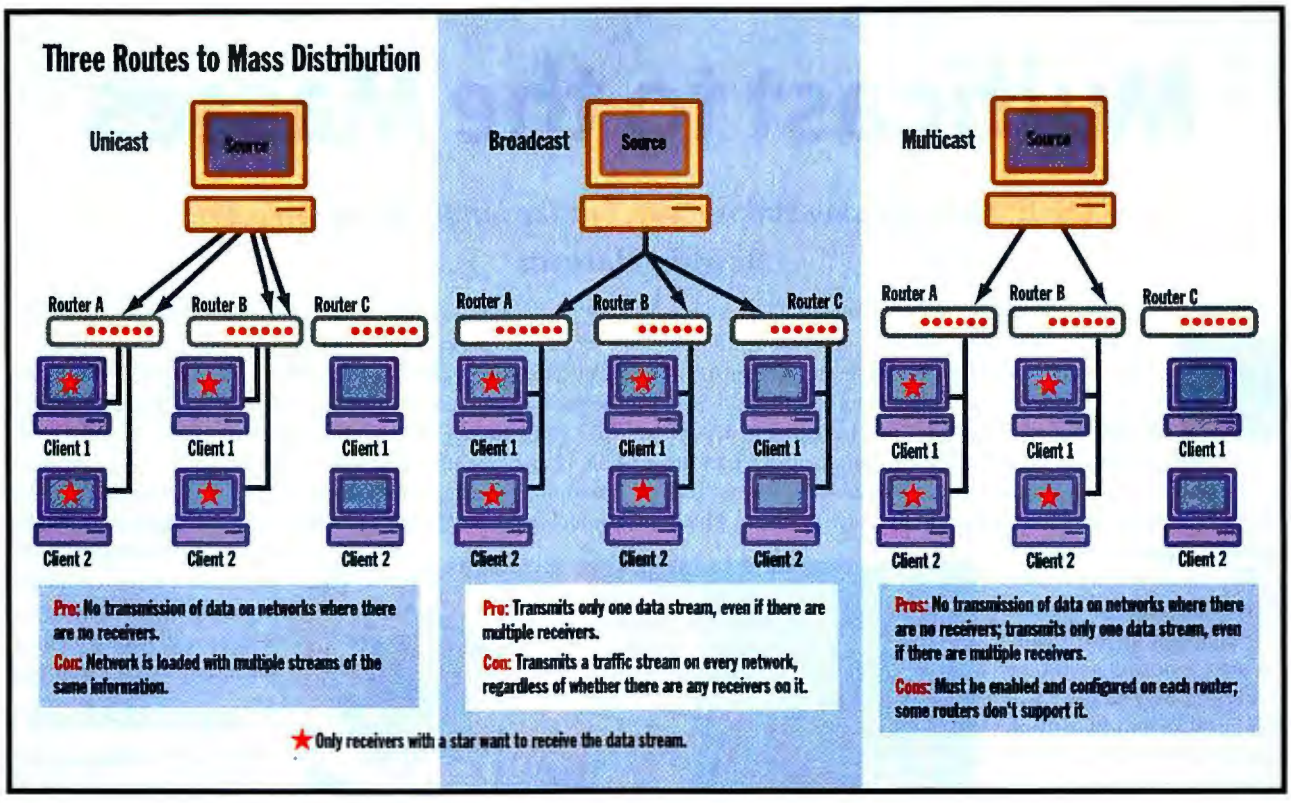


Multicast offers a happy medium. A multicast is a single data stream that is intended only for stations that have joined the appropriate "multicast group." Other stations filter out multicast packets at the hardware level (e.g., Ethernet or Token Ring). The sender has to generate only a single data stream. Unlike a broadcast, however, a multicast-enabled router will forward a multicast to a particular network only if there are multicast receivers on that network. When the last station on a network segment leaves a multicast group, the router "prunes" the multicast data stream associated with that group by ceasing to forward that stream to that segment. Thus networks with no receivers are spared the burden of carrying the multicast traffic. Pruning also makes "storms" much less likely. Multicasting offers the best of both worlds: efficiency for members of the multicast group, peace and quiet for nonmembers.

Using It Today

Pioneering development on IP Multicast, which was introduced in 1989, was done on the MBONE (multicast backbone). The MBONE, created in 1992 to multicast audio and video from IETF meetings, provides multicast service over the Internet.

Other early adopters included satellite networks, where return on investment is particularly high. That's because all satellite traffic is inherently multicast in nature, bandwidth is limited (often to 256 Kbps per satellite), and the number of receivers is large. In addition, satellite networks usually have no routers but act as one large bridged network. (Most of the problems in implementing IP Multicast relate to routers in one way or another.)

As an example of what can be accomplished using satellites and IP Multicast, Toys R Us has reduced from more than 6 hours to less than 4 minutes the time it takes to send software updates to 865 stores nationwide. Toys R Us uses StarBurst Multicast, file transfer software from IPMI member StarBurst Communications, over a VSAT satellite network from Hughes Network Systems.

Intel currently has about 6000 employees who can watch and listen to company presentations using Intel's Proshare Presenter, IP Multicast-enabled video-distribution software. Intel is also using its IP Multicast network to test bandwidth reservation capabilities based on the Resource Reservation Protocol (RSVP). Intel has done some trials with Cisco, MCI, and a few customers, testing IP Multicast and RSVP. Intel licenses RSVP to developers for use in both multicast and unicast environments.

By the third quarter of this year, 8900 General Motors auto dealerships will be receiving software upgrades and data from GM headquarters in Detroit, over the Hughes Network Systems satellite network, using StarBurst Multicast. Multicasting reduces the time required for updates from 3 hours to about 20 minutes.

Multiproblems

Despite these examples, IP Multicast technology overall has made little headway on corporate networks. Interlocking obstacles stand in its way.

Although popular LAN topologies and nearly all current TCP/IP stacks, as well as router and switch products, support IP Multicast, their support may be minimal or not well tested in a variety of environments. As an example of minimal support, John Meylor, a network engineer for the NASA Research and Education network, notes that NASA's DEC GigaSwitches actually broadcast multicast traffic. Broadcasting is better than dropping the multicast traffic, but it would be better still if the switches intelligently multicasted it. That many IP Multicast implementations are not thoroughly tested results from the fact that

most organizations have not enabled multicast capabilities in their networks. And some have not even upgraded to recent releases that support multicasting.

Users' lack of interest stems largely from the lack of killer applications that require multicasting. Applications must be modified to interface with the multicast capabilities of TCP/IP stacks, which in turn join and leave multicast groups by using the Internet Group Management Protocol (IGMP). Developers, however, haven't been eager to create such applications, knowing that most users' routers and switches aren't configured to support multicasting. In addition, the majority of IP applications, including individual Web, e-mail, and file access, derive no benefit from multicasting since they are inherently single-point-to-single-point applications.

IP Multicast has also been at odds with firewall strategies. The conflict stems from IP Multicast's use of the connectionless User Datagram Protocol (UDP). Connectionless protocols provide only best-effort delivery. They do not use acknowledgments (acks), negative acknowledgments (nacks), or retransmission to achieve reliable delivery. IP Multicast requires a connectionless protocol in order to avoid "ack implosion," in which the sender is overwhelmed by acks from multiple receivers. Unfortunately, the most popular type of firewall, the application gateway, cannot secure connectionless protocols.

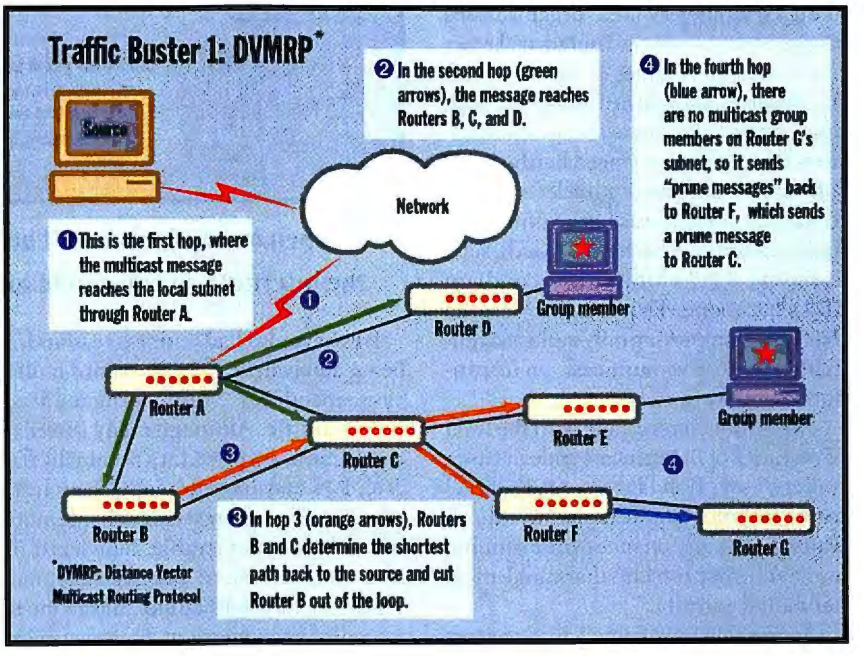
It is possible to configure an application gateway firewall with a "generic service pass" that locks open certain ports for all packets. Unfortunately, that also opens a huge security hole. Even though it may be possible to limit exposure by performing further checks on the UDP packets that are passed, most organizations have chosen simply to block UDP entirely.

Unreliable delivery also means that a reliable protocol has to be layered on top of IP Multicast in order to accommodate applications such as financial transactions or file transfers, where any loss of data is unacceptable. Even for applications like video and audio multicasting, where some loss is acceptable, it might become more worthwhile to safeguard the quality of the data stream as the number of stations receiving it increases. Unfortunately, reliable IP Multicast protocols and products that implement them have been slow in coming. Other protocols that could help insure the quality of IP Multicast data streams, such as RSVP, are also in their infancy. Given the need to reconfigure, replace, or upgrade routers and applications, to stay within firewalls, and to address reliability and bandwidth issues, most network managers have found it easier to curtail deployment of applications such as voice and video over IP rather than try to implement IP Multicast.

The major technical hurdle for Internet service providers (ISPs) has been the lack of a protocol for interdomain multicast routing (IDMR). Protocol-Independent Multicast (PIM), Multicast Open Shortest Path First (MOSPF), and Distance Vector Multicast Routing Protocol (DVMRP), the multicast routing protocols in common use, are not designed for multiple autonomous systems that do not necessarily want to share all their routing information. All three protocols lack controls to limit route propagation based on policy considerations, such as definitions of autonomous systems. Instead, both protocols send all routing information to all known routers.

The Border Gateway Protocol (BGP) provides interdomain routing capabilities for IP. There is no equivalent of BGP for IP Multicast. Lack of an IDMR protocol limits the scalability of IP Multicast and, along with limited bandwidth, is a major reason why the MBONE has only about 30,000 users. Growth is severely limited if all routers have to contain all routing information for the whole network. "It's a flat routing topology," says NASA engineer John Meylor. "The only way to scale is with a hierarchical routing topology."

DVMRP, the protocol currently used on the MBONE, can also be tricky to configure. DVMRP maintains its own routing tables, separate from the unicast routing tables, which is why the MBONE is described as an overlay to the IP network. With the overlay architecture, there can be discrepancies between DVMRP routing tables and unicast routing tables, with the result that multicast traffic does not follow the routes that the organization prefers for connecting to particular network locations.



When many clients subscribe to multicast traffic, a dense-mode multicast routing protocol such as DVMRP works best.

PIM solves the routing discrepancy problem by using the unicast routing tables for multicasting. But, of course, it has its drawbacks. In particular, if there are specific routes that multicast traffic should or must take, it can be difficult to ensure that it will continue to take those routes as the unicast routing topology adjusts automatically to equipment or link failures. In today's networks, where only some of the routers are likely to be multicast-enabled, there usually are specific routes that multicast must take.

NASA addressed this problem partly by

moving the responsibility for the multicast network to the same groups that were managing the unicast network, Meylor explains. That shift made it much easier to insure that the unicast and multicast routing tables are congruent.

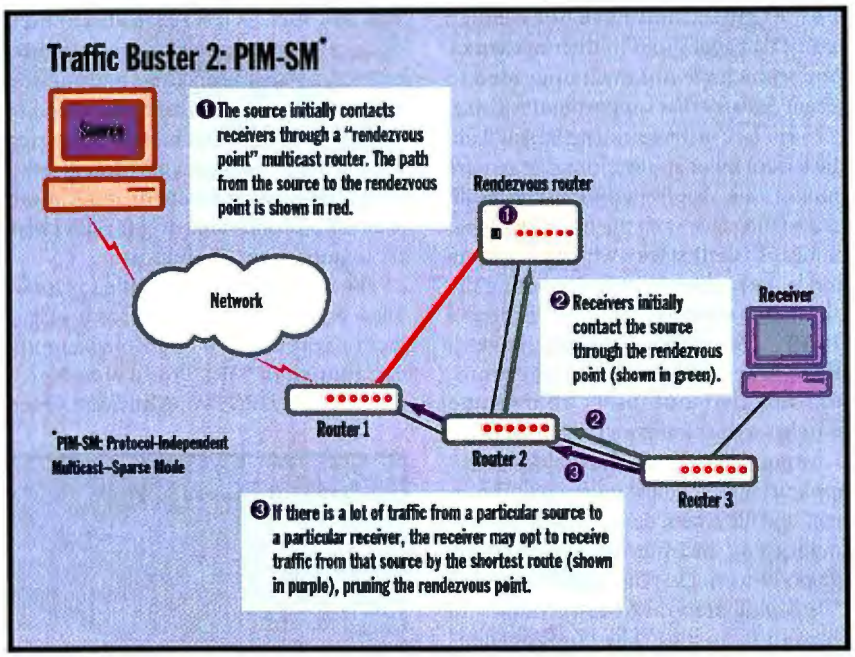
NASA also uses PIM in the Cisco-based portions of its network. The hardware usually has a decisive influence on the choice of multicast routing protocol, says Meylor. Cisco has focused on PIM, for instance, while Proteon is more oriented toward MOSPF. NASA tends to use the protocol that works best on the particular type of router.

Big ISPs and very large organizations also need to know how routers will react to steady, high volumes of multicast traffic. Unfortunately, little testing has been done in this area. There are some indications that routers may need hardware or software enhancements in order to be able to handle continuous high volumes of multicast traffic at backbone speeds, such as the OC-3 (155 Mbits per second) on MCI's backbone. That is a major reason that MCI is supporting only multicast tunneling, not native multicast, on its production network today.

"We're not comfortable with the level of maturity of IP Multicast code in Cisco routers," says Rob Hagens, MCI's director of Internet engineering. "We don't want to take any chances with running into multicast problems that could affect nonmulticast traffic."

On the MBONE, some Cisco routers managed by NASA have had performance problems when traffic has been very heavy, Meylor says. "The router code may be fine," surmises Meylor, "but the input buffer may be full. With streaming multicast, you may be more likely to get head-of-line blocking on switches and routers. It may be that the interface cards or switching mechanisms were not designed for that kind of traffic."

Another question of special interest to large users and ISPs is whether to use the multicasting native to asynchronous transfer mode (ATM) or IP Multicast over ATM. The former requires a gateway between the two multicast technologies. The latter introduces added overhead, although that may be minimized with technologies such as Ipsilon Network's IP switching or Cisco's tag switching. The jury is still out as to which approach is best, according to Meylor, who currently leans toward IP over ATM.



When most clients won't be subscribing to a multicast (e.g., the Internet), sparse-mode routing such as PIM-SM works best.

ISPs have also had business reasons for being ambivalent, at best, toward multicast capabilities: Multicasting tends to reduce traffic. Although many Internet connections are priced at a nominally flat rate, ISPs may have graduated services, which in effect allow them to charge more when there is more traffic. Thus less traffic could turn out to mean less income. Theoretically, ISPs could charge more for multicast connections. However, most are not set up with the traffic monitoring and accounting mechanisms to do that today. In addition, once in the ISP's network, multicast traffic can "explode" as it is routed to multiple receivers. ISPs currently have no way to track or bill for such explosions and might therefore tend to grossly undercharge for multicast traffic.

For customers who demanded multicast capabilities, some ISPs have implemented multicast tunneling. Tunneling is relatively quick and easy to implement and may be the best solution when both the number of customers using IP Multicast and the quantities of multicast traffic are limited. However, there are two major disadvantages to tunneling. First, it involves setting up and managing separate multicast servers or gateways. Native multicast, in contrast, is implemented and managed on routers, along with native IP. Thus all the work that vendors and organizations have put into streamlining and automating router management has to be either duplicated or, more likely, sacrificed for multicast traffic. Second, tunneling inserts the encapsulation process into the transmission chain, slowing things down and introducing scaling problems.

We're Working on It

Vendors are working on some of these problems now. For instance, IP Multicast support in routers and other equipment is being widely tested this year. MCI has RSVP and native IP Multicast running in the lab and hopes to have native IP Multicast deployed throughout its network by the end of the year. That schedule may be reasonable, according to NASA's Meylor, given that major router vendors have been working on multicast capabilities since at least late 1996. For the most part, he adds, IP Multicast is running fine on NASA's Cisco-based router network.

At least two companies are pushing reliable protocols for IP Multicast. StarBurst Multicast is based on the company's Multicast File Transfer Protocol (MFTP). As the name implies, the protocol is designed strictly for file transfer as opposed to real-time applications like videoconferencing. StarBurst Multicast is being used to distribute software, to transfer business-critical information such as inventory, parts, pricing, and account information, and to

prevent degradation in multimedia files.

In contrast, the Reliable Multicast Transport Protocol (RMTP) used by Lucent Technologies in its e-cast product can handle file transfer, real-time applications, and near-real-time applications. Whereas StarBurst Multicast involves one sender and multiple receivers, Lucent's e-cast is based on a single sender, an optional hierarchy of "designated receivers," and multiple ordinary receivers. The ordinary receivers are divided into domains, with receivers in each domain sending status packets (which combine the functions of acks and nacks) to the designated receiver in that domain. The designated receiver also performs retransmissions where necessary. Since the sender receives status packets only from the first tier of designated receivers, there is no ack implosion. If a designated receiver fails, receivers in that domain use the designated receiver one step closer to the sender in the hierarchy. RMTP is currently being used in the AT&T network, transferring billing records from toll switches.

Both StarBurst and Lucent are likely to offer their technologies as a basis for standardization efforts within the IETF. Because reliable protocols are implemented primarily on end stations, it could actually be useful to have multiple standards for different applications.

Other issues appear to be on the back burner. The firewall problem remains, for instance, and is a major reason why most organizations may implement IP Multicasting on their intranets but not try to exchange multicast traffic over the Internet. If organizations keep IP Multicast traffic behind the firewall, there is no requirement to pass UDP through the firewall.

IDMR is another area not being addressed currently. "Interdomain routing is really a research issue, at this point," says Henning Schulzrinne, an associate professor in the computer science department at Columbia University and one of the architects of the Real-Time Transport Protocol (RTP) used on the MBONE. There is not even a proposal for a standard, he adds.

The bottom line is that for most of 1997, the bulk of IP multicasting will be confined to satellite networks and bridged LAN environments. IP Multicast will see more deployment in routed intranets in 1998.

"The real wild card is when native IP Multicast will available on the Internet," observes Steve Collins, vice president of marketing and business development for StarBurst. "I'm not counting on seeing widespread deployment until 1999." According to Todd Dagres, a general partner with Battery Ventures (Wellesley, MA), a venture capital firm focusing on the communications and software industries, IP Multicast could take five years to reach critical mass on the Internet. B

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WHERE TO FIND

Intel
Santa Clara, CA
408-765-8080
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IP Multicast Initiative (Stardust Technologies)
Campbell, CA
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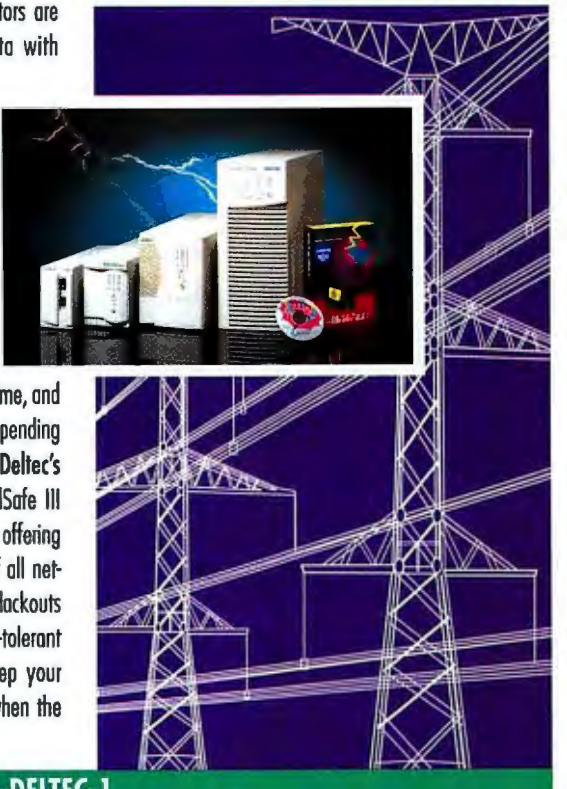

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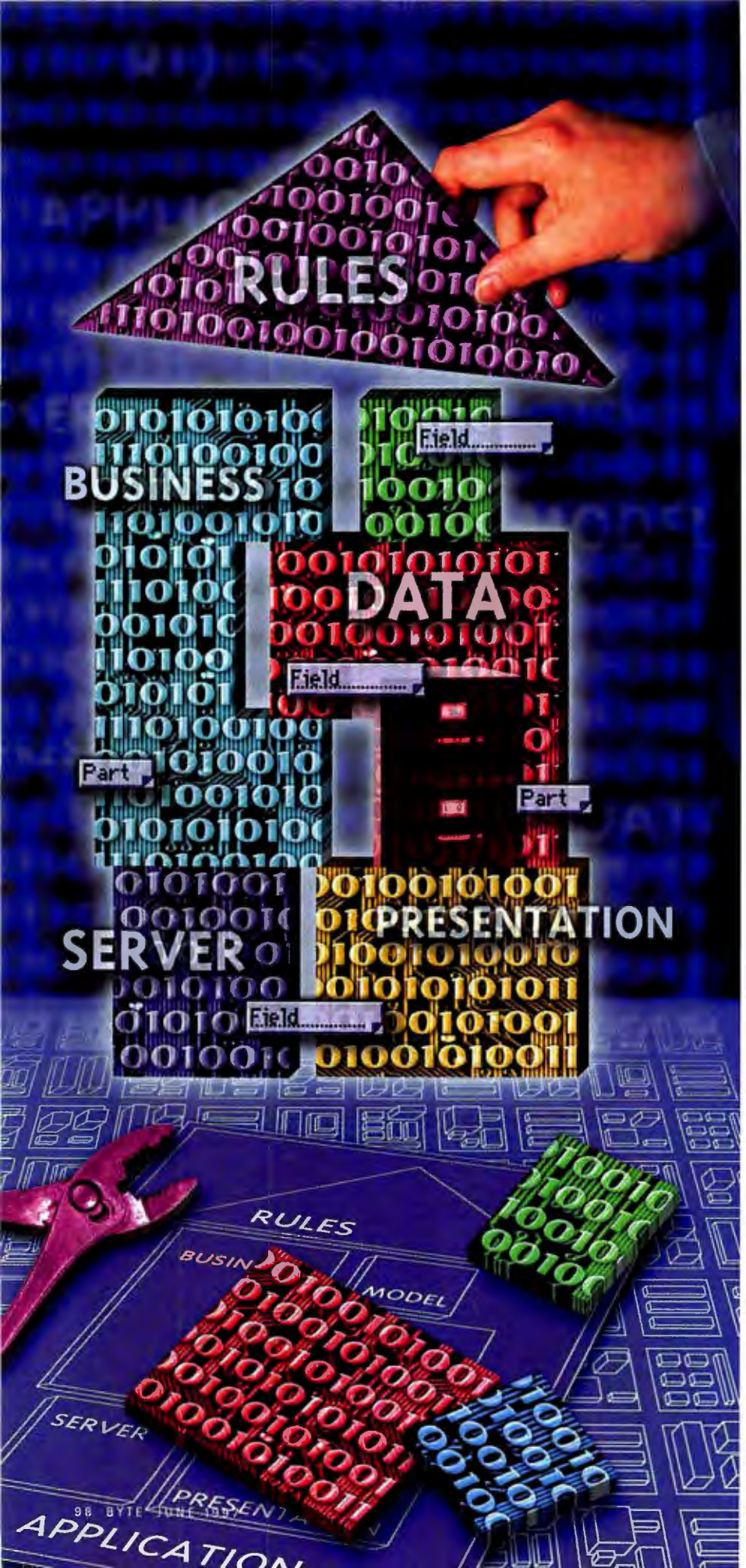

Remember all those COBOL applications that have been written over the past 20 years? You know, the ones that have been tweaked and patched a million times? The ones that are no longer intelligible? The ones that contain all the business rules for your company? Yeah, *those* COBOL applications.

Sometimes you can leave them alone and hope they do what they were intended to do. More often, corporate acquisitions and reengineering change the way companies do business, changing processes and practices at the same time.

These changing business rules must be clearly defined into systems so that they can be easily understood and changed as the business changes. There are two challenges to achieving this goal. First, you have to keep the capability to quickly access existing rules to insure that they are still relevant. Second, you must allow the professionals responsible for business planning to be able to incorporate their thinking into systems easily.

The problem is that we still use 3GL and 4GL development tools as the starting point for creating the complex logic that drives applications. The resulting code often ends up being more technology-focused than business-focused. A basic database application, for example, requires the developer to think in terms of querying database tables, executing joins, and manipulating database input and display fields instead of concentrating on business-related concepts, such as checking a customer's credit limit. Clearly, thinking in these terms has very little if any relationship to the actual business process the application is being designed to address.

A new breed of development tools promises some relief. These tools often aim to go directly from business rules to code. Unfortunately, they still have a way to go before you can put them directly into the hands of the business people.

What Are Business Rules?

A business rule is a simple statement that governs the validation, computation, and presentation of data. Developers using a business rules approach design applica-

PLAY BY THE RULES

Forget COBOL and database triggers. Business rules are moving to middle tiers and simpler languages.

By Michael Barnes and David Kelly

tions by creating a concise set of business-oriented rules that defines the business process and operating constraints of the organization. Business rules can be a good solution for separating and centralizing the data handling or logic specific to an application.

The business rules approach has the potential to be very valuable in environments of rapid change. Changes in business operations need only be reflected in the business rules, not throughout the entire application. Unlike procedural coding, an application developed using business rules will not necessarily need to be modified to accommodate changes to the underlying data structure.

Of course, easily making changes to an application requires that the business rules that form the application's foundation are logically separated from the application data and functionality. At the same time, these rules must be easy to access. The most common approach is to store the rules in a rules engine. This engine is the access layer through which developers and business professionals can view, modify, and manage the rules that govern their business processes and the applications that support them. As business rules and users' corresponding requirements change (and they always do), developers can simply change the business rules that form the basis for the application. The current alternative is to search for rules buried in stored procedures and database triggers within SQL statements.

There are two main ways to look at business rules. First is the data-centric approach, where business rules define the way that applications interact with data. The other is the business-centric approach, where business rules define the business policies and logic associated with an application.

The data-centric approach to implementing business rules is by far the most common today. This is the reason business rules are most often implemented as triggers and stored procedures within the database. For example, a standard business rule tied to a customer name field might require that before a customer is added, the customer information must also include a valid phone number. Any time a new customer is added to the database, this business rule is triggered and validates the data.

The data-centric approach can be implemented in one of four main ways:

Database-driven: Business rules are stored as procedures or triggers in a SQL database. This approach is highly focused on specific data fields or tables. Any development tool that can interface to stored procedures or triggers (but not necessarily create or manage them) could potentially be called a business rules development tool. Using this definition, products like Oracle's Developer/2000 or Powersoft's PowerBuilder could be business rules-based products.

Database-independent: Business rules are stored procedures or triggers in a database, but they are generated and managed by the development tool. This approach effectively moves the creation and management of data-centered business rules up one level to an application development tool rather than a database-specific tool. A good example of this type of product is Vision Software's VisionBuilder, which automatically generates the appropriate stored procedures and triggers that reside in the target database.

Client-based: Business rules can also be encapsulated at the client, although few vendors market this as a differentiator. In this case, the logic associated with database interactions is coded into the client side of an application, and stored procedures or triggers would not generally be used. Most two-tier client/server

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tools take this approach. However, typically in these situations, the data and the business logic are wrapped up into the application logic, leaving no clean separation between the two.

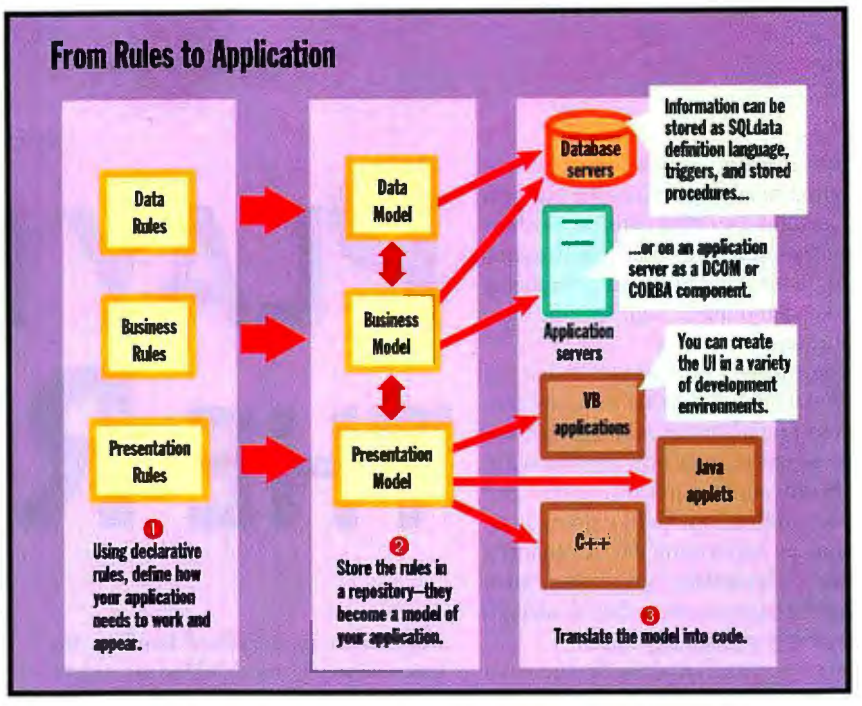
Server-based: Some second-generation development tools have used this definition when talking about business rules. In this scenario, business rules created in a development tool become middle-tier application services that reside on an application server. Client-side applications invoke objects, methods, or functions on the server that contains business rules. Thus the main application and data-related logic reside on the application server and not the database itself. Examples of products associated with this type of approach include Forte's Advanced Application Development Environment and USoft's Developer.

The business-centric approach is usually implemented in a logic-oriented way. Instead of specifying constraints on specific data elements or tables, a logic-oriented approach captures the higher-level business logic and rules associated with different situations. At run time these rules are then used to generate appropriate responses and actions for specific situations. This approach is a business-oriented application of expert systems technology. Neuron Data's Elements Environment is the embodiment of this type of business rules approach.

Where IT Fits In

All organizations are facing stiffer competition and time-to-market pressures. Increased investment in information technology is one of the most popular methods for dealing with these pressures. Most organizations have come to realize that IT advantages can easily translate into business advantages like improved productivity, communication, and efficiency. Business applications are therefore more often being looked at by the business people they are designed for. So what's the problem?

If the IT department is to be a critical part of the business management team, the business practices and processes at the heart of the organization must also be the core of its applications and systems. These processes are therefore being coded into the applications during development. Then what? Are you as a business manager comfortable running your operation on autopilot? How do you know what business constraints and policies form the heart of your applications? More important, how do you know the ones being used are still valid?



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A business rules approach is a good way to foster a more business-focused mentality within the application development life cycle rather than an adherence to strictly data-driven concepts. Applications, the theory goes, can be developed around the basic needs of an organization, not the constraints of the methodology being used. While this theory is definitely valid in many circumstances, there are two other values to business rules. First, they increase the ease with which users can specify and later modify their business requirements to developers. Second, they give developers the ability to make changes to an application as these business requirements change.

Companies should consider a business rules approach to application development for projects in which business logic plays a key role—for example, when multiple applications need to access common data or when continued application changes will be driven by changes in the underlying data. It is also appropriate for organizations involved in a data warehousing or business process reengineering effort. Basically, rules are most valuable anywhere there is a high demand for a proper understanding and exploitation of corporate data.

No Rules

While a business rules approach can be used in a variety of situations, it may not be applicable to all development needs. For example, decision support applications and executive information systems would not be ideal candidates since they are not ordinarily update-intensive. In addition, organizations that are comfortable building desktop-oriented applications in rapid application development (RAD) environments such as Visual Basic or PowerBuilder, or that have experience developing small applications using low-end tools like Access, may find it easier to continue creating small applications using these tools.

A business rules approach is very difficult (but perhaps extremely beneficial) when an organization has a poorly defined business process. A rules-based approach provides a methodology for describing business processes in an unambiguous form so they can be automated. While all organizations theoretically have a set of business rules that define their business processes, a great many do not have any formalized understanding or

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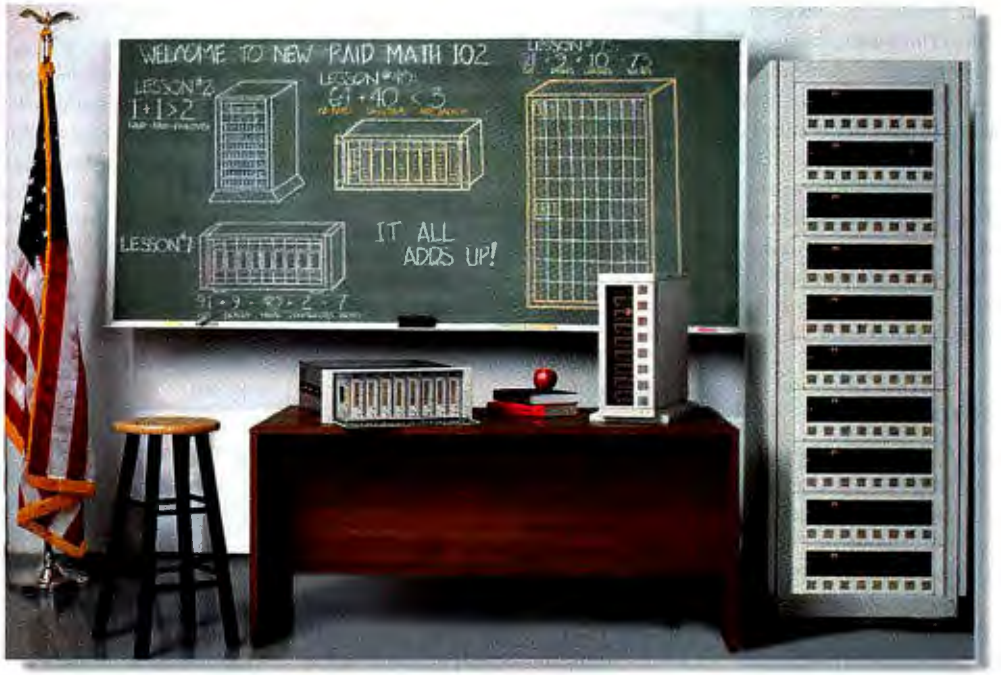

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*Compared to Clariion® Series 100 Disk Array (1350 IOPS) and Digital StorageWorks RAID Array 310 (3000 IOPS) controllers at the desktop level.

Lesson #7 *Capacity That Passes All The Tests!*

In only 7" (4u EIA) you can pack in 82 GB of disk capacity and still have room for dual hot-swappable failover controllers. This densely packaged, extremely powerful RAID configuration is ideal for environments where space is at a premium.

Lesson #40 *High Scores in Backup.*

Pop Quiz: How are you going to backup your RAID? You'll score high with LynxArray because of its ability to support inline DLT or hot-swap tape devices, making RAID and backup in the same enclosure a viable choice.

Lesson #70 *Graduate To The Next Level!*

Graduating to the next level of RAID systems is almost impossible with other entry-level RAID solutions due to the number of confusing choices in controllers and enclosures. LynxArray gives you true scalability. From a few gigabytes to multi-terabyte RAID systems, each component can be used toward your system's move to the next grade.

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representative model for this process. Defining effective business rules when the business process itself is vague could prove impossible.

Another possible negative consequence for a development team working with a poorly defined business process is losing focus and turning application development using business rules into a business process reengineering effort. A business rules approach is descriptive and focuses on the automation of specific business practices currently in place. Business process reengineering is prescriptive and analyzes whether a company's overall business operations are correct. This distinction is very important and must be clear to both the developers and the business professionals involved in a development effort.

Rules as Components

Competition and time-to-market pressures are not going to ease up any time soon. In addition, the Internet has fundamentally changed the application development process by greatly simplifying application deployment and opening up development to more people such as Webmasters. As a result, development cycles are getting shorter, and managing change within applications is more critical than ever.

Component-based development is becoming increasingly popular as a way not only to create flexible, mission-critical applications but also to increase the productivity of the development process through code reuse. Business rules will make up only one type of component. Other components will be made up of application functionality, data, or resources that are encapsulated. However, from an overall operations perspective, business rules components could end up being your most important asset.

The rise of the Internet and the Hyper-Tier computing model means greater access by more people to more data from more sources. To remain competitive, firms must increasingly look to enabling unified access to data and applications from many disparate and formerly unconnected sources. This means developers must focus on flexible, scalable applications with a large amount of distributed processing. At the same time, organizations need to be more aware of providing consistent definitions of elements and greatly increased use of metadata.

The beauty of using business rules is that business professionals can write the rules that govern their business processes in the natural language they are comfortable with. Developers then build the application around these rules while retaining the actual rules as the application's foundation. In effect, the rules are the common language between developers and the business community. The alternative is for users to define their requirements and then pray that the developer clearly understands them and, more important, accurately creates the application around them. Without business rules, there is no clear, traceable, and bidirectional path from requirements to code.

