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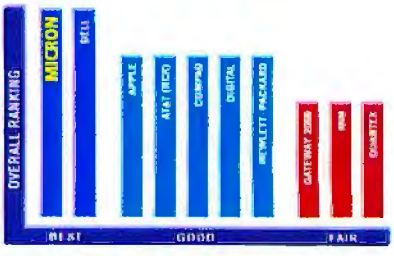

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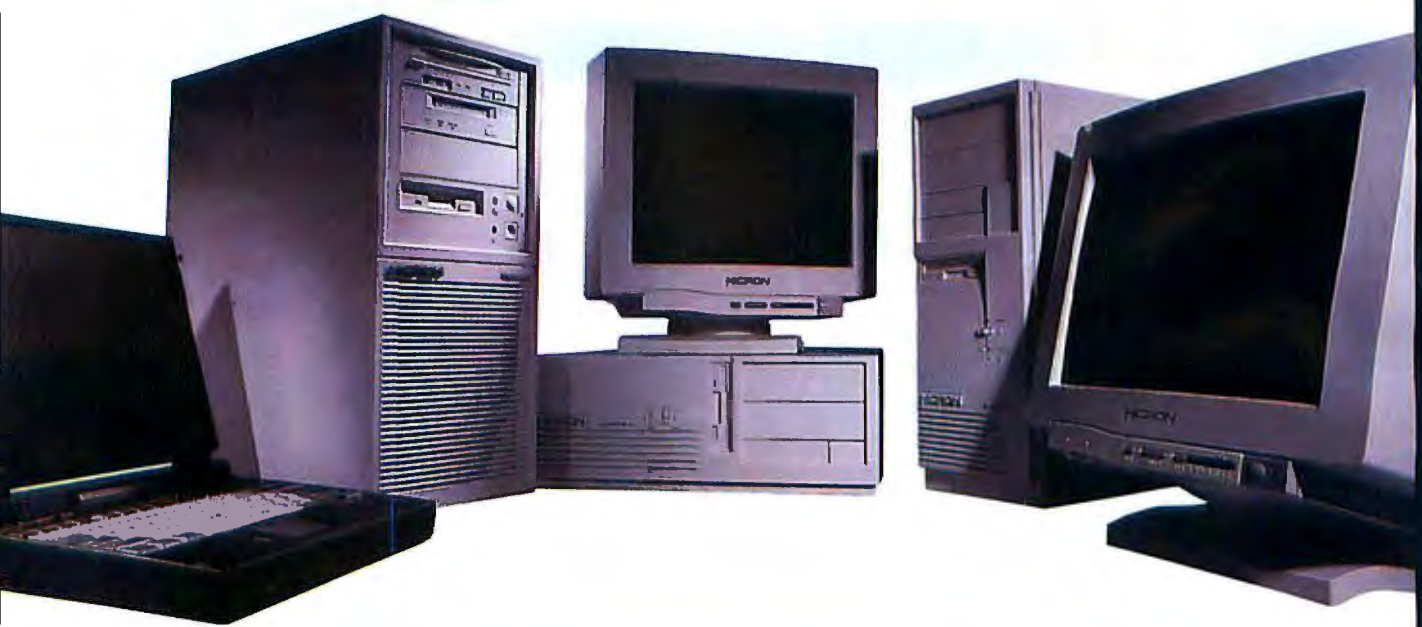

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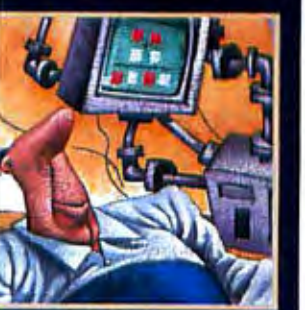

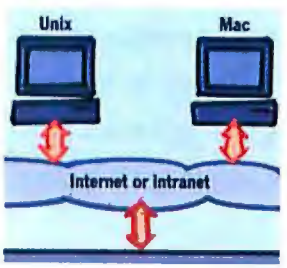

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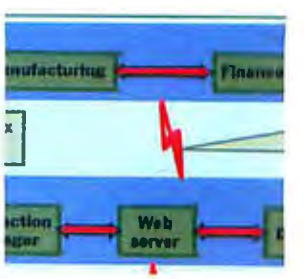

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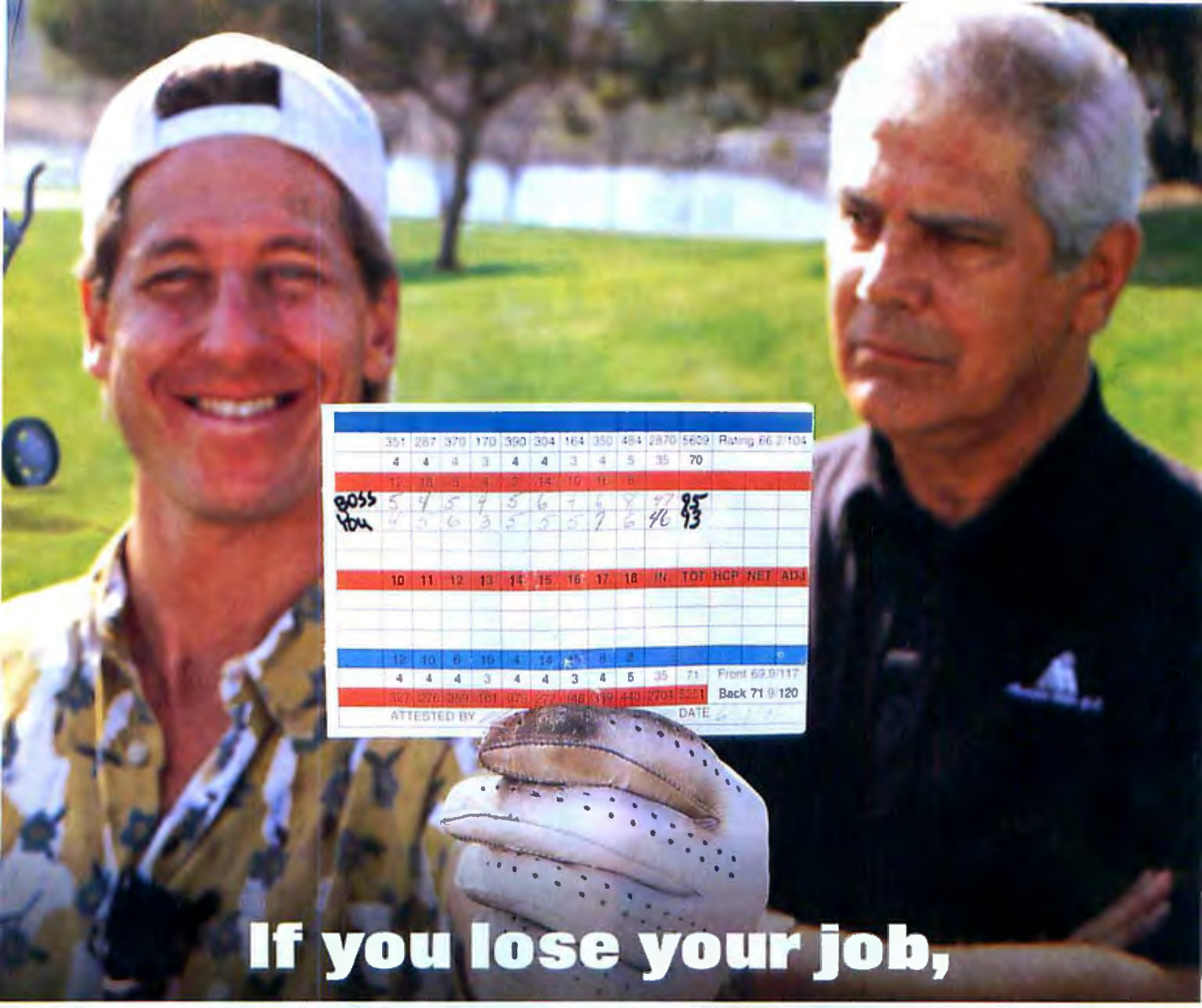

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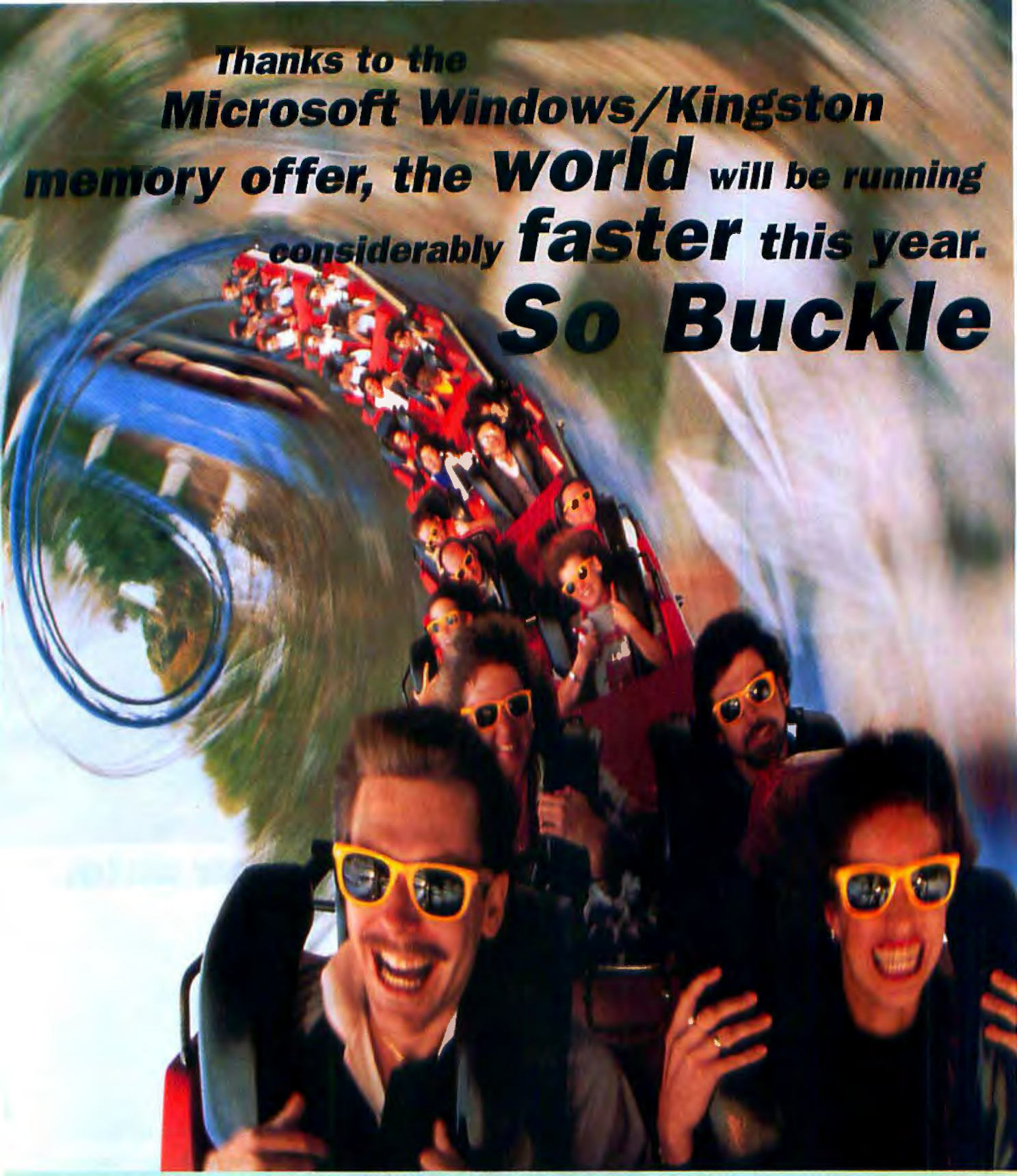

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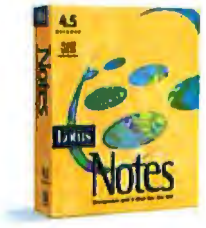

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editorial

Serve 'Em Up Hot

The prevailing server-side trend will go a long way toward providing new, really useful applications.

Last October I complained loudly about the lack of interesting new desktop applications. I haven't exactly been overwhelmed since then, but it's stopped bothering me as much.

At that time, I said I wasn't buying the idea that server apps were going to replace client apps. I'll now amend that statement: Software development is definitely doing a 180 away from stand-alone apps and toward server apps. Slow, expensive, or simply unavailable networks will keep stand-alones in business for years, but it's becoming clear that server apps are hot.

Modern server apps offer services and processing to large groups of people trying to accomplish something together. That's the agenda that information technology experts need to respond to now. Personal productivity apps haven't made that big a dent in these kinds of collaborative tasks.