Unfortunately, we are still not close to defining business rules to the level of abstraction that would really make this scenario possible. The application modeling and development tools that currently support business rules do not provide an intuitive path from defining rules in plain English to generating application code. Once business rules are articulated by users, developers must still define these rules within the application. The benefits of business rules disappear if they are not easily understood by IS professionals and the business community. The widespread use of business rules within application development will occur only when tools increase the level of abstraction for defining rules and have improved support for the translation of rules into code. B

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So You Want to Use Business Rules...

Modeling the behavior of complex systems is not an easy task. While vendors have made the process easier, defining business rules and translating them into an actual application is not yet easy enough or intuitive enough to gain widespread acceptance. As with any opportunity involving a potentially large amount of profit, however, this problem will be solved. With that in mind, here are some vendors that offer software with strong support for business rules:

Compendium Research: *Universal Transaction Exchange Engine* (UTX) is a transaction-processing engine for building data warehouse and vertical market solutions. Rules can be configured, developed, and managed by business personnel instead of by developers.

Neuron Data: *Elements Environment* is a cross-platform C++ development tool that includes the Intelligent Rules Element, which enables you to model rules separate from application logic.

Riverton Software: An object-oriented application development tool for modeling and generating PowerBuilder applications, *How* supports the inclusion of business rules within objects.

Sapiens: *ObjectPool* is an object-oriented development environment that supports the creation of business rules within objects and integration with legacy applications.

Texas Instruments Software: *Performer* is a component-based development environment with support for creating and managing business rules within a repository.

USoft: *USoft Developer* is a graphical environment with a focus on business rules as an integral part of the development process. It supports the creation of business rules in standard SQL.

Vision Software: *Vision Builder* is a development environment that supports the creation of business rules from a visual interface. It automatically generates SQL code for inclusion within a relational database.

A Career in Data Modeling

Taking up-front time to organize a database model can save time during applications development.

By J. L. Weldon

Some people are planners; others are executors. The mad rush to get applications into the hands of users has been a boon to executors. But the challenges of integrating data from a variety of sources into a consistent data warehouse has caused many development teams to reassess the value of one form of planning—data modeling—as a precursor to database design.

From the beginning, data modeling has been somewhat controversial. In the 1970s, there was a brief push toward developing an "enterprise data model." But this idea has largely been abandoned, leaving many large, expensive, and uncompleted projects in its wake. CASE tools promised automated development of an application from its model. Again, reality has failed to deliver on the promise. Consequently, many developers view data-administration and information-resource groups (which usually do the modeling) as obstacles to rapid development. Some think that these groups stand between the developers and application delivery, placing unnecessary constraints on developers' designs.

In other cases, however, firms have seen the value of having database models serve as a common framework within which new applications can be designed and older applications integrated. For instance, the reusability of good models has proved itself to be a valuable asset, rather than a hindrance, to rapid application development (RAD). Models have also proved useful to organizations trying to integrate many heterogeneous systems developed over time by designers and developers who may be long gone from the corporate environment.

What do you need to know to be able to use database modeling in your company? To illustrate the issues and complexities of—as well as the potential gains from—good database models, I'll first explain the fundamentals.

What Is Data Modeling?

A *model* is an abstract representation of a real object or environment. *Data modeling* is the practice of designing a database using a series of related models. The process works something like this: First, you develop a high-level, conceptual model of the business process or activity you're going to support. Next, use this conceptual model to derive a logical data model that captures more detail, but in an implementation-independent way. Finally, transform the logical data into a physical data model, or *schema*, that provides the details of the database's implementation in a particular DBMS (see the figure "From Muddle to Model" on page 104).

The first step is, in many ways, the most time-consuming. You begin by collecting data and reviewing business procedures and practices to ascertain the business requirements of the application. These requirements lead to the identification and definition of entities and relationships essential to the business activities being represented. For example, in a university's registration application, the entities might include STUDENT, TEACHER, and CLASS, and the relationships might include STUDENT "is registered for" CLASS, TEACHER "is assigned to teach" CLASS, and CLASS "is composed of" STUDENTs.

In the conceptual model, you should figure out how you're going to distinguish instances of each entity type. For example, you determine the attribute, or group of attributes, necessary to uniquely identify a particular STUDENT. The university might issue a unique STUDENT ID NUMBER or use the student NAME

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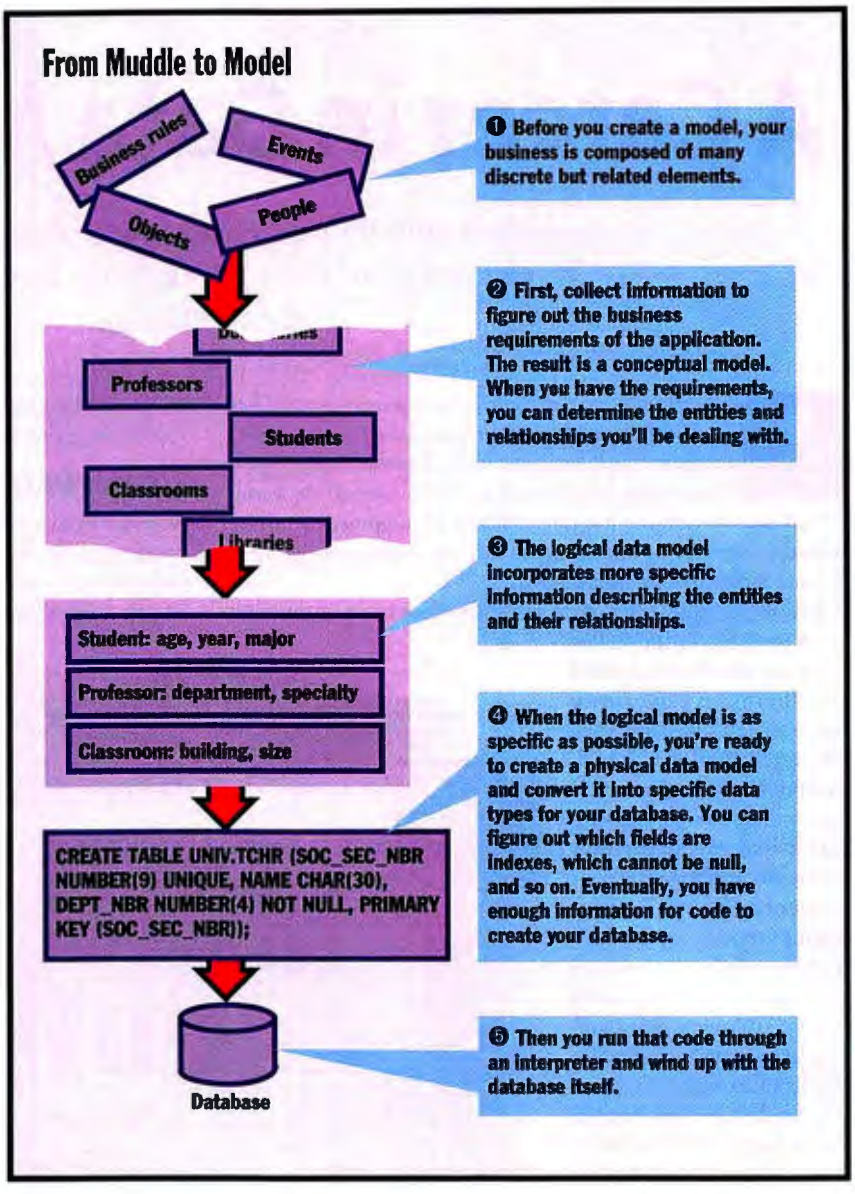
and DATE OF BIRTH instead. Similarly, you figure out how to distinguish relationships—whether they're one-to-one (e.g., one LAB DESK for each STUDENT and vice versa) or one-to-many (e.g., one CLASS containing many STUDENTs). By determining these attributes and relationships, you ensure that the model accurately reflects reality.

You transform a conceptual model into a logical data model by capturing specific data about the descriptive attributes of each entity and more details about the relationships. For example, a STUDENT might be represented by his or her NAME, GENDER, and AGE, but not necessarily by eye color or blood type. As you select attributes, you capture their definitions as well as information on the domain of values on which the attributes are based. For example, GENDER might take its values from the domain {Male, Female}, and the domain for AGE might be {any integer greater than 0 and less than 120}.

Similarly, the description of a relationship can be made more informative if you associate *cardinality* data with it. For example, a STUDENT might be registered for up to five CLASSes, yielding a one-to-five cardinality for the "is registered for" relationship. Furthermore, the relationship can be described as optional or mandatory (i.e., must each STUDENT register for at least one CLASS, or may some STUDENTs not be registered for any?).

As a model becomes more specific, you might be able to divide some entities into subtypes—TEACHER might be either a PROFESSOR or a TEACHING ASSISTANT, for example. Also, some entities might be roles rather than actual entities, so a STUDENT might also act in the role of TEACHING ASSISTANT. In such a case, the attributes of TEACHING ASSISTANT include those of the STUDENT as well as others specific to the role, such as START DATE for the teaching assignment.

Once it's at its most specific state, you convert the data model from a logical representation to a description of the physical database. This process converts logical domains for attributes to the specific types of data that a DBMS can handle. It includes *volumetrics* (i.e., counts of expected entity instances and lengths for text-string fields) to determine size and space allocations; it also identifies attributes to be used for indexes and adds constraints, such as which fields can or cannot be null. This process continues until you've assembled enough information to create the database-description-language (DDL) statements to create the actual tables (see the figure "Backward and Forward" on page 105).



The data-modeling process helps you analyze what your company does and your application needs.

Why Model?

Now you know what modeling is. But why do it? You hear this most often from applications developers and others who are anxious to get on with the implementation of a database or business system and are impatient with the time spent developing and refining a data model.

From a logical perspective, you model to increase your understanding of the business problem and to identify the basic components on which the solution will be built. A good model lets you develop a database that's flexible and supports new features as they become necessary.

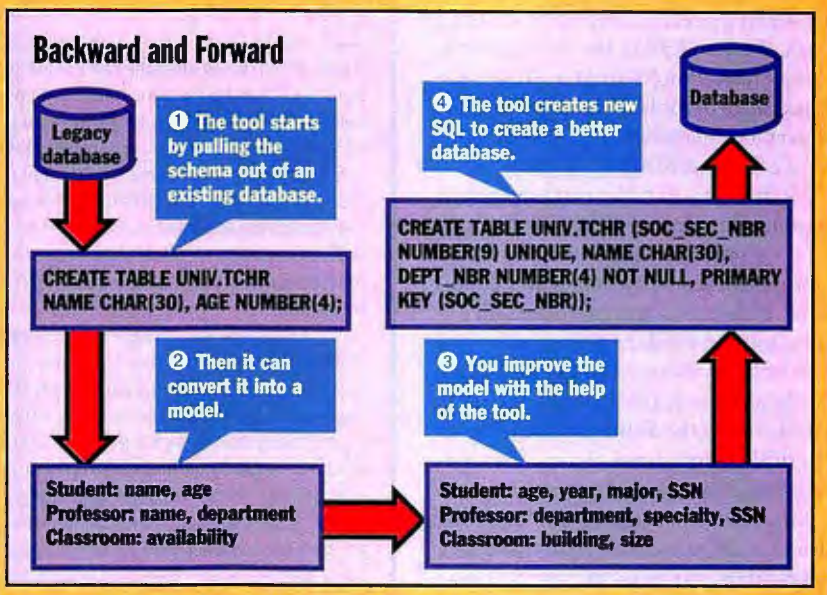
Furthermore, these components are reusable. A flexible, reusable design promotes stability, and there's no need to revise the database as new applications are added. Finally, a database built from a model that accurately depicts the business is sharable across business functions, unlike one that's built for a specific function. It has been said that if people had always used proper modeling in the past, the need for data warehousing (i.e., integration of

Reverse Engineering

So, you think that models might provide some useful insights and lead to better-designed databases. But what if you're faced with legacy databases created over time by different development teams for different applications, and no models exist? Most modeling tools provide just what's needed to atone for these past sins: reverse engineering.

When you reverse-engineer a database, the modeling tool inputs schema descriptions from a relational DBMS and produces a model for the database. It does this by creating an entity for each table and creating relationships by using the connections shown by keys that appear in multiple tables. You can then use the model to clarify the semantics in the database that guide you to modifications or integrate this database with another (see the figure "Backward and Forward" at right). Reverse engineering also allows you to compare two different databases by creating a model for each and comparing them—or, in a development environment, to compare two versions of the same database to identify differences, additions, and deletions.

Some tools support a dynamic connection between the physical database and a model representation (e.g., ERWin's Server FRE [for Forward-and-Reverse Engineering]). The model becomes a live representation used to monitor the physical database. You can then use the model to implement changes (forward) or to observe them (reverse). This provides a database administrator with an easy way to manage and control the database. Using graphical representations of tables and the relationships among them (rather than database-description-language [DDL] code) simplifies the task of maintaining the database.



Here's how a database-modeling tool might reverse-engineer a database.

data from multiple functional applications) would never have come about.

Disciplines of data modeling, such as abstraction, generalization, and normalization, force you to explicitly evaluate design decisions that are made when moving from the abstract, logical representation to the physical database. Without such a model, developers are prone to build physical designs that incorporate existing, though not necessarily fundamental, data relationships. For example, a data record representing the university-registration relationship might be designed to include five fields for CLASS information (based on the fact that students may not register for more than five classes). But over time, such a rule is likely to change (say, to a maximum of six), and in either case the database must be changed.

From a physical-design perspective, data models are a vehicle for capturing and maintaining *metadata*—data about the data—such as business definitions, domain information, value lists, and edit criteria. Data models can translate relationships between entities into key-based associations between tables that allow a database to automatically enforce referential integrity (e.g., not allowing a CLASS to exist without STUDENTs). Physical data models also allow organizations to apply standards (e.g., standard data names and domain definitions), thus promoting consistency across applications. Physical models can also be used to automate certain detailed and time-consuming database-administration tasks, such as volumetric calculations and DDL generation, thus freeing an administrator to spend more time on performance and tuning issues.

Models have been found to be so valuable that many organizations have been developing them in reverse from existing databases that were originally built without the use of explicit design models. For more information, see the text box "Reverse Engineering" above.

You, Too, Can Model

Database modeling requires expertise in business-requirements analysis. To successfully build a model, you must interview business representatives, review processes and documentation, and make the model reflect your understanding of the environment. You review initial models with business experts and other analysts and then refine them. While much has been written about this process, it remains more in the realm of art than of science. In general, a good modeler is like a good reporter, continually asking, "What? Why? How? Where? When?"

Some notational systems exist that can help you develop and record data models. Bachman, Chen, Martin, and other data-modeling gurus each have their own methodology and notation. Each system has its own way of representing the essential aspects of the model (e.g., entities, relationships, cardinality, optionality, subtypes, and domains). While all you need to produce these diagrams is paper and a pencil, most modelers opt for a modeling tool, frequently referred to as a CASE tool.

Modeling tools have evolved from text-based mainframe tools to graphically oriented PC-based and client/server workgroup tools that interface with a variety of DBMSes. The advent of object-oriented systems and databases has also led to new and extended forms of modeling (see the text box "Object Modeling vs. ER

Modeling" at right). These methods support user-oriented semantic modeling and object-oriented analysis and design methodologies. Most modeling tools in use today are entity-relationship (ER) tools (e.g., Logic Works' ERWin). But the interest in object orientation (OO) has resulted in the appearance of tools designed to support object modeling as well (e.g., Rational Software's Rational Rose).

Modeling tools make extensive use of graphical interfaces and visual editing to produce model diagrams. Pop-up forms capture the necessary names and definitions. Definitions produce a data dictionary. You can produce reports to review with business users to validate and refine the definitions. If a tool can produce DDL automatically, the dictionary also includes physical design characteristics, such as volumes, domains, and indexes.

Most tools that support ER modeling also provide rule-checking to make sure the models produced are valid. These tools check for violations to the rules of normalization and flag the absence of primary keys or the inappropriate use of foreign keys. Since an analyst develops the model interactively, this feedback allows him or her to catch errors at once rather than their being perpetuated into lower-level models.

One continuing problem that modelers face is communication with business users. The notational systems used by most modeling methodologies are more technical than intuitive, and many business users are uncomfortable with reviewing any model that's more complicated than the most abstract conceptual model. Recently a tool called InfoModeler, which is based on the Object Role Modeling (ORM) methodology espoused by G. M. Nijssen and Terry Halpin, has gained attention due to its fact-based approach.

In this approach, you gather statements in English (or any other language you choose) about an application or a business. A step-by-step process then groups the facts into fact types, checks for uniqueness, and eliminates any unnecessary types. A modeler assembles a complete model, which can be either diagrammatic or textual, by adding constraints and validating the model against the original set of facts. The existence of the corroborating facts, even with a model diagram, can improve communication with business reviewers.

Object Modeling vs. ER Modeling

Early approaches to data modeling were designed to simplify the construction of relational databases. Thus, these methods focused on representing entities and relationships, which would ultimately be implemented by tables in a relational database. The attributes of each entity became columns in a table, and the relationships between entities became either foreign keys (with one table pointing to another) or intersection tables (containing the keys of two or more related tables).

Object-oriented analysis and design takes a process-oriented approach rather than a data-oriented one. You define objects by their behaviors (based on use–cases are documented during analysis), and the relationships among objects represent interactions, generally described as requests for service from one object to another. The information required to represent an object is defined as part of that object and is available to other objects only by request.

The limitation of each approach is exactly the strength of the other. Entity-relationship (ER) modeling lacks any sense of process, so such models must be augmented by process models, create/retrieve/update/delete (CRUD) matrices, and other design templates that capture the characteristics of the activity or business process that the database must support. Object models lack a direct connection to database schemata, so they provide little guidance regarding the physical construction of a database.

Kroenke's Semantic Object Modeling system uses an object approach at the conceptual level, representing semantic objects that can be described by a combination of data- and action-oriented attributes. Kroenke's goal is to develop tools that can "compute" the database schemata and even the application (i.e., entry and retrieval forms and the transition from one type of object to another) from a user's description of the semantic objects involved. Emphasis on semantics rather than on tables puts design decisions into the hands of business analysts and users rather than programmers. This makes the resulting applications and databases easier to understand and change.

Plan, Then Execute

Modeling a database as a part of the development process can be compared to developing a blueprint before constructing a building. A good model captures business essentials and focuses on the broad perspective rather than a narrow one. Good modelers separate those relationships and dependencies that result from current practice from those that are fundamental and unchanging. A sound data model leads to a database that is sharable, reusable, and flexible and that accurately reflects the business it supports. B

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What's New with RAD?

The advances in the latest versions of the top 4GLs.

By David S. Linthicum

Life speeds up. So does application development. To keep pace, you long ago started using a rapid application development (RAD) tool. Maybe you chose Microsoft's Visual Basic or Powersoft's PowerBuilder. Or maybe it was Oracle's Developer/2000 or Borland's Delphi. You've become proficient with it.

But things have changed. Microsoft just released the final beta of Visual Basic 5.0. Borland is preparing Delphi 3.0. Powersoft is working on a new release of PowerBuilder, and Oracle is preparing Developer/2000 version 2.0. Now it's time to ask if you're still using the best tool or if you're missing a crucial upgrade.

So what's the big picture? There are three big trends to watch for: multitier development capabilities, Web-enabled features, and the capability to generate ActiveX controls.

Traditionally, client/server tools including PowerBuilder, Delphi, and Visual Basic have supported only two tiers: client and server. The problems with two-tier client/server development are the architectures' inability to scale to enterprise-class applications and to separate the business logic from the data and the interface.

Three-tier and multitier (sometimes called *n-tier*) client/server development tools allow the programmer to split an application across several application servers. All the tools covered here support multitier computing and application partitioning, but they do so in very different ways. In addition to application partitioning, most client/server tools support Web development for Internet and intranet programming.

PowerBuilder, Delphi, and Visual Basic support ActiveX development, but Visual Basic provides the best support for ActiveX. PowerBuilder provides server-side development capabilities, including support for proprietary server-side APIs such as Netscape server API (NSAPI) and Microsoft's Internet Server API (ISAPI). Delphi supports ActiveX but is really pushing its users to JBuilder for Web development using Java.

Powersoft PowerBuilder

PowerBuilder is one of the most popular client/server development tools. It led the way for Visual Basic and Delphi. PowerBuilder is multiplatform, supporting Mac, OS/2, and Unix, but Windows NT and Windows 95 are its largest installed base.

PowerBuilder promotes data-driven development. The programmer first defines the metadata in PowerBuilder's Extended Attribute Set, then constructs the application on top of the metadata, building data windows and augmenting their behavior with code (PowerScript). With the 5.0 release, Powersoft is providing a true compiler with better application-execution performance. Also to improve performance, PowerBuilder supports both the Win16 and the Win32 API sets for Windows 3.1 and Windows 95, respectively. Plus, it provides a 32-bit ODBC interface supporting clustered indexes and a number of connection objects. Building on the existing object-oriented development model, PowerBuilder 5.0 now supports function overloading, allowing the developer to create functions that are dependent upon the objects supplied to it. ObjectCycle, PowerBuilder's new team-oriented development tool, provides a server-based object management facility, which permits versioning, reporting functions, and labeling. PowerBuilder is also enabled with Component Object Model (COM) technology, allowing developers to create both ActiveX and COM servers.

continued

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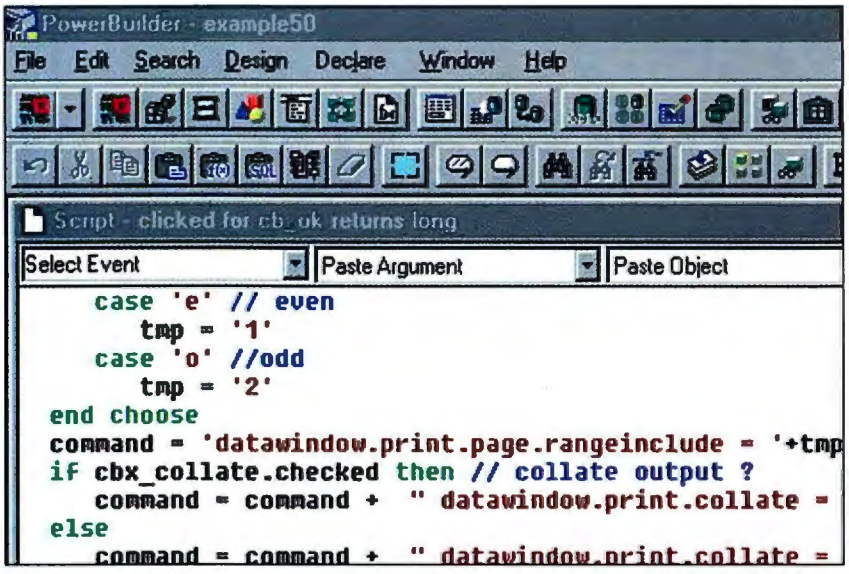
With 5.0, PowerBuilder can spread the processing load by placing nonvisual objects (objects that don't interact with the user) on remote servers. Such application partitioning allows developers to produce applications that can conceivably scale to larger user loads than traditional two-tier client/server computing by placing some of the application processing on a remote server. Powersoft calls this feature Distributed PowerBuilder (DP).

Although the architecture is compelling, people are finding DP difficult to configure. Other drawbacks are that it lacks heterogeneous server support and does not provide the scalability of other architectures using proven three-tier technology such as transaction processing monitors. Most PowerBuilder developers consider DP a good start, but PowerBuilder's ability to support COM could be the best way to partition PowerBuilder applications in the end.



With PowerBuilder 5.0, you get a true compiler with improved application-execution performance.

Borland Delphi

Delphi 2.0's component-based development paradigm provides developers with the best of object-oriented and component development. Building a Delphi application is a mere matter of building the interface and adding behavior by defining the properties using a properties window or through Object Pascal (Delphi's native programming language).

Delphi provides an application framework, the Visual Component Library (VCL), that the developer uses as a base for the application. Building the application is just a matter of understanding this framework and finding the components that provide the best starting point for your application. For example, VCL provides user interface objects for viewing and changing data, as well as list boxes, combo boxes, and menus. Delphi is able to use native Delphi components or ActiveX components. You can take the components as they are or extend their capability using traditional OO techniques. Delphi is COM-ready, able to create applications as COM servers or containers.

Delphi 3.0, now in early beta, drives deeper than the current version into the world of complex client/server programming. It will support multitiered, thin client, client/server computing using Delphi's traditional component-based architecture as well as Microsoft's Distributed COM (DCOM). This new Delphi will also provide developers with application-partitioning capabilities through small executable files and DLLs that can be shared in a distributed application processing environment.

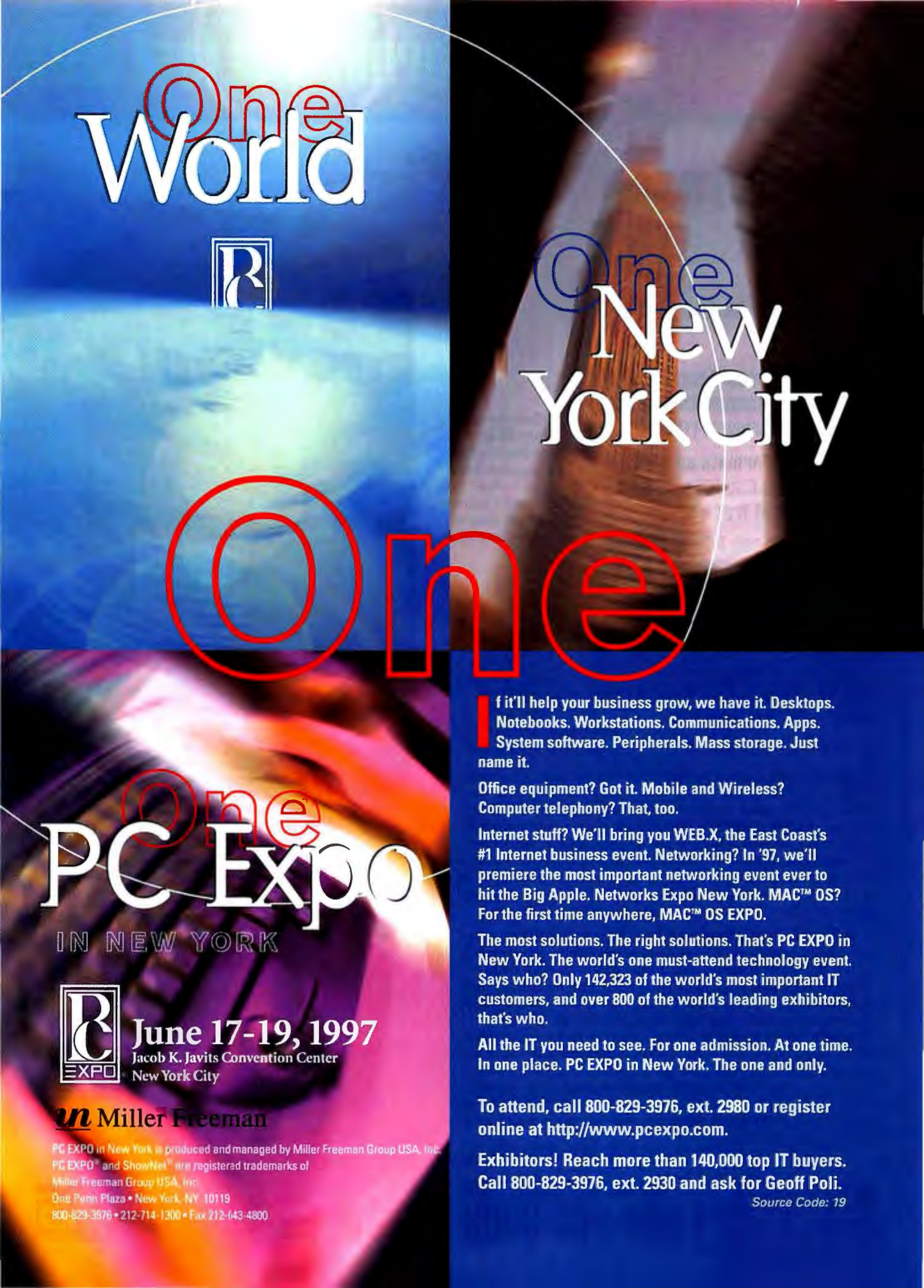
Borland is producing two other tools that look a lot like Delphi: JBuilder, for rapid Java applet and application development, and C++ Builder, for rapid C++ application development. Both of these tools are due this year.

Visual Basic 5.0

With Visual Basic, developers create applications by dragging and dropping ActiveX

4GL Tools Features

	Native Web Support	COM Support	Component Support	DBMS Connections	Native n-Tier Support	Deployment	Repository Support	Platform Support
PowerBuilder 5.0	ActiveX NSAPI ISAPI	Yes (client and server)	ActiveX	ODBC Native Proprietary ORBs	DCOM	Native 32-bit compiler	Extended Attribute Set	• Windows • Mac • Unix • OS/2
Visual Basic 5.0	ActiveX	Yes (client and server)	ActiveX	ODBC	DCOM	Native 32-bit compiler	Microsoft Repository	• Windows
Delphi 2.0	ActiveX	Yes (client and server)	ActiveX Proprietary	ODBC Native	DCOM	Native 32-bit compiler	None	• Windows
Developer/2000	CGI	Yes (client and server)	ActiveX	ODBC Native	Proprietary using Oracle DBMS	Interpreter	Oracle Repository (shared with Designer/2000)	• Windows • Mac • Unix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Web Project

Java Servlets

Servlets, the Java equivalent of CGI applications, can deliver on many of Java's promises while dodging some of its worst limitations.

For many months I wondered when and how Java would first appear on The BYTE Site. I was determined not to use Java in a gratuitous way; the Web certainly doesn't need any more scrolling marquees. Java would have to earn its keep by solving real problems. What broke the logjam was the alpha release of JavaSoft's Jeeves (http://jeeves.javasoft.com/) (aka JavaSoft's Java Web Server), which can run Java extensions called servlets.

Like CGI programs, servlets are easy to write and easy to run, and they play to the entire installed base of browsers. Servlets can do things applets can't—write to files, open sockets—and they can do them very quickly because they're invoked as threads in a demon process.

The truth is that I still haven't found a compelling reason to send Java applets over the wire to your browser. HTML assisted by JavaScript can handle a remarkably wide range of user-interface and data-collection chores—not as prettily as Java, I'll grant, but a lot more efficiently. Client-side Java will really flower on next-generation computers and networks. But server-side Java is ready for prime time now.

My First Servlet: A URL Redirector

Way back in my February 1996 column, I showed how to track the use of individual links on a Web page. I'm still using that mechanism—a Perl script that logs data and then returns a "Location:" header—but I've grown increasingly aware of its shortcomings. Mostly it's just too slow.

In part that's because I've been unable to get the ISAPI version of NT Perl to cooperate with the O'Reilly WebSite server that handles most of our site's CGI work.

URL Redirection in Perl and Java

A Perl redirector, invoked as http://www.byte.com/cgi-bin/goto.pl?http://elsewhere.com.

```
require 'cgi-lib.pl'
open(LOG,">>goto.log");
print LOG "$ARGV[0]~$ENV{HTTP_REMOTE_ADDR}\n";
print "Location: $ARGV[0]\n";
```

Here's a classic CGI script. It logs the user's IP address and redirects the user to another Web page. You can write this in just four lines of Perl. But it's computationally expensive to run the script.

A Java redirector, invoked as http://www.byte.com:8080/gotoUrl?http://elsewhere.com.

```
import java.io.*;
import java.util.*;
import javax.servlet.*;
import javax.servlet.http.*;
public class gotoUrl extends HttpServlet {
 public void service(HttpServletRequest
   req, HttpServletResponse res)
  throws ServletException, IOException
 {
 DataOutputStream log = new DataOutputStream
   (new FileOutputStream("goto.log",true));
 log.writeChars(req.getQueryString() + "~" +
   req.getRemoteAddr() + "\n");
 log.close();
 res.sendRedirect(req.getQueryString());
 }
}
```

Here's the same logic in Java. Thanks to the servlet API, it's only a bit more complex than the four-line Perl script. And it's far more efficient because the servlet runs as a thread dispatched by a Java Web server.

But even when ISAPI Perl works, it's still not a panacea. "In-process Perl doesn't deliver the speedup you'd expect," observes Bob Denny, WebSite's creator, "because all that OLE crap has to get initialized every time."

Perl just isn't a good way to implement lightweight services. And it's terrible on NT, which lacks the fork mechanism that Unix-based Perl servers rely on for a kind of poor man's multithreading. A classic Unix socket server forks copies of itself to handle incoming requests, so the parent process can remain responsive to new requests. Perl can't do this on NT.

Unix partisans like to blame "brain-dead" NT for this. But there's another side to the story. Unix-style process-cloning is not a substitute for real lightweight multithreading, which is built into NT. Unfortunately, Perl isn't multithreaded and can't take full advantage of NT (or other threaded OSes).

Java, on the other hand, is an almost ideal way to build lightweight services. Given a Java-oriented Web server, you can create lightweight Web services, or *servlets*, that are automatically threaded and extremely responsive. And thanks to the Java frameworks that support serv-

PHOTOGRAPH: KELLIE WALSH © 1997

lets, they needn't be much more complicated than their Perl counterparts (see the listing "URL Redirection in Perl and Java" on page 115). The day I wrote my first servlet it went into production, and it has now been used by thousands of visitors to The BYTE Site.

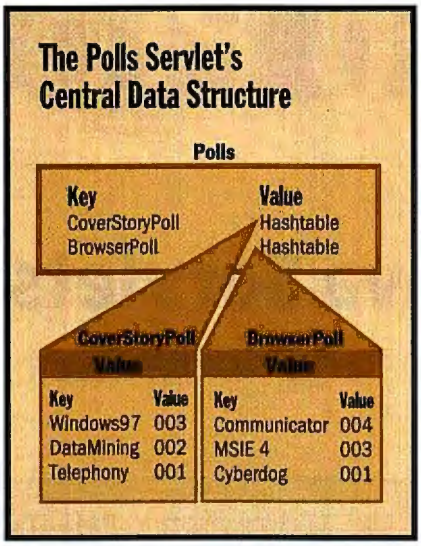
Our site's inaugural Java deployment doesn't do anything flashy. It just streamlines some basic accounting tasks. If you've used that servlet, you almost certainly did not realize you were tapping a Java-based service. That's precisely why I say that Java is now ready for real server-side work.

Deploying Servlets

For its first few weeks, my Java redirector ran as a Jeeves servlet. Now in beta, Jeeves is a full-blown Web server that supports user/group access controls, Secure Sockets Layer (SSL), and proxying, and it can also run servlets. To run Jeeves, you fire up the Java interpreter and load the Jeeves classes. The Web server appears on port 8080.

An administrative server simultaneously appears on port 9090. The Java applet that you use to manage Jeeves looks sexy, I'll admit, but I soon concluded that it's yet another example of gratuitous Java. Nothing that it does couldn't be done in HTML/JavaScript. Waiting for a dozen classes to load before being able to set a password on the server quickly grows tiresome. And since the Jeeves beta reset itself to the default administrative password every time I ran it, I had to do a lot of waiting.

Eventually I realized that I didn't need most of Jeeves; I only needed a platform for servlets. Jeeves was overkill, and all the extra stuff it can do was just causing headaches. Was the administrative applet adequately secured? Should Jeeve's CGI servlet be disabled to ward off possible attacks? There had to be a simpler way to run servlets.



In Java, as in Perl, you can dynamically create complex nested data structures.

Enter Acme.Serve, Jef Poskanzer's minimal Java Web server (http://www.acme.com/java/software/Acme.Serve.Serve.html). This brilliant contribution to the Web emulates the Jeeves servlet API, runs servlets handily, cooperates with version 1.1 of the Java Development Kit (JDK), and (unlike Jeeves) includes source code. Thanks, Jef! My redirector ran immediately under Acme.Serve, and I have been using it ever since. It was easy to modify Acme.Serve so that the server responds only to the handful of URLs that invoke the servlets I choose to export.

I appreciated being able to tweak a few other things, too. For example, when the servlet logged the requesting browser's address, it wrote both a Domain Naming System (DNS) name and an IP address into the log. But I didn't want to log the DNS names. I don't want users to wait for reverse DNS lookups; it's my policy to do those lookups off-line in batch analysis. Adjusting the `getRemoteAddr()` method was straightforward.

There are other ways to run servlets. The recently released first beta of the Java Web Server comes with a ServletRunner that will run a servlet without all of Jeeves's baggage. The World Wide Web Consortium recently announced that its Jigsaw (http://www.w3.org/pub/WWW/Jigsaw/), the original Java Web server, will be compatible with JavaSoft's servlet API. There's also a servlet API in Netscape's Enterprise Server 3.0, although I found no examples of its use in the currently available beta version of that product and so have not yet tried it.

Making the Hard Things Easy

With servlet technology in hand, I next tackled a project that I ordinarily would have handled in Perl. The task: to write a service that would enable users to create quick polls, vote in polls, and check the results of polls. The resulting servlet, which is called Polls (http://www.byte.com/art/downloads/polls.zip), makes a fascinating counterpoint to the kinds of Perl applications I'm used to building.

Larry Wall, Perl's creator, likes to say that Perl aims to makes easy things easy and hard things possible. Java, on the other hand, tends to make hard things easy, but easy things hard. You'll see what I mean as I describe how Polls works.

At the heart of Polls is a data structure that Perl hackers call a hash-of-hashes (HoH)—that is, an associative array (i.e., a set of name-value pairs) whose values are in turn another set of associative arrays (see the figure "The Polls Servlet's Central Data Structure" above). In Perl, as in Java, it's easy to grow this object on the fly. But Perl in a CGI context does not readily handle the following requirements:

- Retain the object in memory across multiple invocations of the application.
- Protect the object from concurrent use by multiple clients.
- Retrieve the object from disk at startup and keep the in-memory version synched with the on-disk version as updates occur.

These are the hard things that become easy in a Java servlet. When the server instantiates the Polls servlet, its class data (the HoH) hangs around indefinitely—until either the server or the servlet restarts. A typical Perl solution would have to refresh its in-memory objects from disk (e.g., by doing a database query or reading in a structured text file) every time a client created a new poll or voted in a poll.

In Java, protecting the object from multiple concurrent voters is as easy as adding the synchronized keyword to the decla-

BOOKNOTE

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ration of the `vote()` method. Saving and restoring the object are trivial tasks, too, thanks to the serialization technology in JDK 1.1. The poll data lives in a Java hash table, which implements the Serializable interface. That means you can simply open a `FileOutputStream`, hook an `ObjectOutputStream` to it, and call `Polls.writeObject(stream)` to save it to disk.

Restoring the in-memory object is just as easy to do. Adding the synchronized keyword to my `saveObjects()` method was all it took to guard the on-disk object store against corruption by multiple update threads.

What about full-fledged object databases? You want one of those if you're dealing with objects that are too large to hold conveniently in memory. Polls, however, is tiny and not likely to get much bigger. Each of the polls it manages is really just a namespace that defines a set of counters. It's the number of counters that determines the size of the data structure, not the number of votes tallied by each counter.

There are a lot of applications in this category. Group scheduling, for example, tends to generate fairly small amounts of complex object data. With nothing more than a servlet engine, the JDK 1.1, and a bit of ingenuity, you can create useful applications in this domain very quickly.

Making the Easy Things Hard

A few things that would have been trivial in Perl consumed most of the time I spent on the Polls servlet. First, there was the problem of sorting the results of each poll. In Perl, that takes just a few lines of code. You can build an array of strings out of the values and keys of each poll and then do this:

```
print reverse sort @array;
```

TOOLWATCH

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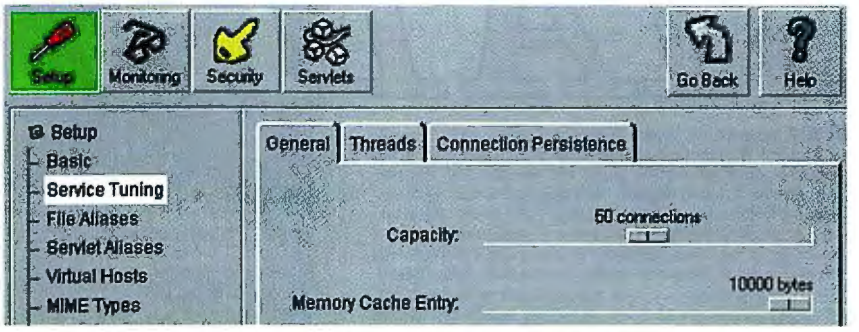
#ifdef Software
http://www.ifdef.com
Tasks that NT's dim-witted scheduler struggles mightily with—such as "run this command every hour at 10 minutes past the hour"—are trivial matters for Unix's `crontab`. Here's a capable NT version that's threaded, runs as a service, and does its job nicely.



This applet, used to control the Java Web Server, looks spiffy. But the novelty soon wears off.

I searched the Java API docs for quite a while before it dawned on me that there just isn't anything equivalent to a Smalltalk `OrderedCollection` in Java. (Try looking for the word *sort* in the index of any Java book. You won't find it.) This is a real shame. Java gives you incredible power to create and manage dynamic, thread-safe, persistent object data, but it has absolutely no tools to manipulate that data in the most elementary ways.

Of course, there are Smalltalk-style libraries for Java. The best of these looks to be the Java Generic Library (JGL; http://www.objectspace.com/). It's an outstanding piece of work that's freely available and does all the sorting, filtering, and queueing that you'll ever need. It's also a huge chunk of code.

I decided not to kill my fly-size sorting problem with the hammer of JGL. A minimal `SortedStringVector` class was all my servlet needed, so I wrote one. But there should be a middle ground. The Java core should provide at least basic sorting.

Another gotcha is the chasm that divides primitive Java types (i.e., `int`) from their object counterparts (i.e., `Integer`). Each poll's hash table contains a set of keys (the names of the choices in that poll) and values (the count of votes for each choice). Both the keys and the values must be objects, not primitive types. But you cannot increment an `Integer`, so the `vote()` method has to unpack the `Integer`, increment its corresponding `int`, and then repackage it as an `Integer` to store it back in the hash table, as shown below.

```
Integer ObjectTally = (Integer)
  hPoll.get ( "choice1" );
int tally = ObjectTally
  .intValue();
tally++;
hPoll.put ( "choice1"), new
  Integer (tally) );
```

which in Perl would reduce to simply

```
$hPoll{'choice'}++;
```

Why can't you just say `ObjectTally++`? Java's not C++; it doesn't support operator overloading. And while I'm whining...What, no `printf`-style formatting? Excuse me? Writing Java routines to pad numbers with leading zeros seems like a very silly thing to do. Again, there are, of course, Java libraries that implement `printf`. But these implementations aren't in the language's core, and they won't be standard.

Did You Run Any Java Applets Today?

It's a peculiar moment in our industry's history. The Java buzz is intense. And yet when you look at the Web applications that people actually use every day to do their work, you invariably find that there are no Java applets in the mix. The universal client today is still the HTML browser. The universal client of tomorrow will be the HTML/JavaScript browser.

Client-side Java is a glorious vision that will not change the way most people use the Internet anytime soon. Why not? It's just more than what the majority of today's computers and networks can readily push. So what are millions of people running every day? Server-based applications that feed the universal HTML client.

I build such applications every day, and I am wildly excited about how Java can help. You won't find dancing penguins on The BYTE Site. But behind the scenes, Java will be helping me run the show. B

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

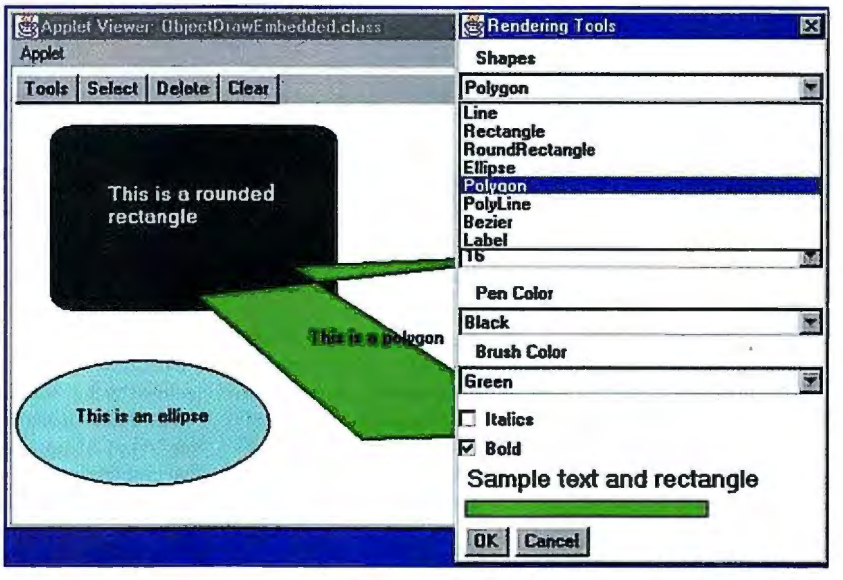
Beyond GUI Graphics

ObjectGraphics delivers true object-oriented graphics programming.

There is more to Java and graphics than just building GUIs for clients. Offerings from the likes of Microsoft, Powersoft/Sybase, and Symantec provide a wealth of visual Java development systems that are well suited for creating GUI-style graphics. However, Java can do much more than act as a client-side framework on which to hang buttons, text boxes, and scroll bars. And as more developers use Java as a general-purpose language, there will be an increased need for packages like ObjectGraphics, from Applied Visions.

ObjectGraphics comprises a set of class libraries and attendant help files. These class libraries encompass a collection of graphical objects that let you build 2-D graphical Java applications and applets in truly object-oriented fashion. With the libraries, you can create paint/draw, CAD/CAM, graphical-financial-analysis, and similar types of applications.

ObjectGraphics comes from a proud heritage. The algorithms that sit at the heart of the package, incarnate in C++ and Pascal, have already been used. For instance, Pascal versions of ObjectGraphics were used in two versions of Imsi's well-known TurboCAD product.



ObjectGraphics includes the full source code to ObjectDraw, an object-oriented, graphics-based drawing package.

Object-Oriented Graphics

You can think of ObjectGraphics as a toolbox of classes for instantiating graphical objects. Classes for rectangles, ellipses, polygons, pie charts, and Bézier curves are included.

The classes provided by ObjectGraphics implement objects that, simply put, do what objects were meant to do. That is, they know how to draw and scale themselves, and they can determine whether they have been touched by a mouse-click. Furthermore, the graphical objects come with methods for altering their appearance (e.g., you can specify the arc width and height of the corners of a rounded rectangle). The objects also have graphics utility methods (e.g., a rectangle can tell you whether a point is within its bounding region).

Drawable objects are not the only entities in ObjectGraphics. You'll also find a set of drawing tools, such as a brush object (for filling shapes), a pen object (for drawing shape outlines), and a font object (for text).

The programming environment of ObjectGraphics is a kind of 2-D world, implemented in a `GCanvas` object. The `GCanvas` object is actually a container that carries (among other things) a `GSpace` object, which understands coordinate systems. The `GCanvas` object also carries a `GPicture` object that contains all the rectangles, circles, and polygons that your program draws.

This is less complicated than it sounds. ObjectGraphics extends fundamental applet and application classes (`applet` and `frame`, respectively) to contain member `Canvas` objects. Consequently, little code is required to imbue your Java applet or application with object-oriented graphics capabilities. Once you've initialized the `Canvas` object, you can begin dropping graphical objects into it. ObjectGraphics automatically does all the real work for you.

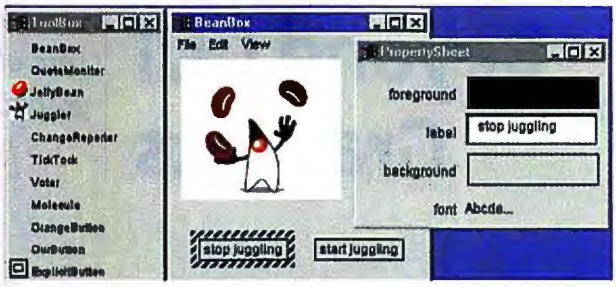
Nice View

For a package like ObjectGraphics to be useful, it must be accompanied by copi-

PHOTOGRAPH: KELLIE WALSH © 1997

Life in the BeanBox

If you want to check out Java component technology, you can download JavaSoft's Beans Development Kit (BDK) from http://www.javasoft.com. The BDK, which is available for Solaris and Windows 95 and NT, requires that you have JDK 1.1 (available from the same Web site and now in general release) downloaded and installed.



The BDK's BeanBox is a complete proving ground for JavaBeans.

Although the BDK's primary utility is as a collection of API documents and sample source code, it's more than that. Specifically, the BDK also includes an executable environment for testing JavaBeans. This environment, which you can think of as a software test lab, is a frame-based Java application called the BeanBox (see the screen above).

During operation, the BeanBox provides three windows. The leftmost is the bean palette, a holding area for candidate beans under test. In the middle, the BeanBox composition window provides a staging area where live beans perform. When you click on a bean in the palette and then click on a location in the composition window, the bean is instantiated and ready to test. The right window is a properties inspector window. When you select a bean in the BeanBox, this window is filled with any editable properties the bean possesses.

The BeanBox contains 16 beans. These range from simple (for example, the JellyBean, which draws a rounded rectangle and supports two properties) to more complex ones, such as the JDBC SELECT bean, which launches a SQL SELECT statement at a Java Database Connectivity database server. The composition window is itself a container bean.

Bean Events and Bound Properties

Beans do not exist independently of each other. Multiple beans within a container must have a mechanism for communicating with one another. An important aspect of a JavaBean is its ability to trigger and/or respond to events.

To properly test the event-managing capabilities of a bean, whether as an event source or a target, you need to wire beans together. The BeanBox lets you do this. Once a bean is in the composition window, you can select it and, through the window's edit menu, browse the event-listener interfaces that the bean implements. You can connect this event-listener interface to any other bean (which becomes the receiver of the event) that implements that interface.

It works like this: Select a bean in the composition window. This will become the event-source bean. From the menu, select the event-listener interface that you want to hook to a receiving bean. You also select the EventObject argument associated with this interface (the purpose of this argument will become clear in a moment). The BeanBox draws a rubber-band line that tracks the mouse. You then select the receiving bean (anchoring the rubber band), which causes the BeanBox to open a dialog box showing the methods in the target bean that can accept the event from the source bean. Which methods are compatible on the target depend on the EventObject you selected back on the source bean.

Pick the target method, and the BeanBox automatically creates, compiles, and loads what is referred to as an "event-adapter class." This is the actual plumbing that connects the source bean's event to the target's receiving method. Once this class is built, you can test the source and target's behavior, verifying that the source event is properly handled by the receiving bean.

The BeanBox also lets you test what are known as "bound properties." A bound property triggers a `PropertyChange` event whenever that property is modified. Consequently, you can wire the property's event to a target bean using much the same mechanism as described above. For example, a text-display bean could properly track the color of a rectangle-drawing bean. Whenever the rectangle's color property gets modified, the text-display bean is notified.

Included with the BDK is a tutorial that guides you through the process of connecting button beans to the animated Juggling Duke bean (as shown in the screen above). This is worthwhile for getting a quick feel for how beans perform event-handling under JDK 1.1. More useful are the later examples in the tutorial that use an analogy of water flowing from sources to destinations through pipes and valves to illustrate the dynamics of event management.

ous source-code examples. Fortunately, it is. The ObjectDraw sample application is the most instructive. It implements a moderately complex drawing application (or applet) that lets you create and manipulate any of the graphical objects supported by ObjectGraphics.

I discovered ObjectGraphics' mouse support while experimenting with ObjectDraw; you can, for example, pick a rectangle up, move it to a new location, and drop it. ObjectGraphics handles the operation smoothly.

Currently, ObjectGraphics is compatible only with Java systems based on version 1.0.2 of JavaSoft's JDK command-line development environment. (I used ObjectGraphics successfully with version 1.0 of Symantec's Visual Café.) At the time of this writing, a spokesman for Applied Visions told me that the company was watching the market's acceptance of JDK 1.1 closely and would consider updating to the new version if circumstances warranted. This is reasonable: Making ObjectGraphics dependent on JDK 1.1 features would make it unusable in virtually all current browsers.

I found working with ObjectGraphics to be straightforward, even though I experimented with a late beta version of the package. Its price of $249.95 (with source code; $99.95 without) definitely makes it worth your attention if your graphics development goes beyond text boxes and buttons. B

WHERE TO FIND

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http://www.avi.com

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

BYTE Reseller

Data Warehousing Opportunities

Data warehouse projects can quickly turn into a maze without the right tools.

Page 120C

Unix's Challenges

Of course, you'll have to master Java, middleware, and the latest hot boxes. The surprise: strong demand for Windows/Unix integration.

Page 120M

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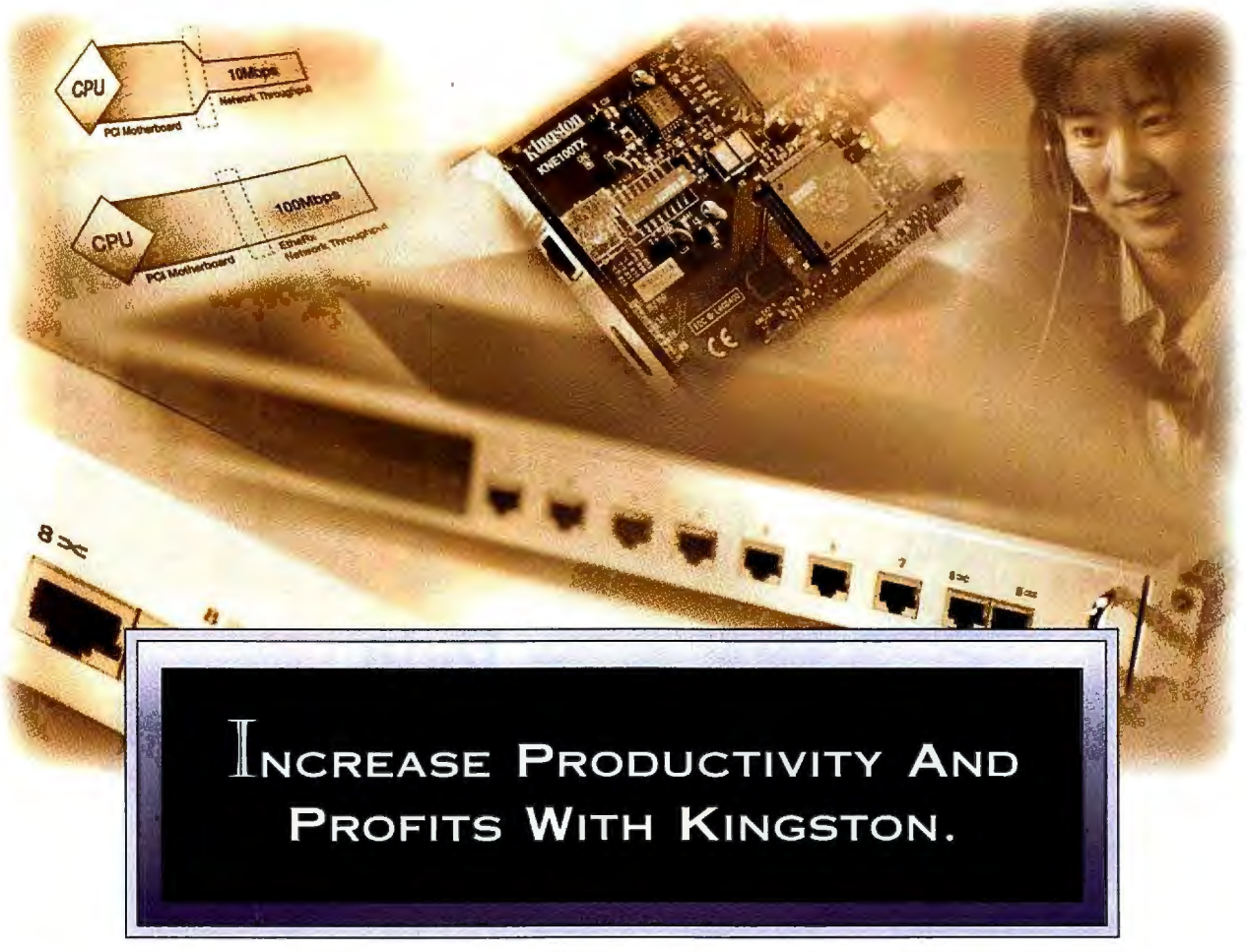

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Resellers Circle 360 on Inquiry Card.

How resellers can profit from data-warehouse opportunities.
By David Baum

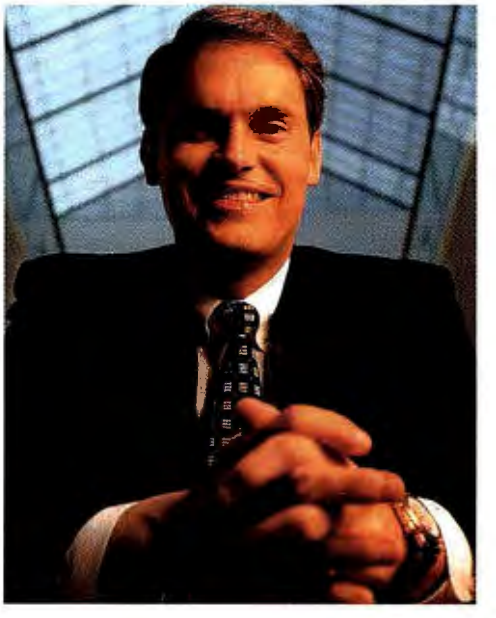
Planning and Implementing a Data Warehouse

Data warehouses promise easy access to business data and a faster way to answer complex questions. However, between the theory and practical use of a data warehouse lies a rocky road. This means danger for data-warehouse users and opportunities for resellers who can handle the architectural planning and extensive integration work necessary for successful implementations.

What are these opportunities? Small reseller shops can find lucrative niche markets by specializing in individual pieces of a data-warehouse launch, such as designing data models or Web-enabling legacy databases. Larger resellers can win warehouse customers by constructing vertical solutions for retail, banking, manufacturing, and other industry segments. The advantage here is that once a reseller solves the hard problems in the first implementation, it can repeatedly sell the solution to other companies in that industry segment.

The large consulting arms of data-warehouse vendors sell everything from piecemeal development services to turnkey, packaged data marts. Take all three of these segments into account, and you'll find a market that will reach $6.9 billion by 1999, according to the Gartner Group.

Data-warehouse projects are sparkling reseller opportunities because they require many specialized skills to design, develop, and deploy. While shrink-wrapped warehouse solutions are beginning to reach the market, most warehouse efforts are still custom jobs calling for the integration of a wide range of hardware, software, and network components. The basic pieces include a data model, a warehouse server and applications servers, the middleware layer, a cohesive network infrastructure, client-side analysis tools, data-scrubbing utilities, data-transport utilities, replication engines, and metadata repositories. But don't let this laundry list intimidate you—the first five items are the key components.



"Our real thrust with each data-warehouse initiative is to help companies identify the information that is truly important to them."

— Rick Roy

Modeling Data

Data warehouses separate day-to-day data that production applications use from the historical data that strategic planners use to uncover new sales patterns or spot other trends that can boost business. Another difference: Data-entry professionals

PHOTOGRAPH: CHRIS CORSMEIER © 1997

and applications update production data continuously, while data-warehouse applications refresh historical data at set times, usually during off-hours when network and CPU use are light.

One of your first steps will be to decide how to store the data. Any relational DBMS (RDBMS), such as Oracle7, Sybase System 10, or IBM's DB2/400, can work as a warehouse repository. However, some organizations opt for multidimensional DBMSes (MDBMSes) designed for data warehousing, such as Oracle Express and Red Brick Systems' Red Brick VPT. A traditional RDBMS lets end users view data in two dimensions (e.g., by product and by region). With an MDBMS, you can look at data in multiple dimensions (e.g., by product and by region over time).

On another front, universal servers, from Oracle, Sybase, Informix, Computer Associates, and IBM (see "RDBMSes Get a Make-Over" and "How to Improve RDBMSes," April BYTE), are object-relational hybrids that store not only text but complex objects such as images, animation, and sound. These RDBMSes are important for companies that post multiple data types on Web sites.

"The data warehouses emerging today can potentially support lots of data types in addition to text," says Mike Thompson, MIS manager at Integrated Device Technology (IDT) in Santa Clara, California. "For example, we often have business-critical information arriving in fax format. We could scan these images and store them in a database with some kind of logic behind them."

Since 1996, Thompson and his colleagues have been immersed in a project to construct a data warehouse for several areas of the company, including marketing, sales, order processing, and finance. After buying a ready-made data model from Applied Data Resource Management (see the text box "Packaged Data Model: A Gift for Warehouse Developers" below), the team went to work extracting data from production databases on a variety of host computers. They loaded the data into an Informix data warehouse that ran using a bank of SparcServers from Sun Microsystems.

Next, IDT will deploy the warehouse applications on the company's intranet. IDT chose the Informix product for its standard universal-server capability to handle complex data and because it lets developers embed SQL statements in HTML documents, so Web users can see query results dynamically displayed. Donald DePalma, an analyst at Forrester Research, says such multimedia warehouses will soon be the norm.

What's in the Middle

Middleware connects warehouse databases and front-end decision-support tools. While standard database middleware can handle this task, specialized middleware for data warehouses is arriving. Colin White, principal consultant at DataBase Associates International, a database and data-warehouse consultancy, says specialized warehouse middleware can help companies monitor, track, and control access to warehouse data. "Users need to access data belonging to other departments for cross-business function analysis," White explains.

Some middleware products, including Sybase IQ and Information Builders' popular EDA, offer copy management (also called data staging) to select, edit, summarize, combine, and load the data warehouse with information from operational databases. Quality-analysis programs and filters identify patterns and data structures in the operational data. The patterns help summarize the data and construct views useful for analysis and reporting.

Network Considerations

Data warehouses typically imply a distributed-data architecture, with bulk transfers of data during off-hours and heavy interactive querying at peak hours of the day. Without proper planning, the performance of the network can suffer. Here's where resellers can help.

There are two primary methods for populating the warehouse with data: bulk downloads, in which the entire database is refreshed on a periodic basis, and change-based replication, where the system copies over just the changes.

Transmitting only the changes puts less stress on the network but requires more complex programming to set up. Bulk downloads can heavily tax the network—a 20-GB database implies a 20-GB transfer—but such warehouses are easier to set up and maintain.

In either case, warehouse architects must pay close attention to the frequency and scheduling of data updates (perhaps job-scheduling software is required). It's usually easy to determine the optimum time for refreshing the warehouse

Packaged Data Model: A Gift for Warehouse Developers

How can resellers build data warehouses that provide flexible data collection, create multidimensional representations of data, and allow for future customizations? For many resellers, the answer is data models, well-structured repositories of metadata that govern the collection and representation of data.

If you think metadata automatically means long hours of custom development, think again. One reseller, Applied Data Resource Management (ADRM), found that packaged software can ease the development burden. ADRM's enterprise templates, created with Computer Systems Advisors' SilverRun data-modeling tools, were a big time-saver for Integrated Device Technology (IDT).

To kick off its data-warehouse design efforts, IDT bought some ADRM models and the SilverRun Business Process Modeling Tool, Relational Data Modeler, and Entity Relationship Expert. The SilverRun tools help warehouse managers tailor the ADRM templates and make changes as the warehouse evolves. "The templates gave us a head start modeling standard business processes, such as sales tracking and lead qualification," says Mike Thompson, MIS manager at IDT.

Larry Heinrich, ADRM's president, says a typical enterprise-wide analysis and planning process takes two to three years and can cost as much as $5 million. The bulk of that baseline effort for a specific industry can be replaced by an ADRM template. "Companies operating in the same industry tend to require the same data related in similar ways," Heinrich says.

Each industry-specific data environment, consisting of up to 25 integrated data models, provides the data platform on which an organization can launch its data-warehouse projects.

It worked for IDT. "The flexible design of these data models allowed us to hit the ground running," Thompson says. "Rather than building a data model from scratch, we could focus our efforts on the requirements that make our warehouse unique."

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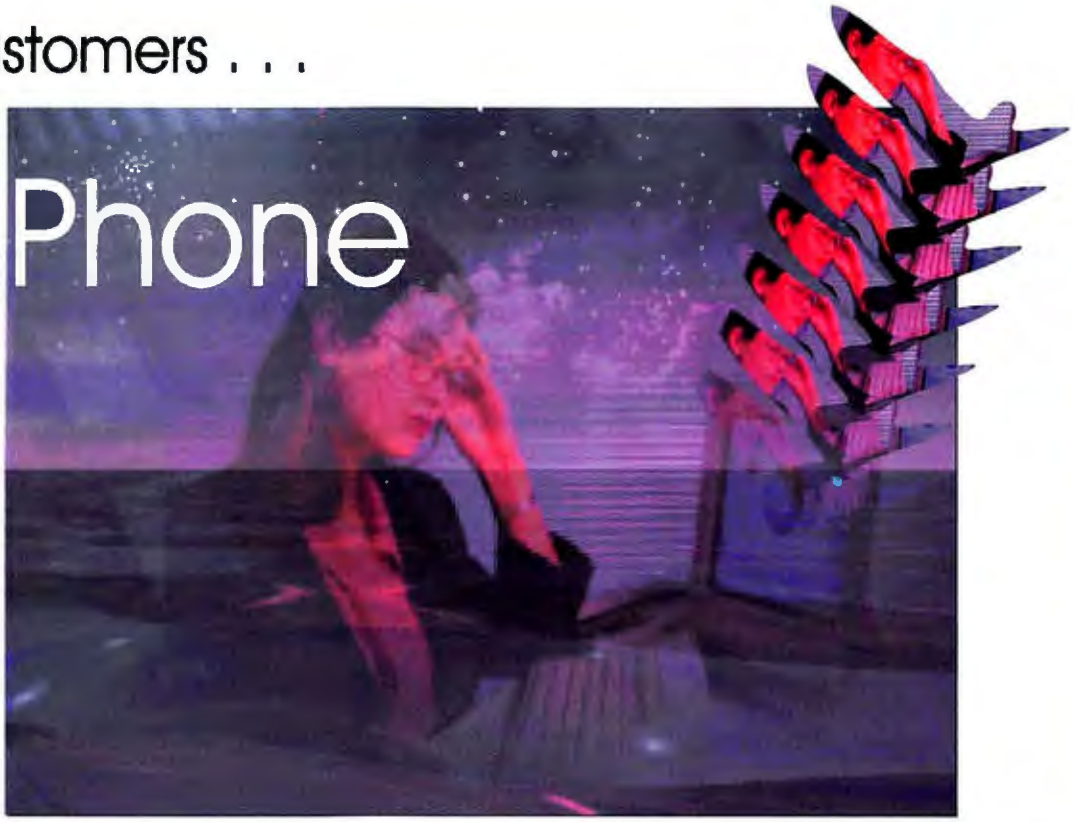

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with new data, such as following a billing or sales cycle.

Browser Access

The final piece of the data-warehouse package is end-user access. Increasingly today, that means a Web connection such as the one Rand built when it linked a data warehouse and an intranet-based reporting system called Oasis. Rand, a nonprofit research firm, helps organizations develop public-policy strategies.

"Instead of having a copy of warehouse-reporting applications on every desktop, users can access server-based versions through their Web browsers," says Ken Krug, a treasurer at Rand. "This streamlines electronic access to corporate financial and man-power data."

Rand created Oasis on top of the Oracle7 database and Oracle Project Accounting software. Andersen Consulting helped with the initial financial-software selection. Oasis incorporates statistical and project-accounting programs built using the Oracle software in conjunction with Microsoft Excel and Netscape Web Server. Every two weeks, data from Oracle Project Accounting flows to an Oracle7 data warehouse that Rand uses to generate dozens of ad hoc reports.

Phase 1 of Oasis includes 45 reports accessible via the company's intranet to help users track the thousands of simultaneous projects and tasks ongoing at the organization. These reports are available

GTE Jump-Starts Data Marts

Data marts are a hot trend among data-warehouse developers because they can quickly deliver results. Unlike enterprise-scale warehouses, which support many departments and business groups in an organization, data marts are single-subject warehouses that are designed for individual groups and specific business units.

"Each successive data mart builds on the previous ones, and all are integrated into a cohesive data warehouse," explains Roger Copeland, administrator of new technology at GTE Supply, a division of GTE in Irving, Texas. GTE Supply provides telecommunications equipment to GTE as a whole, as well as to other major telecommunications companies.

When it realized what a large undertaking data-warehouse development requires, GTE Supply sought help from experienced consultants. It chose Information Builders to supply development services and an integrated set of tools for applications development, data access, data transformation, data migration, and reporting. GTE Supply also used the Incremental Warehouse Methodology (IWM), pioneered by Earl Hadden, a pragmatic approach to warehouse implementation and design.

"The IWM encourages a phased construction process that achieves results quickly," GTE's Copeland says. "Companies begin with small, manageable pieces. Each increment provides tangible business value and a demonstrable return on investment."

GTE Supply's first four data marts—currently totaling 20 GB—handle purchasing, inventory, forecasting and planning, and measurement. Payback on each data mart is expected within a few months. (The company declines to say how much the four data marts cost to launch.)

"Our developers are getting more efficient, reducing the cycle time with each data mart," Copeland says. "The first data marts were delivered in about 90 days apiece. By the end of this year, we expect to be delivering new increments in 60 days or less."

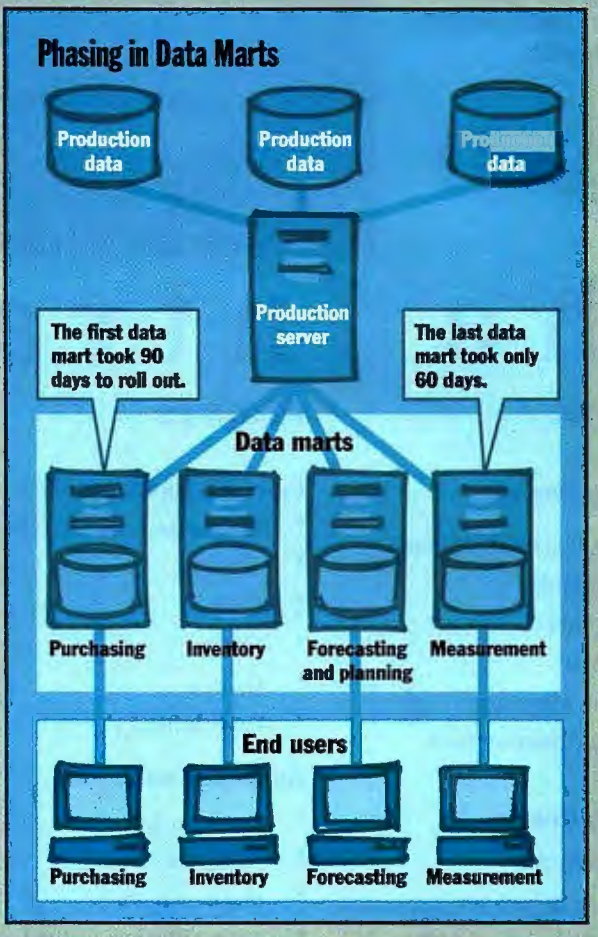
If you're a reseller looking to cut data-mart development time, check out packaged solutions from the SAS Institute, Platinum Technology, Prism Solutions, Sybase, or Information Builders. Packaged offerings typically include the database itself, middleware, front-end decision-support and data-mining tools, and data-extraction tools. Some packages include usage-analysis tools and query governors as well.

Taking packaged data marts a step further, some vendors are starting to work with VARs to release packaged data marts tailored for specific vertical markets. Such solutions include not just the bundled warehouse hardware and software products but also data models, data-extraction scripts, and prewritten queries and reports designed for target industries such as financial services, retail, and manufacturing. Such offerings are particularly attractive to customers because 80 percent of the development work has already been done. The last 20 percent? That's the niche that VARs and resellers hold onto.

Data in Manageable Bites

- Data marts allow for incremental development and rapid deployment.
- Data marts reduce dependency on network services.
- Data marts improve performance by storing data closer to users.
- Data marts use relatively low-priced hardware and software.

Source: DataBase Associates International



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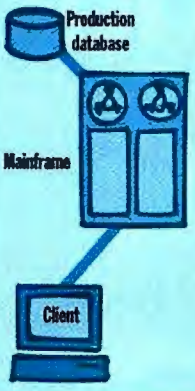
Architectural Distinctions

The simplest data warehouse has a two-tier, homogeneous architecture. A single-server tier hosts the production and warehouse databases. An application tier hosts the front-end decision-support and analysis tools.

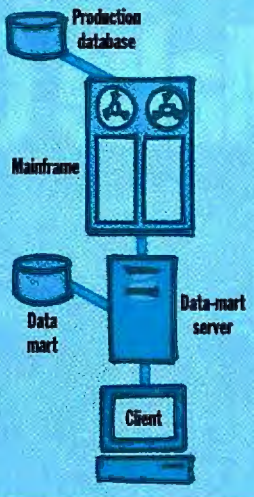
More complex data warehouses use a three-tier architecture with a separate middleware layer for data access and translation. The first tier is the host CPU, which is devoted to real-time, operational data processing. The second tier is a separate warehouse server optimized for query processing, analysis, and reporting. The third tier is the desktop application layer, which handles decision support and the graphical presentation of data. As data warehouses go on-line, the third tier can also be a Web server.

Data-Mart Architectures

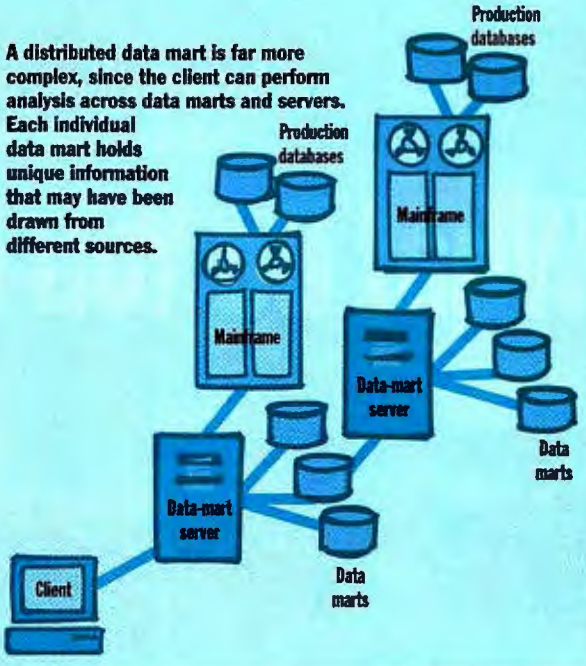
A simple two-tier data mart places the warehouse data on the same server as the production data. The data mart queries might even execute against the production data.



In a three-tier data mart, the warehouse data will reside on a separate system—one that periodically refreshes itself from the production database.



A distributed data mart is far more complex, since the client can perform analysis across data marts and servers. Each individual data mart holds unique information that may have been drawn from different sources.



anytime at all via Netscape Navigator.

A new generation of decision-support tools is helping VARs build next-generation applications, such as MicroStrategy's DSS Web, an analytical engine for translating user queries from Web browsers into an optimal SQL execution plan. Other products in this category include Oracle Express Server, Information Builders' WebFocus, Seagate Software's Crystal Reports, BusinessObjects' soon-to-be-released Darwin, and IQ Software's IQ LiveWeb.