Case in point: How do you enable dispersed groups of people too numerous to attend the same videoconference to work together in real time? Recently I previewed three apps that address the problem of simultaneous, real-time collaboration: Venue, a virtual office, from Activerse (Austin, TX); Symposium, an on-line classroom aimed at corporate training, from Centra Software (Lexington, MA); and Auditorium, a virtual space for large meetings, from Xerox PARC spin-off PlaceWare (Mountain View, CA). Time will tell how well they deliver on their promise, but in concept they're strikingly powerful programs.

They provide in a box what an IS shop would be hard-pressed to cobble together on its own. And they do it by marrying established client-side technologies like GUIs, 3-D graphics, and digital audio with new server-side technologies like the Web and Java. Significantly, the developers of these apps didn't invent these technologies—they merely assembled them in interesting and worthwhile ways. Where once developing those apps was no task for the fainthearted, you need no longer be a master of kernel architectures and C to produce useful server-side code.

Our cover story focuses on the OS side of this equation—specifically, the soon-to-be-released NT 5.0. It's the most significant NT since 3.51 achieved basic usability and stability. Reading this story, I was struck by how different it is from those articles we used to write about desktop OSes. What's important isn't the details of NT's internals, but how concentric layers of middleware ripple out from it to provide application services that will eliminate years of work from development projects.

Enterprise computing experts have long pointed out that real companies need PC operating systems that do much more than make a microprocessor scream. Microsoft addressed some of that with BackOffice. Now it has dropped the other shoe with an array of software to make distributed computing work on a large scale: directory services, security, object support, and more.

You need no longer be a master of kernel architectures and C to produce useful server-side code.

Take platforms like NT and Unix, make liberal use of components and the Net, and you have a server application development platform that just won't quit. That's great news for those pushing the envelope with components, network computers, and other net-centric technology. But I think it's also increasingly the tune that even fat-client advocates will march to. After all, ultimately you want to harness all that graphical and information processing power to make the most of the server-side apps that draw together your company, its partners, and its customers.

On another subject, subscribers will notice a new feature section in this month's issue: Reseller. Our research tells us that roughly a third of our subscribers are value-added resellers, systems integrators, independent software developers, and similar providers of IT services. Our new section will focus on technology that you can use flexibly and profitably to meet the needs of your customers. If you're a reseller who doesn't subscribe but buys us on the newsstand, you can check out this new section by visiting our Web site. In either case, let us know what you think. B

Mark Schlack

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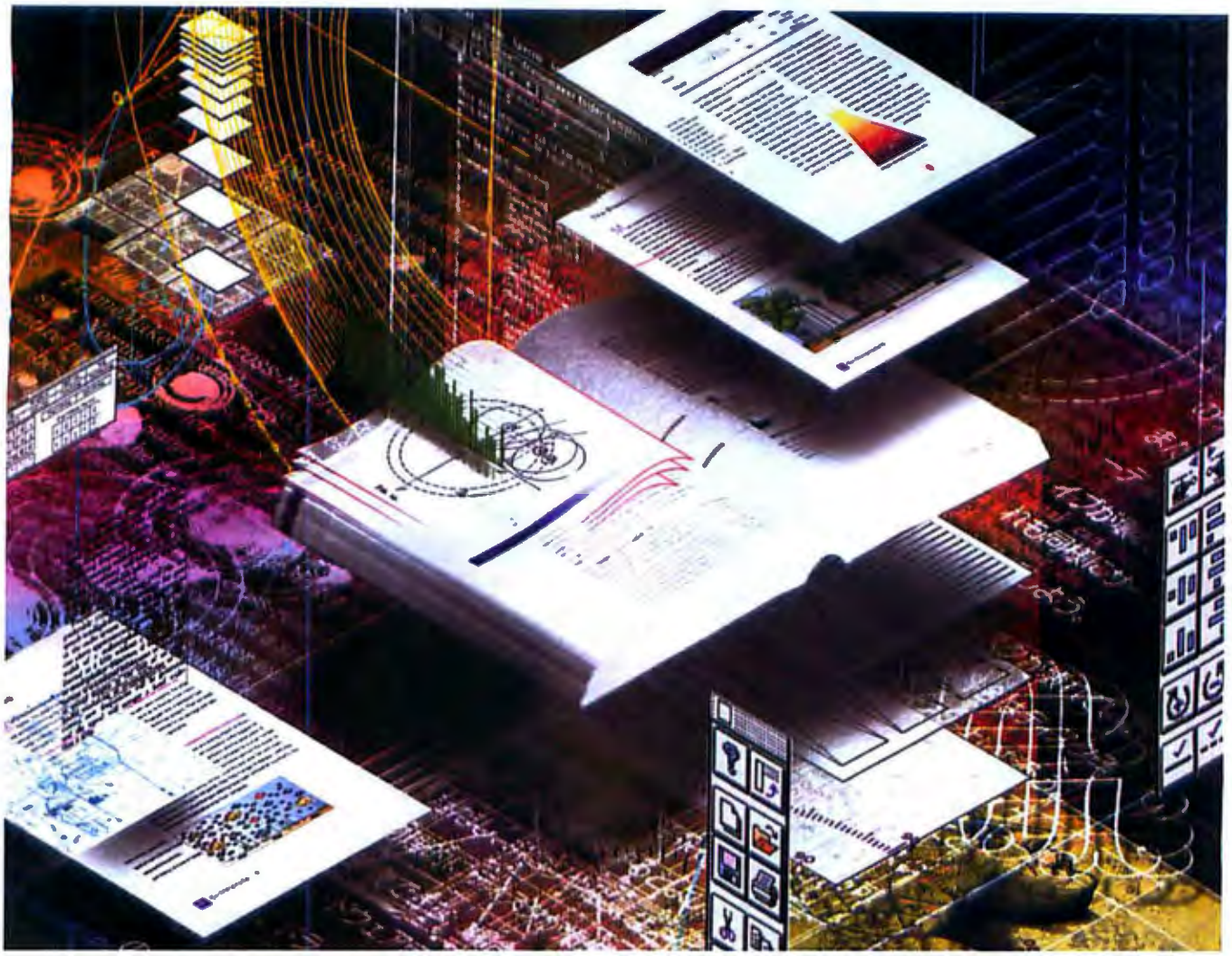

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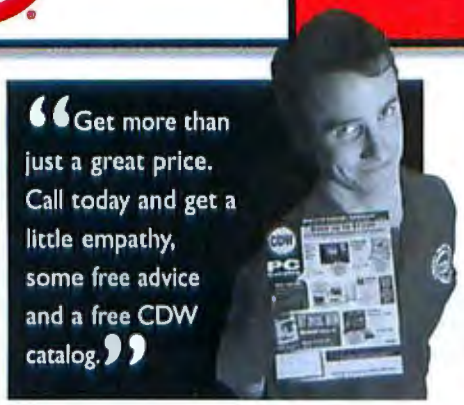

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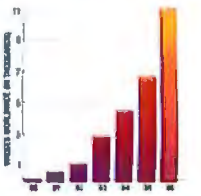

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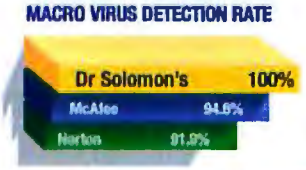

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inbox

Taking Sides

Most people I know are taking sides in some sort of PC versus NetPC/Java/Internet paradigm. I think that's unfortunate. It was refreshing to see you take a balanced view in your editorial ("Cadillacs and Cherokees," February). I am glad that BYTE has not taken the position of most (it seems) technical journalists, who only quote sales statistics anymore.

Mark Duling
markduling@iname.com

Thanks. In last month's cover story ("Cheaper Computing") we discussed the real benefits—and costs—of network computers. For the PC side of the equation, see "PCs Strike Back," on page 81 of this issue. — Eds.

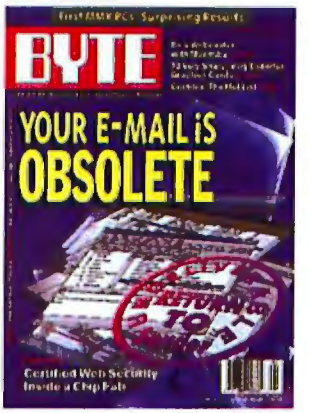
The Wrong Key

In your discussion of encrypting and decrypting messages (see the text box "Security: Who's Got the Key?" in the February cover story), author Michael Nadeau states that "the private key encodes the message, and the public key decodes it." This is correct for digital signatures but not for secure e-mail. In secure e-mail, you use the recipient's public key to encode the message; the recipient uses his private key to decrypt it. The problem is not "how to make those keys available to only the people you want using them." The public key should be accessible to everyone! To read the message, the recipient uses something that only the recipient has: the private key. At no time is there a need for secure channels to transmit information to anyone in the transaction.

Note that an e-mail message sent to many users cannot be bulk-distributed as in a nonencrypted scheme. The message must be individually encrypted using each recipient's public key. This does increase traffic, but there is no known way around it that doesn't require a secure channel for key dissemination, short of creating public/private key pairs for every conceivable combination of recipients needed. This still requires that private keys be distributed to several people, opening up the possibility of compromised communications.

Thomas Paul Karrmann
tkarrman@giddings.com

You are correct. I confused the terminology. The point I was trying to make was that most companies don't want the public keys to be truly public. To make an analogy between public keys and phone numbers, most individuals don't mind that their phone numbers are published, but few companies make their internal phone lists public. They don't want unsolicited traffic on the network. Your point about bulk mailing and encryption is an important one. While it may be possible to create "group-level" sets of keys, it is often too cumbersome to be practical.
— Michael Nadeau



Bus No Bottleneck

In "The Mac Goes Multiprocessor" (February Core CPU), Tom Thompson mentions how the system bus limits use of processor capacity. How much of that capacity can the system bus handle? How do you determine the maximum capacity of your own system bus?

Steve Gold
goldie@earthlink.net

System 7.6's System Profiler application will indicate the system bus clock rate. And yes, the bus imposes a bandwidth limitation, which I alluded to. In terms of system cost, it's going to be cheaper to add a second processor that can grab its share of the bus while the first processor is busy, rather than add a higher-speed bus. Put another way, the second processor helps utilize the existing bus's capacity. — Tom Thompson, senior technical editor

Java for C++

I agree with your point that though Java may be the largest installed software platform in the world, it still can't displace the OS that supports its run-time environment ("Today the Web, Tomorrow the World," January). Why isn't the industry trying to develop a Java-like run-time environment for C or C++? This would offer the stability of an established language along with the portability that is the hallmark of Java. A substantial portion of the huge installed base of C/C++ software could become available

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across a range of platforms—provided it isn't tied to OS-specific features. Of course, C/C++ compilers would have to be modified to generate something analogous to Java bytecode that can run in their own runtime environment or a C++ virtual machine.

Balaji Raghunathan
braghuna@stratacom.com

C/C++ programs, as you point out, often use OS- or CPU-specific features. Existing C/C++ software written to APIs and GUIs such as Win16, Win32, the Mac Toolbox, OS/2 Presentation Manager, or Unix Motif would have to be extensively rewritten. C/C++ by nature is a statically linked and compiled language. References to methods, for example, are resolved at link and compile

time by a C/C++ compiler-linker. With Java, those references are not resolved until run time because Java programs load classes dynamically. It would take major reengineering to make C/C++ work like Java. Someone would have to write C/C++ virtual machines to run on all the major platforms, as well as develop a standard set of class libraries to abstract the OS-specific features of those platforms—as Sun did for Java. Imagine the infighting over this evolution among the major vendors. Sun had the luxury of defining a new language from scratch.

There is an alternative: Other languages can target Java bytecode when they compile. Think of bytecode as the native instruction set of the Java virtual machine. It's already been done for Ada, and there have been experiments with a Smalltalk compiler. James Gosling, the father of Java, says that even Visual Basic could target bytecode. This opens up exciting possibilities.
—Tom R. Halfhill, senior editor

Platform Agnostics

I appreciate BYTE's efforts to remain platform-independent—it helps the growing number of platform agnostics make intelligent buying decisions. "MMX: Better in Fits and Starts" (February Bits) in particular addresses an issue that I've been curious about. However, you compare a third-tier vendor (Polywell) to a first-tier vendor (Apple). While this probably won't skew the performance results that much, it greatly affects the bottom line. Mac clones have been as much as 25 percent cheaper than their Apple counterparts, while providing equal if not better performance.

John Flores
jflores@jfinteractive.com

We received a lot of mail regarding this news story, some pointing out, as you do, that less-expensive Macintosh clones are available. But then, Intel proponents took us to task for failing to note the Mac OS's belated (compared to NT) support for multiple processors. We tried to narrow the scope of the story to make it a CPU versus CPU comparison, not an OS versus OS comparison.
—Dave Andrews, news editor

NT Security

In "NT Security" (February Web Project) Jon Udell mentioned that the Windows NT 4 Resource Kit includes a utility to activate lockout for the administrator account. Can you be more specific and provide the name?