WHERE TO FIND

Business Objects
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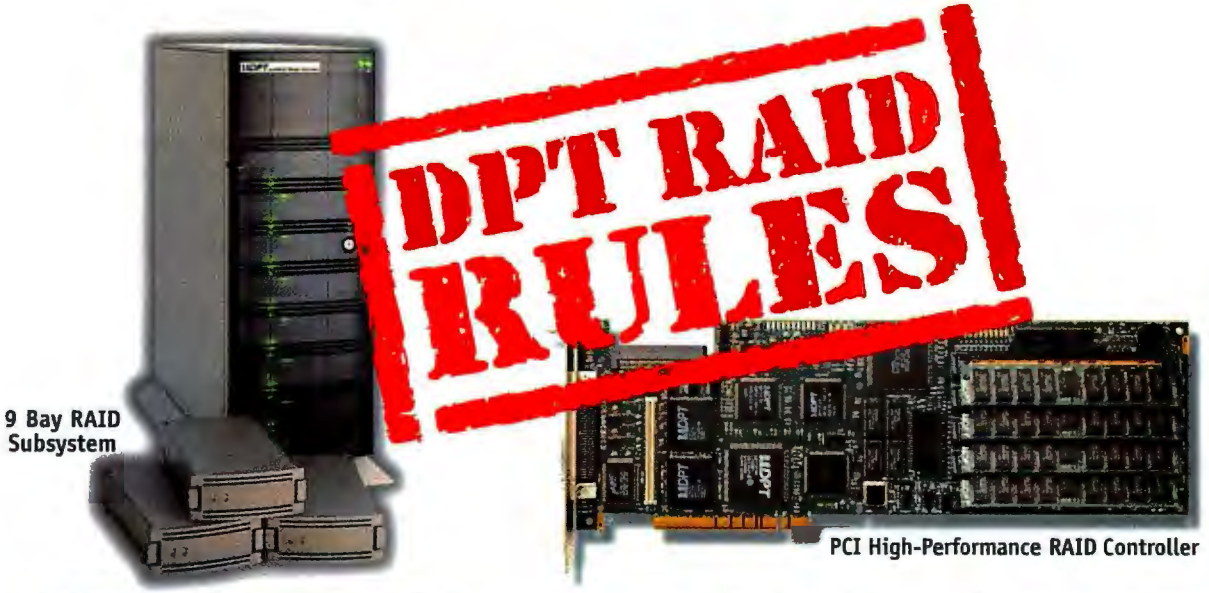
David Baum is a freelance technology writer residing in Santa Barbara, California. You can reach him at **dwbaum@silcom.com.**



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City of Industry, CA - Sceptre Technologies' new Soundx 4500 notebook computer will begin shipping in April 1997. The S4500 is not just an upgrade to Sceptre's already feature-loaded Soundx 4000 but a substantially new machine from the case in. Among the features carried over from the previous model are the large and brilliant 12.1" TFT display, the 128 bit NeoMagic graphics accelerator, smart lithium-ion battery, and the modular design.

An interesting feature of the NeoMagic graphics accelerator is that it carries its one MB of video memory on board the graphics accelerator chip, a scheme similar to the high-speed level 1 cache RAM onboard the main CPU, instead of using a separate RAM chip on the adapter card. This feature, along with the 128 bit memory path, allows video processing at speeds surpassing those of graphics accelerators with twice as much video memory while helping to keep costs down. In fact, the Soundx 4000 with the NeoMagic accelerator posted the highest graphics scores in PC Magazine's January 21, 1997 notebook roundup.

From here, the differences become apparent. The three biggest and best changes are: Intel's P55C MMX Pentium processor in either 150 or 166 MHz versions, 16 MB of onboard RAM expandable up to 80 MB via two DIMM sockets and the integration of the 1.44 FDD with the 12x CD-ROM into one modular

The S4500 now supports 16 bit color at 800 x 600 resolution and 24 bit color at 640 x 480 resolution. Less apparent but equally significant is the upgrade to an ESS 1688 audio chip to the ESS The new chip provides ZV audio support and full audio duplexing.

Of course the biggest news is the MMX processor. With the onboard cache doubled from 16K to 32K, non-MMX applications run 10 to 20 percent faster they would on Pentium processors MMX. As more applications are MMX instruction take full advantage multim

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Will you profit from these four make-or-break technology trends?
By Cate T. Corcoran

Four Challenges Every Unix Reseller Must Face

You can't be a successful reseller if you don't thrive on relentless technological change. No group understands this better than Unix resellers, who must grapple with new technologies while managing some of the largest and most complex projects in the business. Handle change well, and innovations in software and hardware will open up new business opportunities and help you improve customer service. Stumble over change, and you might begin searching for a new career.

What are the key challenges facing Unix-oriented resellers for the next six months? After talking to a number of firms that manage projects throughout the U.S. and Europe, I found that four categories rise to the top: Unix/Windows NT integration, advances in Unix middleware, Java, and growing hardware sophistication. Let's look at each challenge separately.

Challenge #1: Unix/NT Integration

NT is becoming a force for Unix resellers to contend with as it makes greater inroads into the realm of desktops, departmental servers, and database servers. But while faster Pentium processors are helping NT break into more large organizations, customers are also demanding bigger systems with fast response times, which is where Unix comes in, according to Marvin Richardson, chief technical officer for MCI Systemhouse (Atlanta).

For example, American Management Systems (AMS, Fairfax, VA) uses Unix systems on the back end for large-transaction, high-volume databases. In some especially large installations, AMS uses Unix servers as a middle tier to integrate front-end clients with legacy systems on the back end, says Jim Simmons, vice president and director of the AMS performance and testing lab.

AMS created a call-handling system for Airtouch Cellular (Walnut Creek, CA), for instance, that uses Sun servers in the middle for transaction routing and middle-level processing with a Sybase database. Although most of AMS's clients choose a PC front end, Airtouch picked a Smalltalk application with a new business process. The GUI runs on Unix workstations and works with Airtouch's legacy applications.

Simmons says NT also supports X Window System terminals

PHOTOGRAPH: ERIC MILLETTE © 1997

Applications written for intranets will talk directly to CORBA clients without using HTTP. "It provides a cleaner and more efficient way to build distributed object applications."

—Mark Interrante

in Unix shops that want Windows applications but don't want to buy full-featured PCs. An NT box with several Pentium Pro processors can support 20 to 30 X terminal users running e-mail, Word, and other PC applications. Forthcoming network computers will also have X terminal capabilities built in, so users will be able to run X, Unix, and Java applications from a Unix server, Simmons adds.

But the relationship between NT and Unix isn't always so cooperative. One example: NT is squeezing Unix out of the loop when some resellers use Back Office to move data from an AS/400 server to a PC, particularly in data-warehousing applications. With so much emphasis on NT these days, customers are frequently asking resellers to connect new departmental NT servers with existing enterprise Unix servers. This is fairly easy, since both OSes support telnet, FTP, and TCP/IP.

However, David Shaw, an associate with Perot Systems (Dallas), wishes that NT would support NFS but doesn't think Microsoft will make it happen. Many DBMSes, including those from Oracle and Sybase, talk to applications servers running on NT, says Shaw, who specializes in document-imaging and work-flow systems. He adds that any connectivity achievable in a Unix-to-Unix installation is also achievable in an NT-to-Unix system, thanks to third-party software.

Surprisingly, what integrators refer to as "NT tools" are becoming increasingly useful for integrating NT, Unix, and mainframe systems. For example, Back Office is fairly easy to connect to Unix, asserts Dave Backstrom, who handles technical and sales support for Vital Integration Solutions (Des Moines, IA). The company also uses SNA Server (a part of Back Office) to connect Unix to mainframes and frequently uses NT as the connection between Unix and the mainframe.

"The tool sets are there to put Microsoft applications on the front end and to hook in ties to a back-end system," explains AMS's Simmons. However, one inconvenience of Unix/NT integration is that tools often ship for NT and Windows 95 before they support variations of Unix. Thus, features in some tools often support the NT and Unix environments inconsistently.

Challenge #2: Middleware

Unix resellers need to get disparate systems working together at a high level as some clients request a single GUI to front myriad systems and other customers move to complex applications, such as data mining. At a lower integration level, there's always the familiar problem of making disparate systems work together over a network.

As a result, resellers that specialize in Unix spend much of their time connecting Unix to legacy systems at the high level and to PC desktops at the low level. They use almost every technique imaginable to transform data into the necessary format to get it out of, or into, any platform a customer might happen to have. Screen scraping, SQL calls, and messaging can all be found in a good integrator's bag of tricks.

Thankfully, over the past few years, the market has matured to the point where resellers no longer must write their own middleware for every project. They say they're almost always able to use something off the shelf, occasionally tweaking it to map to an odd platform or two. Many resellers also expect Common Object Request Broker Architecture (CORBA)—along with Distributed Component Object Model (DCOM) and OLE—to replace industrial-strength middleware, such as CICS, IBM's MQ Series, and Tuxedo, over the next six months or so.

Another big change in middleware comes in the Internet awareness that vendors are adding to their products to let integrators tie back-end systems into Web sites and corporate intranets. For example, Federal Express's Web site, which helps customers track packages, actually initiates CICS transactions in response to Internet events, according to Mark Interrante, a manager with Deloitte & Touche Consulting Group (Wilton, CT).

There are as many ways to exchange data as there are incompatible systems. For instance, Perot Systems' Shaw uses FTP software running on a mainframe to transfer files back and forth between the mainframe and Unix boxes. He has also used NFS to get images off Unix file servers, since many of the applications he installs cache them there. Perot Systems chooses document-management and work-flow applications with an API or toolkit that makes it easy to talk to a Unix server from a PC environment if the PC network is running a Visual Basic or PowerBuilder application. (The application has to be written to the API or the toolkit.) And Vital Integration has worked frequently at writing SQL interfaces into the mainframe that strip out data and bring it into a smaller RISC box running Unix or NT. "Often we just rewrite part of an application and use SQL to dump data back and forth," Vital Integration's Backstrom says.

Sometimes integrators find they need

How to Cope with Change

Problem: Windows NT is making inroads into the realm of desktops, departmental servers, and database servers, competing against Unix.

Solution: Position your business to capitalize on the growth of multitransaction processing and the size of corporate databases, which now can be measured in terabytes. Unix's scalability and reliability shine in these types of applications.

Problem: Unix resellers frequently must tie together disparate systems for complex applications, such as data mining. However, writing custom middleware for every project is time-consuming and unprofitable.

Solution: Take advantage of off-the-shelf middleware programs whenever possible and focus training efforts on CORBA and DCOM rather than on older solutions, such as CICS, MQ Series, and Tuxedo.

Problem: Java is changing the face of applications development, but mature Java programming tools and skills are in short supply.

Solution: Take advantage of tools such as the Rational Rose CASE program, Symantec's Café, and Microsoft's J++. In addition, JDBC, part of the Java API, is maturing and getting support from third-party products, such as Intersolv.

Problem: Margins for Unix hardware are becoming thinner as prices drop and inexpensive Pentium systems become more common in Unix environments.

Solution: Concentrate on software opportunities, such as creating applications to support new business processes. Develop expertise in more-sophisticated hardware architectures, including NUMA.

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to write custom code to map data correctly between disparate systems. "If a system or a package has its own data model and has to integrate with a whole bunch of legacy systems, there's no tool that can map everything from Unix to a mainframe environment," explains Prem Mehra, an associate partner with Anderson Consulting (Chicago). Application tools are playing more of a role in this arena. For instance, IBM's Data Propagator takes information from the mainframe side and pushes the changes out to Unix.

CORBA is already finding its way into products, and it is being rapidly adapted by integrators, who believe it will ease the job of developing complex, distributed applications. Tivoli, for example, already uses a CORBA-based infrastructure to send messages. Also, Netscape has licensed the Internet Interoperable Object Protocol (IIOP), a lighter version of CORBA, and plans to bundle it with the next version of Navigator. That alone means there will be several million CORBA clients by the end of the year, so applications written for intranets will be able to talk directly to CORBA clients without using HTTP. "It provides a cleaner and more efficient way to build distributed object applications," Deloitte & Touche's Interrante says.

DCOM and OLE are not likely to be displaced by CORBA, if only because they're bundled into Microsoft products. Products that bridge the technology between the two, such as Digital Equipment's Object Broker, are likely to become important, according to MCI's Richardson.

Challenge #3: Java

One of the biggest changes that resellers—and everyone else—are currently dealing with is a new development language: Java. Many Unix resellers say they are excited about using Java to write applications that will run anywhere, even without a browser interface. Many resellers are already using Smalltalk to do the same thing but plan to switch to Java or combine the two. (Smalltalk, like Java, runs on a virtual machine and is therefore platform independent.)

But because Java applications require less memory than Smalltalk applications, Java allows resellers, such as Deloitte & Touche, to distribute more processing on the client side and enable more interactivity, Interrante says. Resellers will also save time by not having to port an application to all customer OSes, and they will be able to deploy applications more quickly, more easily, and more frequently by putting up the latest copy on a server. Nobody will have to figure out what's on a user's machine, update drivers, and then install one big new release, Interrante explains.

Version 1.1 of Java, which Sun is releasing this quarter, has eliminated the bugs in 1.0 and is ready for some of Deloitte & Touche's clients, Interrante says. It's more reliable, has more GUI features, has more flexible security, and offers better database connectivity, he adds.

Challenge #4: Hardware

Prices for Unix hardware continue to drop as many Unix systems now run on Intel boxes rather than costlier RISC machines. This leads a few resellers to worry that hardware will soon become a commodity with little opportunity for value-added business. But others view hardware commoditization as an opportunity for them to devote more time to other matters, such as creating applications to support new business processes.

At the other end of the hardware spectrum, many integrators are excited by nonuniform memory access (NUMA), the architecture that combines symmetric multiprocessing (SMP) with the scalability of massively parallel systems. Perot Systems and MCI have pilot NUMA systems in place, one from Pyramid and one a four-way Pentium box running Sequent Unix. Both companies say the NUMA systems offer better performance than SMP systems.

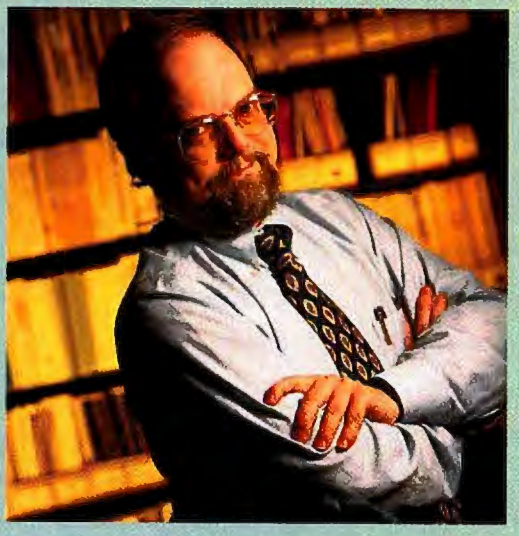
Better Service

In the end, Unix-oriented resellers who embrace change see a refreshing break from the world of minuscule hardware margins and custom middleware development. What's left is the fun stuff: creating better, more ambitious applications for their customers. B

Cate T. Corcoran is a freelance writer who specializes in Unix and other technologies for large corporations. You can reach her by sending e-mail to **ctcorcoran@aol.com.**

A Bridge for Disparate Systems

Unix resellers are pleading for more end-to-end debugging, capacity, and management tools to handle giant conglomerations of disparate systems. "We can debug each of the pieces of a large system individually on the host platforms, but when we glue them together into the larger picture, it's more difficult to do reliability, performance, and stress testing and figure out why and when something fell apart," says Jim Simmons, vice president and director of the American Management Systems performance and testing lab. "When we're constructing a system where each part depends on another part for the completeness of a processing cycle or transaction, products that allow us to trace and debug systems during development—things that have to occur correctly against multiple tiers—are going to be extremely important."



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"We can debug individually on the host platforms, but it's more difficult to figure out why something fell apart."—Jim Simmons

But many Unix-oriented resellers admit that it would be difficult for a commercial developer to maintain such a tool because it would need to keep up with so many different applications, standards, and platforms. In the meantime, resellers rely on platform-specific products, their own judgment and experience, and occasionally a custom program for full-system testing.

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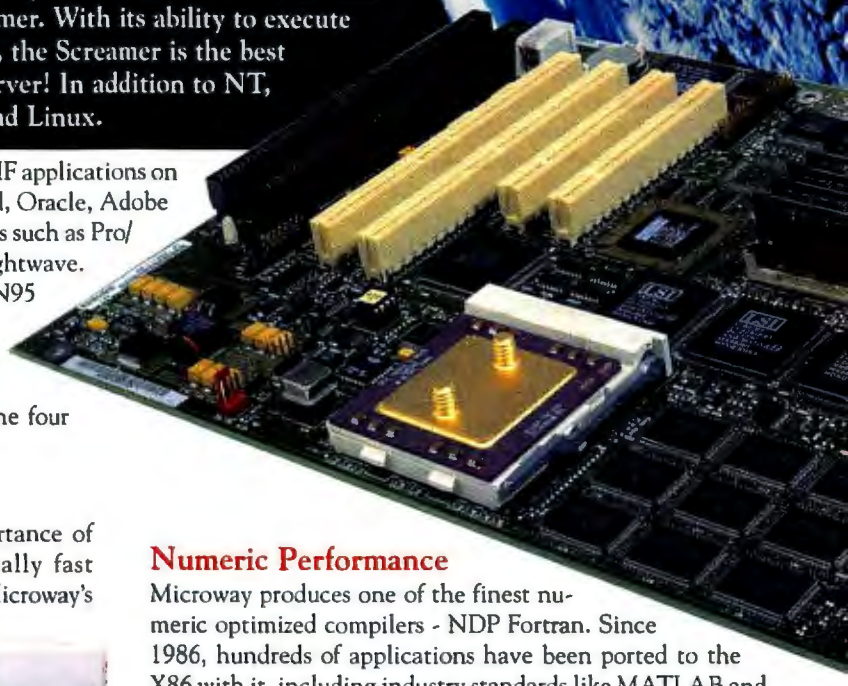

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These CD-ROM servers pump up your network's data delivery.
By BYTE Editors

Centralize Your CD-ROMs

Today the CD is inarguably the most popular medium for applications and data distribution. Immune from the vagaries of magnetic media, the CD's durable nature makes it a natural choice for long-term data storage. Data distributors use CDs to hold, in addition to software, periodicals, legal and medical databases, government regulations, catalogs, and reference materials.

As more applications and data are deployed and distributed on CD, network administrators must step up to the challenge of sharing these resources efficiently within corporate workgroups and across the enterprise-network environment. One solution is networked CD-ROM servers, which are the focus of this month's Lab Report.

Defining the Field

We asked manufacturers to provide a stand-alone server providing support for Windows NT and NetWare and containing from seven to 14 internal 8X-to-12X CD-ROM drives. The systems had to be configured for a 10Base-T Ethernet network. We set an arbitrary maximum cost of $20,000. We excluded nonindependent server solutions and jukebox systems that don't keep data constantly available on-line.

The six systems that we tested come from manufacturers who specialize in CD-ROM server solutions: Boffin, Excel Computer, Micro Design International (MDI), Microtest, Microtest Enterprise Group, and TAC Systems. During our evaluation, the measured performance of these systems ranged from superb to unacceptable. We exercised them when serving single clients as well as multiple clients in a heavy-traffic environment.

Four of the systems, the Boffin 7 Bay Tower, MDI CD-Express Connect, Microtest DiscPort Tower-7, and TAC Systems HotSwap LanRedi TowerDrive, are non-PC servers. Each is built around a smart SCSI-to-Ethernet interface that contains all the hardware, software, and processor power required to perform as an independent file server with few or no external components. The units from Boffin and TAC Systems use implementations of the Axis StorPoint CD-ROM server controller. The two devices from MDI and Microtest use proprietary designs.

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CD-ROM SERVERS

Microtest DiscPort Enterprise Server

This was the outstanding performer in our tests, although we down-rated it a bit for its poor documentation. But note that you'll pay a luxury-level price (almost double that of the next-least-expensive unit) for this high-speed CD server, and you might be just as satisfied with a less-expensive but slower alternative.

The other two systems are built around more conventional Intel Pentium systems and come complete with system board, memory, hard disk, network interface cards (NICs), and video subsystems. To this the manufacturers add all the software and hardware needed to create a system that can serve CD-ROMs.

We were unable to get two additional systems that we received to run. One, a Cutting Edge CDPowerServ, was configured for NetWare, but not Windows NT; the NetWare software was inoperable. Our attempt to install and configure NT—despite consultation with Cutting Edge and its network software supplier, Ornetix—was unsuccessful.

We also passed on a Plextor PlexServer NT system. The device arrived with 16 MB of RAM, which Plextor said was the standard configuration for the unit. The software that Plextor provided, however, clearly states that it requires a minimum of 32 MB to run. As received, the system would boot but was unable to run any benchmarks.

Setup of the MicroTest DiscPort Tower-7 was problematic. The provided software did not work, but we were able to set it up using a separate PC as a server. And the TAC Systems HotSwap LanRedi TowerDrive ran two of our three performance tests but could not complete the full set. TAC tentatively attributed the cause to a problem in the firmware on the Toshiba CD-ROM drives.

(Dis)Economies of Scale

The need for shared access to CDs generally occurs first at the department or workgroup level. Most existing networked PCs don't have CD-ROM drives. And while the price for an individual CD-ROM drive is relatively low, equipping each workstation in a department or workgroup with its own drive is not cost-effective. A multiplicity of drives implies too many copies of applications, data disks, and license agreements.

As deployment naturally evolves to the enterprise level, other problems crop up. Logistics aside, the massive distribution

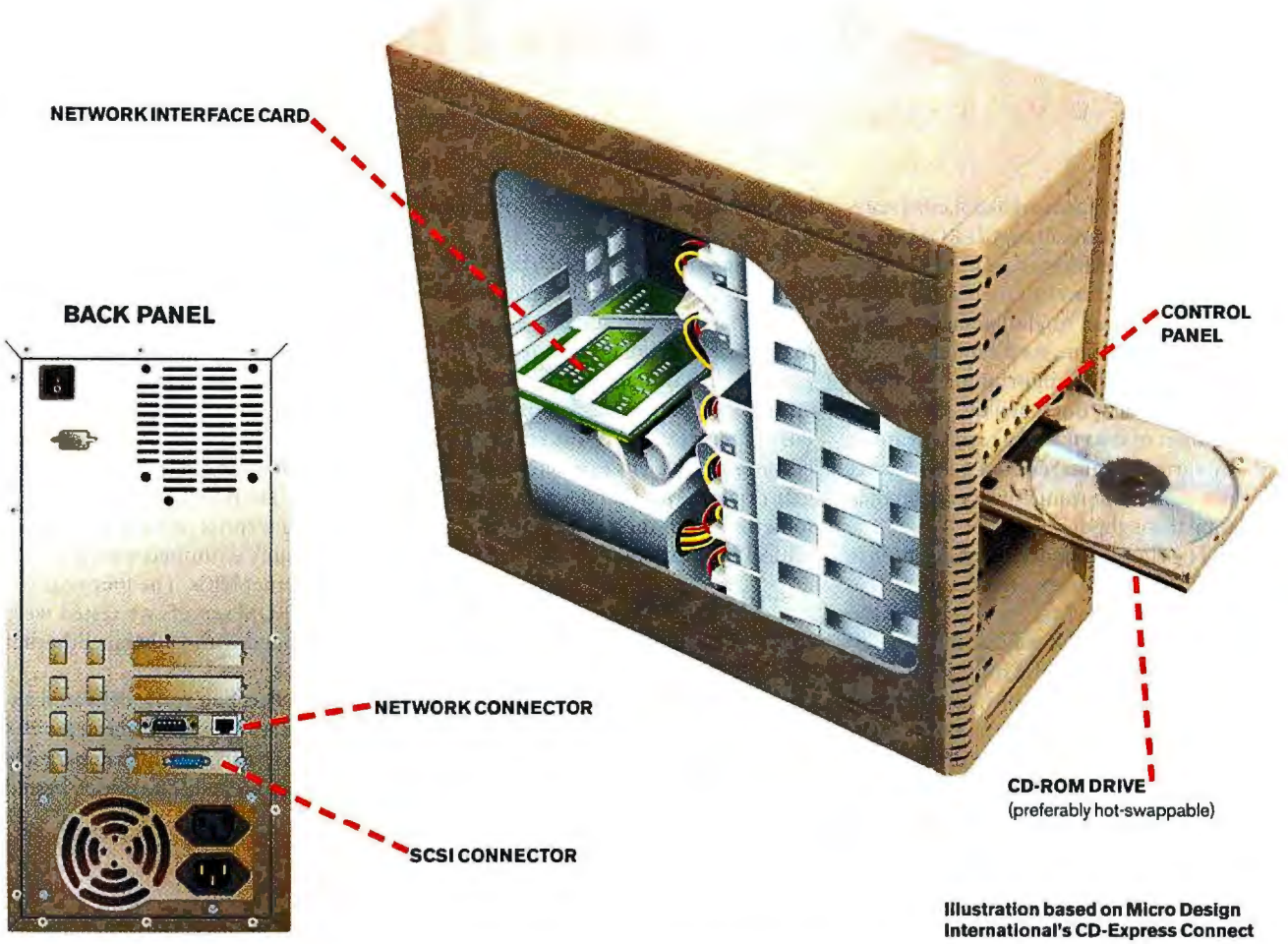

Illustration based on Micro Design International's CD-Express Connect

of CDs is proscribed in situations where data is updated frequently or security is a concern. Networked CD-ROM drives, by comparison, incur lower hardware and software costs and eliminate the need to retrofit each PC in a workgroup.

One Goal, Many Paths

Network administrators everywhere must solve several concurrent problems. They must give access to data to many users over a network. They must serve an increasing number of discs. And, on the practical side, they must keep administration and configuration chores to a minimum. Several different solutions are currently used.

One common method of networking CD-ROM drives is simply to attach them directly to an existing file server. This solution requires a file server that has sufficient processor and memory resources available. This works well for single-protocol workgroups where administration is located close to the server hardware.

Another solution, the peer-to-peer approach, is common in the Unix world. Software loaded on each workstation communicates directly with networking software loaded on a dedicated CD-ROM server. Using existing workstations in this way makes for a cost-effective solution. But the client software consumes resources on every workstation and creates additional administrative chores.

A third solution, using a dependent CD-ROM server, lets you connect a series of CD-ROM drives or a tower unit anywhere on the network. Although the dependent server has no direct connection to its supervising PC, it still requires a software module on the server to control it. The main disadvantage of this approach is that CD-ROM requests must travel twice on the network—once from the client to the server, and again from the server to the CD-ROM tower.

A high-performance, low-impact solution can be obtained using an independent CD-ROM server that connects directly to the network and operates without the aid of any file server. The CD-ROM server contains its own software and hardware, does not tax other file-server resources, and communicates directly with clients.

Because an independent CD-ROM server appears as a true file server to the network, it doesn't require you to load special software onto clients, thus eliminating the need to distribute, configure, and update the clients. Adding an independent CD-ROM server to the network is quick and easy, requiring only standard network OS management utilities. Some independent CD-ROM servers offer support for multiple protocols. A single server, for example, can operate simultaneously in NetWare, Windows, OS/2, Unix, and Web environments.

Contributors
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ILLUSTRATION: SANDERS/TIKKANEN DESIGN & ILLUSTRATION © 1997

Best Overall

CD-ROM SERVERS

It's hard to make blanket statements about CD-ROM server performance. In heavy-traffic environments, CD-ROM servers that can single-handedly fill the Ethernet pipeline spend much of their time waiting for opportunities to transmit their data. But when the same small amount of data must be read repeatedly by various clients, cached performance is a more important consideration than total throughput.

The clear leader in our testing, both in the PC-based server category as well as overall, was the Microtest DiscPort Enterprise Server. Not only did the DiscPort Enterprise turn in the most impressive results in all three of our data-delivery tests, it also ranked highest in the number of features offered. The device's lack of adequate documentation, however, lowered its usability score to somewhat below average.

Although it couldn't match the performance of the DiscPort Enterprise, the Boffin 7 Bay Tower nonetheless turned in top marks in the non-PC server category. Its data throughput never exceeded about 60 percent of that of the DiscPort Enterprise, but it was impressively consistent. Given its easy setup and bargain price, the Boffin 7 deserves a serious look for all but the most performance-critical applications.

Serving Data

In the uncached data test, we measured how fast each CD-ROM server could satisfy a unique request from a single client for a sequential file read from a single file on a single CD-ROM. In theory, the maximum rate of data delivery from the server to the client is constrained to either the CD-ROM drive's transfer rate or the bandwidth of the network, whichever is smaller.

All the systems that we tested used 8X or 12X SCSI CD-ROM drives, so the only external hardware-imposed performance limit was the Ethernet connection. Internally, your choice of SCSI and network hardware might create a performance bottleneck. The two PC-based servers, the DiscPort Enterprise and the Excel CDS-14, both came equipped with 10-/100-Mbps Ethernet NICs. The four non-PC-based CD-ROM servers we tested were each equipped with 10-Mbps Ethernet connections.

The DiscPort Enterprise delivered uncached data at 51 percent of the network's maximum capacity, which is a remarkable achievement indeed. The device bested

Gauging Bang for the Buck

The advantages of adding a dedicated CD-ROM server to your network are clear. A system that serves CDs responsively, allows easy management and control, and—most important—doesn't negatively impact your network infrastructure is obviously a net gain. But when you are defining true value, you must carefully weigh the perceived benefits against the real costs.

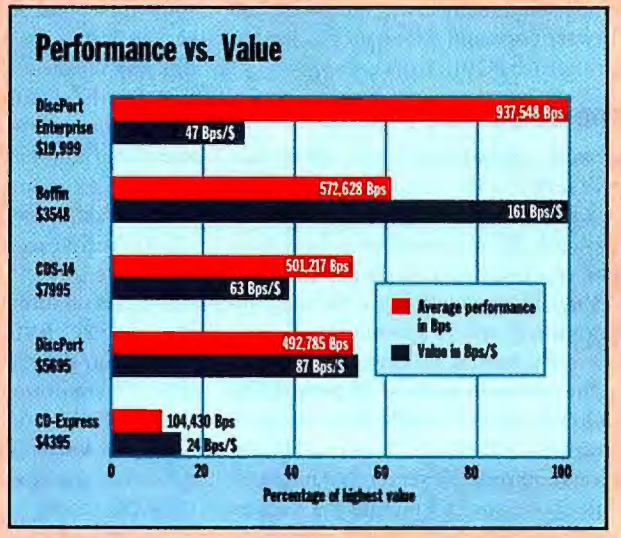
The accompanying graph shows two interesting gauges of the tested systems. The first set of data shows the average throughput of each system across the three performance tests, in bytes per second. The second data set shows how much it costs to get that throughput, measured in bytes per second per dollar.

The Microtest DiscPort Enterprise Server turns in the highest average throughput of any system we tested: 937,548 Bps. This performance is extremely pricey, however. At $19,999, the DiscPort Enterprise was—by a wide margin—the most expensive system we tested. The runner-up, the Boffin 7 Bay Tower, was able to turn in only about 60 percent of the DiscPort Enterprise's performance.

In terms of real value for the dollar, however, the 7 Bay is the clear leader. Priced at $3548, it delivers data at the highly cost-effective rate of 161 Bps/dollar. This is nearly four times the DiscPort Enterprise's 47-Bps/dollar performance.

Your first instinct might be to buy a single high-performance server for the entire network. In that case, total throughput is important for serving many simultaneous clients across an enterprise-level network. When a single central CD-ROM server makes sense, the extra performance edge that the DiscPort Enterprise provides could be worth the premium.

On the other hand, having several CD-ROM servers distributed across a network, such as at the workgroup level, might be a more logical topology for your application. (Does accounting really need to read engineering's CDs?) Isolated servers can reduce the need for swapping discs, enhance security, and, in the case of the Boffin 7 Bay, save you money and increase your network's effective throughput.



Performance and price are often at odds, but here the least expensive system provides the best value per dollar.

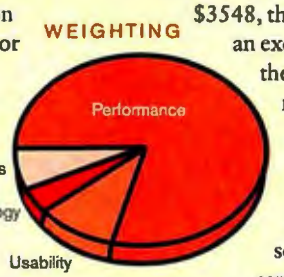
LAB RESULTS

CD-ROM SERVERS

BEST OVERALL/ BEST PC-BASED SERVER

Microtest Enterprise Group DiscPort Enterprise Server for Windows NT

The DiscPort Enterprise Server is the champion of the crop, equaling or outperforming the other systems consistently. Providing near-maximum throughput under all conditions, it's the best choice for high-demand environments where performance is the only concern. For less demanding applications, however, its high price makes it a poor value for the money.



BEST NON-PC SERVER

Boffin 7 Bay Tower

Located at the opposite end of the price spectrum from the DiscPort Enterprise Server, the Boffin 7 Bay offers middle-of-the-road performance but does so consistently, regardless of demand. At a price of just $3548, the device represents an exceptional value for the money. Unless money is no object, this unit deserves serious consideration for a role as your primary or secondary CD-ROM server.

	PRICE	TECHNOLOGY	IMPLEMENTATION	PERFORMANCE	FEATURES	USABILITY	OVERALL RATING
Microtest Enterprise Group DiscPort Enterprise Server	**$19,999**	★★★	★★★	★★★★★	★★★★★	★★★	★★★★★
Boffin 7 Bay Tower	$3548	★★★	★★★	★★★	★★★★	★★★	★★★
Excel CDS-14	$7995	★★★	★★★	★★	★★★★	★★★★	★★★
MDI CD-Express Connect	$4395	★★★	★★★	★	★★★★	★★★	★
Microtest DiscPort Tower-7	$5695	★★★	★★★	★★★	★★★★	★★★	★★★
TAC Systems HotSwap LanRedi TowerDrive	$11,050	★★★	★★★	★	★★★★★	★★★★	★

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

its nearest competitor in this test, the Boffin 7 Bay, by 34 percent, and the MDI CD-Express Connect by a staggering 750 percent.

The cached-data test provides an insight into both the adequacy of the server's cache and the design of the CD-ROM-drive-to-Ethernet data path. A system with effective caching should be able to deliver the requested data at memory speed, subject to the bandwidth limitation of the Ethernet port.

With the DiscPort Enterprise, DiscPort Tower-7, and Excel CDS-14, the cached-data performance did indeed jump to approximately 80 percent of Ethernet capacity. Meanwhile, the Boffin 7 Bay showed only a minor improvement over its uncached performance, which is symptomatic of a too-small cache. The CD-Express Connect exhibited no significant performance change compared to its uncached performance.

Juggling Conflicts

We designed the multiple-client/multiple-disc test to stress the server systems and evaluate their ability to manage contention for the network, internal SCSI bus, and cache. Again, the DiscPort Enterprise led the pack, delivering the same aggregate amount of data as it did in the single-client test, but divided essentially equally among seven clients.

The Excel CDS-14 and DiscPort Tower-7, both of which performed well in the cached-data test, fared poorly under the strain of serving multiple high-demand clients. These systems, which had previously managed to fill over 80 percent of the available network bandwidth when delivering data to a single client, dropped to 24 percent and 12 percent of network bandwidth, respectively, when attempting to serve multiple users. Again, the data that was delivered in our tests, though of reduced quantity, was approximately equally divided among the clients.

The TAC Systems HotSwap LanRedi TowerDrive, which scored well in the uncached single-client tests, would not run the multiclient test at all. This unit is based on the same Axis StorPoint technology as the Boffin 7 Bay Tower, but while the 7 Bay uses Plextor drives, the TowerDrive uses drives from Toshiba. Because TAC was unable to resolve the problems we encountered with this system, we gave the TowerDrive poor performance and overall-score ratings.

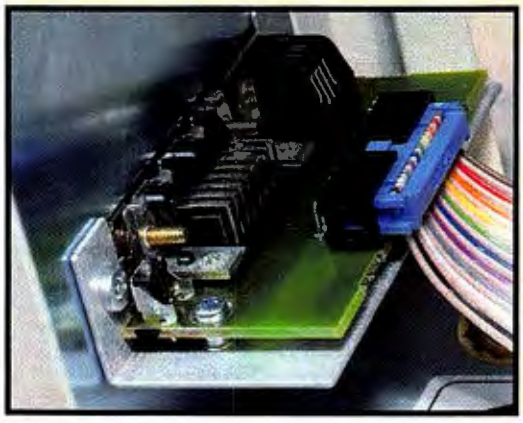
In the multiclient test, as in the others, the 7 Bay clung tenaciously to the middle of the performance range, filling from 38 percent to 49 percent of the Ethernet pipeline regardless of cache status or number of users. Still, given the 7 Bay's aggressively low price, this moderate but consistent performance is entirely reasonable and a good value.

PHOTOGRAPHS: BRIAN WILDER © 1997

Details

Microtest's Honkin' Server on Wheels

Mounting the Microtest DiscPort Enterprise Server on rollers is a necessity. Typical of the larger server models, its sheer bulk and weight mean you won't be carrying it around the office. As compensation, you get plenty of space for expansion. A blind-mate backplane (which makes plugging in drives a simple, "blind" operation) allows the CD-ROM drives, each in its own pop-out tray, to be replaced easily. And the large power supply and plenty of extra cooling allow the unit to easily handle a large number of drives.



Just Boffin Along

At the opposite extreme of stature from the DiscPort Enterprise is the Boffin 7 Bay Tower. Compact, and with no wasted space, this unit is the ideal candidate for remote installations or workgroup applications. Its compact SCSI-to-Ethernet connector provides multiprotocol support that makes it a viable plug-and-play addition to nearly any network.

TECH FOCUS | PERFORMANCE

Calculating Throughput

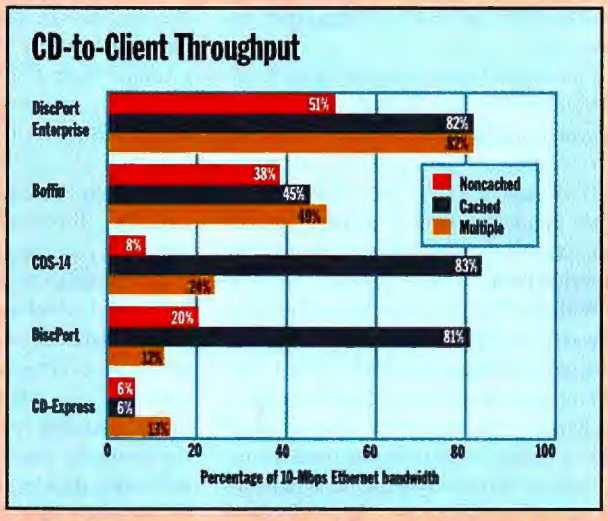
Several factors conspire to reduce the bandwidth that a CD-ROM server can deliver. The data transfer from the server must deal with the bandwidth and latency imposed by its CD-ROM drive, SCSI bus, and network interface card (NIC). On the receiving end, similar inefficiencies apply.