J. Rodney Grisham
Houston, TX
grisham@neosoft.com

This command-line utility is called PASSPROP and can be used to set two domain policy flags: whether passwords must be complex, and whether the administrator account can be locked out. For details on syntax and usage, run "passprop," with no parameters, at the command prompt. —Jon Udell, executive editor

I enjoyed "NT Security" even though I don't use NT machines. One nit: You said a router would only have to allow TCP ports 80 and 21 into the server. Most FTP servers support the PASV command, and a number of firewalls now require that their clients use it. This implies that you must allow the incoming TCP connections for the second channel to the FTP server. I have no idea if the NT FTP server chooses the PASV port in a predictable way, but the router rules would have to allow whatever incoming ports were needed.

Bill Cheswick
Bell Laboratories
ches@bell-labs.com

Thanks for pointing that out. It does complicate matters, since the inbound port seems to be chosen at random. I should have subtracted FTP from the example.
—Jon Udell, executive editor

In "NT Security" you ask for a way to suppress the connection banner when logging onto a Windows NT FTP server. I took the challenge. I found the message in the file FTPSVC.DLL. I copied the file to a DOS system, examined it with Norton Utilities, found the messages, replaced the characters with spaces, saved the file, and copied it back to the NT System root area (you have to stop the FTP server-service to do this). You can replace the original message—Windows NT FTP Server (%s)—with anything within that number of characters (27).

Halvard Gomo
Ulset, Norway
gomo@online.no

Thanks! It'd be nice for Microsoft to make that a registry setting, wouldn't it?
—Jon Udell, executive editor

Clean Data In

"Garbage in, garbage out ...," the opening sentence of "Take Your Data to the Cleaners" (January State of the Art), is somewhat ironic. The article certainly addresses what to do with "dirty" data, yet it doesn't address the "garbage in" part of the equation. If you're going to invest effort in cleaning your data, you should also control how you enter data in the first place. If your workers enter months as Jan., January, J, and 01, you clearly need to standardize input procedures. Training helps, but automating quality control might yield better results: Use formatted data fields with built-in error checking, pick data from pick lists, verify data with lookup tables, and post-process inputs before committing them to the database. Controlling the "in" part of

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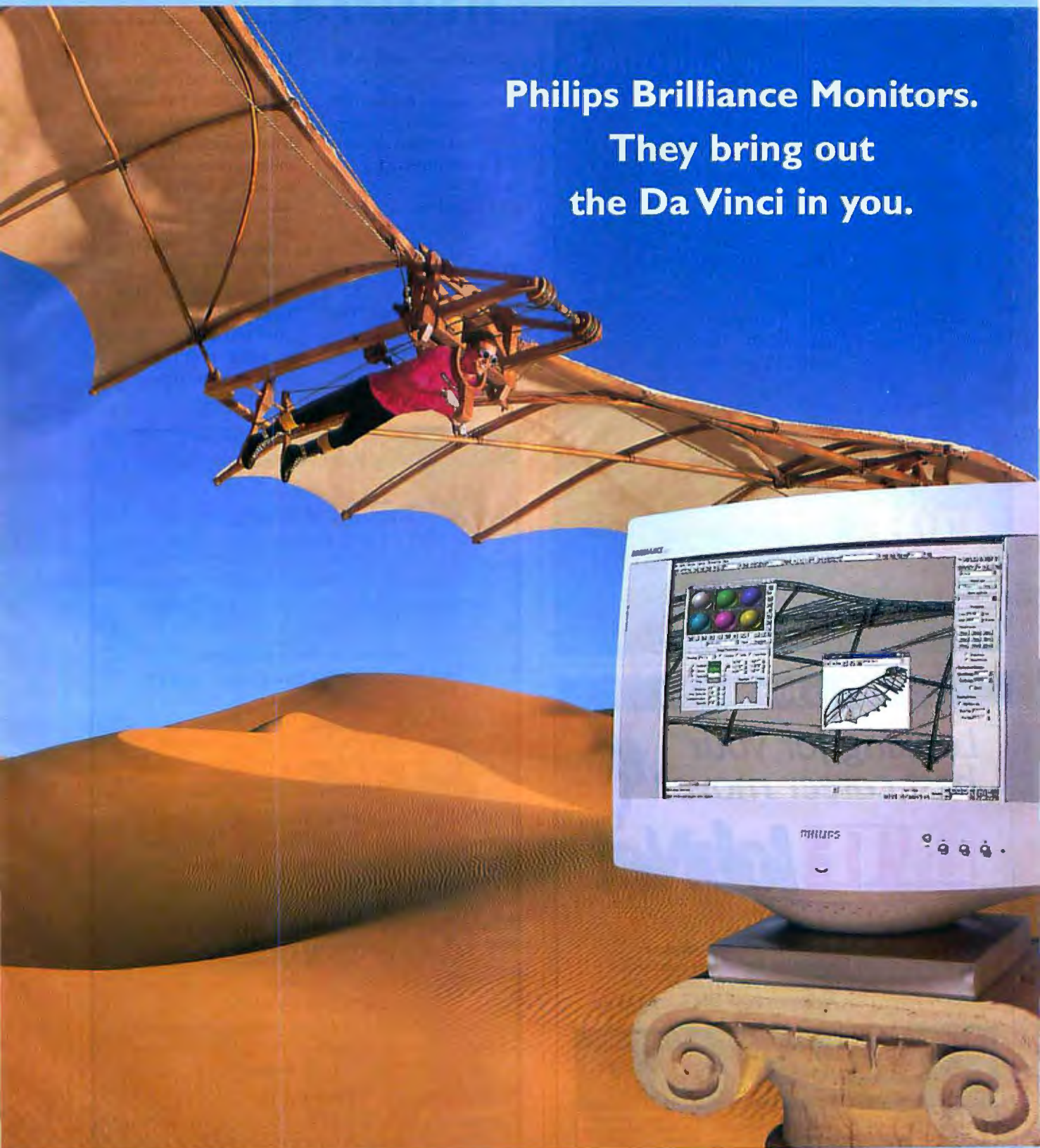

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the equation makes the data more immediately usable, might increase productivity, and might even reveal some properties of your data that you never suspected.

Geoff Hart
geoff-h@mtl.feric.ca

FIX

The features table for "13 Graphics Cards for Business" (February Hardware Lab Report, page 106) contained several errors. The Hercules Dynamite 128/Video card does not support hardware 3-D acceleration. The 8-MB Matrox Millennium card supports 16.7 million colors in all resolutions up to 1600 by 1200; the 4-MB Matrox Mystique supports 16.7 million colors in all resolutions up to 1280 by 1024 and 65K colors at 1600 by 1200. The 4-MB VideoLogic GrafixStar 450 supports 16.7 million colors up to resolution of 1280 by 1024 and 32K colors at resolution of 1600 by 1200.

COMING UP IN JUNE

COVER STORY

The Digital Safety Net

All the pieces are in place for secure electronic commerce but one: public confidence. BYTE looks at the technologies needed to verify that real people are buying real products with real credit, safely, securely, and without disclosing their purchases to prying eyes.

BUILDING NETWORK APPLICATIONS

Microsoft's Transaction Server

There is more to Web/database integration than the ability to display the latest data from a database on a Web server. We look at Microsoft Transaction Server, a tool to get user input—orders, for example—from the Web server into the database.

NETWORK INTEGRATION

IP Multicast

LAN technology is like a phone call: You send a message to another user. Many businesses want the equivalent of TV: You send one message, once, to many users. IP Multicast does that, and it could usher in a whole new way to use Web servers, both Intranet and public.

REVIEWS

CD-ROM Servers

The NSTL Hardware Lab Report looks at stand-alone systems that let you centralize your CD-ROMs and share them with everyone on your network.

Firewalls

National Software Testing Labs tries to crack the defenses of programs designed to keep intruders from accessing your network.

U.S. Robotics x2 Sportster Modem

Just how fast and how reliable is U.S. Robotics' new 56-Kbps modem technology? We look for the answers in one of the first new modems from a company that is trying to set the standard.

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Video Graphics	Cirrus 5446 PCI	Cirrus 5446 PCI	Matrox MGA Millennium
Diskette Drive	3.5" 1.44MB	3.5" 1.44MB	3.5" 1.44MB
Expansion Slots/Drive Bays	5/5 Desktop	5/4 Desktop	7/5 Minitower
Ports: Serial/Parallel	1/1 (ECP)	1/1 (ECP)	1/1 (ECP)
Intelligent Manageability	Yes	Yes	Yes
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x86 Breaks the 200-MHz Barrier

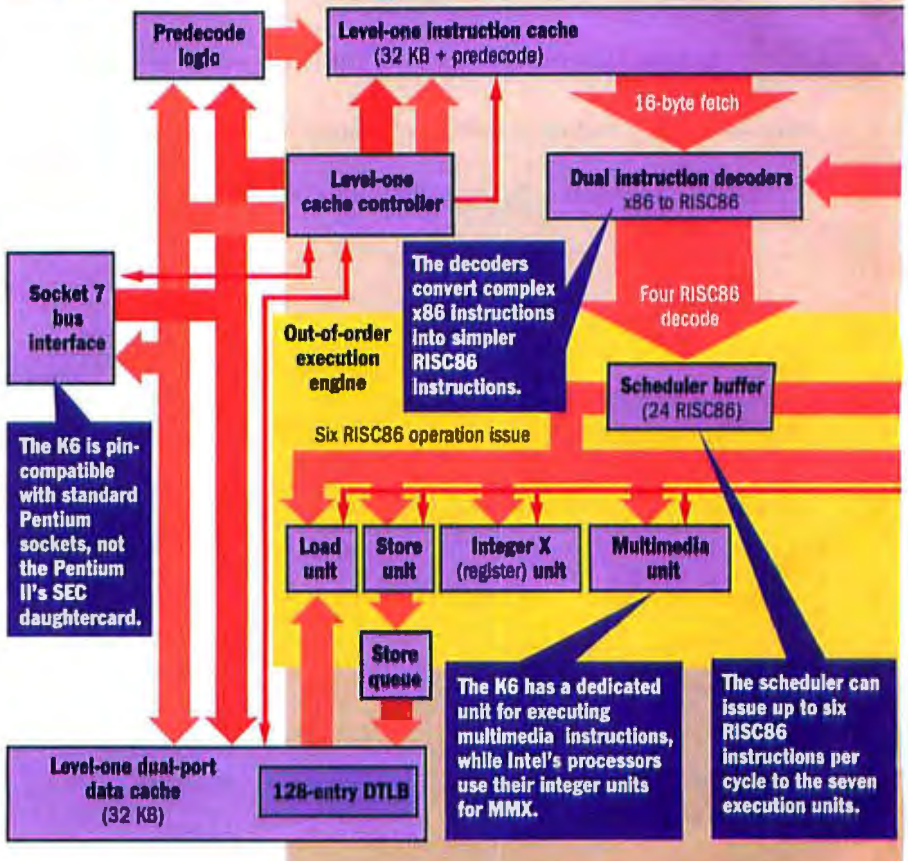
The newest x86 processors run at higher clock speeds (finally).

Stuck at 200 MHz since November 1995, x86 processors are finally ready to break that barrier. AMD was expected to introduce its long-awaited K6 chip in April at speeds up to 233 MHz. Sources say Intel will release its Klamath processor—now officially named the Pentium II—at a comparable speed in May. And Cyrix says it's still on track to deliver its M2 at 200 MHz by this summer, with a 233-MHz version to follow later this year.

Intel previewed a sixth-generation x86 chip running at 433 MHz at the recent IEEE Solid-State Circuits Conference in San Francisco. Intel claims the chip has reached 451 MHz in the lab. Known as Deschutes, this processor is similar to the Pentium II but is not an official product. To attain those astronomical clock speeds, Intel had to chill the chip to below 32°F with a special liquid-cooling system. Intel also modified the computer's motherboard, cranking it up to nearly 96 MHz instead of the standard 66 MHz.