A detailed analysis of transmission protocols, packet sizes, overhead, and other variables might be interesting in the abstract. But for evaluating these servers, it's simpler to do a back-of-the-napkin calculation based on the full 10-Mbps Ethernet bandwidth.

All the systems we tested use 8X or 12X CD-ROM drives, providing 1200- and 1800-Kbps transfer rates, respectively. All drives were connected to a fast SCSI or equivalent, providing approximately 10-Mbps bandwidth. We measured the performance of the servers directly in bytes per second delivered to the client.

The graph at right shows the data delivered by each server in each of the three tests as a percentage of Ethernet bandwidth. The highest scores range from 81 percent to 83 percent bandwidth. This is consistent with a ballpark estimate of 15 percent to 20 percent overhead on the network, and it represents saturation. Servers scoring high in this test are in a good position to fill requests quickly.

Lower scores indicate that the server was unable to collect and transmit data fast enough to fill the network pipe. If you assume that other network traffic would likely reduce the available bandwidth by half, percentages as low as 40 percent still represent respectable throughput. Scores below 40 percent are indicative of unresolved contentions within the server itself.



The ability of these servers to fill the network pipeline varied from excellent to unacceptable.

Test Specs

We rated these CD-ROM servers based on their performance, usability, features, technology, and price (all on a scale of one to five stars, except for price). We derived the performance rating by averaging the results from three equally weighted tests. Each performance test measured the systems' performance under various conditions that occur in a real-world network environment, including network and data contention.

The overall-rating score comes from a 65:20:10:5 weighted rating of performance, usability, features, and technology, respectively (see the pie chart on page 125). Because performance is the overriding concern with servers, we gave it the highest weighting in our overall rating. We judged system performance based on raw throughput.

Test Methodology

We connected each CD-ROM server individually to a 10-Mbps Ethernet network using the network interface adapters provided with each product. Each server was configured according to the manufacturer's directions. Setup included installing any provided software needed to make the server and the CD-ROM drives visible to the test network. When CD-ROM management programs were provided, we installed and evaluated them to gauge their ease of installation. However, the servers we tested provide network access without these tools.

Our test network comprised three Dell Optiplex Pro GXs that had dual 200-MHz Pentium Pro processors and 64 MB of RAM. The OS for all six systems was Windows NT Server 4.0. We attached each of the client systems to the network through an Ethernet hub and cables.

Our performance test software is a proprietary application developed by NSTL. Executed from a client system, it makes file-read requests from a drive mapped to a CD-ROM drive in the server system. The application reads a specified number of 16-KB sequential blocks of data from a contiguous 650-MB file on a specially authored CD.

Each read test is executed for a fixed period of time. Then the cumulative number of bytes read is reported and the performance, in bytes per second, is calculated. Thus, the tests measure throughput speed for sequential reads of one file.

No evaluation of random-read speed was conducted, as random reads are far less frequent than sequential reads. Because all files are written to the original CD-ROM in sequential fashion, there's no file fragmentation. In addition, each CD-ROM drive in the system under test was loaded with an identical CD-ROM disc to eliminate variances in performance due to file size or location on the disc.

Cache Evaluation

Our first performance test evaluates data transfer speed when reading uncached data. The CD-ROM server is rebooted to ensure that no data is cached. A single client system requests 1000 16-KB blocks of data from a single mapped CD-ROM drive. Because this is the first time the server reads the information from the CD, neither server- nor client-based caching has an effect on performance. Theoretically, the throughput for this test should closely match the maximum data-delivery speed of the CD-ROM drive itself.

The second performance test measures the efficacy of the CD-ROM server's caching. A second, different workstation reads the identical 1000 blocks of data from the same file on the same CD. We found that it was vital to use a different workstation here; if we used the same workstation, NT's caching completed the test with no network activity at all.

In this test, the impact of the server cache is isolated; the server should cache the data from the previous test. If the CD-ROM server has enough cache to hold the entire section of the file read in the test, the data transfer speed should approach the speed of the network interface. These two single-client tests provide an indication of the CD-ROM's data transfer speed and the effects of server-side caching.

The third test maximizes contention for SCSI and network bandwidth so well that the TAC Systems HotSwap LanRedi TowerDrive was unable to complete it. We used a single-client system for this test and mapped each of seven CD-ROM drives on the server being evaluated to an individual drive letter. Then we started seven iterations of the test program simultaneously as separate tasks in separate sessions.

For this test, each program requested 2000 16-KB sequential blocks of data. To properly service these requests, the CD-ROM server must manage the data traffic across the network interface as well as the use of its SCSI channel. The total throughput for the test is the sum of the throughputs for each individual session.

On the fastest servers with the fastest drives, the aggregate throughput closely approaches the limit of network speed. The larger the number of CD-ROM drives, and the faster each drive was (the systems came with 8X and 12X drives), the more likely the response time under high loads will be restricted by the pipeline.

In high-traffic environments, the network bandwidth of the CD-ROM server might be a factor when you choose your system. The four systems with specialized SCSI/network-interface-card (NIC) connectors—the Boffin 7 Bay Tower, MDI CD-Express Connect, Microtest DiscPort Tower-7, and TAC HotSwap LanRedi TowerDrive—offered only a 10-Mbps network interface. The two systems we tested that included full-blown servers, the Excel CDS-14 and Microtest Enterprise Group DiscPort Enterprise Server, supported 100-Mbps network adapters.

Several of the devices offer software that implements a strategy known as *load balancing*. Load-balancing software allows you to load several identical copies of a CD-ROM onto the same system. In a situation where many users require simultaneous access to the same files, the server automatically rolls over the requests to the next free CD-ROM drive to avoid contention and reduce the overall waiting period for users.

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; editors@nstl.com. For a subscription, call (800) 328-2776. BYTE magazine and NSTL are both operating units of The McGraw-Hill Companies, Inc.*

CD-ROM SERVERS FEATURES

	Boffin, Ltd., Boffin 7 Bay Tower with Plextor 12x Drives and Axis StorPoint	Excel Computer Excel CDS-14	Micro Design International, Inc. CD-Express Connect
Price as tested (MSRP)	$3548	$7995	$4395
Overall rating	★★★	★★★	★
SPECIFICATIONS			
CPU manufacturer and model	Axis Etrax	Intel Pentium	AMD 80186
Memory	32 MB	128 MB	N/A
Floppy drive		✔	
Maximum number of CD-ROM drives	7	14	14
Hot-swappable CD-ROM drives	Optional		
Serial interface		✔	✔
Internal form factor	Half-height	Half-height	Full-height
CD-ROM DRIVE SPECIFICATIONS			
Manufacturer and model	Plextor PX-12TSi	Toshiba XM-5701B	NEC CDR-1410A
Sustained data transfer rate	1.8 MBps	1800 KBps	1200 KBps
Burst data transfer rate (synchronous)	20 MBps	10 MBps	10 MBps
Burst data transfer rate (asynchronous)	56 MBps	5 MBps	5 MBps
Maximum spin rate (rpm)	6360	6360	1840
Average random seek time (ms)	95	115	130
Spin-up time (seconds)	1.2	5	4
SCSI CONTROLLER			
Manufacturer and model	Axis Etrax	Adaptec 2940 & 3940 Twin	N/A
Fast	✔	✔	
Cache	✔		
External SCSI connector		✔	
Multichannel		✔	
Maximum number of drives supported	7	56	7–14
CASE			
Height × width × depth (inches)	15.75 × 7.5 × 16	33 × 14 × 25	16.1 × 6.5 × 16.5
Weight (pounds)	30	110	39
Power-supply quantity/wattage	1/250	2/250 each	1/200
NETWORK ENVIRONMENTS			
NetWare 3.x and 4.x	✔	✔	✔
Windows 3.11, 95, and NT 4.0	✔	✔	✔
Microsoft LAN Manager	✔		✔
IBM OS/2 LAN Server	✔		✔
Unix	NFS		PCNFS, Sun Solaris
Macintosh			
NETWORK CONNECTIONS			
Ethernet 10Base-T (twisted-pair)	✔	✔	✔
Ethernet 10Base-2 (thin)	✔	✔	✔
Token Ring	Optional	Optional	
FDDI	✔	Optional	
Number of simultaneous users	255	Unlimited	20–50, depending on usage
CUSTOMER SUPPORT			
Warranty length (years)/coverage	1/P, L, R	2/P, L, F, R	1/P, L, F, R
Toll-free phone	800-248-5328	800-995-1014	800-228-0891
Phone	612-894-0595	972-980-7098	407-677-8333
On-line address	http://www.boffin.com	http://www.excelcdrom.com	http://www.mdi.com
Inquiry number	**1093**	**1094**	**1095**

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

Microtest, Inc. DiscPort Tower-7 8x CD-ROM Drive	Microtest Enterprise Group DiscPort Enterprise Server for Windows NT	TAC Systems, Inc. HotSwap LanRedi TowerDrive
$5695	$19,999	$11,050
★★★	★★★★★	★
*	Intel Pentium	Axis StorPoint
*	64 MB	2–32 MB
	✔	
7	56	14
	✔	✔
	✔	✔
Half-height	Half-height	Half-height
NEC 1410	Toshiba XM-5701B	Toshiba XM-5701B
1200 KBps	1.8 MBps	1800 KBps
10 MBps	10 MBps	10 MBps
5 MBps	10 MBps	1.7 MBps
INP	2400–6360	1000
130	115	115
INP	3	4
N/A	Adaptec 3940U	N/A
	✔	
		✔
✔	✔	
	✔	
7	14	7
20×10×13	35×10.75×24	32×7×16
50	112	60
1/250	1/450	2/250 each
✔	✔	✔
✔	✔	✔
	✔	✔
	✔	✔
	✔	All
✔	✔	✔
✔	✔	✔
✔		Optional
✔	✔	✔
	✔	
Unlimited	NT Server maximum	128
1/P, L	1/P, L, F, R	1/P, L, R
800-526-9675	800-880-5644	800-659-4440
602-952-6400	603-880-0300	205-721-1976
http://www.microtest.com	http://www.microtest.com	http://www.tacsystems.com
1096	**1097**	**1098**

* The DiscPort Tower-7 attaches logically to a real server. Because of that, it doesn't have a CPU, L2 cache, memory, or hard disk.

INP = information not provided by CD-ROM manufacturer.

Firewall Software for NT and Unix

All kinds of people are trying to get into your organization through the Internet. These software firewalls help keep out the riffraff.

By David Seachrist and Helen Holzbaur

Over the past year or so, organizations as clever and exalted as the Central Intelligence Agency, the U.S. Department of Justice, and NASA have had their Web sites hacked. If the spooks, wonks, and rocket scientists are having trouble protecting their Internet assets, how successful is the average IS department likely to be?

Help is available from Internet firewalls. They can keep unauthorized visitors from accessing sensitive resources inside the corporate intranet while still allowing access to public resources like the corporate Web server. Even if the Internet server isn't connected to an internal network, a firewall can help protect the integrity of data published there. While some network resources are too sensitive to expose to the Internet through a firewall, most organizations with any Internet connectivity can use one—it's just good security policy.

One firewall benefit is screening out the details of your site and intranet from prying eyes: The less outsiders know about your network, the harder it is to attack. Even if your Web server is isolated from your intranet, a firewall is still a good idea for screening the server from unfriendly probes and thwarting HTML vandals. And it's an absolute necessity if the server supports commercial transactions.

For this report, we tested six Unix products and three Windows NT products. All the Unix packages use a "hardened" version of the OS, in which as many security holes as possible are plugged: usually unnecessary system services that vandals like to use as toeholds to gain access to servers and connected systems. The three Windows NT products we tested—AltaVista FireWall 97, Centri, and Eagle—build on NT's security model, which is designed for C2-level security as defined by the U.S. Department of Defense.

We tested these servers for performance under typical real-world network loads and for how well they handled typical Internet attacks, as well as for ease of use and configurability, which are equally important in light of the 90 percent or more of security breaches that result from improper firewall configuration.

Of the nine packages tested, CyberGuard's CyberGuard Firewall tied with three others for a near-perfect security score, but it edged out its two closest competitors with a combination of the best features, easiest management, and respectable performance.

BYTE BEST
INTERNET FIREWALL

CyberGuard Firewall
outperformed all other products in everything but performance, where it still came in well above average. Its ease of use makes it an ideal choice for companies seeking to leverage their internal expertise instead of hiring an Internet security expert.

Two runners-up are also worthy. AltaVista Firewall 97 overcomes its relative lack of features (like the absence of a hardened OS) with top performance and a simple management interface. Check Point Firewall-1's full feature set and high performance are countered by its less-than-perfect configuration tools.

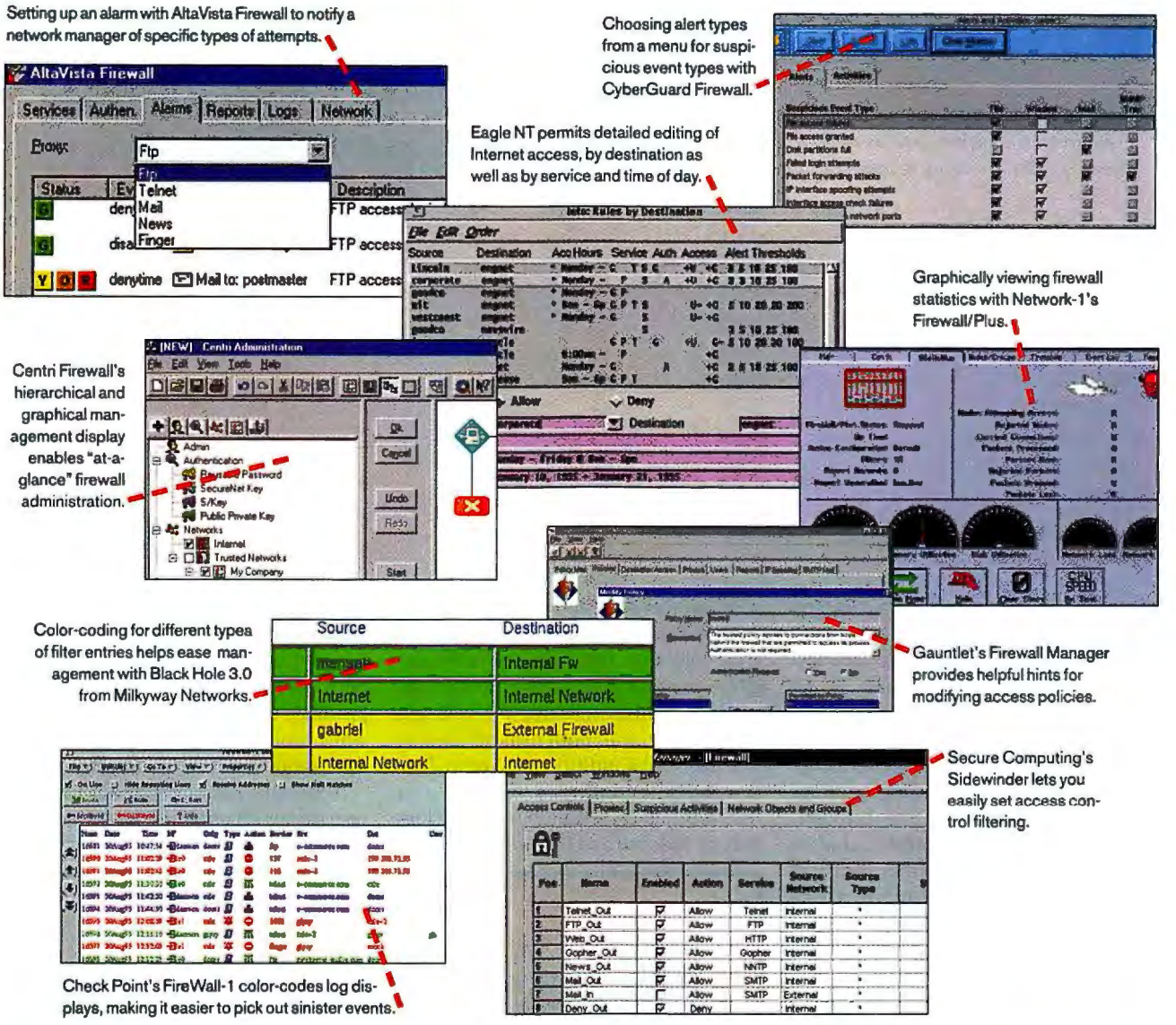
Big Hack Attacks

The NSTL security test suite uses two different name servers, both located in the same domain. One is situated on the private network. Its purpose is to handle name-service requests on the private network. The other name server is located on a segment of the network known as the demilitarized zone. The purpose of this second server is to handle all name-service requests for the private network that cannot be handled by the private network's Domain Naming System (DNS) machine. In effect, it acts as the "root" name server to the Internet.

The results of the security tests show that all nine products offer high levels of security when properly configured. To assure proper configuration, vendors set up their own products for the security tests. Most of the firewalls we tested managed to detect all but one or two of the nearly 100 simulated attacks. None of the programs failed during attacks deemed to be high risk in nature. Centri Firewall and Eagle NT Firewall each failed a medium-risk attack. Centri Firewall failed three low-risk attacks; Eagle NT Firewall failed two. Black Hole failed two medium-risk and nine low-risk attacks. Gauntlet and Sidewinder Security Server failed two low-risk attacks. The other products each failed only one low-risk attack.

What About the OS?

Unix and NT both have exploitable security weaknesses. For example, if a hacker cracks the Unix root account (with read and write access to all system resources), the entire network and its resources are at the hacker's command. Windows NT



Running a firewall is not a trivial task, so vendors provide network managers with a variety of tools for choosing types of alerts, scanning entry attempts, and setting up access control filters.

offers an option to store passwords in cleartext in the system registry, which, if enabled, puts those accounts at risk. Various system and network services, notoriously the Unix sendmail program, can also offer hackers a backdoor through which they can gain access to the operating system.

Often weaknesses in network security are as much a problem of proper configuration as the OS's design. The main thing is to remove unnecessary services and locate as many "holes" as possible and configure the network in a way that is both usable and secure. Most of the vendors offer their software with securely configured OSes, usually some variant of Unix.

Micromanaging the Firewall

Since one can never tell when and where security break-ins might occur, firewall programs that allow remote notification of the system administrator are very handy. If a program can alert the network manager to a security breach by pager, then the response time to shut down the system will be much faster than if you have to browse through the system logs the next day. In addition, the ability to shut down further access from a remote site is preferable to requiring the network administrator to drive from home to the office when breaches occur after hours.

All the firewalls we tested, except FireWall/Plus, can notify the system administrator by e-mail or pager in the event of an attack; the notification capabilities of Centri Firewall and Black Hole were slightly more difficult to configure than those of the other products. Centri Firewall and FireWall/Plus are the only two that do not allow administrators to turn off outside access to a site remotely. Of the products that do, Black Hole and Sidewinder Security Server required the most effort to accomplish.

Logging and Tracing

When an attempt to enter the system fails, you might not want the system to page you at home, but you do want the firewall to

INTERNET FIREWALL SOFTWARE RATINGS

BEST OVERALL

CyberGuard Firewall

This program combines usability and lots of features with top security and performance.

	SECURITY	MANAGEMENT	FEATURES	PERFORMANCE	TECHNOLOGY	OVERALL EVALUATION
CyberGuard Firewall	★★★★★	★★★★	★★★★★	★★★★	★★★★★	★★★★★
AltaVista Firewall 97	★★★★★	★★★★	★★★	★★★★★	★★★★	★★★★
Black Hole	★★★	★★	★★★	★	★★★	★★★
Centri Firewall	★★★	★★	★	★★★★	★★★★	★★★
Check Point FireWall-1	★★★★★	★★★	★★★★★	★★★★★	★★★	★★★★
Eagle NT Firewall	★★★	★★★	★★★	★	★★★★	★★★
Firewall/Plus	★★★★★	★	★★	★	★★	★★
Gauntlet Internet Firewall	★★★★	★★★	★★★★	★	★★★	★★★
Sidewinder Security Server	★★★★	★★★	★★★	★	★★★	★★★
AVERAGE	★★★★	★★★	★★★	★★	★★★	★★★

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

record the attempt. Firewalls that log and attempt to trace addresses of failed authentication are helpful in spoiling the attempts of unwanted visitors to break in.

AltaVista Firewall 97, Black Hole, and Sidewinder Security Server scored highest in the management scenario that measures the firewall's logging function; they offer the widest breadth of circumstances in which information could be sent to a log file. Every other program offered adequate logging functions except Gauntlet, which logged entries in only two of the 11 logging trigger scenarios. Only two firewalls allowed running traceroute or finger on an attacking machine: Eagle and Sidewinder.

Preventing Denial of Service

In addition to actual break-ins, some inconsiderate hackers cause annoyance attacks by flooding a Web site with requests, thus blocking access to the site by other users. Firewalls should be able to prevent such denial-of-service attacks. All nine programs protect well against SYN flooding and the Ping of Death. But the firewalls vary in how they handle full logs and disk-full errors (in both scenarios, the most secure option is for the system to shut down).

CyberGuard Firewall shuts down during both disk-full and log-full error conditions. AltaVista Firewall 97 and Sidewinder Security Server both shut down on a disk-full error, but they simply rotate log files on a log-full error. Black Hole and Gauntlet deny access in disk-full situations. Gauntlet rotates logs in a log-full error condition. Black Hole turns off logging—the least preferable action to take with a log-full error. Centri Firewall and Eagle NT Firewall both turn off logging in a disk-full condition and rotate logs in a log-full condition. Check Point FireWall-1 and FireWall/Plus turn off logs in both disk-full and log-full conditions.

Transparent Protection

Security is essential, but you can't overlook how it might be affecting routine operations. With this in mind, NSTL looked for products that allow all outgoing access while protecting against external attacks that "spoof" internal IP addresses.

Although all nine programs place no restrictions on outgoing access and protect against IP spoofing, configuring the

Firewall Technology Trade-Offs

The four basic firewall technologies involve clear trade-offs that differentiate them from each other:

Filtering gateways make routing decisions based on information in network packets. If a packet passes the security criteria, the gateway passes it through. Filtering gateways are easy to build but difficult to configure securely. Because filters pass traffic directly from an untrusted network, they are not as secure as other gateways.

Circuit-level gateways operate at the session level and require modified clients to communicate directly with the gateway, which appears to the outside host as the session originator. Typically these gateways use a state table listing valid connections, with subsequent connections granted or denied by comparing the request with state table data. Circuit gateways are less useful in environments where users need several types of Internet service or where in-bound services must be provided.

Application-level gateways (aka proxies) operate at the application level, negotiating each client/server connection made between a host on the trusted network and a host outside. Like the circuit gateway, they never directly link trusted and untrusted networks. Hosts inside the trusted network point their clients to the application gateway, which accepts client requests (e.g., HTTP, Telnet, or FTP) and relays them to an external destination host as if the firewall were the requesting client. The firewall accepts replies from outside and resends them to the internal client. Operating at the application layer enables features such as user authentication and protocol-specific filters like ActiveX blocks.

Stateful inspection uses a table of rules in which the firewall administrator defines parameters for the different services on your network. The firewall then tests the "state" of TCP traffic as it passes through the firewall by checking it against the state table. Although stateful inspection detects many known attacks, with many more added as they become known, if the state table becomes corrupt the network has a chance of being exposed.

–David Seachrist

FEATURES

	AltaVista Firewall 97	Black Hole	Centri Firewall	Check Point FireWall-1	CyberGuard Firewall	Eagle NT Firewall	FireWall/ Plus	Gauntlet Internet Firewall	Sidewinder Security Server
DESIGN									
Packet filter	✔		✔		✔		✔		
Application proxy	✔	✔	✔		✔	✔		✔	✔
Circuit relay	✔		✔		✔	✔		✔	✔
Stateful inspection				✔	✔		✔		
Other architecture					DH	ED			TE
OS AVAILABLE	BSDI Unix, Digital Unix/ Ultrix, Windows NT 3.51, NT 4.0	BSDI Unix, SunOS	Windows NT 3.51	HP Unix, Solaris, SunOS, Windows 95, Windows NT 3.51, NT 4.0	AT&T SVR4 Unix, SCO Unix w/security enhancements	HP Unix, Solaris, Windows NT 4.0, DG-UX, SINIX	MS-DOS, PC-DOS, Windows NT 3.51, NT 4.0	BSDI Unix, HP Unix, Irix, Solaris, SunOS, Windows NT 4.0	BSDI Unix, Windows NT 4.0
PRICING									
25 users	$3995 (50 nodes)	10 clients/ $2900	$5000	$2995	$9995	$6500	$4500	$11,500	$6995
1000 users	$14,995 (unlimited nodes)	$20,500 (unlimited users)	$15,000	$18,990	$19,995 (unlimited users)	$15,000	$13,000	$11,500	$19,995
INTERFACES (in addition to 10-Mbps Ethernet)									
4- or 16-Mbps Token Ring	✔	✔	✔	✔		✔		✔	
FDDI	✔		✔	✔	✔	✔		✔	✔
25-Mbps ATM	✔		✔	✔				✔	
155-Mbps ATM	✔		✔	✔					
Fast Ethernet	✔		✔	✔	✔	✔	✔	✔	✔
100VG-AnyLAN	✔	✔	✔	✔		✔			
Serial up to T1/E1	✔		✔	✔		✔		✔	
T3/E3	✔		✔	✔				✔	
Asynchronous	✔		✔	✔	✔				
ISDN	✔		✔	✔					
Maximum interfaces	2	13	U	INA	U	U	2	U	4
SUPPORTED SERVICES									
Finger	✔	✔	✔	✔	✔	✔	✔	✔	✔
NFS	✔	✔	✔	✔			✔		
Ping (ICMP)			✔	✔	✔		✔		
RPC			✔	✔			✔		
rlogin, rsh, rcp, etc.			✔	✔	✔		✔	✔	
S-HTTP	✔	✔	✔	✔			✔	✔	✔
SNMP	✔		✔	✔	✔		✔		✔
QuickTime	✔		✔	✔					
Pointcast	✔		✔	✔	✔	✔	✔	✔	
Java content screening	✔		✔	✔	FUT	✔		✔	✔
ActiveX content screening			✔		FUT			✔	
ENCRYPTION									
MD-5	✔			✔	✔	✔		✔	
Radius				✔		✔			✔
SecureID	✔	✔		✔	✔	✔		✔	✔
Socks					✔				
Secure Sockets Layer (SSL)	✔	✔	✔	✔	✔	✔	✔	✔	✔
MANAGEMENT AND CONFIGURATION									
Telnet		✔		✔	✔			✔	✔
Dial-up				✔	✔				
Remote config. allowed?	✔	✔		✔	✔	✔	✔	✔	✔
Remote encryption?	✔	✔		✔	✔	✔	✔	✔	✔
LOG FILTERS									
Time	✔	✔		✔	✔	✔	✔	✔	✔
Source	✔	✔		✔	✔	✔	✔	✔	✔
Packet tracing	✔			✔	✔	✔	✔	✔	
Configuration checking	✔	✔		✔	✔	✔	✔	✔	✔
Central console	✔	✔		✔	✔	✔	✔	✔	✔
Load balancing	✔	✔			✔	✔	✔	✔	✔

✔=Yes; U=Unlimited; INA=information not available; FUT=feature planned for a future release.

programs to accomplish this varies in level of difficulty. With almost no difficulty, Check Point FireWall-1, CyberGuard Firewall, Eagle NT Firewall, and Sidewinder Security Server can be configured to protect against IP spoofing while allowing full outgoing access. AltaVista Firewall 97, Centri Firewall, and FireWall/Plus are almost as easy to configure in this circumstance. Black Hole is average. Gauntlet is difficult to configure to prevent against IP spoofing.

Performance

Another measure of transparency is the load the firewall places on system performance. NSTL uses Intermark, a homebrewed traffic-generation tool, to offer a mix of Web and FTP requests. Intermark creates traffic on all three sides of the firewall, and NSTL measures both throughput and transaction rates over a Fast Ethernet (100-Mbps) test bed.

NSTL performance tests measure throughput in kilobits per second for four levels of user connections: 16, 32, 48, and 64 users. The results show more disparity between programs than between user loads. In general, performance increases or stays the same from a load increase of 16 to 48 users, then takes a marked nosedive when the load goes up to 64 users.

The top three performance winners are AltaVista Firewall 97, Centri Firewall, and Check Point FireWall-1, all of which boast throughput of about 50,000 Kbps and above when 16 to 48 users are connected; they drop to about 40,000 Kbps when 64 users are connected. CyberGuard Firewall offers very acceptable performance of around 40,000 Kbps until it reaches a load of 56 users; it falls off to about 33,000 Kbps at 64 users. Eagle NT Firewall is the only other program to offer consistent throughput rates above 10,000 Kbps for 16 through 64 user loads. Gauntlet provides throughput of about 11,000 Kbps for 16 to 48 users, but it drops steadily after 50 users and offers only about 3200 Kbps when 64 users are connected.

Choosing the Right Wall

Choosing the right firewall requires plenty of consideration, but if you know what your priorities are in terms of security, ease of management and configuration, performance, and scale, then you have a good chance of finding a product that well fits your needs. Beyond the information in this report, you'll find good reference materials at the National Computer Security Association (NCSA) and Internet Security Systems (ISS) Web sites.

The NCSA maintains a site at http://www.ncsa.com that includes a section on firewall security. The group has a certification program that lists the levels of functionality it deems important. NSTL uses ISS's SAFEsuite to verify the security and integrity of firewall software. You can find a complete listing of the attacks used by SAFEsuite at http://www.iss.net/tech/techspec.html. B

TECH FOCUS BUSY SIGNALS

Denial Isn't Just a River in Egypt

Denial-of-service attacks are a serious threat, and any good firewall should be able to stop at least some of them. Two have gotten a lot of attention because they take advantage of the openness of TCP/IP protocols.

Ping of Death: IP datagrams larger than 65,535 bytes are "illegal," but some TCP/IP implementations incorrectly attempt to process them. Because large datagrams are almost always fragmented and hosts don't start reconstructing datagrams until receiving the last fragment, when illegal datagrams are accepted, some TCP/IP stacks will crash the system that is attempting to process them. This attack uses Ping (a semi-acronym for Packet Internet Groper) because all TCP/IP hosts support it and it's easy to use; the attack itself requires only one command line.

SYN flooding: When hosts use Transmission Control Protocol (TCP of TCP/IP) for virtual circuit service, they use a three-way handshake protocol to negotiate the link. Every time a host is asked to open a TCP link, it responds with the second part of the handshake and waits for acknowledgment from the requesting host to open the circuit. Attackers generate a flood of TCP SYN (for "synchronize") requests to a server, but they never answer the server's responses. The server must allocate resources to handle these phony requests, in some cases tying up all the server's available resources.

–Pete Loshin

PRODUCT INFORMATION

AltaVista Firewall 97 (beta)
$3995 for 50 nodes
AltaVista Internet Software
Littleton, MA
508-486-2308
http://altavista.software.digital.com
Circle 1007 on Inquiry Card.

Black Hole 3.0
$2900 for 10 users
Milkyway Networks
Santa Clara, CA
408-566-0800
http://www.milkyway.com
Circle 1008 on Inquiry Card.

Centri Firewall 3.1.2
$6000 for 50 users
Global Internet Software Group
Monticello, IL
800-682-5550
http://www.gi.net
Circle 1009 on Inquiry Card.

Check Point FireWall-1 2.1
$2995 for 25 users
Check Point Software Technologies
Redwood City, CA
800-429-4391
http://www.checkpoint.com
Circle 1010 on Inquiry Card.

CyberGuard Firewall 3
$9995 for 25 users
CyberGuard Corp.
Ft. Lauderdale, FL
800-666-4273
http://www.cyberguardcorp.com
Circle 1011 on Inquiry Card.

Eagle NT Firewall 4.0
$6500 for 50 users
Raptor Systems
Waltham, MA
617-487-7700
http://www.raptor.com
Circle 1012 on Inquiry Card.

FireWall/Plus 3.0
$4500 for 25 users
Network-1 Software & Technology
New York, NY
212-293-3068
http://www.network-1.com
Circle 1013 on Inquiry Card.

Gauntlet Internet Firewall 3.2
$11,500 for 250 users
Trusted Information Systems
Rockville, MD
888-347-3925
http://www.tis.com
Circle 1014 on Inquiry Card.

Sidewinder Security Server 3.0
$6900 base (100 users) plus $2995 install fee
Secure Computing Corp.
Roseville, MN
612-628-2700
http://www.sctc.com
Circle 1015 on Inquiry Card.

David Seachrist has tested all major categories of business software at NSTL for 10 years. You can reach him by sending e-mail to **dseachrist@prodigy.com**. *Helen Holzbaur is manager of communications testing for NSTL. Kathleen Bishop, senior technical analyst for NSTL, also contributed to this report.*

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.*

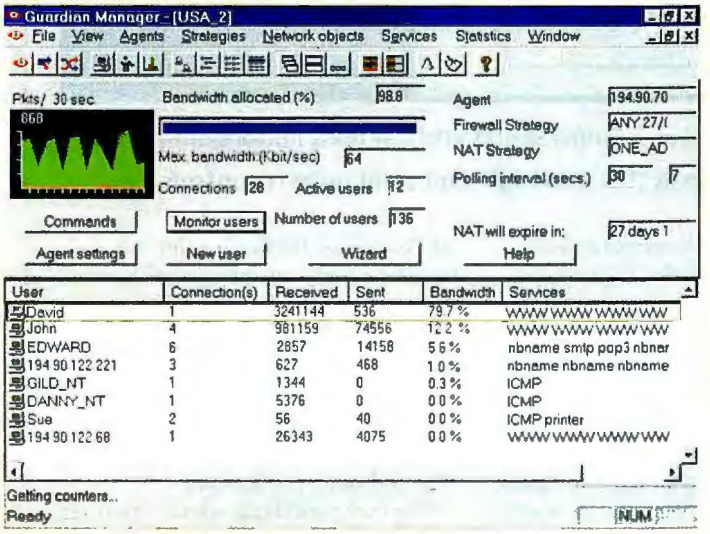
FIREWALL FOCUS

NetGuard's Guardian moves data at rates above real-world maximum

Guardian has emerged as the top performing firewall operating on a standard Windows NT system and Pentium platform, according to the NSTL lab test results for firewall products. NetGuards' Guardian moved data at rates above the real-world maximum. In fact, Guardian's throughput was more than twice that of the other standard NT vendors.

Guardian's inspection of all packets at the MAC layer reduces the high overhead of packet handling in the higher protocol layers. MAC layer inspection also provides an extremely important security advantage by blocking hacker's attacks on the firewall's operating system and TCP/IP layers, where most firewall penetration occurs.

Security testing plays a large role in the examination of firewall products and Guardian's MAC layer stateful inspection placed it among the best. Guardian passed the NSTL security tests with impressive results. In some security scenarios Guardian was among the only entries that provided the maximum protection.

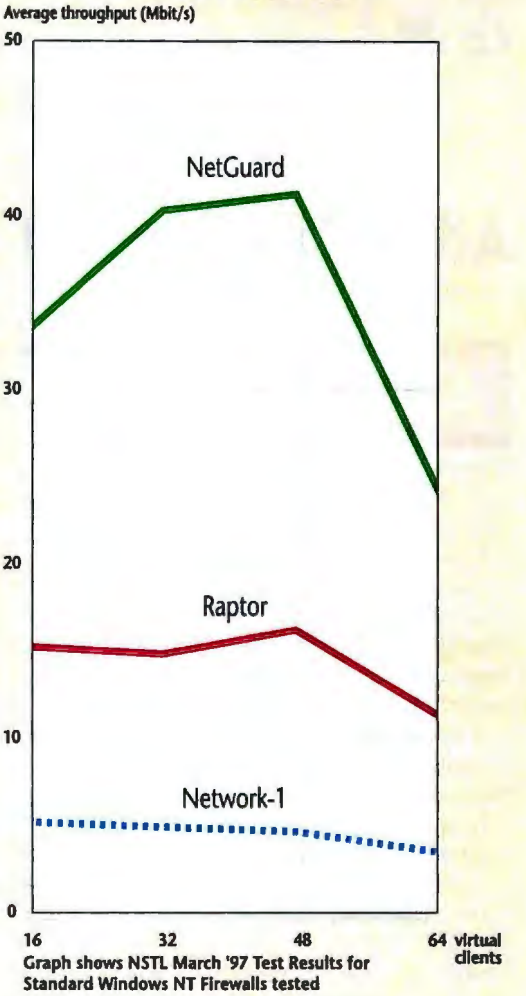


Guardian however, is not simply a firewall preventing penetration to local networks from the external Internet. Guardian provides a vital function in bandwidth control as well as providing tools to control users' productivity through access restrictions, monitoring capabilities and activity reports.

The *Guardian Manager* monitors every piece of information to and from the outside world, and creates a database which supplies comprehensive information on users' connections. The Guardian generates reports on bandwidth consumption, users' total connection time, total data sent or received, and destination hosts' addresses. Reports can be viewed on screen, printed or exported to Excel or Access for further processing. These powerful new tools add to the overall excellence of the Guardian management and security solution.

Guardian is available for free evaluation by download or request for free CD-ROM from NetGuard's Website: http://www.ntguard.com

NSTL Windows NT Firewall Performance



Graph shows NSTL March '97 Test Results for Standard Windows NT Firewalls tested

GUARDIAN

Productive Security

Internet Product of the Year

NetGuard

LanOptics Inc.
2445 Midway Road
Building 2
Carrollton, Texas
75006 USA
Tel: 1-972-738-6900
Fax: 1-972-738-6999

LanOptics (UK) Ltd.
Thamesbourne Lodge,
Station Road, Bourne End,
Buckinghamshire SL8 5QH
United Kingdom
Tel: +44-1628-533-433
Fax: +44-1628-523-252

NetGuard Ltd.
LanOptics Building
Ramat Gabriel Industrial Park,
P.O.Box 184
Migdal Ha-Emek 10551, Israel
Tel: +972-6-644-9944
Fax: +972-6-654-0124

Free Evaluation Download
http://www.ntguard.com

Circle 177 on Inquiry Card.