The prototype Deschutes runs so hot it won't be practical until Intel makes the transition to 0.28- and 0.25-micron fabrication processes later this year. (The prototype is 0.35 micron.) Smaller pro-

AMD K6 Internal Block Diagram



Sixth-Generation x86 Processors

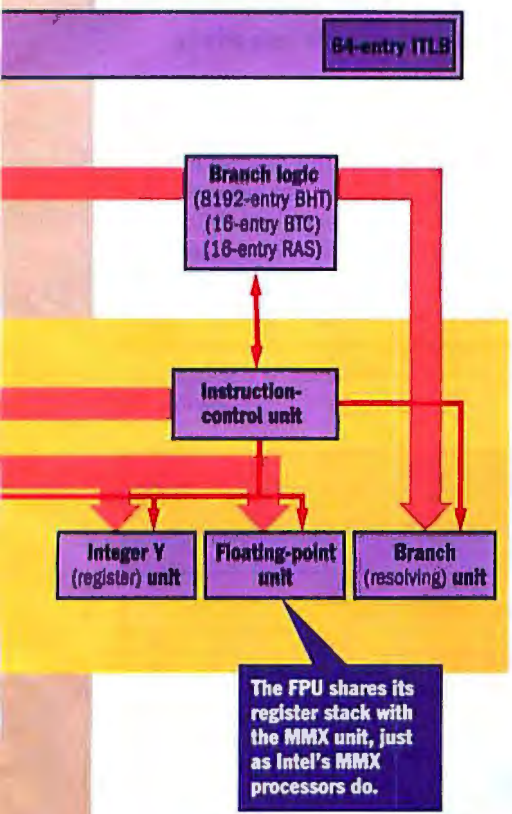
Intel's Pentium II and Deschutes can execute two MMX instructions in parallel, unlike AMD's K6, which can execute only one MMX instruction at a time. But the K6 has shorter latencies for the multiply and multiply-accumulate instructions.

	AMD K6	Intel Pentium Pro	Intel Pentium II	Intel Deschutes	Cyrix M2
Introduction	April 1997	November 1995	May 1997*	Q4 1997?	Q2 1997
Top speed at debut (MHz)	233	150	233*	266 to 333*	200
MMX-compatible	Yes	No	Yes	Yes	Yes
MMX parallel execution	No	Not applicable	Yes	Yes	Unknown
L1 cache (instruction + data)	32 KB + 32 KB	8 KB + 8 KB	16 KB + 16 KB	Unknown	64 KB unified
L2 cache	External	Internal	External	External	External
Pin-out	Socket 7	Socket 8	SEC cartridge	SEC cartridge	Socket 7

*= BYTE estimate.

cess geometries will reduce the operating voltage, and therefore the heat dissipation. Even with these improvements, Deschutes will probably debut at more realistic speeds of 266 to 333 MHz.

These power limitations and the general complexity of the x86 architecture account for the long delay in breaking the 200-MHz barrier. The peak power dissipation of a 200-MHz Pentium Pro manufactured at 0.35 micron is a hefty 35 W. Clock speeds much higher than 200 to 233 MHz won't be practical until AMD, Cyrix, and Intel make the transition to smaller process geometries later this year.



All the new processors from these three companies are sixth-generation x86 designs with MMX-compatible multimedia extensions. Despite their similarities, however, they have some important differences (see the table at left).

So far, AMD's K6 is the king of complexity. It has 8.8 million transistors—about a million more than a Pentium II, and 3.3 million more than a Pentium Pro. It's by far the most complicated x86 chip ever made.

AMD produced the K6 by starting with the nearly complete Nx686 core that the company inherited by acquiring rival NexGen in late 1995. (See "AMD K6 Takes On Intel P6," January 1996 BYTE.) For more than a year, AMD has been tweaking the design to make it compatible with Intel's MMX standard. The original K6 had proprietary multimedia extensions.

Initially, AMD is offering the K6 at three speeds: 166, 200, and 233 MHz. Prices (based on 1000-unit quantities) are $244, $349, and $469, respectively. First-quarter pricing for a 200-MHz Pentium Pro ranged from $525 to $1035, but that includes a built-in Level 2 cache (256 or 512 KB), which the K6 doesn't have.

AMD claims the K6 is faster than comparably clocked Pentium Pro chips when running the Winstone 97 benchmark on Windows 95. AMD says the K6 matches Pentium Pro performance when running the same benchmarks on Windows NT. The reason for the difference, says AMD, is that the K6 doesn't suffer when running 16-bit code, which is a well-known fault of the Pentium Pro. However, BYTE has not yet been able to benchmark a K6-based system to verify AMD's claims.

Currently, AMD is manufacturing the K6 on a 0.35-micron, five-layer-metal process at its foundry in Texas. Later this year, AMD will move to a 0.25-micron process that should boost clock speeds to 266 MHz this fall—and to 300 MHz in 1998.

–Tom R. Halfhill

Multifunction Peripherals Get Better

Multifunction peripherals (MFPs) seemed like a pretty good idea when they first hit the market, but initial reaction from customers was tepid. One reason: These products, which are designed to do many different things (e.g., print, scan, fax, and copy), often didn't do any one function all that well. "There were always some limitations in these products," contends Charles LeCompte, principal at Lyra Research (Newtonville, MA), a market-research firm.

But now vendors are releasing improved MFPs that better target individual markets. And Andrew Johnson, senior industry analyst at market-research firm Dataquest (San Jose, CA), predicts that MFP sales will increase as vendors unleash better products with improved software integration and more intuitive user interfaces (see the figure "U.S. MFP Products Shipment Forecast" on page 28).

Two examples of new and improved MFPs are Hewlett-Packard's (800-752-0900; http://www.hp.com) new products, the OfficeJet 500C series and the OfficeJet Pro 1150C. What sets them apart from previous products? In addition to a name change to "all-in-one" (HP prefers it over the term *MFP*), color is now considered a basic feature instead of a rare option. HP has also improved the ease of use and

Geek Mystique

Geek Humor Hits the Boob Tube

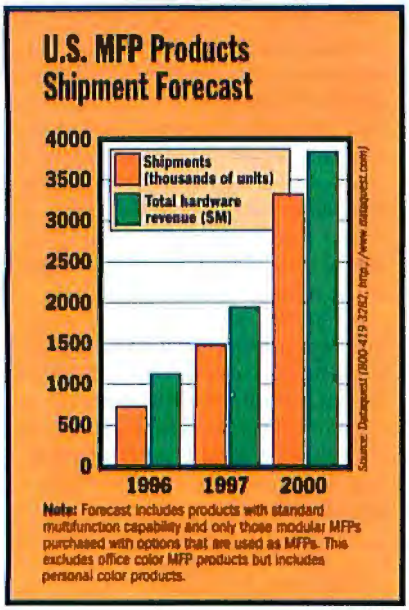
Super Bowl commercials pitching better Internet access and the appearance of Web addresses in magazine ads are just two signs that computer technology has seeped into pop culture. We're even seeing U.S. TV sitcoms work computer jokes into their plots. For example, in a recent episode of Frasier, the lead character's brother, Niles, is preparing for an important dinner party in his swank new digs. Frasier, looking at the place cards on the dining table, asks for more information about an invited guest.

Niles: "He's on your right. He's an investment banker from Amsterdam. Apparently, he handles a lot of Bill Gates' money, so don't say anything derogatory about the Netherlands or Microsoft."

Frasier: "Oh, damn, there goes my opening joke about the Dutchman trying to install Windows 95."

Contents

overall quality of each individual function while increasing overall speed. The previous OfficeJet 300 series of devices printed at a rated speed of 3 ppm (in black and white), compared to the 1150C's rated 8 ppm for black and white, and 4 ppm for color (at 600 by 300 dpi).



The personal color category will drive increased MFP sales.

The OfficeJet 500C series ($499 and up) and Pro 1150C ($999) are tailored for different markets. The 500C is geared more for the home: It lacks support for color copying (although it can print in color) and has a fax component, whereas the 1150C lacks faxing capabilities. (HP says its research indicates that, unlike homes, many businesses already have a fax and don't want another, so the company left this feature out of the 1150C.) Each product has OCR and other software and connects directly to your PC, although you can use the 1150C's copier in stand-alone mode.

Canon (516-488-6700; http://www.usa.canon.com) also has a new MFP, the CFX-L4500 IF. This $1695 unit also attaches directly to a PC and includes a 4-ppm black-and-white laser printer, Windows management software, a 14.4-Kbps modem for faxing, and other features. Canon and other vendors also offer more expensive units for the enterprise. For example, Canon's GP200 starts at $6000 for its color-copier capabilities.

Although analysts believe these new products are an improvement, it remains to be seen whether HP's new units and new entries from Brother, Canon, Panasonic, Samsung, Xerox, and others will be enough to make this category take off. LeCompte says that many businesses that already have a fax or printer will buy peripherals modularly, or separately.

Canon's new MFP includes a black-and-white laser printer.

Dataquest's Johnson predicts MFPs will battle copiers and network printers for output-volume responsibilities in small- to mid-size companies or departments.

–Jon Pepper

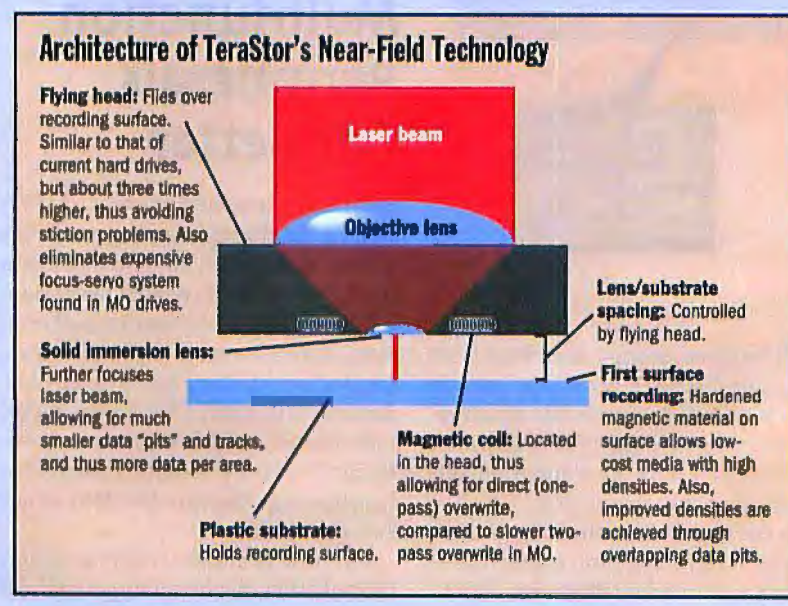
Future Watch

10-Times-Better Hard Drives

Coming in early 1998: new mass-storage products that offer hard drive–like performance at a lower cost per gigabyte than magnetic, magneto-optical (MO), and tape formats, and 10 times the storage capacity of current hard drives. A company called TeraStor (San Jose, CA, http://www.terastor.com) hopes the first of these products, which are based on near-field recording, will appear early next year. Initial capacities of 20 GB per surface are predicted.

Near-field recording relies on several techniques (see the figure at right), but the most important is the solid immersion lens, which allows for a reduced bit-cell size that lets you fit about 10 times more data onto a surface than is possible with hard drives.

According to TeraStor officials, with their fast performance, reasonable cost, and high-data-density capabilities, near-field-recording devices will replace a host of storage media in use today for a variety of applications, including tape for archiving.



"What TeraStor is doing is quite interesting and seems possible," says Bob Katzive, vice president of Disk/Trend (Mountain View, CA), a storage-market-research firm. "If the company releases it on time, at a reasonable cost, with good manufacturing partners, it could threaten a variety of storage technologies."

–Dave Andrews

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.

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For you to reserve a hotel room, our staff must make a reservation for you at the hotels listed. Please indicate hotel choices in order by writing the numbers 1 (first choice) through 10 next to your preferred hotels, and specify your arrival and departure dates below. Also please indicate single or double room. **IMPORTANT: All hotels require a first- and last-night deposit plus 13% room tax (unless otherwise indicated) to hold your reservation. Please supply your credit card name, number, expiration date and cardholder's name and signature in the space provided.** NOTE: Changes, cancellations and refund policies are determined by the individual hotels. Some hotels may elect to charge your first- and last-night deposit on your credit card upon receipt rather than waiting for your arrival. Also, a minimum credit card processing fee might apply at some hotels. Room rate and tax are subject to change.

❑ Single ❑ Double Arrival Date Departure Date Share With Comments

(1) **Atlanta Marriott Marquis** is the COMDEX/Spring and WINDOWS WORLD Headquarters Hotel.
(2) **Hyatt Regency Atlanta** is the EXPO COMM Headquarters Hotel
(3) **Westin Peachtree Plaza** is the Spring CES Headquarters Hotel
(4) The Omni Hotel requires a 3-night minimum stay, June 1 – 3 inclusive, and full prepayment. Payment must be made by check only, and payment is non-refundable.
(5) Holiday Inn Select Peachtree Corners requires a 3-night minimum stay

2 REGISTRATION FEES

Every conference program or special program includes exhibits of all four shows, Keynotes, SuperSession, PowerPanels and COMDEX Shoot-Outs!