Illustrator for Windows gets the unified PageMaker/Photoshop interface and feature parity with the Mac version. By David Em

Adobe Nails a Hat Trick

Adobe Systems set the bar for graphic design software in 1987 when it introduced Illustrator 1.0 on the Mac. Now, Adobe is poised to release Illustrator 7.0 for both the Power Mac (PowerPC) and the Intel platforms.

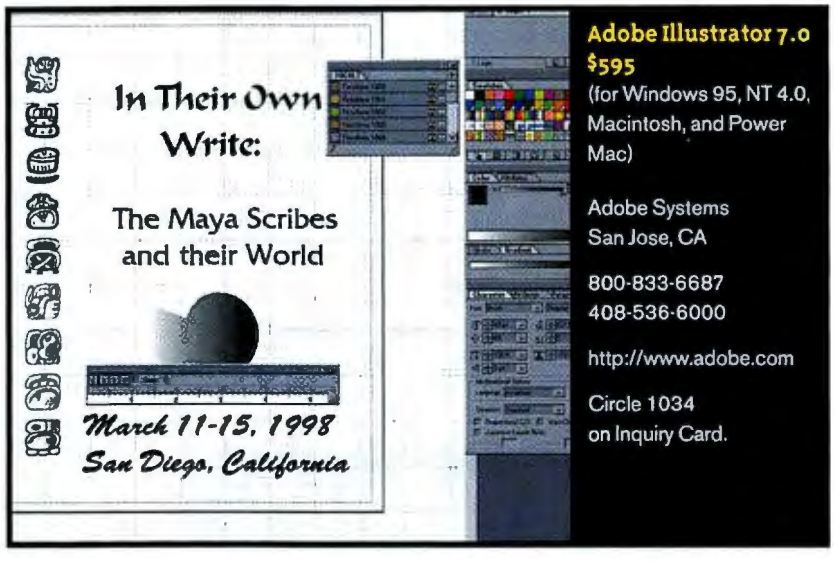
Illustrator has had a very different history on the two platforms. On the Mac side, version 6.0 dominates the field with more than two-thirds of the market for drawing and composition programs. But on the Windows side, Illustrator 4.1, with its much smaller feature set, lags dismally behind CorelDraw, which commands three-quarters of the market.

In version 7.0, Adobe has created a common code base for both platforms, resulting in virtually complete feature parity for the Mac, Windows 95, and NT. You can now move files seamlessly between the Mac and Windows, a boon for designers and service bureaus that work with files from multiple sources.

Adobe has gone to great lengths to integrate Illustrator 7.0 with Photoshop 4.0 and PageMaker 6.5. You can drag and drop elements between the three, and they all now have a unified interface design that includes similar menus, floating toolbar, shared keyboard instructions, and tabbed palettes in containers that can be docked and, in the case of Illustrator, grouped and minimized.

RATINGS	
TECHNOLOGY	★ ★ ★ ★
IMPLEMENTATION	★ ★ ★ ★

High-resolution raster images display considerably faster than before, and you can now link bit-map images to disk files, greatly reducing Illustrator file sizes. Files can be in a wide variety of formats, including EPS, DXF, BMP, TIFF, TGA, and PICT. You can also rasterize vector artwork for export to image editing programs, and you can create URL-embedded GIF89a files in Illustrator and export them into Web-page design programs.



Adobe Illustrator 7.0 now sports vertical text, nonprinting grids, tabbed palettes, and high-end color output controls.

New precision features include a Transform palette with numeric feedback for object locations on a page, nonprinting grids and guides, and up to 200 levels of undo and redo. There are new palettes for layers, color swatches, and gradient fill types, and the character and paragraph palettes offer very precise control over all aspects of text placement and size.

A new reshape tool globally adjusts any path or paths without loss of detail, and regardless of the number of anchor points. You can attach horizontal or vertical text to paths of any shape. Pathfinder filters can create Boolean shapes using Unite, Exclude, Divide, and Front Minus Back filters, and you can hide paths to isolate areas of a complex composition.

Illustrator 7.0 excels at high-quality color output, thanks in part to built-in color trapping information that is saved automatically in Illustrator Encapsulated PostScript (EPS) files that you can transfer to other printing applications. Also included are built-in color separations and color profiles for common output devices. Illustrator now supports the RGB color space, effectively extending the program's range beyond traditional CMYK color print publishing to Web and video publication.

Illustrator still lacks some important features that its competition has, such as brushstrokes on paths, text autocorrect, macro scripting, and the ability to export HTML files. Nevertheless, Illustrator 7.0 is an extremely powerful and feature-laden drawing and composition program that artists, ad agencies, and design firms working in all media will want in their imaging arsenals. B

David Em is a digital artist whose work has appeared in Newsweek, Smithsonian, Forbes, *and other publications. You can reach him at* **davidem@earthlink.net.**

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

Two fast, inexpensive modems from U.S. Robotics and Cardinal give your downloads a boost—maybe. ***By Robert L. Hummel***

How Fast Is a 56-Kbps Modem?

Promising much higher speeds and backward compatibility, the new, low-cost 56-Kbps fax/data modems are destined to become an instant success. But whether they can deliver on the lofty promise of higher-speed connections and faster downloads to your PC is less certain.

When the first Sportster 56K Faxmodems rolled off the production line, we wanted to see if U.S. Robotics (USR) could translate its "x2" theory into throughput reality. We ran real-world tests on the $219 external Sportster and also looked at a $179 internal Connecta modem from Cardinal Technologies (717-293-3000; http://www.cardtech.com). The results were decidedly mixed.

Sportster 56K Faxmodem
$219 (external; internal, $199)

U.S. Robotics
Skokie, IL

800-342-5877
847-982-5010

http://www.usr.com

Circle 1117 on Inquiry Card.

U.S. Robotics' Sportster 56K Faxmodem is leading the company's x2 charge, along with many ISPs.

Up and Running

Even with plug-and-play hardware, installation continues to be the weakest link for many products. Physically, connecting the external Sportster to a COM port or plugging in the internal Connecta was easy. However, in both cases, trying to follow the explicit step-by-step software-installation guide left me puzzled.

Right off the bat, Windows 95's autodetect feature failed to notice either modem. An explicit hardware search missed the Sportster and thought the Cardinal was a COM port. I finally tossed the instructions, installed the modems "manually," and began dialing.

With both modems, I saw connection speeds as high as 49 Kbps. But the stability and usability of those x2 connections were marginal. The x2 modem's downlink speed often dropped back from its initial connection speed. In some cases, I wound up with a slower connection than I obtained with a standard 33.6-Kbps modem. And on highly compressible data, download speeds were slower than when using a 28.8-Kbps modem.

I consulted extensively with USR's technical support regarding these results, even to the point of loading the modem's ROM with updated software. There was no noticeable improvement, however. USR speculated that the problem was located in the phone line I used for the test. That line did, however, pass the USR LineTest diagnostic connection program, which pronounced it x2-capable (see the text box "USR's LineTest: Check It Yourself and See" on page 138).

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

Despite the spotty results of this informal testing, there are still several good reasons to make the switch to an x2 modem. If your current modem is slower than 28.8 Kbps, you're overdue for an upgrade anyway. An x2 device will give you all the speed of a 33.6-Kbps V.34 modem—along with the potential for higher speeds—for about the same cost.

If your phone-line conditions are favorable and your local Internet service provider (ISP) offers x2 service, you can see download speeds approaching 53

Modems Compared: Throughput in Characters per Second

	File Description (compressibility)				
Modem type	**High**	**Medium**	**Low**	**None**	**Mixed**
28.8	9742	6234	3554	2768	8700
56 (line A)	8769	6818	4458	2921	7849
56 (line B)	9652	983	6579	4811	10220

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

Kbps, although uploads remain limited to a maximum of 33.6 Kbps. Combine this potential speed increase with the low cost and flash-ROM upgradability of these units, and they represent true bargains.

Counting Bits

There's a big difference between testing a technology and testing the application of that technology. The theoretical basis for x2 is sound. And in a lab full of test equipment, there's little dispute that you could easily demonstrate an asymmetrical transfer rate of 33.6 Kbps up to, and 56 Kbps down from, an x2 provider's digital modem. But, as my testing showed, the theory has little bearing on what you see in the real world.

A casual test of the x2 technology is far more difficult. It's not enough to simply time how long it takes to download a file or load a Web page. You have to consider the factors that control the perceived speed across an Internet connection. For example, variables that change from connection to connection include local and long-distance phone conditions, the load at the local phone office, the response of the local ISP, and so on.

Over the course of four days, I initiated over 100 x2 dial-up sessions at various times of the day and night, connecting via long-distance lines to USR's x2 point of presence (POP) and x2 BBS in Illinois. I also tried my local provider's x2 POP over local lines. Given my high expectations, the experience was disappointing.

My initial sign-ons indicated connection speeds ranging from a paltry 33.3 Kbps to an exciting 49.3 Kbps. But these initial speeds don't tell the whole story. After connecting, an x2 modem automatically drops down to 33.3 Kbps and then renegotiates back up to the highest reliable speed it can maintain.

I interrupted these sessions periodically to query the modem as to its actual connection rate and found that, despite the initial connection speed, the downlink rate never exceeded 40 Kbps. Uplinks topped out at about 24 Kbps. When I connected to the same provider using a 28.8-Kbps modem, I achieved a 26.4-Kbps rate for both the uplink and the downlink.

Should You Buy?

Modems using K56flex, a competing 56-Kbps standard that's promoted by modem-chip maker Rockwell and backed by the likes of Lucent and Motorola, were just coming out after I completed my tests. Despite this jockeying within the industry, it's easy to forget that neither x2 nor K56flex are actual standards. Instead, they're similar to the early independent attempts at establishing Class 2 commands for fax modems and V.FC modulation. U.S. and international committees are working on standards, but they aren't likely to appear until next year.

Does buying an x2 modem make sense? If you're running on a standard analog phone line, want incrementally improved download speed without the hassle and cost of ISDN, and have a local ISP that's x2 compatible, then it certainly does. In areas that have better local lines than mine, it's reasonable to expect better results than I observed. Even in the worst case, an x2 modem makes an economical and easily upgradable V.34 device. B

Robert L. Hummel (Sullivan, NH) is an electrical engineer, programmer, and consultant. You can reach him by sending e-mail to **rhummel@monad.net.**

USR's LineTest: Check It Yourself and See

Is your telephone line ready for a 56-Kbps modem? Although you won't know for certain until you actually get a 56-Kbps modem, there's a test that you can perform now using your current modem and U.S. Robotics' LineTest facility.

First, open a terminal session using, say, Windows' HyperTerm. Next, dial the LineTest toll-free number (888-877-9248). You can do this by creating a phone-book entry or sending the `ATDT1-888-877-9248` command to your modem.

When connected to the LineTest system, you're asked if your system supports graphics. Press the Enter key to proceed. When prompted for your name, type in `Line Test`. The LineTest system then performs a series of diagnostics on your connection and informs you of its conclusion.

TECH FOCUS: DIRECT DIGITAL

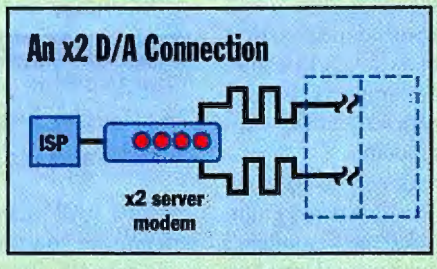
A 56-Kbps Primer

The x2 and K56flex technologies use similar techniques to capitalize on the increasingly digital nature of the Public Switched Telephone Network (PSTN). Both also boost the speed limit for downloads to 56 Kbps.

For two decades, the phone companies have been gradually replacing portions of their analog networks with digital circuits. In a typical phone-network connection, the only analog portion remaining is from your home to the telephone company's central office. Your Internet service provider (ISP) probably has its servers connected digitally to the PSTN.

A V.34 modem generates an analog signal that the PSTN digitizes by sampling 8000 times per second. At the receiving end, the data is converted back into an analog wave form. The difference between the original signal and the reconstructed signal is called quantization noise, a factor that limits the bandwidth of the line to around 35 Kbps.

Instead of generating an analog signal and allowing the PSTN to digitize it, a 56-Kbps modem bypasses initial sampling and generates samples directly into the PSTN. No A/D conversion means no quantization errors and, theoretically, a 64-Kbps communications channel.



Transferring digital data directly to the PSTN allows x2 connection speeds.

However, other constraints conspire to limit bandwidth. The D/A conversion at your local telephone office, for example, is designed to reconstruct voice, not data. Some pairs of digital values produce analog tones that are too closely spaced to distinguish on noisy lines. As a result, a 56-Kbps modem encoder uses only a subset of the 256 available digital values—128 on the most robust connection. Finally, an FCC limitation on the amount of power that your ISP's digital modem can pump into the phone lines further limits the possible speed to about 53 Kbps.

ViewSonic's new flat-panel display gives back a lot of room on your desk. By Russell Kay

More Room, and a View

Computer displays in science-fiction movies are usually flat, thin, wall-hung panels. A decade ago, laptop computers brought us the first real-world prototypes of that vision, but those early screens were small, dim, expensive, and smeary.

Times change. ViewSonic has now introduced an elegant-looking, flat-panel desktop display that most users would love to have—but at $2599, it costs more than most complete systems.

With a 14-inch viewable diagonal, the ViewSonic VP140 ViewPanel is slightly larger than a 15-inch CRT monitor and much larger than any laptop. To the subjective eye, the image appears larger than it really is. For most applications, this 6-inch-thick display can easily replace a 17-inch monitor while taking up a lot less desktop space. Complete with its weighted base, it weighs only 12 pounds.

Contrast is high, blacks are really black, and there's a crispness to the image, corner to corner, that you don't see with CRT. Unfortunately, the image could be even crisper if it weren't for a persistent surface sparkle, which I found distracting.

The 2.3 million thin-film transistor (TFT) cells support a maximum resolution of 1024 by 768 pixels at 65,536 colors, and that's how the panel looks best; it may be the best-looking 1024 you've ever seen. But at 800 by 600, with any number of colors, the displayed image isn't nearly so attractive. Text is thicker than necessary and looks heavy, quite different from the same text on a CRT monitor.

The VP140 is finicky about video signals. It can use a standard graphics card, provided the card's not too good. I first installed the VP140 on two systems equipped with higher-end video cards—one an Artist Graphics 2000, the other a Number Nine Imagine 128 Series 2—each having 4 MB of RAM. Both had previously been set for 85-Hz refresh rates, but the VP140 can't handle more than 75 Hz.

After changing the refresh rate on one machine, I had to sit through more than a half-dozen retries and reboots until the computer finally presented a signal that the VP140 liked, but it always got a bit flustered by the screen change after a Ctrl-Alt-Del. In the end, I didn't get the VP140 to work well with the Imagine board; when I substituted an inexpensive PCI video card, I experienced no further problems.

But this is one great monitor—once it's up and running. If you can live with its limitations and its price, the VP140 is a terrific display that cleans up both your computer image and your desktop image. B

VP140 ViewPanel
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With its small footprint, sleek styling, and crisp image quality, the ViewSonic VP140 will dress up any desktop.

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

TECH FOCUS

Looking at All the Angles

Even the most expensive laptop active-matrix panels show problems with image consistency. No matter how you tilt the panel, the top of the screen is darker or lighter than the bottom, with color variations, too. But the VP140 presents a clear, bright image that's remarkably consistent, from top to bottom and from side to side. ViewSonic achieved this with a backlight that's more diffused and thus less directional. Another factor, important for compatibility with both Mac and Windows platforms, is the unit's analog interface, which, when it converts the signal to digital, also gets rid of some noise and garbage. Address times under 50 milliseconds let pixels turn on and off cleanly, and a 200:1 contrast-to-brightness ratio also contributes to image quality.

Russell Kay is a BYTE technical editor. You can reach him at **russellk@bix.com.**

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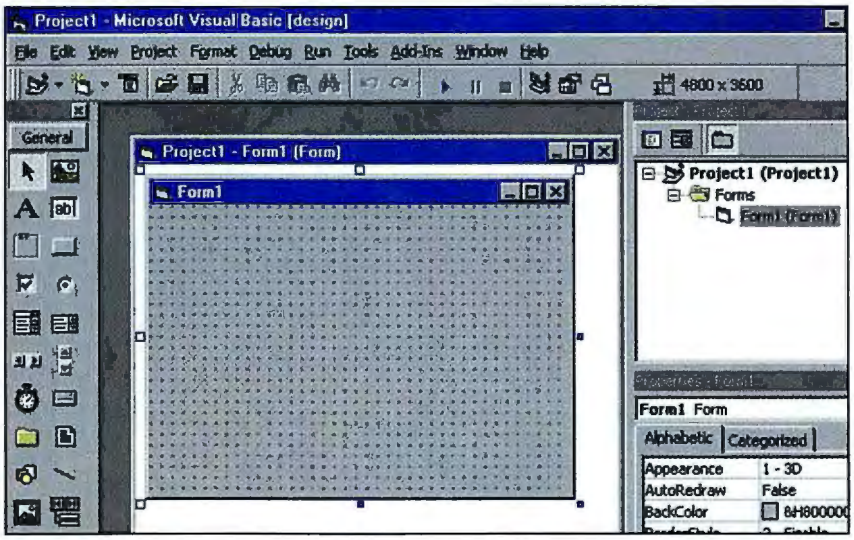
controls, then adding behavior with Visual Basic for Applications (VBA). VB provides database links through ODBC exclusively. Lately, VB has been geared toward the use of COM and DCOM, and with 4.0 it became completely ActiveX-enabled.

Visual Basic 5.0 is just out of the chute. New with 5.0 are a number of performance and productivity enhancements such as a native code compiler, high-speed ODBC connections, and an ergonomic development environment. The package includes a new version of VBA that you'll find not only in VB but also in dozens of other products that have licensed it. There are also links to Microsoft's new Transaction Server, providing inexpensive transaction processing capabilities. The new T-SQL Debugger gives developers the ability to debug stored procedures interactively on the client.

However, the best feature is 5.0's ability to create ActiveX controls using the VB rapid development paradigm. You can create controls from scratch or by augmenting existing controls using a pseudo-OO subclassing system. You can even combine two or more existing controls to create a single control, customizing it as needed. These controls can snap into other ActiveX-enabled tools or applications, or they are are ready for delivery by the Internet or intranet to ActiveX-enabled clients. Microsoft is also providing a scaled-back version (VB Control Creation Edition) for developers who want to produce only ActiveX components.

VB 5.0 Enterprise Edition comes with Microsoft Repository 1.0, and it shows that Microsoft can learn new tricks from its competition. The Microsoft Repository provides developers with a set of ActiveX interfaces for defining shared information models, as well as a repository engine that provides a storage mechanism for those models. Thus developers can define the application architecture using other tools, such as a CASE tool (e.g., Rational Rose), feed that model directly into Visual Basic, then back into the CASE tool again. The repository becomes the central control point for the information model. Developer/2000 and Designer/2000 from Oracle (described next) use a similar architecture, but Microsoft's repository is a bit more open. The Microsoft Repository uses Microsoft SQL Server as the physical storage engine.



Visual Basic 5.0 sports a new native code compiler, high-speed ODBC connections, and an ergonomic development environment.

Oracle Developer/2000

Developer/2000 is really an old tool revamped for modern OO application development and application partitioning. Without putting too fine a point on it, Developer/2000 is Oracle Forms 4.5 for Windows. It provides all the traditional features you'll find in Forms, including PL/SQL programming and an interface design environment.

Developer/2000 wraps its application development capabilities around the Oracle repository that it shares with Designer/2000, its CASE-like sister product. Oracle's view of the world is that you define and design the application using Designer/2000 and store the design information (metadata, schema, process models, etc.) in the repository. You then use that information to create the client-side application and partition the application.

Developer/2000 programmers create an application by defining it with the Object Navigator, a structural browsing and editing interface. Object Navigator lets developers locate, edit, and inspect application components. From the Object Navigator, developers can go right to a screen painter for defining the interface. Developers can go directly to the code editor, where they can enter PL/SQL to define behavior. PL/SQL is also the native code for Oracle Database Server.

Developer/2000 provides application-partitioning capabilities by allowing the developer to drag and drop PL/SQL defined objects from the client to an Oracle database. This provides the developer with a mechanism to balance the load between the client and the server, but there is no mechanism for deploying proprietary Developer/2000 to middle tiers. What's more, you're married to Oracle as your database since other databases don't know how to run PL/SQL objects.

Where to Now?

These wonder tools will continue to support rapid development with easy-to-use environments. They'll also provide high-performance deployment mechanisms and glide paths to Web deployment and application partitioning. The use of repositories is promising, as is the inclusion of links to middleware such as TP monitors and distributed objects. They are, however, not yet ready to take on large-scale enterprise computing right out of the box without a lot of extra work, but that day is coming. B

David S. Linthicum (**linthicum@worldnet.att.net**) *is a senior manager with AT&T Solutions in Chantilly, Virginia.*

WHERE TO FIND

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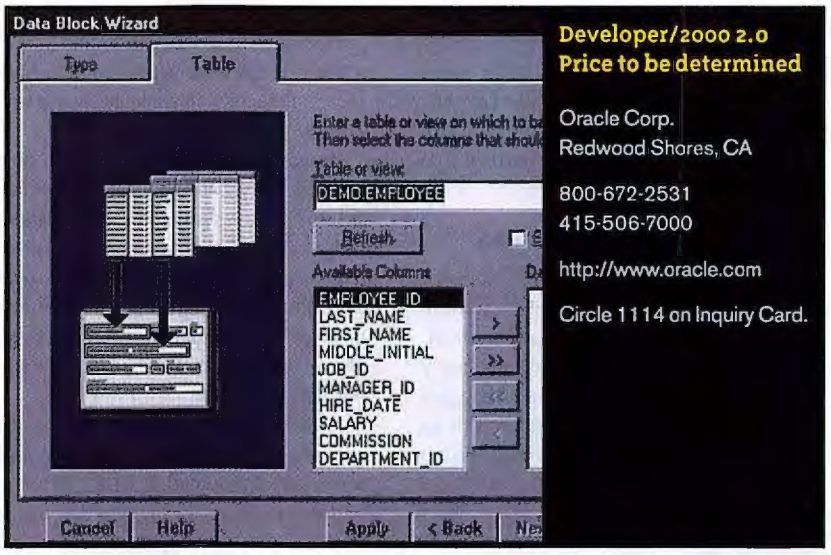
Building a Web front end to Oracle databases just got much easier. By Robert J. Muller

Oracle's Web-Footed Friend

This season's corporate Tickle-Me Elmo doll is the client/server application that can publish legacy database information over the Internet or intranets to a Web-browsing consumer. Everyone wants one. Oracle's Developer/2000 2.0 should help stem the demand by allowing you to quickly develop full-scale client/server applications for the Web. Version 2.0 adds wizards, subclassing, and the Object Library to existing support for Java integration and data output in HTML and Adobe Acrobat formats.

Up to now, writing a Web page that accesses a database on a server has meant gluing an HTML edifice together with an amalgam of Java, Perl, or any other scripting or programming language or plug-in product. You then interface that agglomeration to your database manager. Developer/2000 2.0 wizards help you define the application based on your database schema and then compile the application and run it on the Web.

To Developer/2000, the Web is just another one of its supported platforms, along with Windows 3.1, Windows 95, Windows NT, and the Mac OS. The giant leap forward Developer/2000 provides is the simplicity of developing applications with new wizards and object-like technologies. Other new features include a Project Builder (for building and deploying multiple-module applications), Data Blocks based on procedures instead of tables, faster server-side report generation, and live, WYSIWYG report editing.



Developer/2000 for the Web adds elegant Web tools to the existing product's three-tier client/server architecture.

RATINGS	
TECHNOLOGY	★ ★ ★ ★
IMPLEMENTATION	★ ★ ★

Mastering the Wizards

The Data Block and Layout wizards let you create a simple Developer/2000 application with no programming at all. You create an Oracle database scheme with Designer/2000 or another database-design tool. You then use the Data Block wizard with the Oracle7 data dictionary to display the data in your tables and let the wizard do the rest.

Developer/2000 can generate some validation code and master-detail relationships between Data Blocks. However, that code is fragile and may require modification with PL/SQL, Oracle's database language that extends SQL with such procedural constructs as loops, conditionals, procedure calls, and packages. I have found that coding validation triggers by hand is usually easier than relying on generated code. The master-detail code does work well but requires some tricky configuration management if you want to modify it.

Once you've finished setting up the Data Block, the Layout wizard helps specify the application window layout. The Layout wizard prompts for information about display items and structure. It then builds your display canvas and frame. The frame puts a level of indirection between the Data Block and the canvas, so you can display Data Blocks and items on different canvases, a major advance over version 1.0 of Developer/2000.

The frame allows you to modify layouts, but it also—unfortunately—serves as a visual border around the display fields. I deleted the border and could no longer manipulate the layout with the Layout wizard.

While the wizard's layout algorithm is an improvement over earlier versions, you'll still need to rearrange items with the Layout Editor's drawing tools. You must do other details by hand (e.g., setting object properties or specifying the fonts and sizes you want). On balance, however, the Layout wizard improves productivity dramatically over previous versions of Developer/2000 and other

applications-development tools (e.g., Powersoft's PowerBuilder).

The wizards help lay down the basic features of the application. Object Navigator and property sheets help fill in the details of every conceivable aspect of the application objects. The new Property Inspector is easier to use than the old property sheets, being much closer to the Object Navigator style.

Triggers and PL/SQL let you do virtually anything as long as you can identify an object and event to which to tie an action. Object Navigator's new SmartTriggers help you choose the most appropriate triggers for an object instead of confronting you with the whole list of dozens of events, though this feature would be more useful if you had more control over this hard-code list.

Subclass Consciousness

Subclassing lets you create an object based on an existing object, avoiding the tedium of building every object from scratch. Developer/2000 1.0 supported property classes, clusters of properties and triggers that you could associate with objects to set the default values of the properties and to override triggers. When you changed a property in a property class, the objects associated with the class changed as well. Standard practice was to put property classes in a shared module and then to refer to those classes by dragging and dropping them into new form modules. Version 2.0 improves on that model by letting you base objects on other objects directly while continuing to support property classes for backward compatibility.

With subclassing, you can drag and drop the base object to create a new object and then edit the new object's property sheet and/or triggers. Changing the original object's properties or triggers changes the new object's properties and triggers. You can override a property by entering a different value or override the code in a trigger by entering new code or modifying the existing code. This technology takes Developer/2000 a step closer to full object orientation, but not quite all the way.

Library of Objects

The Object Library module is a repository for objects to be shared between form modules. The library uses a series of tabbed sections into which you can drag and drop objects. Save the library, and its objects are available for dragging and dropping into an open form. Marking a library object as a SmartClass means that it's available as a base object. If you right-click on a new object, you can choose a SmartClass object on which to base the new object. You can lock SmartClass properties, disallowing changes once they are copied to the library.

The Object Library and subclassing create a powerful reuse library for your forms-development process. Reusing objects is the classic method for improving productivity in object-oriented programming (OOP). If you can build most of your application objects through subclassing from a standard reuse library, you can quickly build applications to deploy on the Web using standard elements and debugged code.

The only problem I've found in this beta version is that once you've copied the object into the Object Library, you sever all links with the original object. To change the object, you must delete it and recopy it to the library; there is no configuration management tool to simplify object changes. Oracle plans to fix this in its final release.

Taken together, the new wizards, the Object Library, and subclassing increase your Web-development productivity dramatically over the alternative of Common Gateway Interface (CGI), scripts, and assorted other development tools, particularly when you're developing several similar applications. This is a first pass at making Developer/2000 easy to use. There is still a way to go, especially in the area of integrating reports and charting. Even so, anyone developing Oracle-based client/server applications for the Web should seriously consider Developer/2000 2.0. B

Robert J. Muller is a partner at Poesys Associates, an OO and client/server development consulting firm. He is the author of The Oracle Developer/2000 Handbook *(Oracle Press/Osborne, 1997). Oracle Press is a joint venture of Oracle and Osborne, a unit of BYTE's parent company, the McGraw-Hill Companies, Inc. You can reach him at* **rmuller@waonline.**

TECH FOCUS 3-TIER WEB

Developer/2000's Web-Friendly Architecture

Developer/2000 versions 1.4W and 2.0 use an architecture already well suited to Web-applications development. Ordinary Developer/2000 client/server applications consist of compiled executable modules and a client-side run-time module linking the application objects to the database server. For Web applications, this run-time module becomes the Web cartridge, running on the Web server instead of the client. The end user's Web browser loads an HTML page with an HTML link to a Java applet on the Web server, as in the following:

```
<APPLET codebase="/webform/" code="oracle.forms.dsp.CfmDispatcher"
width=710 height=400>
<PARAM name="server" value="server module=FMX_file_path"></APPLET>
```

You supply the virtual directory (`"/webform/"`), the server name (`"server"`), and the name of the Developer/2000 module file accessible to the Web server that you want to run (`FMX_file_path`). This module file and any modules that it calls are compiled for the Web server's OS.

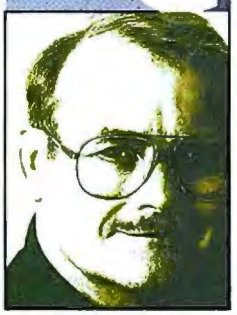
The applet is a generic Developer/2000 display driver handling all the display requests from any Developer/2000 application. Oracle has obtained 100 percent Java certification from Javasoft for this system. The applet establishes a connection to the Web cartridge, stores its widget library in the Java cache on the client, and gets out of the way. The Web cartridge handles all requests from the Developer/2000 module for display by sending requests to the Java widgets running on the Java virtual machine in the client browser. It also handles the connections to the database server, which may be running on a separate machine somewhere else on the network. The cartridge is a SQL*Net client that sends SQL to the database server and gets back data.

From the point of view of Web users, they click on a link in a standard Web page and see a client/server application frame open up. That frame lets them interact with the database server just as though they were a DBMS client application.

Developer/2000 for the Web thus has a true three-tier architecture: the browser as client, the Web cartridge as applications server, and Oracle7 as the database server. This architecture will become more flexible when Oracle8 and other products are available, bolstered with support for Java beans and other distributed-object technology.

Jerry Pournelle

Chaos Manor



Of Supercomputers, Sound Files, and Sugarscape

Jerry encounters some powerful machines and embarks on some programming projects.

Last week, I was the featured speaker at ComputerFest in Springfield, Illinois. As part of my visit, we drove over to the National Center for Supercomputing Applications (NCSA) at the University of Illinois. It was only my second trip to Urbana-Champaign. The first time was in 1953, when I went there to see ILLIAC, which was at that time the world's most powerful computer. Today, a good pocket calculator is more powerful than ILLIAC was.

Larry Smarr, the director at NCSA, showed us marvels, such as the Cave for doing 3-D editing and directing. You can stand in the Cave and watch galaxies collide, moving your viewpoint as you like. It's an astonishing experience.

NCSA was established in 1985 with a Cray X-MP vector supercomputer operating at 8.5 nanoseconds. NCSA was directed to make supercomputing available to a wide range of people. One of their goals is to teach students what supercomputers are and how to use them, since what you'll work on after you graduate is likely to be a great deal more powerful than what you have now.

It's surprisingly easy to get an account with NCSA for your project. Time is available for high schools and colleges, and they have classes for teachers at various levels. You can find out more at NCSA's Web site (http://dilbert.ncsa.uiuc.edu). Incidentally, Mosaic, the Web browser, was developed at NCSA; people who were formerly on the NCSA staff later developed the most successful commercial Web browser.

NCSA has come a long way since the Cray X-MP. They now have a number of Silicon Graphics machines as well as massively parallel systems. There's support for languages other than FORTRAN, although most supercomputing models are done in FORTRAN.

There's extensive work on graphics and displays, pioneered by art and design professor Donna Cox working with the supercomputer gurus. NCSA's early work in display design brought about a virtual revolution in scientific data display, and NCSA collaborated on a documentary on colliding universes that won an Academy Award nomination for best documentary.

You can find out much more about the uses of supercomputers in *Supercomputing and Science* by William Kaufmann and Larry Smarr (Scientific American Books, ISBN 0-7167-5038). Kaufmann is a well-known astronomical writer. Between them, they've done a great introduction to why you need supercomputers. The graphics are stunning.

The desktop world and the supercomputer world are nearly unaware of each other at the moment; but that will change. Meanwhile, the Compaq workstation with dual Pentium Pro processors on my desk is more powerful than the Cray X-MP supercomputer of 1985. You may recall that a Hollywood consortium got a Cray to do *The Last Starfighter*. Now I've got a desktop system I could do that with. By 2000, I may have a machine that could do *Jurassic Park*.

I'D FORGOTTEN JUST HOW MUCH fun programming can really be.

I have two large projects, and I'm using two languages, Microsoft Visual Basic 4.0 and Borland Delphi 2. Delphi is enhanced Object Turbo Pascal. So far, I've done more with VB than Delphi, mainly because I have so many VB books, but this is going to be a great opportunity to compare the two languages.

They're similar in concept and in the mechanics of programming, sharing such features as hiding local variables from the rest of the program and a top-down structure. The major difference is that Delphi is compiled, while there are more third-party enhancements to VB. Both are powerful and fun to work with. Of course, Microsoft recently released VB 5.0, and one day I may move one or both of my projects to that environment.

In both cases, the book to start with is the *Teach Yourself in 21 Days* volume. *Teach Yourself Delphi 2 in 21 Days* by Dan Osier (Sams, ISBN 0-672-30863-0) comes with the introductory version of Delphi, and with good reason. *Teach Yourself Visual Basic 4 in 21 Days* by Nathan and Ori Gurewich (Sams, ISBN 0-672-30620-4) is similar, well organized and laid out in a series of logical lessons, each with plenty of examples.

Neither book is sufficient. For some reason, all programming books overlap but aren't congruent. I don't know what to recommend as supplemental reading for Delphi. For VB, I have found Peter Aitken's *Visual Basic 4 Programming Explorer* (Coriolis Group, ISBN 1-883577-21-7) to be well done. In addition to the 21-day program described by the Gurewiches, it's worth doing a parallel effort

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in Aitken's projects. Finally, Mark Steven Heyman's *Essential Visual Basic 4* (Sams, ISBN 0-672-30771-5) cleared up several problems and isn't a bad reference. Heyman's book has the subtitle *All You Really Need to Know*, but that's not quite true, or at least it wasn't for me.

The problem with all these books is that the authors are so familiar with their subject that they leave out things they think obvious, but certainly weren't to me. Fortunately, what one thought too obvious to mention was generally covered by one of the others. Given VB, these three books, a reasonably good Windows 95 (Win 95) or NT computer, and some determination, I think anyone can learn to do quite sophisticated programs. The resulting code may not be either elegant or efficient, but that's not as important as it used to be.

My first project is to move Roberta's reading instruction program to Win 95.

MY FIRST PROJECT IS TO TAKE Roberta's reading instruction program and move it from the Mac to Win 95. That's harder than it sounds, partly because the Mac version is written in SuperCard and the transformation to either VB or Delphi isn't all that straightforward. Mostly, though, it's because unlike Macs, Windows systems don't have acceptable text-to-speech programs. Macs come with a speech synthesizer that's spectacularly better than anything you can get for Windows. It's good enough to teach reading.

Since there's no acceptable text-to-speech synthesizer for Wintel systems, we'll have to record all the sounds using the Win 95 Sound Recorder. Roberta's phonics program uses the 1000 most common words in English (as well as quite a few others); this means Roberta will have to record each of those words as well as about a thousand sentences and blends. There's probably a better way to do it, but for the moment, we're making each of them a separate WAV file. I'm devising a nomenclature scheme to make it easier to find the sound file we want when it's needed.

Including some 2000 wave-table recordings means the program will be on a CD-ROM and can be run only on a Win 95 machine with a CD-ROM reader and a Sound Blaster–equivalent sound card. The Mac version is distributed on floppy disks and is designed to run on the kind of low-end machines you're likely to find in classrooms.

One implication is I'll have to learn how to make CD-ROMs; given that we have two different read/write CD-ROM drives, I suppose that's no bad thing. Of course, once we bite the bullet and make all those recordings, we'll port it back to the Mac. While the Mac speech synthesizer is very good, it doesn't always get all the inflections right, and we've had several people object to using "talking computers." It will be interesting to see if there's a difference in results.

Most software publishers say that wave-table recordings of real speech work better for education than synthesized speech. I've always questioned that assumption. Certainly voices count. Our tests show that using the harsher "Agnes" Mac voice gets better results than the far more pleasant and human-sounding "Victoria" voice.

However, when we use Agnes, we get such spectacular results from the synthesized Mac version—an average of 1.5-year's growth in reading capability from three months of using the program—that there's not much room for a wave-table-recorded program to make improvements. It would be wonderful if it did.

I GENERALLY GO TO THE ANNUAL MEETings of the American Association for the Advancement of Science. It's where I find out what's going on in medicine, physics, astronomy, biology, climatology, and so forth. Of course, it's also a convenient way to learn the latest about using computers in the sciences, and generally there's at least one good session on the future of computing. However, I really go to find out the latest developments in those other fields.

This year, there were papers on everything from life on Mars, to theories of how the immune system works, to really good epidemiological evidence that if you don't smoke and you do eat lots of fruits and vegetables, you are unlikely to get cancer. (I asked about vitamins, and Dr. Bruce Ames of the University of California, Berkeley, pointed out that the same people who take vitamins are likely to eat lots of fruits and vegetables, so epidemiological studies aren't going to help with that one.)

The real conclusion is that we would

be better off spending our money on diet than annually spending almost $2000 per American family taking the last carcinogens out of the air we breathe. In fact, spending half that on fruits and vegetables (and eating them) would reduce cancer by orders of magnitude over the effect of getting those last carcinogens out of the atmosphere. Ames told of the coffee-drinking scientist smoking a cigarette as he exposes a rat to megadoses of smog....

MY SECOND COMPUTER PROJECT, Sugarscape, comes from a paper given by Robert Axtell of the Brookings Institution. His presentation was largely a summary of *Growing Artificial Societies: Social Science from the Bottom Up* by Joshua M. Epstein and Robert L. Axtell (Brookings Institution Press/MIT Press, ISBN 0-262-05053-6). It's a report on using computers in "bottom-up" social sciences to simulate quite complex behavior with very simple rules. There's a CD-ROM version available with QuickTime movies of test runs.

Sugarscape starts simply. Consider a grid of 50 by 50 squares. Each square contains from zero to four units of "sugar." The grid is inhabited by 400 creatures represented by dots. The creatures live on sugar (and nothing else), consuming from one to three units per turn. These creatures can see from two to four squares in all directions, and they can move as far as they can see.

Each "year," the creatures are considered in random order, and when its turn comes, a creature looks in all directions, finds the uninhabited square it can see that has the most sugar, goes there, and collects all the sugar in the square. It consumes what's needed to keep it alive; if it hasn't got enough, it dies. If it got more than it consumes, it keeps the surplus.

We need one more rule: sugar replacement. That can be either full replacement (four unit squares are instantly restored to four units, etc.) or partial replacement, such as one unit per year up to the square's starting level.

That's it. Fire it up and watch the dots move. With those simple rules, you get some pretty complex behavior. As you'd expect, the creatures with long vision and low metabolism do the best. You can simulate evolution by keeping the number of creatures constant: if one dies, it is replaced by another with random metabolism and vision. If you correlate vision with metabolic activity, you get a different result. Mostly, what you end up with is a hunter/gatherer society of immortals.

Now you can add combat. One rule might be that the creature with the most sugar wins and takes the loser's supplies. You can add sexes with mating and inheritance, including the computer equivalent of chromosomes and genes. You can let them age and die. You can add a second substance so that commerce can develop. You can add cultures and education; and so on. Before you know it, with very simple rules you get very complicated "societies." I was fascinated when I heard the paper, even more intrigued when I got the book, and couldn't wait to start building my own Sugarscape experimental landscape.

The program isn't complicated. I have not used the actual Brookings program. I'm designing mine to make it easy to add rules I've thought of that Epstein and

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Axtell don't seem to have tried. Besides, it's fun to plan the program.

They did most of their work on a Mac. What I'm planning is a bit more complicated. It would probably be easier to do this on a Mac, but it will run faster on my Compaq workstation with dual Pentium Pro processors; besides, I have to learn VB and Delphi to get Roberta's program running in Win 95. Both projects are taking longer than I like, but that's mostly because I'm also writing these columns, finishing two novels, and making several out-of-town speeches. It's a great life if you don't weaken.

I OFTEN FIND MYSELF PLAYING INTELlectual honeybee. Sometimes it does some good. I'm getting Larry Smarr of NCSA together with Axtell with the notion that given supercomputers, they can build even more complicated societies with parallel movement rather than serialized random movement. They can also add many more creatures: NCSA is accustomed to keeping track of thousands to millions of stars in colliding galaxies, with stellar explosions, collapses to pulsars and black holes, and suchlike. You haven't lived until you've watched galaxies collide at a million years a second. But the real point is that with supercomputers, it's possible to go far beyond Sugarscape.

You haven't lived until you've watched galaxies collide at a million years a second.

The social sciences haven't been very good at using computers. When Einstein was asked why we knew so much more about physics than sociology, he said it was because sociology was much harder than physics. Physics thrived under analytical methods, reducing things to their simplest elements: a ball rolling down an inclined plane, a pendulum swinging in a vacuum; that sort of thing. When the same methods were applied to social sciences, they didn't work well if at all.

This was true at a certain level in physics. When you get down to the atomic level, the classic reductionisms don't work well. The best way to simulate some systems is to program and track every single element: millions of stars or molecules of fluid.

One of the NCSA models is a picture of Chesapeake Bay chopped up into thousands of small "cells" not all the same size. The Bay is a shallow layer of water over a thick layer of mud; mud flows, but not in the same way that water does. It's not hard to simulate what happens with each cell, but that cell will affect the ones around it. To watch the Bay as a whole, you need a computer capable of keeping track of all those cells and their interactions; but with that model, you can look at the effect of big storms or taking all the water out of one of the feed rivers. They display all this in 3-D in the Cave.

Epstein and Axtell are taking the same approach to studying societies: build them up from individuals following relatively simple rules, let them interact, and see what happens. They have intriguing

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results from small models of a few hundred individuals, but computational limits make it more difficult to compute the interactions you'd get from simultaneous movement. (They get around this by letting the players act serially, but each "year" randomly chooses the order in which they act.)

With supercomputers, the "players" can act simultaneously. You can keep track of vastly many more of them. Finally, with the wonderful display techniques developed at NCSA, you'll have a better chance of spotting results. I can't wait for Smarr and Axtell to get together.

Having said that, there's still a lot of room for ingenious use of desktops here. Not only is playing with Sugarscape a fun thing to do with a computer, but who knows, you might make a real contribution to understanding human economics. If this intrigues you, get the Epstein/Axtell book. You'll love it.

DAVID EM IS OUR ARTIST ASSOCIATE who works on high-end graphics. He has our large test-bed Compaq workstation with dual Elsa video boards I described last month, as well as our new Mac. His report is too long for the column, but you can find it on the BYTE Web site. It's well worth reading. What David is working with would have been called a supercomputer a couple of years ago, but you can buy the whole system for $30,000 or less right now, and it will be half that within two years.

We now have two Compaq workstations. When it became obvious I'd never get David to give up the big Compaq, I wangled a second one. The big one is still in David's studio because he can actually make use of its power.

Meanwhile, I have the Compaq Professional Workstation 5000, with dual 200-MHz Pentium Pro processors, 64 MB of main memory, a Matrox Millennium video board, and built-in Sound Blaster–compatible stereo sound. It can boot up in NT 4.0 or Win 95. Needless to say, it is wickedly fast in either.

I've been accused of being overly fond of my machines, and I suppose it's true. I've never had a computer without a name, even before networking required computer names. This one is Princess, and she's pretty wonderful. At the moment, she's set up next to Cyrus the Cyrix P166; love may be blind, but I have a rule against changing main machines without a lot of routine use of the new one. I'm writing this on

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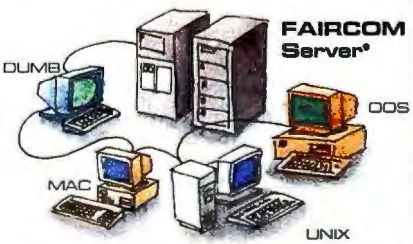

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Cyrus, but my program development is all done on Princess.

In Win 95 mode, Princess runs all the Win 95 games I know and the DOS games that run on anything else. Games are a good way to test driver compatibilities. In NT mode, I can run anything advertised as NT-compatible; in particular, VB works just fine, including calls to play WAV files. Some VB books don't cover sound at all, and it's not well described in the rest. In particular, although the *21 Days* book has a long discussion on wave-table sound, I don't believe I'd ever have learned how to include sound in a program from that book. Fortunately, it's easy enough when you learn how.

VB has no sound capability as such. Instead, you make calls to the Windows media control interface (MCI) by sending it messages telling it to open a wave-table file, play it, and close it again. There are at least two ways to do this. The method I used is described in Aitken's book. It's complicated enough that I won't describe it here; look under sound in the index. It works well, but one caution: this particular operation is extremely case-sensitive.

I CONTINUE TO BE IN LOVE WITH THE Olympus D-300L digital camera. It takes 1024- by 768-pixel pictures that look just gorgeous blown up full-screen on a good ViewSonic or NEC monitor. They make huge BMP files, but JPEG compression cuts them down to size (about half a megabyte each), and they still look great. The lens is good, with good depth of field, and I get good pictures in far lower light levels than I thought I would.

I'm going to talk about the problems with this camera, but keep in mind that I love the thing.

First, there's no PC Card slot, meaning that you can't change "rolls" of film. Those who take a lot of pictures may find this important, particularly since it takes over 30 seconds to transmit each picture to your computer. You can squirt the pictures onto a laptop, but that takes time. On the other hand, you can erase any given picture right on the camera, so you're keeping only the ones you want. I never get a full 30 good pictures I want to keep before I have a chance to move them. On trips, I often carry a regular film camera just in case, but so far I haven't had to use it.

Second, it's fairly easy to run down the batteries. The D-300L is activated by opening a slide that uncovers the lens. That feels very natural, and I don't often forget to close that slide; but sometimes when I put the D-300L away in my briefcase or shoulder bag, I accidentally slide the lens cover and thus activate it. At least once, I've found I had insufficient battery power to take pictures. The D-300L uses standard AA batteries you can find all over the world. After I replaced the batteries, I was pleased to see that the low battery warning comes on in plenty of time, and the camera disables itself before the power gets so low it loses any pictures already taken.

The D-300L comes with Adobe PhotoDeluxe software. It's all right, but if you're used to Photoshop, you'll hate PhotoDeluxe. On the other hand, it works, and it will output your picture in most standard formats, including JPEG. It's also a lot cheaper than Photoshop.

The neat thing about the D-300L is that once your pictures are saved on the computer, they're available as wallpaper, or you can put them up on the Web.

You can also print your digital picture on the Alps MD-2010 Photo-Realistic Color Printer I've described in previous columns. The result probably won't be as stable as an actual photographic print, but it will be considerably cheaper (per copy, that is; you can get a lot of photos printed for the cost of the printer). The MD-2010 output is remarkably good, and so far we haven't noticed any fading despite being hung in normal light.

It's pretty clear that digital cameras are the wave of the future.

I'M ALSO EXPERIMENTING WITH FRANKlin Quest's Ascend coupled with the PalmPilot PDA. It works quite well. The PalmPilot has a dock you attach to a serial port, and when you put it into the dock, everything synchronizes automagically. It's pretty neat. The real question with the PalmPilot, as with any PDA, is, will I carry it? I must have a peach crate full of neat PDAs. They all work, I got excited about each and every one of them, and then one day I noticed I hadn't carried it in weeks, and into the crate it went. We'll see if the PalmPilot escapes that fate. Meanwhile, I can't live without Ascend, which I use as my calendar, appointment book, task manager, scheduler, and diary.

The book of the month is Epstein and Axtell's *Growing Artificial Societies*. The game of the month is Blizzard Entertainment's Diablo, which is great fun for a single player, but it also comes with a way to hook up with others over the Internet to have multiple heroes in one dungeon. Next month, I'll try to get a running start on the piles of stuff that accumulate here. Wish me luck. Tomorrow, Niven and I go to the beach to blitz *The Burning City*, and our agent just called to say United Artists is buying *The Legacy of Heorot* for a movie. Hollywood money is like fairie gold, but we'll see. B

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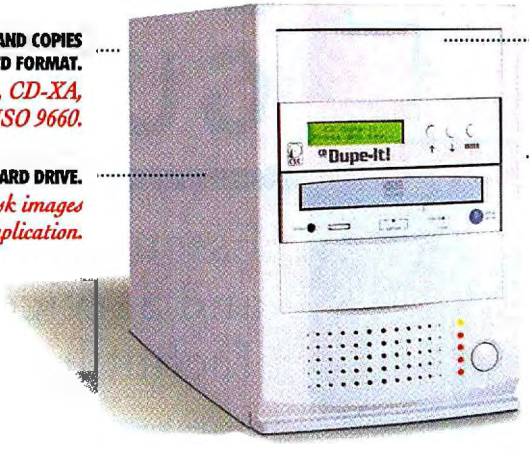

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256 x 32	6.00	–
512 x 32	10.00	–
1 x 36 4 mg	35.00	35.00
2 x 36 8 mg	62.00	61.00
4 x 36 16 mg	192.00	191.00
8 x 36 32 mg	190.00	189.00
16 x 36 64 mg	489.00	489.00
1 x 32 4 mg	25.00	24.00
2 x 32 8 mg	47.00	46.00
4 x 32 16 mg	84.00	83.00
8 x 32 32 mg	169.00	168.00
16 x 32 64 mg	456.00	456.00
1 x 32 4 mg EDO	26.00	26.00
2 x 32 8 mg EDO	48.00	48.00
4 x 32 16 mg EDO	180.00	180.00
8 x 32 32 mg EDO	478.00	478.00

DIMMS (168 pin)

INDUSTRY STANDARD DIMMS Unbuffered	16Mb	32Mb	64Mb	128Mb	256Mb
3.3V ECC, EDO	Call	Call	Call	Call	Call
3.3V EDO	Call	Call	Call	Call	Call
5.0V ECC	Call	Call	Call	Call	Call
5.0V FPM	Call	Call	Call	Call	Call
Buffered					
3.3V ECC, EDO	Call	Call	Call	Call	Call
3.3V ECC, FPM	Call	Call	Call	Call	Call
APPLE					
1 x 64		8Meg			48.00
2 x 64		16Meg			64.00
4 x 64		32Meg			175.00
8 x 64		64Meg			329.00
DELL, OPTIPLEX, EXPRO 200					
3.3V ECC, EDO		16Meg			119.00
3.3V ECC, EDO		32Meg			249.00
3.3V ECC,EDO, 4/32/16p		64Meg			479.00
3.3V ECC, EDO		128Meg			1090.00
DELL POWER EDGE 2100/4100					
3.3V ECC, EDO		16Meg			119.00
3.3V		32Meg			249.00
3.3V, 8/32 chip		64Meg			479.00
3.3V		128Meg			1090.00
3.3V		256Meg			3627.00
DELL & GATEWAY		8Meg			62.00
3.3V EDRAM		16Meg			110.00
3.3V SDRAM		32Meg			229.00
3.3V SDRAM		64Meg			499.00
MOTOROLA (Apple Compatible)					
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3.3V EDO		16Meg			99.00
3.3V EDO		32Meg			197.00
3.3V EDO		64Meg			393.00

ECC SIMMS

Pentium Pro 72 Pin (Install in pairs) / SIMMS

8Meg	64Meg 599.00
16Meg 110.00	128Meg 1206.00
32Meg 229.00	

SIMM MODULES (Add $5.00 for SIPP)

	60NS	70NS	80NS	100NS
256 x 9	–	6.00	8.00	5.00
1Meg x 9 (2 chip)	–	6.00	–	–
1Meg x 9 (4 chip)	17.00	17.00	12.00	10.00
4Meg x 9	33.00	33.00	33.00	–
16Meg x 9 (9 chip)	139.00	139.00	–	–

CACHE MODULES

256K (168 pin) Pipeline Burst Cache Module $22.00 (Cost Chip)

512K (168 pin) Pipeline Burst Cache Module $30.00 (Cost Chip)

256K (168 pin) Async Cache Module compatible with IBM Aptiva AAM Series $59.00

256K (168pin) Async Cache Module $25.00

CACHE MEMORY

	12NS	15NS	20NS	25NS
32Kx8	9.00	6.50	4.25	4.00
32Kx8 (3.3V)	–	14.00	9.50	–
64Kx8	–	11.00	9.00	8.00
64Kx8	–	15.00 (5V)	–	–
128Kx8	–	29.50	26.00	24.00
32x8 SOJ 3.3V	–	12.00	11.00	9.00
128x8 SOJ	–	99.00	–	–
512x8 SOJ	–	–	109.00	–

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Intel SX (Does All)	54.00
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1Meg x4	–	19.00	18.00	17.00
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256x4(Page Zip)	–	7.25	6.75	6.50
256x4(Page Zip)	–	9.25	8.00	7.85
256x4(Video Zip)	–	–	10.95	9.95
256x8(SOJ)	–	12.00	11.00	–
256x16 SOJ	34.00	29.00	29.00	25.00
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Matrox Mystique	2Meg SGRAM 59
ATI 3D Pro Turbo	2Meg/4Meg 69, 179
ATI Xclaim 3D	4Meg SGRAM 179
ATI 3D Xpression	2Meg SGRAM 79
Apple PowerMac 4400	2Meg/4Meg 89/179
NEC Powermate Pro 150, 220	2Meg /4Meg WRAM 129, 259
HP Vectra XV/6, VL/6, VA, XA	2Meg/6Meg WRAM 129, 259
Compaq 1Meg Video 213922-001	1Meg 69
Compaq Deskpro 2000, 4000 6000	2Meg/6Meg WRAM 129/299

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Ready 5010, 7010, 7020, 9010, 9022 (pairs)	4Meg/8Meg/16Meg/32Meg 22/43/94/186
Ready 9510, 9520, 9522, 9530, 9532 (pairs)	4Meg/8Meg/16Meg/32Meg 22/43/94/186
Ready 7022 (EDO, pairs)	4Meg/8Meg/16Meg/32Meg 22/43/94/186
Image P60, P90, D, P100E (pairs)	4Meg/8Meg/16Meg/32Meg 22/43/94/186

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Netserver LE 486SX33 – 486DX266	4Meg/8Meg/16Meg/32Meg 34/59/99/199
Netserver LH Plus 5/133, 5/166 (EDO, ECC)	16Meg/32Meg/64Meg/128Meg 129/239/489/969
Netserver 4/33LM – 5/100LM (pairs)	4Meg/8Meg/16Meg/32Meg 34/59/99/199
Netserver 5/75LS – 5/133 LS4 (pairs)	4Meg/8Meg/16Meg/32Meg 34/59/99/199
Pavilion 5010-7170 (pairs)	4Meg/8Meg/16Meg/32Meg 34/59/99/199
Vectra 500 (EDO, pairs)	4Meg/8Meg/16Meg/32Meg 34/59/99/199
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Vectra VE2 5/75 – 5/133 (EDO, pairs)	4Meg/8Meg/16Meg/32Meg 34/59/99/199
Vectra XA 6/180, 6/200 (EDO, pairs)	4Meg/8Meg/16Meg/32Meg 34/59/99/199
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Aptiva M Series	4Meg/8Meg/16Meg/32Meg	24/49/99/169
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PC 330 Model 6577 (EDO Model)	4Meg/8Meg/16Meg/32Meg	24/49/99/169
PC 340 (EDO, pairs)	4Meg/8Meg/16Meg/32Meg	24/49/99/169
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PC 350 Model 6587 (EDO pairs)	4Meg/8Meg/16Meg/32Meg	24/49/99/169
PC 360	4Meg/8Meg/16Meg/32Meg	39/59/109/199
PC 730 Models 6875-6876 (pairs)	4Meg/8Meg/16Meg/32Meg	39/59/109/199
PC 730 Model 6877 (EDO pairs)	4Meg/8Meg/16Meg/32Meg	24/49/99/169
PC 750 Models 6885-6886 (pairs)	4Meg/8Meg/16Meg/32Meg	39/59/109/199
PC 750 Model 6887 (EDO pairs)	4Meg/8Meg/16Meg/32Meg	24/49/99/169
PC Server 310 (pairs)	4Meg/8Meg/16Meg/32Meg	39/59/109/199
PC Server 500 (ECC, pairs)	4Meg/8Meg/16Meg/32Meg	59/79/119/249
P/S 1, 30 Pin Simms	1Meg/4Meg	12/34
P/S 1, 72 Pin Simms	4Meg/8Meg/16Meg/32Meg	39/59/109/199
P/S 2, 55SX, 65SX	4Meg	49
P/S 2, 53, 53-S, 56, 57	4Meg/8Meg	39/69
P/S 2, 95XP (ECC, pairs)	4Meg/8Meg	49/79
P/S 2 Server, 95, 195, 295 (ECC, pairs)	4Meg/8Meg/16Meg/32Meg	59/79/119/249
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Thinkpad 365X, 365XD	8Meg/16Meg/32Meg	69/139/298
Thinkpad 500, 510CS	4Meg/8Meg	59/89/149
Thinkpad 560	8Meg/16Meg/32Meg	69/139/289
Thinkpad 700, 720, 750, CL57SX	4Meg/8Meg/16Meg/32Meg	39/79/159/268
Thinkpad 701, 701C	4Meg/8Meg/16Meg/32Meg	49/89/109/499
Thinkpad 730T, TE	4Meg/8Meg/16Meg/32Meg	49/109/189
Thinkpad 755C, CE, CD, CS	4Meg/8Meg/16Meg/32Meg	39/69/129/419
Thinkpad 760C, CD, L, LD	4Meg/8Meg/16Meg/32Meg	69/169/339
Thinkpad 760E, ED, EL, ELD	8Meg/16Meg/32Meg	79/129/399

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Deskpro 486/25, 33L, 50L	2Meg/4Meg/32Meg	29/79/199
Deskpro 3/25i, 33i, 4/25i5, 66i	2Meg/4Meg/8Meg	39/69/89
Deskpro 386, 486 M Series	2Meg/4Meg/8Meg	29/39/69
Deskpro M Series Expansion Board	2K (no memory)	119.00
Deskpro 4/50, 4/66, 575, 590, 5100, 5133	4Meg/8Meg/16Meg/32Meg	24/43/79/159
Deskpro 575, 5120, 5133, 5150, 5166 (EDO, pairs)	4Meg/8Meg/16Meg/32Meg	24/42/79/159
Deskpro 2000, 4000, 6000 Series (EDO, pairs)	4Meg/8Meg/16Meg/32Meg	24/42/79/159
Deskpro 5/60M, 5/66M, XE560 (quads)	2Meg/4Meg/8Meg/16Meg/32Meg	39/49/69/139/229
Deskpro XL (pairs)	4Meg/8Meg/16Meg/32Meg	49/69/139/279
Deskpro XL 6150, 6200 (ECC, pairs)	8Meg/16Meg/32Meg/64Meg, 128Meg	Call
Deskpro 2000, Presario 4112, 4122, 4712, 4716, 5526, 5528	1Meg Video	69
Presario 5536, 5632, 9034, 9240, 9250, 9260, 9642, 9660	2Meg Video	79
Presario 510, 520, 524, 660, 720, 724, 860	4Meg/8Meg/16Meg/32Meg	24/42/79/159
Presario 920, 924, 954, 974, 978, 992	4Meg/8Meg/16Meg/32Meg	24/42/79/159
Presario 833, 850, 860, 866	4Meg/8Meg/16Meg/32Meg	39/49/79/229
Presario 5528, 7110, 7152	4Meg/8Meg/16Meg/32Meg	24/42/79/159
Presario 7170, 7180, 9536, 9546, 9548, 9564 (pairs)	4Meg/8Meg/16Meg/32Meg	24/42/79/159
Presario 9232, 9234, 9240, 9250, 9642, 9660 (pairs)	4Meg/8Meg/16Meg/32Meg	24/42/79/159
Proliant 1000 5/60, 2000, P, 4000, R (quads)	4Meg/8Meg/16Meg/32Meg	36/62/99/189
Proliant 1500, 1500R (pairs)	4Meg/8Meg/16Meg/32Meg	36/62/99/189
Proliant 4500, 4500R (quads)	4Meg/8Meg/16Meg/32Meg/64Meg	39/64/119/239/599
Proliant 5000, 5000R (pairs)	32Meg/64Meg/128Meg/256Meg	Call
Prolinea 4/25S, 4/33, 4/66	2Meg/4Meg/8Meg	29/39/69
Prolinea (enhanced), MT	4Meg/8Meg/16Meg/32Meg	36/62/99/189
Prolinea 575, 590, 5100, 5120, 5133 (pairs)	4Meg/8Meg/16Meg/32Meg	36/62/99/189
Prolinea 5100, 5120, 5133, 5150, 5166 (EDO pairs)	4Meg/8Meg/16Meg/32Meg	36/62/99/189
Prolinea 575E, 100E, 120E, 575MX (pairs)	4Meg/8Meg/16Meg/32Meg	36/62/99/189
Prolinea 590MX, 5120MX (pairs)	4Meg/8Meg/16Meg/32Meg	36/62/99/189
Prolinea 8150E, 6180E (pairs)	8Meg/16Meg/32Meg	69/119/239
Prosignia 300 5/75, 5/90, 5/120, 5/150 (pairs)	4Meg/8Meg/16Meg/32Meg	36/62/99/189
Prosignia 500 5/90, 5/120, 5/150 (pairs)	4Meg/8Meg/16Meg/32Meg	36/62/99/189

COMPAQ NOTEBOOK/LAPTOP MEMORY

Armada 1120, T, 1125, 1130, T	8Meg/16Meg/32Meg/64Meg	69/129/239/309
Armada 4100, 4110, 4120, 4130 (pairs)	8Meg/16Meg/32Meg	69/129/239
Concerto 4/25, 4/33	4Meg/8Meg/16Meg	49/79/139
Contura 4/25, C, CX	4Meg/8Meg/16Meg	49/79/139
Contura 4000, 4000C, 4100, 4100CX	4Meg/8Meg/16Meg	49/79/139
Contura 4/25C, 4/25CX, 4300, 4300CX	4Meg/8Meg/16Meg/64Meg	49/79/139/199
Contura Aero 4/25, 4/33	4Meg/8Meg/16Meg	39/79/109
LTE 5000, 5100, 5200, 5300, 5400	8Meg/16Meg/32Meg/64 Meg	79/129/249/479
LTE Elite 4/40C, CX, 4/75CX	4Meg/8Meg/16Meg/24Meg	49/89/139/189
LTE Lite 4/25	4Meg/8Meg/16Meg	49/85/129
Presario 1000, 1010, 1020, 1030, 1070, 1080	8Meg/16Meg/32Meg	59/109/199

DELL MEMORY

Dimension XPS M166S, M200P, P133s, 166s, 200s, P133v, 166v, 200v	8Meg/16Meg/32Meg	Call
Dimension XPS P60, P75, P90, P100	4Meg/8Meg/16Meg/32Meg	Call
Dimension XPS P100c, 120c, 133c, 166c, XPS P75T, 100T (pairs)	4Meg/8Meg/16Meg/32Meg	Call
Dimension XPS P100c, 120c, 133c, 166c, XPS P75T, 100T (pairs) edo	4Meg/8Meg/16Meg/32Meg	Call
Dimension XPS Pro 150 Pro 200 (quads)	4Meg/8Meg/16Meg/32Meg	Call
Dimension XPS Pro 150n, 150n, 200n (pairs) edo	4Meg/8Meg/16Meg/32Meg	Call

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AMOUNT UPGRADED	OK 6d	256k	1	2	3	3.5	4	5	6	8	16	32
Brother 630, 631, 641, 645	–	–	39	49	–	–	–	–	–	–	–	–
Canon LBP 430	–	–	39	–	–	–	39	–	–	–	–	–
Canon LBP 860, 1260	–	18	–	39	–	–	39	–	–	69	89	179
Canon LBP4, 4Lite, 4plus	–	129	179	–	–	–	–	–	–	–	–	–
Epson Action Laser 1100, 1600	–	19	29	–	–	–	59	–	–	89	99	–
Epson Action Laser II	–	74	–	175	–	–	–	272	–	–	–	–
Epson 8000, 1000, 4000 4100, 4300	–	89	–	173	–	–	–	272	–	–	–	–
Epson 1000, 1500, 5000, 5200	–	–	45	–	–	–	98	–	–	–	–	–
HP 2, 2D	–	–	59	59	–	–	79	–	–	–	–	–
HP 3, 3D, 3P, 3P Pro	–	–	89	–	–	–	79	–	–	–	–	–
HP 4, 4M, 4Si, 4SiMX	–	–	19	–	–	–	49	–	–	79	–	–
HP 4P, 4PLUS, 4MPro 1600 *600DM*	–	–	19	–	–	–	39	–	–	69	–	–
HP 4L	–	–	29	–	–	–	–	–	–	–	–	–
HP 3Si	–	–	9	–	–	–	29	–	–	69	–	–
HP 5L	–	–	39	49	–	–	67	–	–	99	–	–
HP 5P, 5MP, 4V, 4MV, 6P, 5MP	–	–	9	19	–	–	29	–	–	69	99	–
HP Design Jet 600, 650, 200	–	–	–	19	–	–	39	–	–	89	109	199
HP Design Jet 700, 750C Plus	–	–	–	–	–	–	29	–	–	49	89	179
HP DeskJet 600, 600C, 600C 550	*29*	–	–	–	–	–	–	–	–	–	–	–
HP DeskJet 1200C 1200C/P	–	–	39	–	–	–	49	–	–	89	–	–
HP Pamilet XL300	54	–	–	–	–	–	69	–	–	144	299	–
IBM Laser 4019, 4019E	–	–	–	–	109	–	–	–	–	–	–	–
IBM Laser 4029, 4037	–	–	–	–	–	–	49	–	–	–	–	–
IBM Laser 4039, 4079	–	–	39	–	–	–	69	–	–	99	–	–
Lexmark Medley 4C, 4x, 4SX	–	Call	Call	Call	–	–	–	–	–	–	–	–
Lexmark, Optra L, LX, R, RX	–	–	–	–	–	–	39	–	–	59	89	169
Lexmark Valuewriter 300, 600	–	–	29	39	–	–	69	–	–	–	–	–
Lexmark Wriewriter 200, 400, 600	–	–	29	39	–	–	69	–	–	–	–	–
NEC 90, 290	–	–	–	59	–	–	–	–	–	–	–	–
NEC 95, 97	–	–	–	59	–	–	–	–	–	–	–	–
Oki 400	–	–	–	59	59	–	–	–	–	–	–	–
Oki 400E, 400EX, 410E, 411EX	–	–	87	89	169	–	189	–	–	–	–	–
Oki 810E, EX, 600E, EX, 610E, EX	–	–	29	79	–	–	119	–	–	119	229	–
Oki 830, 840	–	–	–	59	–	–	–	–	–	–	–	–
Panasonic 4420/4450i	–	–	–	79	–	–	109	–	–	–	–	–
Panasonic 6418/4439	–	–	–	89	–	–	89	–	–	–	–	–
Panasonic 4450i	–	–	89	–	–	–	–	–	–	–	–	–
Panasonic 4400/5400	–	–	49	69	–	–	109	–	–	–	–	–
Panasonic 4440, 5410	–	–	89	–	–	–	109	–	–	–	–	–
Panasonic 6500	–	–	14	29	–	–	79	–	–	–	–	–
Sharp 9400, 9480, 9600, 9700E	–	–	49	69	–	–	119	–	–	–	–	–
Sharp 9500 E, H, 9700 H	–	–	49	–	–	–	236	–	–	–	–	–

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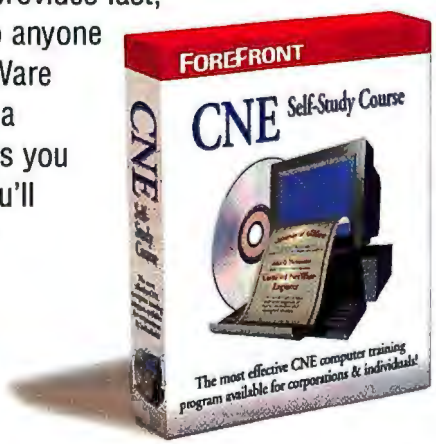

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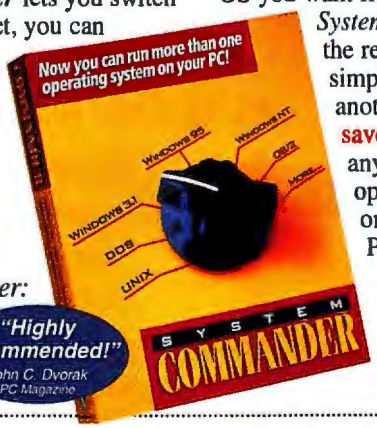

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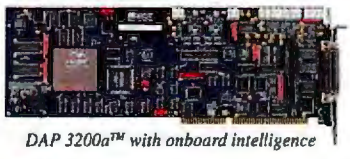

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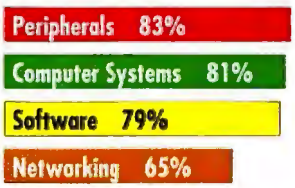

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What's New

Hardware

This month, we look at Palm Computing's latest PalmPilot organizer, videoconferencing and networking hardware, and Web-publishing tools.

PREVIEW

PalmPilot Professional
$399

Circle 1063 on Inquiry Card.
Palm Computing
Mountain View, CA
415-237-6000
http://www.usr.com/palm

Brighter PalmPilot Adds Communications

The original PalmPilot organizer was widely praised as the best of the bunch. It was small enough to carry easily, had the basic organizer functions most users wanted, and didn't try to be all things to all people. It was also criticized for lacking e-mail connectivity.

The PalmPilot Professional keeps the basics from the earlier model and adds expense management software, a backlit screen, and games. Most important, however, are the new ways to exchange data besides the direct-cable HotSync. For instance, the built-in e-mail software supports HotSync updating of the PalmPilot's mailbox via Microsoft Mail, Exchange, or cc:Mail. Two optional features, Network HotSync ($69) and the PalmPilot modem ($129), offer even more possibilities. The former supports a HotSync over LANs or WANs, while the modem supports remote connectivity and dial-up.

The modem supports about 150 HotSyncs with two AAA batteries. The backlit screen seems to have a negligible effect on the roughly two-month battery life of the PalmPilot, provided you don't keep the backlight turned on all the time.

The PalmPilot has even more third-party support now, so you have additional opportunities to use your favorite desktop applications. Separately available packages such as Act, Goldmine, Notes, Internet Sidekick, and several other PIMs support one-button HotSync synchronization of data between the PalmPilot and the desktop.

The PalmPilot Professional delivers all the power of the earlier model but is easier to use, thanks to the new features. The modem is an especially welcome addition. I found it lighter, less expensive, and easier to use than Windows CE computers. **–Jon Pepper**

PHOTOGRAPH: BRIAN WILDER © 1997

Add-Ins

Millennium Turns Pro

MATROX'S MILLENNIUM PRO (STARTS AT $399) graphics accelerator card offers improved performance with its fast Gouraud-shading engine, as well as support for 32-bit z-buffering and perspective-correct texture mapping for PC-based 3-D workstation applications. Available with 4 MB of dual-ported WRAM (expandable to 16 MB), the card has a 230-MHz DAC and a video engine that supports X and Y interpolation to deliver full-screen, full-motion video playback. With 16 MB of WRAM, it offers 1800- by 1440-pixel resolution with 16-bit z-buffering or 1600- by 1200-pixel resolution with 32-bit z-buffering. Optional companion video cards for digital video editing, capture, and output to TV are available.

Contact: Matrox Graphics, Inc., Dorval, Quebec, Canada, 514-685-2630; http://www.matrox.com.
Circle 1064 on Inquiry Card.

Communications

Look Ma, No PC

VIATV PHONE WORKS WITH A TV AND A plain old Touch-Tone telephone line to let you communicate visually without using a computer. The $499 unit, which contains a video-processing chip, video camera, and modem, attaches to your phone and TV. You use the phone to call another ViaTV Phone (or other H.324 system), press a button, and begin a two-way video conversation. The current version supports U.S. phones. The company plans

support for other countries this summer.

Contact: 8x8, Inc., Santa Clara, CA, 408-727-1885; http://www.8x8.com.
Circle 1091 on Inquiry Card.

Low-End Routers

U.S. ROBOTICS' LANLINKER 56 ($995) and LANLinker BRI ($795) offer LAN connectivity to remote offices that need a direct connection to corporate networks and the Internet. Both support IP, IPX, and AppleTalk. LANLinker 56 lets you make the connection via frame relay or PPP. LANLinker BRI supports an ISDN connection and comes with an analog-device port.

Contact: U.S. Robotics, Skokie, IL, 847-982-5001; http://www.usr.com.
Circle 1121 on Inquiry Card.

PC Videoconferencing System

XTOX INTEGRATES A PENTIUM-PROCESSOR PC, an overhead projector, a video camera, and other equipment to let you incorporate the typical elements of a business meeting into a videoconference over H.320 ISDN. Besides video, you can transmit images from the overhead projector or share data from standard office applications. You can remotely control the camera and pan to preselected angles around the meeting room. The unit costs about $20,000, but versions for desktop PCs are available for $5000 or less.

Contact: Xenex Oy, Espoo,

Finland, 358-9-521-5411; http://www.xenex.fi.
Circle 1065 on Inquiry Card.

Networking

Dual-Mode Spread-Spectrum Modem

THE HOPPER FD WIRELESS MODEM SENDS data via direct sequence or, for areas with high interference levels, frequency-hopping spread-spectrum technologies. The Hopper FD operates in the 902–928-MHz band and can deliver 19.2 Kbps in full-duplex mode and 38.4 Kbps in half-duplex mode. Its range is six to 12 miles, and prices start at $1495.
Contact: Wi-LAN, Inc., Calgary, Alberta, Canada, 403-273-9133; wi-lan@wi-lan.com; http://www.wi-lan.com.
Circle 1068 on Inquiry Card.

LAN Switch with Electronic Patch Panel

THE LANMAKER FAMILY OF MODULAR ETHERnet switches integrates 10-/100-MB Ethernet switching, electronic patch-panel capability, and graphical management software at a price of about $200 per port. The patch-panel module lets you add, move, and change users on the network without physically disconnecting and reconnecting a user at

the wiring closet. Other modules support 100Base-T, 100Base-TX, and 100Base-FX. LANmaker's network auto-load balancing dynamically reassigns power users to underused network segments.
Contact: LanOptics, Ltd., Migdal Ha-Emek, Israel, 800-533-8439 or 972-738-6900; mktinfo@lanoptics.co.il; http://www.lanoptics.com.
Circle 1066 on Inquiry Card.

Internetwork Protocol Analyzer

PRISMLITE COMBINES A WAN/LAN/ATM protocol analyzer in a 15-pound unit that you use with a Pentium-processor notebook. The unit has

three slots that can hold up to three ATM and/or up to six WAN and LAN line-interface modules. You can view ATM and LAN or ATM and WAN traffic at the same time. Prices start at $30,000 for an ATM-only configuration.
Contact: Radcom, Tel Aviv, Israel, 800-723-2664 or 201-529-2020; info@radcom.co.il; http://www.radcom-inc.com.
Circle 1067 on Inquiry Card.

Peripherals

Print Your Photographs

THE ALPS MASTERPIECE MD-2300 ($749) lets you print photographic-quality images at 600- by 600-dpi resolution. A faster photo-realistic mode (approximately 2 to 3 minutes for 8- by 10-inch color compared to 15 to 20 minutes for an 8- by 10-inch photographic-quality image) is also supported. You can print on regular laser-printer paper at 600 by 600 dpi in color or 1200 by 600 dpi in black

and white or gray scale. The photographic-quality process, which uses dye-based photo inks that are sublimated into the porous layer of the receiving medium, requires special photographic paper. Output in both the photographic-quality and photo-realistic modes are smearproof and waterproof. The MD-2300, which prints in four passes, supports both Macs and PCs and includes color-matching and Adobe PhotoDeluxe photo-editing software.
Contact: Alps Electric, Inc., San Jose, CA, 800-825-2577 or 408-432-6000; http://www.alpsusa.com.
Circle 1069 on Inquiry Card.