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To attend a conference program, check one:

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4. **COMDEX and WINDOWS WORLD Conference** (One day) ❑ WC $495
   Circle day of choice: Monday Tuesday Wednesday

SPECIAL PROGRAMS

To attend a special program, check one:

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3. **COMDEX Digital Insight** ❑ DI $1495
4. **Tutorial Package** ❑ BB $595
   Indicate two tutorial selections * _____ _____
5. **COMDEX Venture Forum** ❑ CV $1295
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   You must pre-register for this Forum to ensure admission

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**For a complete list of tutorials, call the Conference Hotline at 617-433-1650*

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Type of card: ❑ American Express ❑ MasterCard ❑ Visa

Card Number

Expiration Date

Cardholder's Name

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CANCELLATION POLICY

In the event of cancellation or changes, registration fee will be refunded if written notice is received by April 25, 1997. After April 25, 1997, all cancellations and changes are non-refundable and will be applied toward COMDEX/Spring '98 or WINDOWS WORLD '98 show registration.

3 ACCOMMODATIONS

Complete this part of the form if you require us to make your hotel reservations*. Please number 10 choices in order of preference.

Choice	Hotel	❑ Single	❑ Double
	Amerisuites Atlanta Buckhead	$125	$135
	Atlanta Airport Marriott	$138	$138
	Atlanta Downtown Travelodge	$83	$97
	Atlanta Hilton & Towers (Main Tower)	$179-$229	$179-$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	$146
	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
	Marriott Fairfield Inn Downtown	$99	$109
	Northwest Atlanta Hilton	$119	$119
	Omni Hotel at CNN Center (4)	$194	$214
	Quality Inn Midtown	$88	$92
	Radisson Hotel Atlanta	$114	$124
	Ramada Downtown Atlanta	$92	$102
	Ramada Inn Atlanta Airport North	$102	$112
	Regency Suites	$139	$159
	Renaissance Atlanta Hotel	$169	$169
	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
	Super 8 Hotel	$112	$112
	Swissotel Atlanta	$159	$179
	Terrace Garden Buckhead	$136	$151
	The Grand Hotel	$239	$239
	Westin Hotel Atlanta Airport	$139	$139
	Westin Peachtree Plaza (3)	$174	$194
	Wyndham Garden Hotel Buckhead	$132	$142

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
- AG 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
- FO R&D
- FR Systems/Software Support/Maintenance
- FS Sales/Marketing
- FX Management
- FN PR/Publishing/Advertising
- FP Purchasing/Buyer
- FG Network Operations
- FE MIS/OP/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
- SD 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

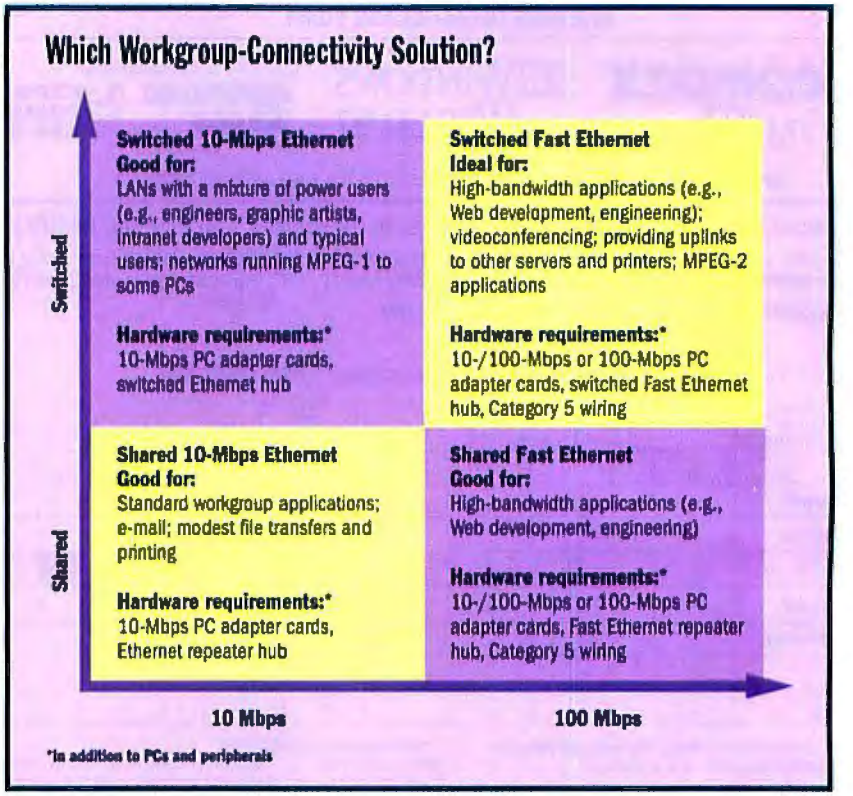
- RA Final
- RB Specify
- RC Recommend
- RD No Role

Fatter Pipes for Workgroup Networks

Thanks to an increased focus by networking vendors on small- to mid-size offices, network managers can now choose from a wide range of increasingly inexpensive solutions when upgrading their 10-Mbps Ethernet networks. The volume of traffic on many networks is up, due to new Internet, intranet, client/server, and image-based applications. Vendors and analysts alike say managers of many workgroup- and modest-size business networks plan on upgrading those networks this year. Naturally, network vendors are moving quickly to provide products for this audience.

"Customers are migrating from shared to switched and Fast Ethernet technology," says Esmeralda Silva, an analyst at research firm International Data Corp. (IDC, Framingham, MA). "Every major networking vendor, through families of products designed specifically for the small- to mid-size office, is targeting the SOHO market."

The list of vendors currently targeting this market with specific lines of products is long; it includes Bay Networks, with its Netgear line; Cisco, with its NetBeyond family of LAN connectivity and remote-access products; and 3Com, with its Office Connect line. Many other companies are also competing in the game, including Accton Technology, Compaq, D-Link, Intel, LANart, Matrox Networks, and others. "There has been tremendous growth in low-end products, since small businesses are often more concerned with pricing and less with brand name," Silva explains.



Deciding to upgrade might actually be easier than choosing which implementation—switched 10-Mbps Ethernet, shared Fast Ethernet (100 Mbps), switched Fast Ethernet, or some combination of these options—to upgrade to. When deciding which upgrade path is the best one to take, network managers need to consider a variety of different factors, including their current infrastructure and network applications.

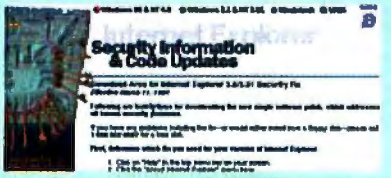
For example, a network for a small graphic design firm—where artists use an office suite of applications and e-mail, in addition to sharing desktop-publishing, graphics, and Web-design application files—would be an ideal candidate for switched, or dedicated, bandwidth, according to Kimberley Peppe, spokeswoman for Matrox Networks, which offers a variety of card-based and external hubs and switches for workgroups. By moving to a switched 10-Mbps connectivity solution, such a graphic design firm can upgrade its existing shared Ethernet repeater hub to a 10-Mbps switch without having to upgrade its 10-Mbps network interface cards (NICs), too.

By giving power users and others who typically run less-bandwidth-intensive applications their own 10-Mbps pipe to the server, a 10-Mbps switched solution can improve network performance for as little as $500 (which is the cost of the switch). Meanwhile, prices continue to drop in the switched Ethernet market. For example, Matrox recently lowered the price of its Piranha Switch 8 from $699 to $499, for a price per port of $62. But different workgroups have a variety of

Bug of the Month

Outside Looking In

Another bug involving security and the Internet recently made the news, but Microsoft acted quickly and says that it has already posted a fix for the problem. The bug affected users running Internet Explorer 2.0, 3.0, or 3.01 running Windows 95 or NT. Anyone who knew how to exploit this particular hole could design a Web site that would use Windows shortcuts to access programs and files on a client PC.



Microsoft says that it doesn't know of any users that were actually affected by the flaw, but the company is strongly recommending its users to upgrade, either by downloading the fix from the company's Web site (http://www.microsoft.com) or by telephoning 800-322-9997. At press time, Microsoft was working on fixes for users running NT on Alpha, PowerPC, and Mips platforms. –D. A.

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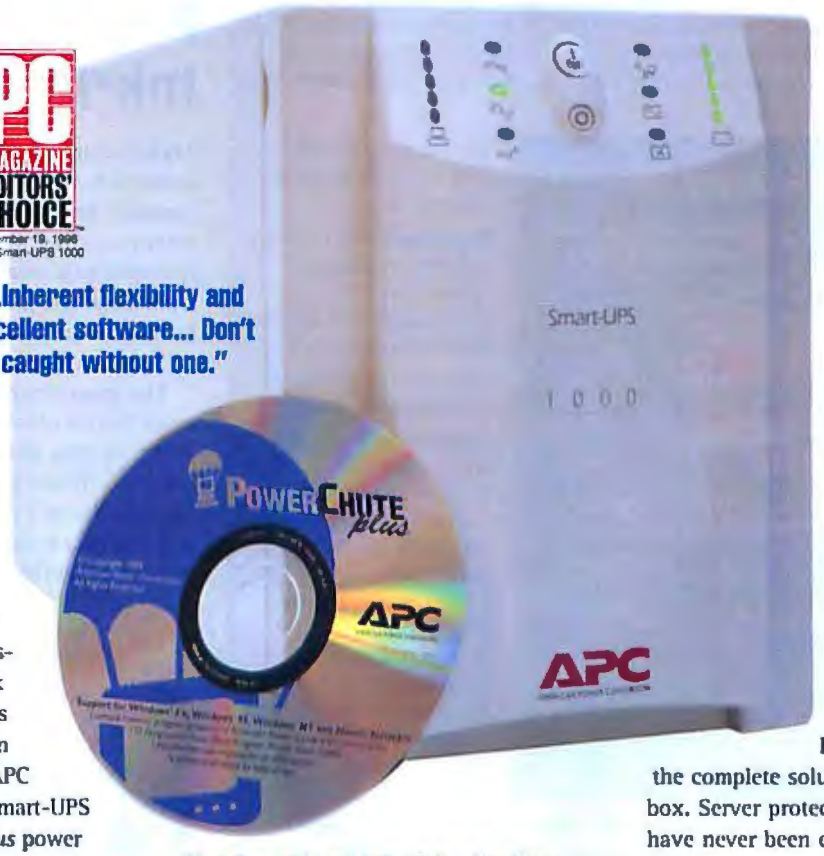

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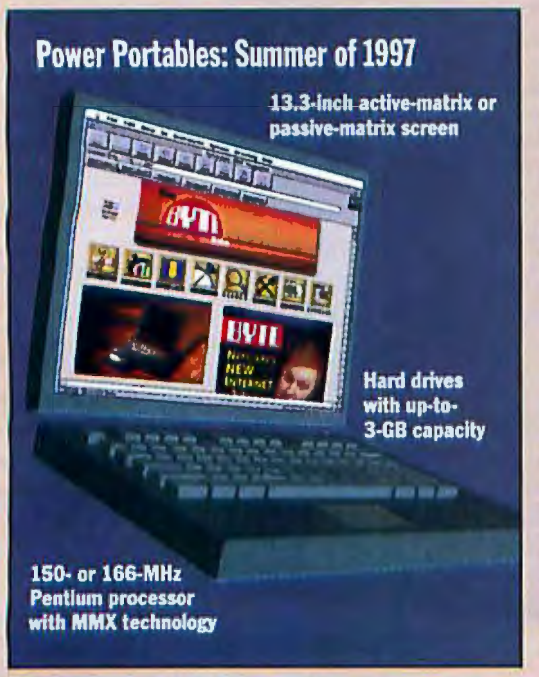
Survey

Big-Screen Notebooks Arrive

The first notebooks with 13-inch screens have arrived (see "Notebook with a View," April BYTE), and more are expected to ship this summer. We surveyed several leading notebook makers regarding their plans for releasing notebooks that use the latest LCD technology to give road warriors even more screen real estate.



This summer, notebooks will take another step closer to being true desktop replacements.

IBM: Will have a ThinkPad sometime this summer with a 13.3-inch active-matrix screen, a 166-MHz Pentium processor with MMX technology, and a hard drive with up to 3 GB.

Toshiba: The company's (800-457-7777; http://www.toshiba.com) Tecra 740 CDT features a TFT active-matrix screen (up to 1024 by 768 resolution) measuring up to 13.3 inches, a 2.02-GB removable hard drive, a 150- or 166-MHz Pentium with MMX technology, 16 MB of EDO DRAM (expandable to 144 MB), a 10x CD-ROM drive, and a PCI system and expansion bus.

Gateway: Doesn't have specific information, but a spokesman said 13.3-inch screens will be an important feature in the company's products during the second half of this year.

Sharp: Released a 13.8-inch LCD notebook "luggable" in Japan recently, but it was not available in the U.S. at press time. The company is "evaluating, and plans to move into, larger-screen LCD monitors" and has showed a prototype 13.8-inch screen at both Comdex and PC Expo. Sharp intends to ship 13.8-inch displays in the U.S. later this year.