UPS for Multiple Servers

THE SYMMETRA POWER ARRAY PROTECTS multiple servers and Internet-working equipment. It offers fault tolerance via redundant power modules, power management tools, and scalability. The power capacity of the array ranges from 8 to 16 kVA (scalable in 4-kVA increments). If one module of the UPS fails, others protect the load to provide a fault-tolerant UPS. Prices start at $8499.
Contact: American Power Conversion, West Kingston, RI, 800-289-2772 or 401-789-5735; http://www.apcc.com.
Circle 1122 on Inquiry Card.

Affordable Sheet-Fed Scanner

HP'S SCANJET 5S IS A COLOR/GRAY-SCALE sheet-fed scanner that offers 300-dpi optical (600-dpi enhanced) scanning. It supports 24-bit color and 8-bit gray-scale scanning for Windows 95, NT, and 3.1. It attaches to the PC via a parallel port and includes OCR and document management software. The ScanJet 5s sells for about $249.
Contact: Hewlett-Packard Co., Santa Clara, CA, 800-722-6538; http://www.hp.com/go/scanjet.
Circle 1123 on Inquiry Card.

$200 Gets You 24 Bits

THE ASTRA 300P FLATBED SCANNER OFFERS 24-bit color capabilities and an optical resolution of 300 by 600 dpi (an interpolated resolution of up to 4800 dpi) for $199. The scanner, for Windows PCs, attaches via the parallel port and includes image-editing and OCR software.
Contact: Umax Technologies, Fremont, CA, 800-562-0311 or 510-651-4000; http://www.umax.com.
Circle 1129 on Inquiry Card.

Multimedia

Wave-Table Sound for Notebooks

JIVE WAVETABLE, A TYPE II PC CARD, PROvides the facility to add wave-table sound to business presentations and games. It has a wave-table sound system, FM synthesizer, and joystick controller on-board. The system (£130) sports 128 musical instruments plus 61 drum programs and 16 channels. Its general MIDI CPU ensures that the system complies with level 1 of the MIDI protocol.
Contact: Chase Advanced Technologies, Bradford, U.K., +44 1274 225000; sales@chase-at.com; http://www.chase.com.
Circle 1124 on Inquiry Card.

Systems

Pro 3D for PC Prices

INTERGRAPH'S NEW TD LINE OF PCS FEAtures an Intense 3D 100 graphics accelerator card, 16 MB of RAM, a 1.7-GB hard drive, and Windows 95 at prices starting at $1185. The TD-22 includes a 133- or up to 200-MHz Pentium processor, while the TD-25 (starts at $1485) features a 166- or 200-MHz Pentium with MMX technology. The TD-220 offers a 180- or 200-MHz Pentium Pro processor (starts at $1680). A variety of 3-D accelerator cards are available as options.

Contact: Intergraph Computer Systems, Huntsville, AL, 800-692-8069 or 205-730-2000; http://www.intergraph.com/express.
Circle 1072 on Inquiry Card.

Midrange Mac

THE POWERCENTER PRO IS A MIDRANGE Mac OS system based on a 180- or 210-MHz 604e processor and a motherboard with a 60-MHz system bus (many other Mac clones today use a 40- or 50-MHz bus). A 180-MHz version with 16 MB of RAM (up to 512 MB), 2-GB hard drive, 16×CD-ROM drive, 1-MB L2 cache card, 3-D graphics acceleration with 2 MB of DRAM graphics memory (up to 4 MB maximum), three PCI slots, built-in Ethernet, and other features costs $2095. A similarly configured system with a 210-MHz processor costs $2395.
Contact: Power Computing, Round Rock, TX, 800-999-7279 or 512-388-6868; http://www.powercc.com.
Circle 1118 on Inquiry Card.

Rugged Palmtop for Mobile Apps

FUJITSU OFFERS TWO NEW RUGGEDIZED portables for lightweight pen-based computing. The TeamPad 7200 ($2635) is a pen-based system for MS-DOS 6.22. It comes with up to 4 MB of RAM and runs on a 66-MHz 486-class CPU. The TeamPad 7600 ($4500) offers a 7.2-inch, 256-color screen and a 100-MHz 486 CPU. It comes with 8 MB of RAM (upgradable to 32 MB) and runs Windows 3.1 or 95. It weighs 1.7 pounds and can withstand drops of up to 4 feet onto concrete.
Contact: Fujitsu, La Jolla, CA, 619-457-9900; http://www.fjicl.com.
Circle 1119 on Inquiry Card.

Desktop Replacement Notebook

THE ASCENTIA P SERIES (STARTS AT $4299) sports a 166-MHz Pentium with MMX technology, a 256-KB L2 cache, and 32 MB of EDO RAM (expandable to 80 MB). It also features a 10×CD-ROM drive, 3½-inch removable floppy drive, 3-GB removable hard drive, and 12.1-inch VGA active-matrix screen. Other features: 16-bit stereo playback and record, and two Type II or one Type II and one Type III PC cards. Battery life with one lithium-ion battery pack is a claimed 3 hours.
Contact: AST, Irvine, CA, 800-876-4278 or 714-727-4141; http://www.ast.com.
Circle 1120 on Inquiry Card.

Bigger-Screen Value Notebooks

DIGITAL EQUIPMENT'S VALUE-PRICED HiNote VP 500 series of notebooks for Windows 95 or NT feature 12.1-

inch displays, 133-MHz or faster Pentium processors, power management, and a two-in-one removable 12-speed CD-ROM/floppy combo drive. Other features include 128-bit accelerated graphics with MPEG support, a PCI bus, EDO memory, 16 MB of RAM (expandable to 80 MB), up to a 2.16-GB hard drive, and two Type I/II (or one Type III) PC Card slots. The VP 575 uses a 166-MHz Pentium processor with MMX technology. Starting prices range from $2499 to $4499.
Contact: Digital Equipment Corp., Maynard, MA, 800-722-9332; http://www.windows.digital.com.
Circle 1071 on Inquiry Card.

SOFTWARE

Business

Publish Info Instantly Over the Net

ARPEGGIO LIVE INFORMATION PUBLISHING Server lets you publish real-time information over the Internet or an intranet to business users with a

Web browser. A Windows NT server application, Arpeggio Live ($1495) includes extension modules that make information available from enterprise databases, IBM mainframes, and AS/400s. Queries and reports are designed by select employees for other business users. Business users click on an icon to receive up-to-the-minute data in a custom query or report format.
Contact: Wall Data, Inc., Kirkland, WA, 800-915-9255 or 415-812-1600; http://www.walldata.com.
Circle 1073 on Inquiry Card.

Text Search for NT

SEARCHER PRO ($69) IS A 32-BIT TEXT search and file management alternative to the Windows 95 and NT Explorer. It provides ZIP, FAT, and NTFS file management, plus exact, fuzzy, and regular expression text searching within these and other file types.
Contact: Cognitronix, Poway, CA, 800-217-0932 or 619-549-8955; http://www.cognitronix.com.
Circle 1074 on Inquiry Card.

Let Your PC Find You a Job

RESUMEMAKER DELUXE ($39.95) FOR Windows creates professional résumés and cover letters. It also locates thousands of job listings on the Internet and posts your résumé directly to major Web résumé banks. The program converts résumés and letters to fax, e-mail, and other electronic formats. The program includes prewritten paragraphs for insertion in your cover letter, follow-up letter, and thank-you letter, plus 100 sample letters. Also included is a contact management program/activity tracker and career planner. It creates your résumé from the virtual interview that you conduct with the program.
Contact: Individual Software, Inc., Pleasanton, CA, 800-822-3522 or 510-734-6767; http://www.individualsoftware.com.
Circle 1075 on Inquiry Card.

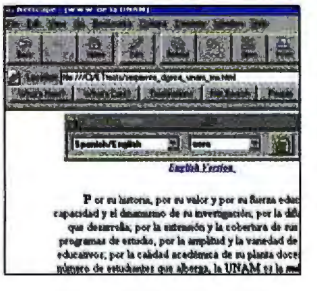
Dictionary for Linux

XDIC, A CD-ROM DICTIONARY FOR LINUX (DM 39), provides bidirectional translations from German to English, French, Spanish, and Italian. It includes more than 150,000 entries and offers quick search and browsing facilities.
Contact: LinuxLand, Munich, Germany, +49 89 99315300; http://www.linuxland.de.
Circle 1126 on Inquiry Card.

Communications

Web and E-Mail Translation Tool

EASY TRANSLATOR ($49) TRANSLATES TEXT, e-mail, and Web pages in Spanish, French, and German to and from English. Web pages are translated on the screen, while text and e-mail require you to paste the document



to a new page. Like other machine-translation tools, the translation will not be 100 percent accurate. However, Transparent Language says you can expect a level of 60 percent to 70 percent accuracy.

Contact: Transparent Language, Hollis, NH, 603-465-2230; admin@transparent.com; http://www.transparent.com.
Circle 1076 on Inquiry Card.

PhotoRecall
$69.95

Circle 1115 on Inquiry Card.

G&A Imaging, Ltd.
Hull, Quebec, Canada
888-772-7601
819-772-7600
http://www.ga-imaging.com

Make Electronic Photo Albums with Your PC

The explosive growth of PC photography thanks to digital cameras, scanners, and color printers brings a concomitant need to manage these images. That is the niche that PhotoRecall for Windows 95 and NT fills. G&A Imaging is also developing a Mac version, but company officials couldn't say when it will be available.

Several packages provide image management, and others deliver image editing. PhotoRecall combines these two functions along with other nifty touches.

The program's two main components—the library and the darkroom—dovetail together seamlessly. In the library, you can open up photo albums you have created and given names such as "Tim's Birthday." Launching the library opens up a portfolio that displays your photos using album, filmstrip, bulletin-board, or thumbnail metaphors, depending on your preference. Creating an album is a no-fuss project, with the ability to take input from digital cameras, scanners, or any TWAIN-compliant device. You can even scan the Internet to find photos using a search form built into the software.

The image-editing features aren't up to Adobe Photoshop's, but there is more than enough here to satisfy most PC photography hobbyists. All the basics are built in (e.g., flip, rotate, and resize), along with fun special effects such as mapping images to a cylinder or sphere or creating emboss or watercolor effects. When you make most adjustments, the software shows you numerous alternatives at once—what G&A calls adjust by example—so you can see how much of an effect you prefer.

PhotoRecall isn't everyone's answer to photo management and editing, but at an affordable price, it accomplishes many digital darkroom tasks.

–Jon Pepper

FirstClass Intranet Server

LIKE ITS SIBLING FIRSTCLASS 3.5, FIRSTCLASS Intranet Server ($999) offers e-mail, replicable discussion databases, remote access, forms processing, enterprise database access, and information publishing, but for the Internet. FirstClass Intranet Server supports POP3, HTTP/HTML, Finger, SMTP/NNTP, and MIME. You can publish FirstClass Intranet Server content on the Web, where it is accessible via a Web browser. You can also use Eudora, CyberDog, or other Internet mail clients to retrieve messages.
Contact: SoftArc, Inc., Markham, Ontario, Canada, 905-415-7000; tim@softarc.com.
Circle 1077 on Inquiry Card.

Use Your Voice to Surf

WITH VOICETYPE CONNECTION FOR Netscape Navigator ($14.95) for Windows 95, you can use your voice to surf the Web. You can choose from a base set of 20 commands (e.g., go to, scroll up, and add voicemark), which are voice-enabled shortcuts to your favorite Web sites. When combined with IBM's VoiceType Simply Speaking or VoiceType 3.0 speech-recognition products, you can dictate and send e-mail notes by voice.
Contact: IBM, 800-825-5263; http://www.software.ibm.com.

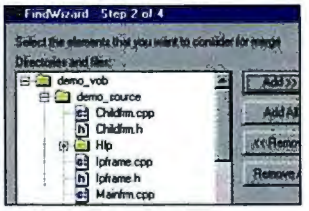
Better Synchronization for PalmPilot

WITH DESKTOP TO GO (ABOUT $50) FOR Palm Computing's PalmPilot, any modifications made to Microsoft Outlook and Lotus Organizer 97 are updated automatically on your hand-held and desktop computers. Desktop To Go provides field-level synchronization for contacts, appointments, tasks, and memos. You can synchronize with multiple PIMs (e.g., use Outlook for scheduling, Organizer for contacts, and the PalmPilot's Desktop application for To Do's and memos).
Contact: DataViz, Trumbull, CT, 800-733-0030 or 203-268-0030; http://www.dataviz.com.
Circle 1078 on Inquiry Card.

Programming

Automated Web-Site Testing Tools

SEGUE SOFTWARE'S SILK PRODUCT FAMILY for Windows 95 or NT offers broad test coverage for industrial-strength Web applications. SilkTest ($3995) provides functional and regression tests across diverse Web



environments. It recognizes text, links, images, HTML, and Java applets. SilkPerformer (to ship in the third quarter) provides multiplatform load testing to gauge Web-applications performance.
Contact: Segue Software, Newton Centre, MA, 800-287-1329 or 617-796-1000; http://www.segue.com.
Circle 1081 on Inquiry Card.

Configuration Management for NT

CLEARCASE 3.1 FOR NT PROVIDES VERSION control, workspace management, build management, and process control for programmers. It stores all file versions in a secure, scalable repository and provides a history of all software changes. The program integrates with Visual Basic, Visual C++, and Oracle's Developer/2000. Available at prices starting at $4000, the program includes wizards that assist you in such tasks as installation and merging files.
Contact: Pure Atria, Sunnyvale, CA, 408-720-1600; info@pureatria.com; http://www.pureatria.com.
Circle 1079 on Inquiry Card.

Tools for Embedded PowerPC

CodeWarrior for PowerPC Embedded Systems ($699) provides an IDE supporting Motorola's MPC 8xx family of embedded processors. The IDE's tools include integrated project manager, text editor, optimizing C compiler, linker, source/assembly-level debugger, and on-line references. It works with Motorola's 821/860 development board.
Contact: Metrowerks, Austin, TX, 800-377-5416 or 512-873-4700; info@metrowerks.com; http://www.metrowerks.com.
Circle 1080 on Inquiry Card.

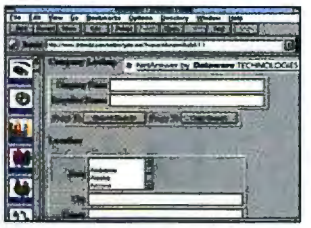
Write NT Drivers in C++

Driver::Works ($795) combines a C++ class library with wizard technology to let you build kernel-mode device drivers for NT. Vireo says that the product's support for Microsoft's Windows Driver Model assures developers that drivers built today with Driver::Works will be compatible with NT 4.0, plus future versions of Windows (e.g., Windows 97). It requires NT 3.5.1 or higher.
Contact: Vireo Software, Acton, MA, 508-264-9200; sales@vireo.com; http://www.vireo.com.
Circle 1082 on Inquiry Card.

The Web

Stateful Internet Publishing Server

NetAnswer 2.0 lets corporate or commercial publishers make up to 100 GB of customized data, text, and multimedia content available via the Internet or intranets. At the beginning of a search session,



NetAnswer 2.0 (starts at $10,000 and available for NT and Unix) establishes a connection with the end user that remains for the duration of the session (aka maintaining state), thus keeping track of successive search queries by the user to increase result accuracy. Other features include enhanced security, metering, and accounting by paragraph, document, or database to allow charging for information on a per-document basis. The program supports fielded queries, relevance ranking, multiple languages, and natural-language queries.
Contact: Dataware Technologies, Inc., Cambridge, MA, 617-621-0820; http://www.dataware.com.
Circle 1083 on Inquiry Card.

WebMaster Suite

Corel's WebMaster Suite ($299) includes WYSIWYG Web authoring, site management, bit-map and photo editing, vector illustration, animation, 3-D virtual-community design, and database-publishing applications for Windows 95 and NT. The program includes O'Reilly's WebSite 1.1.
Contact: Corel Corp., Ottawa, Ontario, Canada, 800-772-6735 or 613-728-8200; http://www.corel.com.
Circle 1085 on Inquiry Card.

Personalize Your Web Site for Customers

InterSite monitors activity such as transactions, help- and chat-session transcripts, and Web-page browsing frequency of customers on your Web site. This helps you deliver personalized content to your customers. The resulting analysis creates a visitor profile without requiring the customer to fill out lengthy questionnaires to rate their preferences. Customer activity is matched with product purchases or responses to mailings to train a set of neural networks that give your marketing staff tools they need to tailor content (e.g., ads or articles) to segments of your client community. InterSite runs on NT and costs $40,000.
Contact: Nestor, Inc., Providence, RI, 401-331-9640; http://www.nestor.com.
Circle 1086 on Inquiry Card.

Take Customer Support Off the Hook

Silknet ServiceDesk (between $75,000 and $500,000) lets you off-load customer-support phone calls to a Web site. Customers can obtain answers to their questions using a Web browser without requiring company assistance. They can also log problems or request assistance on-line. Customers search a knowledge base of published solutions, on-line documentation, or newsgroups for answers to questions. ServiceDesk runs on NT, and customer-support personnel can author new solutions graphically using an ActiveX-supporting Web browser.
Contact: Silknet Software, Inc., Manchester, NH, 888-745-5638 or 603-625-0070; http://www.silknet.com.
Circle 1084 on Inquiry Card.

Data Analysis

WinRosa Generates Fuzzy Rules

WinRosa automatically generates fuzzy rules from data sets. It provides faster and more efficient data analysis in monitoring and controlling applications, the developer says. The software (DM 1990) integrates with other analysis systems such as DataEngine, FuzzyTech, and Matlab.
Contact: MIT, Aachen, Germany, +49 2408 94580; rw@mitgmbh.de; http://www.mitgmbh.de.
Circle 1127 on Inquiry Card.

Software Updates

NeoAccess 5.0 ($749), a cross-platform ODBMS, adds support for databases larger than 4 GB, support for the latest versions of all major compilers, expanded schema evolution with less applications-developer involvement, support for collections that are not based on B-trees, and template-based swizzler classes that reduce the need for casting and ease object reference counting issues. The program runs on Windows NT, Mac OS, and Unix.
Contact: NeoLogic Systems, Inc., Berkeley, CA, 800-919-6353 or 510-524-5897; neologic@neologic.com; http://www.neologic.com.
Circle 1087 on Inquiry Card.

Legato's NetWorker 4.4 for Windows NT ($1000), a storage management program that preserves programs and data on file/print and database and applications servers, offers a new administrative GUI, disaster recovery support, and centralized recovery of remote clients.
Contact: Legato Systems, Inc., Palo Alto, CA, 415-812-6000; http://www.legato.com.
Circle 1088 on Inquiry Card.

AAA Map'n'Go 3.0, the mapping program for Windows that plots the best route based on your parameters, adds a new highway exit services database, new tourbook information, improved routing, the ability to download detailed street maps from Street Atlas USA 4.0, direct access to 250 city Web pages containing local and regional information, and many more improvements.
Contact: DeLorme, Freeport, ME, 207-865-4171; http://www.delorme.com
Circle 1089 on Inquiry Card.

improbable

Advances and Retreats in Computing

Revenge on junk e-mailers, theme music for real life, and what the Internet will kill.

Monkey on Your Head

Suggestions we've received for Project Whacko (our campaign to help e-junkmailers whack themselves out of existence) are promising. Two that readers sent in use the same simple mechanism: monkeying with your message header.

One individual, who requested anonymity, reported success using a method that we admire but cannot and do not advocate. "Netscape lets me type in my e-mail address, and of course it's easy to type in the wrong address, so I did," wrote the covert Whacko commando. "I used a series of addresses, such as [the one for the] U.S. postal inspection service and the FBI's computer-crime hot line... when posting to a newsgroup, and within a couple of weeks, the spam had almost stopped...."

That approach has obvious drawbacks, which we need not discuss here. Simon Read uses a similar technical trick but applies it in a more wholesome way. He takes advantage of the fact that many e-junkmailers use automated address sniffers to get the addresses of future victims. By putting rubbish in the "from" field of a message header, a robot scanner won't pick it up, because it is not in the correct format, claims Read. "I have used blah@bleah.blurg.retch quite a lot," says Read. "I put my e-mail address in the body of my posting so that humans can read it."

The results of our 15-month experiment, Mental Life of the Programmer, #205, are in. It boils down to this: You know you're not awake yet when you can't click the mouse button fast enough to make it a double-click.

Next month we will describe, to the extent legally permissible, the details of our e-junkmailer assassination bureau.

THE END OF MANY THINGS

Consider this snippet of a news item: "An editorial in the Iraqi government newspaper Al-Jumhuriya says that the Internet—which is not accessible in Iraq—is 'the end of civilizations, cultures, interests, and ethics.'" Associated Press, February 17, 1997.

Governments are cautious in their public statements. Surely, the Internet is the end not just of civilizations, cultures, interests, and ethics, but of many other things, too. As a service to mankind, help us compile a list of everything the Internet is the end of. Send your items (10 words or less per item, please) to marca @improb.com.

Music of the Social Spheres

I think we all agree that one of the biggest disappointments in life is that people don't come with background music. When warming up to a new friend, the relationship progresses more quickly and deeply if good background music accompanies the conversation. In movies, this music is the glue that joins strangers' lives together quickly.

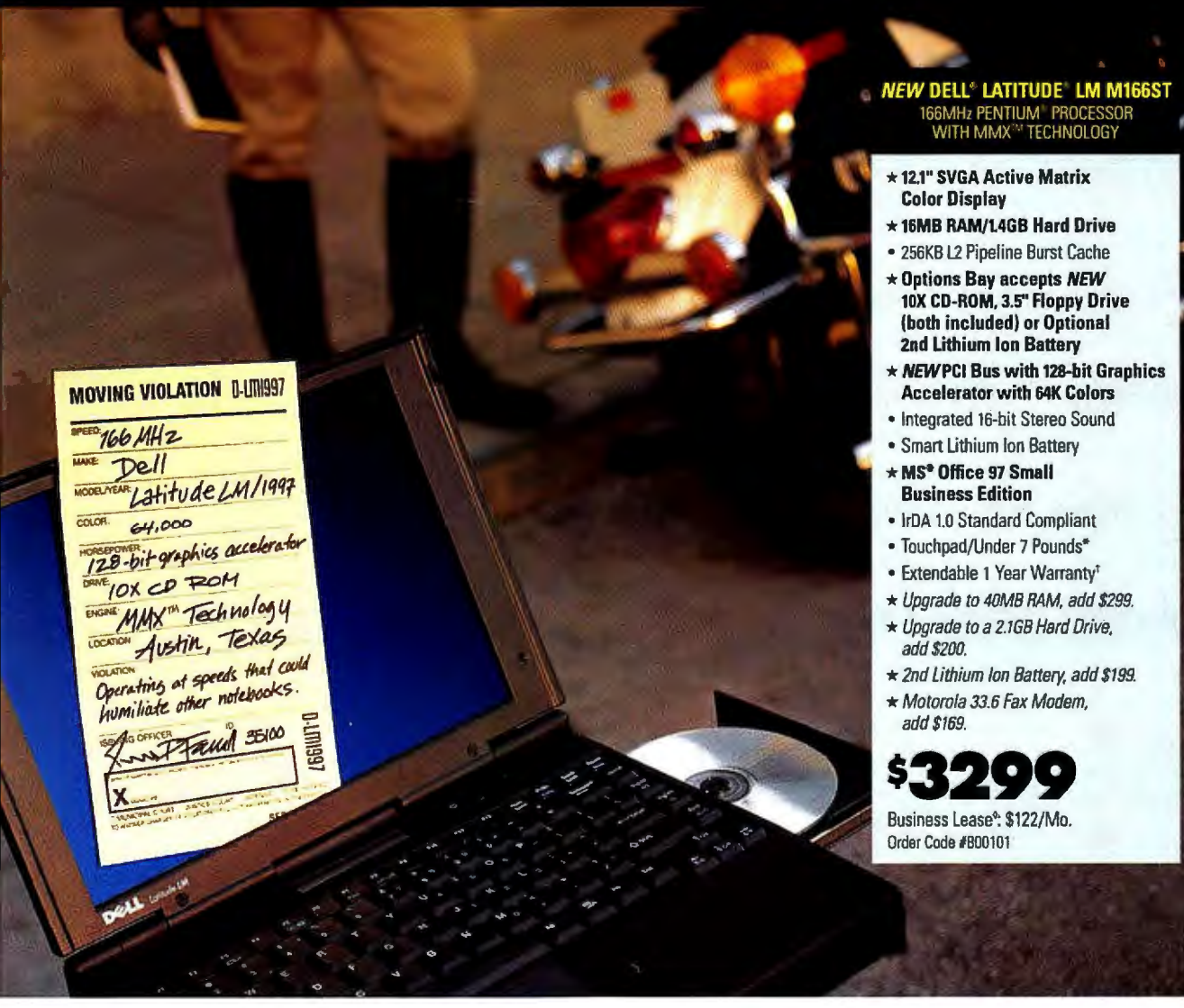
In everyday life, the effect is no less impressive. Producing a flow of such music is a snap when you use a product called the SoulMan. It was developed not by Sony but by Teichholtz. The Teichholtz SoulMan couples a multidisc CD player to a rudimentary voice-recognition system. Rudimentary neural-network software chooses and changes the music continuously.

We tried a precommercial version of the system in our office and must report that it's a dangerously powerful thing. So stock up on earplugs. When the SoulMan arrives, we'll discover the sad truth: That try as we might, we can't all live together in perfect harmony.

Marc Abrahams is the editor of The Annals of Improbable Research. *You can contact him at* marca@improb.com.

ILLUSTRATIONS: VICTOR GAD © 1997

SORRY, OFFICER, WE DIDN'T REALIZE WE WERE GOING THAT FAST.



***NEW* DELL® LATITUDE™ LM M166ST**
166MHz PENTIUM® PROCESSOR WITH MMX™ TECHNOLOGY

- ★ **12.1" SVGA Active Matrix Color Display**
- ★ **16MB RAM/1.4GB Hard Drive**
- • 256KB L2 Pipeline Burst Cache
- ★ **Options Bay accepts *NEW* 10X CD-ROM, 3.5" Floppy Drive (both included) or Optional 2nd Lithium Ion Battery**
- ★ ***NEW* PCI Bus with 128-bit Graphics Accelerator with 64K Colors**
- • Integrated 16-bit Stereo Sound
- • Smart Lithium Ion Battery
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- • IrDA 1.0 Standard Compliant
- • Touchpad/Under 7 Pounds*
- • Extendable 1 Year Warranty†
- ★ *Upgrade to 40MB RAM, add $299.*
- ★ *Upgrade to a 2.1GB Hard Drive, add $200.*
- ★ *2nd Lithium Ion Battery, add $199.*
- ★ *Motorola 33.6 Fax Modem, add $169.*

$3299

Business Lease‡: $122/Mo.
Order Code #B00101

NOW WITH MMX™ TECHNOLOGY. The speed limit for notebooks has just been raised. You see, the new Latitude LM M166ST is powered by the 166MHz Intel® Pentium® processor with MMX™ technology. The one that turns multimedia into multispeedia. But this Latitude LM doesn't just have one of the fastest chips available in a portable. It has fast everything. Such as the new 10X CD-ROM drive. And a new 128-bit graphics accelerator that gives you faster and better color resolution and 64,000 colors. So give us a call. And start enjoying life in the fast lane.

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GSA Contract #GS-35F-4076D

Keycode #01214

THESE NEW 266MHz DELL SYSTEMS AREN'T JUST INCR THEY'RE INCREDIBLY

NEW DELL DIMENSION® XPS DESKTOPS–PENTIUM® II PROCESSOR

Common features: • Mini Tower Model • 512KB Integrated L2 Cache • *NEW* 16X Variable EIDE CD-ROM Drive • Matrox Millennium 4MB WRAM Video Card • Yamaha 32 Wave Table Sound Module • **MS® Office 97 Small Business Edition** • MS IntelliMouse • 2 Universal Serial Bus (USB) Ports • 3 Year Limited Warranty† with 1 Year On-site^ Service

DELL DIMENSION® XPS H266
266MHz PENTIUM® II PROCESSOR

Common features listed above plus:
- 64MB EDO Memory with ECC
- *NEW* 6.4GB Hard Drive with 512KB Cache [9.5ms]
- 1000HS Trinitron® Monitor (15.9" v.i.s.)
- Altec ACS-490 Full Dolby® Surround Sound Speakers with Subwoofer
- 33.6 U.S. Robotics Telephony Modem
- Iomega Zip 100MB IDE Internal Drive with One Cartridge
- MS Windows® 95

★ *Upgrade to 128MB EDO Memory with ECC, add $599.*

$3799

Business Lease◊: $137/Mo.
Order Code #500509

DELL DIMENSION XPS H266
266MHz PENTIUM II PROCESSOR

Common features listed above plus:
- 32MB EDO Memory
- 4.3GB Hard Drive [9.5ms]
- 1000HS Trinitron Monitor (15.9" v.i.s., .26dp, 1600x1200 max. res.)
- Altec ACS-290 Speakers with Subwoofer
- Iomega Zip 100MB IDE Internal Drive with One Cartridge
- MS Windows NT® Workstation 4.0

★ *Upgrade to 64MB EDO Memory with ECC, add $299.*

$3299

Business Lease: $122/Mo.
Order Code #500508

DELL DIMENSION XPS H233
233MHz PENTIUM II PROCESSOR

Common features listed above plus:
- 32MB EDO Memory with ECC
- 4.3GB Hard Drive [9.5ms]
- 17LS Monitor (15.7" v.i.s.)
- Altec ACS-90 Speakers
- Iomega Zip 100MB IDE Internal Drive with One Cartridge
- MS Windows 95

★ *Upgrade to a 6.4GB Hard Drive with 512KB Cache (9.5ms), add $149.*

★ *Upgrade to a 1000HS Trinitron Monitor (15.9" v.i.s, .26dp, 1600x1200 max. res.), add $165.*

$2899

Business Lease: $107/Mo.
Order Code #500507

DELL DIMENSION XPS DESKTOPS–

Common features: • Mini Tower Model • Sound Blaster 16 WaveSynth Wavetable • Software Publishing Association MPC-3

DELL DIMENSION XPS M200s
200MHz PENTIUM® PROCESSOR
WITH MMX™ TECHNOLOGY

Common features listed above plus:
- 64MB SDRAM Memory
- *NEW* 6.4GB Hard Drive with 512KB Cache [9.5ms]
- 1000HS Trinitron Monitor (15.9" v.i.s., .26dp, 1600x1200 max. res.)
- Altec ACS-290 Speakers with Subwoofer

★ *Upgrade to a 20TD Trinitron Monitor (19.0" v.i.s., .26dp, 1600x1200 max. res.), add $599.*

★ *4/8GB TR4 IDE Tape Backup, add $299.*

$3199

Business Lease: $118/Mo.
Order Code #500506

NEW DELL DIMENSION DESKTOPS–PENTIUM PROCESSOR WITH MMX

Common features: ◆ Mini Tower Model ◆ 512KB Single Bank Pipeline Burst Cache ◆ 12X EIDE CD-ROM Drive ◆ 2MB EDO ViRGE 3D Video ◆ **MS Office 97 Small Business Edition** ◆ Microsoft Windows 95 ◆ MS Mouse ◆ 2 Universal Serial Bus (USB) Ports ◆ 3 Year Limited Warranty with 1 Year On-site Service

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.)

★ *Upgrade to 32MB SDRAM, add $119.*

★ *Upgrade to a 17LS Monitor (15.7" v.i.s.), add $175.*

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★ *Sound Blaster 16 PnP Sound Card and Altec ACS-90 Speakers, add $89.*

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Business Lease: $74/Mo.
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Common features: ◆ 256KB Integrated L2 Cache ◆ Integrated PCI Ultra-Wide SCSI-3 Controller ◆ 8X SCSI CD-ROM Drive ◆ Intel® EtherExpress Pro/100 Ethernet Adapter ◆ Intel LANDesk® Server Manager v2.5x ◆ *NEW* Dell Server Assistant CD-ROM ◆ 3 Year Warranty with 1 Year On-site Service*

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Common features listed above plus:
- 64MB ECC EDO Memory (512MB Max.)
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- MS Windows NT Server 4.0 (10 Client Access Licenses)
- 800HS Trinitron Monitor (13.7" v.i.s.)
- 3Com OfficeConnect Hub 8/TPC

★ *Upgrade to 128MB ECC EDO Memory, add $630.*

★ *Upgrade to a 9GB Ultra-Wide SCSI-3 Hard Drive, add $850.*

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Business Lease: $162/Mo.
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200MHz PENTIUM PRO PROCESSOR

Common features listed above plus:
- 48MB ECC EDO Memory (512MB Max.)
- *NEW* 2GB Ultra-Wide SCSI-3 Hard Drive [7200RPM, 8ms] (27GB Max.)
- 3Com DfficeConnect Hub 8/TPC

★ *Upgrade to a 4GB Ultra-Wide SCSI-3 Hard Drive, add $320.*

★ *MS Windows NT Server 4.0 (with 10 Client Access Licenses), add $799.*

★ *4/8GB SCSI DAT Tape Backup, add $749.*

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200MHz PENTIUM PROCESSOR
WITH MMX TECHNOLOGY

Common features listed above plus:
- 32MB SDRAM Memory
- 3.2GB Hard Drive [12ms]
- 1000HS Trinitron Monitor (15.9" v.i.s., .26dp, 1600x1200 max. res.)
- Altec ACS-290 Speakers with Subwoofer
- 33.6 U.S. Robotics Telephony Modem
- Iomega Zip 100MB IDE Internal Drive with One Cartridge

★ *Upgrade to a 4.3GB Hard Drive (9.5ms), add $75.*

$2899

Business Lease: $107/Mo.
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DELL DIMENSION XPS M200s
200MHz PENTIUM PROCESSOR
WITH MMX TECHNOLOGY

Common features listed above plus:
- 32MB SDRAM Memory
- 3.2GB Hard Drive [12ms]
- 17LS Monitor (15.7" v.i.s.)
- Altec ACS-90 Speakers

★ *Upgrade to 64MB SDRAM, add $239.*
★ *Upgrade to a 4.3GB Hard Drive (9.5ms), add $75.*
★ *Upgrade to a 1000HS Trinitron Monitor (15.9" v.i.s, .26dp, 1600x1200 max. res.), add $165.*
★ *Upgrade to Altec ACS-290 Speakers with Subwoofer, add $75.*

$2499

Business Lease: $92/Mo.
Order Code #500504

DELL DIMENSION XPS M166s
166MHz PENTIUM PROCESSOR
WITH MMX TECHNOLOGY

Common features listed above plus:
- 32MB SDRAM Memory
- 3.2GB Hard Drive [12ms]
- 800HS Trinitron Monitor (13.7" v.i.s.)
- Altec ACS-290 Speakers with Subwoofer

★ *Upgrade to 64MB SDRAM, add $239.*
★ *Upgrade to a 17LS Monitor (15.7" v.i.s.), add $175.*
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Common features: ◆ 256KB L2 Pipeline Burst Cache ◆ Options Bay accepts *NEW* 10X CD-ROM, 3.5" Floppy Drive (both included), or Optional 2nd Li-Ion Battery ◆ Integrated 16-bit Stereo Sound ◆ Smart Lithium Ion Battery ◆ IrDA 1.0 Standard Compliant ◆ Touchpad ◆ Under 7 Pounds* ◆ Extendable 1 Year Warranty†

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166MHz PENTIUM PROCESSOR
WITH MMX TECHNOLOGY

Common features listed above plus:
- 12.1" SVGA Active Matrix Color Display
- 40MB RAM/2.1GB Hard Drive
- *NEW* PCI Bus with 128-bit Graphics Accelerator with 64K Colors
- MS Office 97 Small Business Edition
- 2nd Lithium Ion Battery

★ *Upgrade to 72MB RAM, add $299.*
★ *3Com LAN+ 33.6 Modem PC Card, add $349.*

$3999‡

Business Lease: $144/Mo.
Order Code #800130

NEW DELL LATITUDE LM M166ST
166MHz PENTIUM PROCESSOR
WITH MMX TECHNOLOGY

Common features listed above plus:
- 12.1" SVGA Active Matrix Color Display
- 24MB RAM/2.1GB Hard Drive
- *NEW* PCI Bus with 128-bit Graphics Accelerator with 64K Colors
- MS Office 97 Small Business Edition

★ *Upgrade to 40MB RAM, add $199.*
★ *2nd Lithium Ion Battery, add $199.*
★ *Motorola 33.6 Fax Modem, add $169.*
★ *Leather Carrying Case, add $129.*

$3599‡

Business Lease: $130/Mo.
Order Code #800132

NEW DELL LATITUDE LM M166ST
166MHz PENTIUM PROCESSOR
WITH MMX TECHNOLOGY

Common features listed above plus:
- 12.1" SVGA Active Matrix Color Display
- 16MB RAM/1.4GB Hard Drive
- *NEW* PCI Bus with 128-bit Graphics Accelerator with 64K Colors
- MS Office 97 Small Business Edition

★ *Upgrade to 40MB RAM, add $299.*
★ *Upgrade to a 2.1GB Hard Drive, add $200.*
★ *2nd Lithium Ion Battery, add $199.*

$3299‡

Business Lease: $122/Mo.
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DELL LATITUDE LM P133ST
133MHz PENTIUM® PROCESSOR

Common features listed above plus:
- 12.1" SVGA Active Matrix Color Display
- 16MB RAM/1.4GB Hard Drive
- PCI Bus with 128-bit Graphics Accelerator

★ *Upgrade to 24MB RAM, add $100.*
★ *Upgrade to a 2.1GB Hard Drive, add $200.*
★ *2nd Lithium Ion Battery, add $199.*
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- 2 Universal Serial Bus (USB) Ports
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- 3 Year Limited Warranty† with 1 Year On-site‡ Service
- ★ *Upgrade to 64MB SDRAM, add $239.*
- ★ *Upgrade to a 4.3GB Hard Drive (9.5ms), add $75.*
- ★ *Upgrade to a 1000HS Trinitron® Monitor (15.9" v.i.s., .26dp, 1600x1200 max. res.), add $165.*

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