Digital Equipment: Company officials say that we can expect big-screen notebooks from Digital in the second half of this year.

HP: Doesn't have a big-screen notebook, but the company plans to offer large-screen notebooks during the second half of this year.

–Kerry Hickox

users, applications, and plans for the future, and thus may need to opt for a Fast Ethernet solution (see the figure "Which Workgroup-Connectivity Solution?" on page 32).

Although many businesses might find that a switched 10-Mbps solution satisfies their needs, networking vendors are setting the foundation for 100 Mbps. Prices vary, and the cost per port for Fast Ethernet hubs can range from $20 to $100 or more than switched 10-Mbps Ethernet, depending on what you buy. But vendors predict prices for Fast Ethernet hubs and switches will continue to decline. In addition, Intel and others are pricing their 10-/100-Mbps NICs to compete with 10-Mbps cards, allowing managers to buy adapters that they can use today as well as in the future.

"If you have a large file that you're transferring or if you're doing a large backup, it doesn't matter if the 10-Mbps connection is yours alone or shared; it will still take a long time," explains Yoseph Linde, chairman and CEO of LANart, a vendor of 10- and 100-Mbps hubs and switches, including ones that have automatic segmenting capabilities. "10-Mbps switched gives a little better performance than 10-Mbps shared, but in many cases 100-Mbps shared will deliver much better performance."

–Curt Harler

Picture-Perfect Ink-Jets

Manufacturers of color ink-jet printers continue to explore new ways to get these modestly priced devices to shine at photoreproduction. In addition, they have managed to increase the output quality from laughable to laudable. Now recent techniques are promising to push the envelope even further.

The most interesting development might be that of two new Epson printers, which up their already-industry-leading resolution from 720 by 720 dpi to 1440 by 720 dpi. Epson's piezo technology does not boil inks as thermal ink-jets do, but instead forces the ink drops through the

The BJC-4200 has 720 by 360 resolution and uses special inks.

head with electromechanical pressure. As a result, it supports a more accurately placed dot and the ability to create the higher resolution with a smaller dot size. Epson uses the technology in two new printers, the $299 Stylus Color 600 and the $449 Stylus Color 800 (which offers similar quality but faster output). For more information on the Epson printers, see "Color That's Simply Amazing" on page 124.

However, Epson's approach is hardly the only one out there. Other leading vendors, such as Hewlett-Packard and Lexmark, opt for six-color printing in an attempt to get better photoreproduction. By mixing primary colors with midtone shades, the six ink colors can be combined for more natural rendering without increasing resolution from the 300 or

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600 dpi these vendors' printers now offer. HP, with its PhotoSmart, and Lexmark (800-358-5835; http://www.lexmark.com), with its Lexmark Color JetPrinter 2055 ($249), deliver photo-realism through so-called photo cartridges.

In its photo-realistic printers, however, Canon (800-848-4123; http://www.ccsi.canon.com) does not use a six-color process. Instead, the company uses a newly designed cartridge that features advances in ink composition and placement precision to give dense, crisp hues. Photo inks are made of a lighter-density ink and allow a printer to use from one to three drops in one spot for better color gradation. Canon's BJC-240 Photo ($199) and BJC-4200 Photo ($299) both use this new technology for producing photo-realistic images.

HP's (888-474-3867; http://www.hp.com) new PhotoSmart photo printer is part of a comprehensive (i.e., camera, printer, and scanner) PhotoSmart system. The $499 printer also uses six ink colors (as HP's regular ink-jet printers do) but is designed only for photographs; it's not intended for general use. The device takes approximately 5 minutes to print an 8- by 10-inch photograph on photo-quality paper; a 4- by 6-inch print takes about 2½ minutes. The unit's print quality is excellent (coming close to that of conventional photographs), with the most important drawback being the device's specialized use. **–J. P.**

Datapro Report

Many Paths to NT/Unix Interoperability

End-user IS departments are increasingly building heterogeneous computer environments that combine legacy systems with Unix and Windows NT. The problem is that these OSes are not transparently integratable; you cannot simply plug an NT system into your Unix network and have it run seamlessly. Nonetheless, many IS departments, attracted by the lower costs and simplified maintenance characteristics of NT applications servers, are scrambling to integrate NT into their environments.

Users are not replacing their original Unix applications but are maintaining their Unix systems while implementing NT. Thus, these users are looking for solutions that will help them preserve their investments by creating a transparent NT/Unix computing environment.

Microsoft has bundled a number of protocols into NT for creating interoperable environments. In addition, many vendors have built NT-to-Unix interoperability suites. While not totally seamless, these solutions are contributing to the rise in NT installations within traditional Unix environments. Most of these solutions, which are available from myriad vendors, can be categorized into the following areas: system/network-management solutions; networking protocols, such as TCP/IP; NFS (which allows NT applications to run on Unix); Unix/NT file sharing; tools for porting applications from Unix to NT or vice versa; and client/server applications development for both Unix and NT.

The goal of most users is to create an NT/Unix computing environment that allows the sharing of files and printers from anywhere on the network and the use of applications from both environments. A TCP/IP stack is usually one of the first technologies implemented, along with a NetBIOS name server for use with NetBIOS over TCP/IP, as well as a DHCP server that supports the various NetBIOS configuration options. While these basic components are supplied with Windows NT Server, several vendors have built upon these components to offer integration packages that provide file and print sharing, remote administration, applications integration, and e-mail connectivity solutions for mixed NT/Unix environments.

Mary Hubley, *principal analyst, Datapro Information Services Group. Hubley is also manager of Datapro's new NT Analyst information service, which focuses on the Windows NT market and related technologies, including case studies, product and technology overviews, and integration and management strategies.*

A Variety of NT-to-Unix Solutions

Company	Product(s)	Brief description	Contact information
WRQ	• Reflection NFS Connection for Windows NT	NT-to-Unix host access	206-217-7100; http://www.wrq.com
Datafocus	• Nutcracker	Unix-to-NT application-porting tools	703-631-6770; http://www.datafocus.com
FTP Software	• InterDrive NT Server	NFS Server for NT (file and print sharing between NT and Unix)	508-685-4000; http://www.ftp.com
Hummingbird Communications	• Exceed for Windows NT • NFS Maestro for Windows NT	PC X Server (lets NT access Unix); NFS Server	416-496-2200; http://www.hummingbird.com
Network Computing Devices	• PC-Xware • WinCenter Pro	NFS client/server (resource sharing among Unix, NT, and PCs); NT applications server	415-694-0650; http://www.ncd.com
Mainsoft	• MainWin Studio	NT/Unix portability toolkit	408-774-3400; http://www.mainsoft.com
Bristol Technology	• Wind/U	NT/Unix portability toolkit	203-438-6969; http://www.bristol.com

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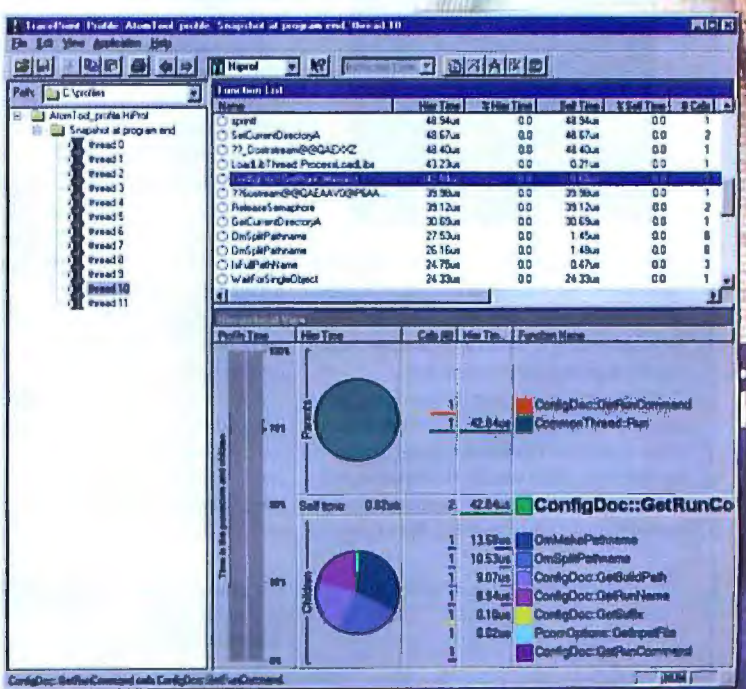

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Book Reviews

Best Linux Book Yet

Linux, a free OS, has inspired many books. But most of them are either rehashes of Linux's obfuscated (but well-intentioned) on-line documentation or beginner-level tomes that barely reveal Linux's true worth. With *Linux A–Z*, author Phil Cornes breaks the Linux book mold. True, its typesetting is substandard, and there are precious few illustrations, but the content soars.

Cornes, a senior lecturer at Staffordshire University, has assembled his lecture notes and lab exercises into a book that he considers suitable for use in an undergraduate course. For that purpose, it's perfectly suited: *Linux A–Z*'s organization lends itself to sequential reading, with topics presented in order of increasing complexity. In the hands of a capable instructor, *Linux A–Z* provides the material for a course covering all but the most advanced levels of knowledge.

But you don't need an instructor to benefit from *Linux A–Z*. The book assumes little prerequisite knowledge other than the basics of hardware and DOS. Wisely, the book establishes a strong technical foundation before discussing Linux installation.

From the topic of installation, *Linux A–Z* takes its reader through administration, networking, Internet services, and security. Cornes' writing is direct and concise, leaving the reader to flesh out details.

Sections III and higher discuss Linux programming and internals. Cornes shows none of the condescension that's typical in modern computer books. He moves quickly and leaves the reader responsible for experimenting and inventing. For example, *Linux A–Z* has a section on terminal I/O. Rather than warm over a tired "hello, world" program, Cornes has his students write a program that queries and displays a terminal's operating parameters.

To say that *Linux A–Z* is for everyone would be an insult to Cornes (casual Linux hobbyists should avoid this book). Later chapters covering file-system structure and run-queue organization speak only to the book's target audience. In *Linux A–Z*, Cornes provides the perfect book for the dedicated, hard-core student of OSes.

–Tom Yager

Moving Bits

Trying to write a comprehensive global overview of data networking nowadays gives new meaning to the idea of trying to hit a moving target. The pace of change in the types of technologies used to move bits is blindingly fast.

Introducing and explaining just about all the important data-network technologies, from ATM to X.25, Darren L. Spohn's *Data Network Design* is a good, but not great, book. Its 25 chapters are full of information about almost every network medium in general use and most of the protocols that are important to network designers. At just under 1000 pages, this is a book to use when you need to know exactly how Distributed Queue Dual Bus (DQDB) and Switched Multimegabit Data Service (SMDS) work together.

First published in 1993, this complete revision reflects the rapid pace of networking change, both in what was added and what missed the boat. For example, Spohn mentions the latest TCP/IP issues, including IPv6 and SNMPv2, but his information is about a year out of date. And while he includes a section on 100-Mbps Ethernet, other parts of the book refer to Ethernet as a 10-Mbps LAN medium.

This could have been a great book if it had a better index. For example, the "Novell" listing points to a description of the IPX protocol, but not to the book's description of IPX addressing. Tighter editing and graphics polishing would also have made *Data Network Design* more approachable. But despite its flaws, this is a good book to have on your shelf.

–Pete Loshin

Linux A–Z by Phil Cornes; Prentice-Hall Europe; ISBN 0-13-742867-7; US$34.95

Data Network Design, Second Edition by Darren L. Spohn; McGraw-Hill; ISBN 0-07-060363-4; $65 (softcover)

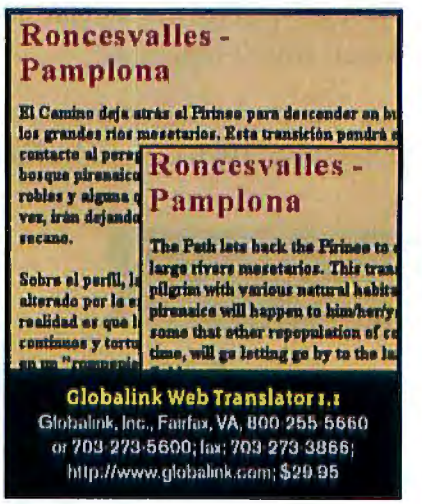
Lost in the Translation

Web translator handles simple stuff but stumbles on nuances

Now that the Web has brought the world to your desktop, what better way to research your company's new European venture than to go to official government statistics available at the click of a URL? The problem is the language barrier: Strategic data is ready to download, but how do you understand it?

Globalink offers a partial answer with its Web Translator 1.1. This clever CD-ROM loads translation algorithms that work with Netscape Navigator and Microsoft Internet Explorer (MSIE). For $30, you get a translator that can convert text from French, German, or Spanish into English or vice versa.

However, Web Translator is only a partial solution. The program works well for simple conversions, but it stumbles when grammar and nuances



affect meaning. For example, the program identified the painter of *The Month of October*, on the Museum of the Louvre Web site, as Brother Limbourg. The correct credit is the Limbourg Brothers. Also, the program lacks support for current Asian languages.

Web Translator is a quick and easy tool for the casual investigation of international Web or intranet sites. But for serious international Web publishing, you'll need a professional translation service.

–Alan Joch

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Blasts from the Past

5 Years ago in BYTE

The DX2, Intel's 486 chip that ran at twice the MHz speed internally as it did externally, made its debut. Meanwhile, Compaq's

50-MHz Deskpro 486 cost $12,999 as tested, although less-expensive systems were available from other vendors. Also in this issue: An explanation of 3-D past and future by Silicon Graphics founder Jim Clark, as well as other pieces on 3-D. Also, notebooks with active-matrix screens were starting to appear, including the T4400SXC from Toshiba, which featured an 8¼-inch screen. (In comparison, today 13 inches will soon be standard.)

10 Years ago in BYTE

In this issue, 10 external 20-MB SCSI hard drives for the Mac were reviewed. We also covered the desktop-publishing phenomenon, which got a big boost from Apple's LaserWriter (which was announced two years earlier).

15 Years ago in BYTE

BYTE devoted several articles to a new wave of PCs from Japan (another wave arrived in the second half of 1996). Some of the companies stumbled, but some, including Canon, NEC, Toshiba, and others, are still familiar today.

20 Years ago in BYTE

Apple's Stephen Wozniak described in detail—over about nine pages—the Apple II computer.

Less Is More

Jim Gettys, visiting scientist at the World Wide Web Consortium, describes a more efficient Hypertext Transfer Protocol.

BYTE: *What are the main improvements of HTTP 1.1 over version 1.0?*
Gettys: HTTP 1.0 [the protocol for transferring hypertext] does not use TCP very well. HTTP is based on top of the TCP transport protocol, and the way 1.0 worked was not very clever. For each little graphical thing you saw on your screen, 1.0 established an independent TCP connection.

Many Web pages that you access contain numerous small objects, and TCP was not anticipated to be used in this particular way. Because the TCP connections were being thrown away so quickly and so often, it was defeating the congestion-avoidance algorithms of TCP.

BYTE: *What are the techniques that HTTP 1.1 uses to fix this?*
Gettys: Version 1.1 fixes this by using two techniques. With the first, called *persistent connections*, rather than throwing the TCP connection away after every use, the connection is kept open, and you use it for subsequent requests. The other technique, which is called *pipelining*, lets a client have multiple requests at once.

With pipelining, it's as if you were presenting a list of things that you want the server to deliver to you rather than asking for them one at a time. Pipelining, in concert with persistent connections, lets you get the performance that you need.

BYTE: *What performance benefits did you encounter while you were testing HTTP 1.1?*
Gettys: If what you're doing is downloading one huge image, there's no substitute for bandwidth. HTTP 1.1 can't make a 28.8 modem run any faster. However, for downloading our [test] home page for the first time from a server that was close by on the Internet over a 28.8 line, we saw a 20 percent improvement [compared to HTTP 1.0]. That's a conservative estimate, roughly what people should expect to get. Performance might improve even more than that for most sites as HTTP 1.1 is widely deployed and as the congestion on the Internet caused by HTTP 1.0 lessens.

However, for cache validation [done when revisiting a page when nothing has changed], HTTP 1.1, even on a dial-up line, does dramatically better than 1.0. In our tests, we saw about a factor-of-4 improvement for the cache-validation tests.

For other network environments, we do a lot better in general. For example, going between California [at the Lawrence Berkeley Lab] and MIT, we achieved nearly a factor-of-2 improvement in the first-time retrieval tests and got a factor of 8 in the cache validation [compared to HTTP 1.0]. And then on our local Ethernet tests, we achieved a factor of about 2 for retrieving and a factor of 2 for cache validation. Therefore, HTTP 1.1 will make a significant difference in people's perception of the Internet.

Jim Gettys is also the editor of the HTTP 1.1 specification for the Internet Engineering Task Force and a consulting engineer for Digital Equipment Corp.

For more information on HTTP 1.1, see http://www.w3.org/pub/WWW/Protocols/HTTP/Performance/Pipeline.html.

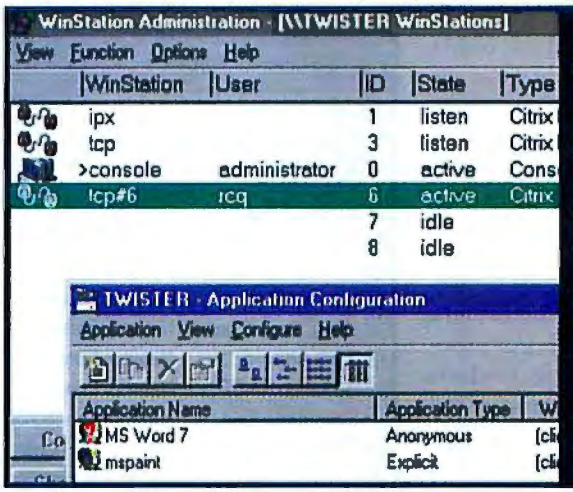
Citrix Systems' WinFrame 2.0 adds "Heidelberg" CPU clustering for better performance and reliability. By Bob Quinn

"Thin" Windows Firms Up

Before the network-PC hype took hold, Citrix Systems' WinFrame offered a similar "thin-client" model, in which a simple PC provided the display and the network provided the computing capacity. Now, with WinFrame 2.0, Citrix adds support for Microsoft NT Server 4.0 and dynamic load balancing between CPUs. However, licensing negotiations were still ongoing between Microsoft and Citrix at press time, which will possibly affect the product release date and price.

WinFrame is a client/server network application pair that allows remote execution of any Windows or DOS application, file access, and print redirection. Its server supports multiple clients running a variety of applications simultaneously, such as X Window System, but with standard Windows applications.

WinFrame's new load-balancing technology (formerly know as "Heidelberg," its code name) is an important addition that promises to improve both performance and reliability. WinFrame clients can now connect to applications rather than to specific servers, and each client request is automatically routed to the least-busy server. Like NT domain servers, the WinFrame master servers need not be dedicated systems and can be implemented with secondary masters to avoid single points of failure.



WinFrame 2.0
Price not available at press time
(requires 16 MB of RAM; 4 to 8 MB per remote user)

Citrix Systems, Inc.
Fort Lauderdale, FL

954-267-3000

http://www.citrix.com

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WinFrame 2.0's administration tools allow flexible client configuration and provide auditing and connection data.

WinFrame clients can run over any common transport protocol (IP, IPX, or NetBIOS) on virtually anything. Applications can run stand-alone or in your favorite Web browser when connected to a third-party Web server configured for the WinFrame Intelligent Console Architecture (ICA) MIME type.

Unlike X Window, which generates network traffic for any mouse movement, WinFrame is much more efficient. When I ran an early beta version of WinFrame 2.0 with Word for Windows 7 over 10-Mbps Ethernet, there was a noticeable but insignificant lag between keyboard or mouse input and screen updates. Over a slow (14.4-Kbps) dial-up link, Word was still usable, but awkward; it ran as it does on an underpowered system.

The blinking cursor in Word generated a constant heartbeat, sending about 5 bytes over the TCP connection with every blink, but otherwise WinFrame used minimal bandwidth. After I started Word and wrote for about 15 minutes, WinFrame transferred about 350 KB to my client and about 17 KB to the server. In comparison, running Word from a network drive generated about 2.5 MB of client traffic and about 500 KB to the server.

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

The WinFrame server requires 32 MB of RAM for reasonable performance, plus 4 to 8 MB per remote user. Given the resource-hogging requirements of Windows applications, you should be prepared to throw a lot of hardware at the server side for adequate service, but it's worth it. B

TECH FOCUS

ICA: Intelligent Console Architecture

The key to WinFrame's capabilities is Citrix's Intelligent Console Architecture (ICA). ICA provides presentation services (layer 6 in the Open Systems Interconnection [OSI] network model) to describe application display from server to client, and user actions from client to server. But depending on the connection and configuration, it can also provide reliable data delivery, encryption, and compression.

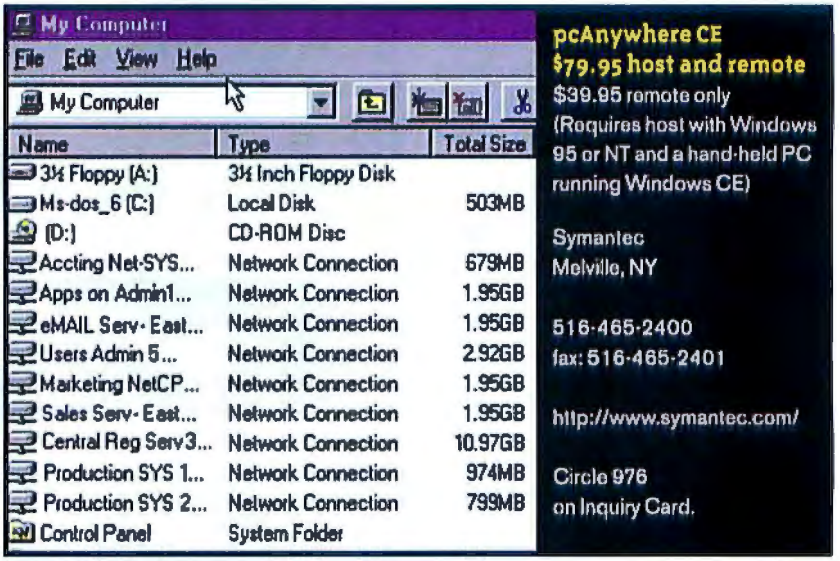
Bob Quinn is a consultant and coauthor of Windows Sockets Network Programming *(Addison-Wesley, 1995). You can reach him at* **rcq@sockets.com**.

Symantec's pcAnywhere CE lets you control distant systems from your Windows CE hand-held PC. By Peter Wayner

Real Remote Control from Your Pocket PC

The first palmtop and hand-held PCs (HPCs) had only a few real tasks in life: manage datebooks and juggle e-mail. Until recently, these little machines weren't really good for much else. Now, Symantec is offering a version of its popular pcAnywhere software for the new HPCs that run the Windows CE operating system. The ability to control a distant machine from a very lightweight pocket-size piece of hardware may prove to be the crucial application that endears the little machines to MIS managers and computer technicians.

The new CE edition of pcAnywhere offers a subset of the basic features found in the standard package. Establish a connection and the screen from the host machine also appears on your HPC. If you click on an icon or type on the HPC's keyboard, that information is transparently sent to the main host, which then acts upon it just as if you were using the host's own mouse or keyboard. You can execute programs, fiddle with control panels, and even reboot the machine from a remote connection. Everything we tried worked except for Microsoft's Flight Simulator, which demanded to run in full-screen mode.



Thanks to pcAnywhere CE, Windows CE hand-held PCs can now let you give orders remotely to your desktop machines.

This edition of pcAnywhere doesn't offer the same file transfer features as the "full-size" version. Symantec says it was aiming for a small binary file to save space. So while you can't transfer files, you can move the clipboard between systems: You can, for example, cut some text on the host machine and then paste it into Pocket Word or Pocket Excel on the HPC.

With pcAnywhere, you can connect to a host over an IP network, a phone connection, or a direct cable link. Even at 19.2 Kbps on our Philips Velo 1, the screen refresh was fairly responsive and usable.

We tested a pre-beta version of pcAnywhere CE that didn't have any of the compression technology Symantec will ship with the final version. This early version of the software was quite steady, although it did exhibit several mistakes redrawing the screen. It was stable, however, and it never crashed either the host or the HPC.

The greatest market for this product may be computer technicians who must maintain servers and help widely dispersed people use software. Such technicians often have to walk long distances throughout a building or campus to handle problems. For them, laptops are often too heavy and bulky. A small, lightweight solution, such as a CE hand-held with pcAnywhere, will give them a useful tool for fixing many problems remotely. B

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

Peter Wayner is a BYTE consulting editor living in Baltimore. You can reach him at **pcw@access.digex.net.**

TECH FOCUS

A Quart of Data on a Pint-Size Screen

Q: How do you show a high-resolution color image on a 480- by 240-pixel display with four gray levels?

A#1: Remove plenty of data.

A#2: Look at it in pieces.

Symantec offers both solutions. One view displays the entire host screen on the hand-held PC through aliasing and pixel averaging. You really can't read much, but you can find your way around. The second view is a one-to-one display of the host screen's pixels. Only color information is lost, and you can see just a portion of the host screen at any one time. There are several commands for toggling between the two views.

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

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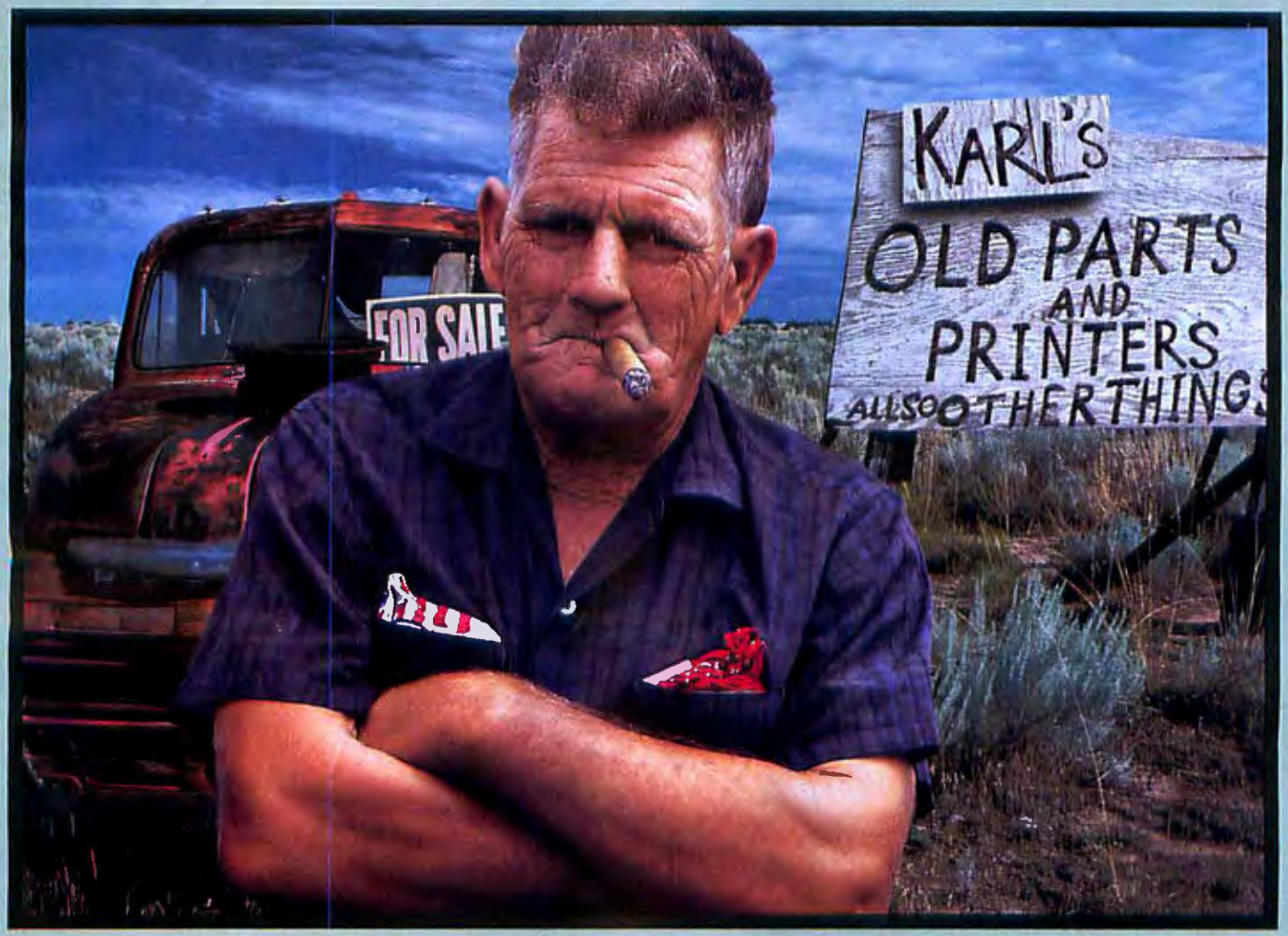

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HITACHI ELITE 751	19"(18.0")	0.22 horiz.	YES (1672)
SONY 205FU	20"(19.1")	0.30 AG	NO
VIEWSONIC PT800	20"(19.1")	0.30 AG	NO
VIEWSONIC GT810	21"(20.0")	0.30 AG	NO

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TUBE SIZE	19"	20"
PITCH	0.22 (H) 0.14(V)	0.25
MAX. REFRESH @ 1600 x 1200	75Hz	75Hz
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The Sony is an inch bigger, but costs 54% more.

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Microsoft's latest Visual C++ scales from lean-and-mean ActiveX components to massive enterprise-wide systems. By Steve Apiki

C++ on Every Level

From tiny components do mighty client/server applications grow. Whether you want to make tiny components tinier or make client/server applications more mighty, Microsoft's Visual C++ 5.0 is a toolkit you can't overlook.

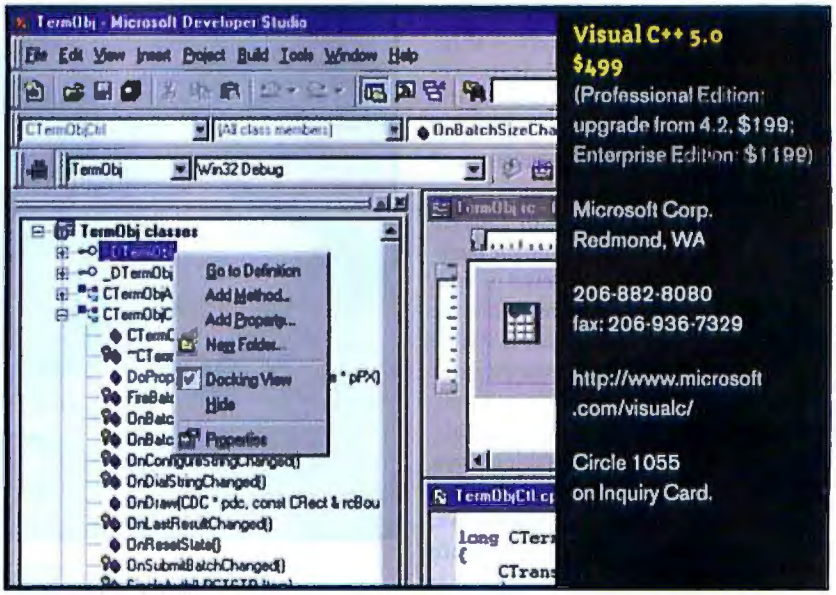
This version dramatically improves support for COM and ActiveX, bringing Microsoft's core Component Object Model technology further into the development mainstream. Version 5.0 also comes with an updated, scriptable integrated development environment (IDE), better Internet support, and a faster and better underlying compiler. At the high end, the Enterprise Edition has visual tools for simplified SQL database layout.

Snapping a well-designed ActiveX control into an application is a thing of beauty. But creating an ActiveX control—especially one that's slim enough to load across a dial-up Internet connection—is no mean feat. It requires both a good working knowledge of COM and sheer programming drudgery.

Visual C++ 5.0 sidesteps some of the most difficult parts of COM development with the Active Template Library (ATL), a new sibling to the Microsoft Foundation Classes (MFC) that provides a starting point for small and fast COM objects. ATL templates implement the basic COM interfaces, take care of reference counts, and can serve as the basis for full ActiveX controls. ATL objects can be tiny. I built a working ActiveX control of 44 KB; Microsoft says a functional ActiveX control can be as small as 28 KB and that simpler COM objects can be much smaller.

ATL is itself supported by two Visual C++ Wizards, the ATL COM AppWizard and the ATL Object Wizard. These two Wizards together generate the skeleton code needed to build COM objects, ranging from simple servers to full controls.

Visual C++ 5.0 also makes a much better COM client than did previous versions. This version introduces an `#import` directive that loads type-library information into a C++ namespace. You add the import line with the name of the type library, and the interfaces defined within are immediately available through the familiar syntax of C++ classes.



Visual C++ 5.0 simplifies ActiveX development with access to methods, properties, and events using the ClassView.

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

Better COM support extends to the IDE's ClassView window, which in earlier versions let you browse C++ classes. Now you can view COM interfaces and add properties and methods. Other changes to the IDE include new AppWizards, IDE scriptability through OLE Automation, and HTML-based documentation (which is slower than its predecessor).

Along with the compiler comes a new class library, MFC 5.0. The most significant updates to MFC are in Internet support, as the new library now wraps `WinInet` functions. The compiler itself shows some surprising improvements, given its maturity. I rebuilt a suite of DLLs from a set made with Visual C++ 4.2 and got an average size reduction of about 6 percent. Microsoft claims a 5 percent to 10 percent size reduction and a 10 percent speed increase, on average, with just a recompile between the two versions.

As the successor to the most prevalent Windows development environment, Visual C++ 5.0 comes out of the gate a sure winner. But its new focus on COM and its performance improvements are even better reasons for upgrading. B

Steve Apiki is senior developer at Appropriate Solutions, Inc. (Peterborough, NH) and a BYTE consulting editor. You can reach him at **apiki@AppropriateSolutions.com.**

Size, weight, and speed—Avatar's removable-medium Shark 250 melds the best of all three in a sleek little package. By Robert L. Hummel

Quick-Striking Mighty Mite

Hoping to garner a share of the explosive removable-medium market, Avatar Peripherals is introducing the Shark 250, a $299 portable hard drive that is a bit larger than a pocket calculator and weighs under 10 ounces. Add the required cables and a couple of 250-MB drive cartridges ($39 each), and the package still tips the scales at barely a pound.

I tested the parallel-port version of the drive, which comes with a cable with a pass-through port, letting you use your printer while the drive is connected. The installation program ran smoothly, and after a few minutes, I was able to copy files to and from the Shark as easily as with the computer's internal hard drive.

Avatar designed the Shark to tap into the power used by the computer's keyboard or mouse. Changing drive cartridges is easy. Double-click on the eject icon in the tool tray, and the cartridge pops out. Insert a new cartridge, and you have instant access to a different 250-MB chunk of data and applications.

To gauge the Shark's ability to move data, I timed file operations (see the graph). When I copied a mix of small and large files from the Shark to the laptop's C drive or vice versa, 209 MB of data moved at just over 500 KBps. Filling or emptying a Shark cartridge takes about 8 minutes. Applications that combine reading and writing large amounts of data will suffer a bit if executed solely on the Shark. The transfer rate when moving data from one spot to another on the Shark averaged only 285 KBps. This compares poorly with the 847-KBps rate when moving data around on the C drive.

Avatar claims that its piggyback power tap works on the vast majority of desktop and laptop computers, one of its big selling points. However, after operating properly with a NEC Versa 6200MX notebook for a short time, the drive would mysteriously stop functioning. I tracked the problem to inadequate power coming from the keyboard connector.

The second problem was easier to diagnose. The piggyback power cable was too short to reach from the keyboard connector to the parallel-port cable. In both cases, connecting the drive to an external power cube cured the problem.

Overall, the Shark 250 provides solid performance at a reasonable price. Even with the external power cube, the Shark's small size and large capacity make it a good choice for portable data storage. B

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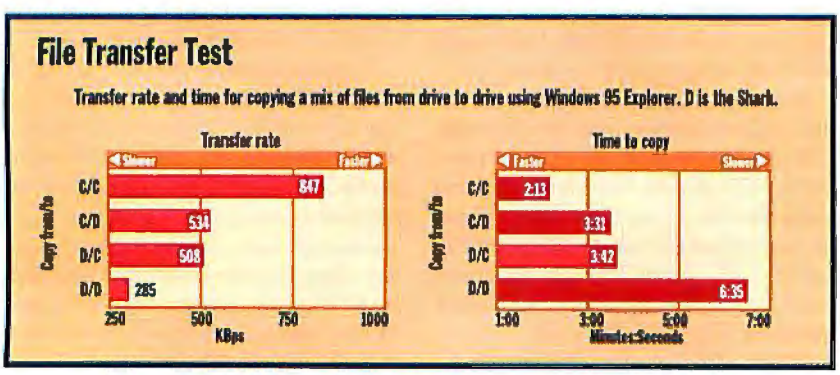
The stylish Shark 250 from Avatar runs without an external power supply on most notebooks.

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



Robert L. Hummel is a writer, engineer, and consultant. You can reach him at **rhummel@monad.net.**

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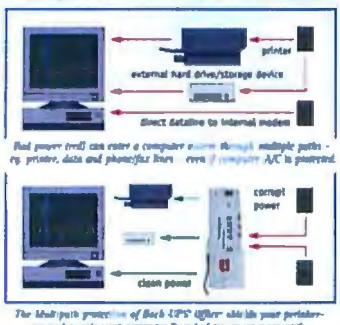

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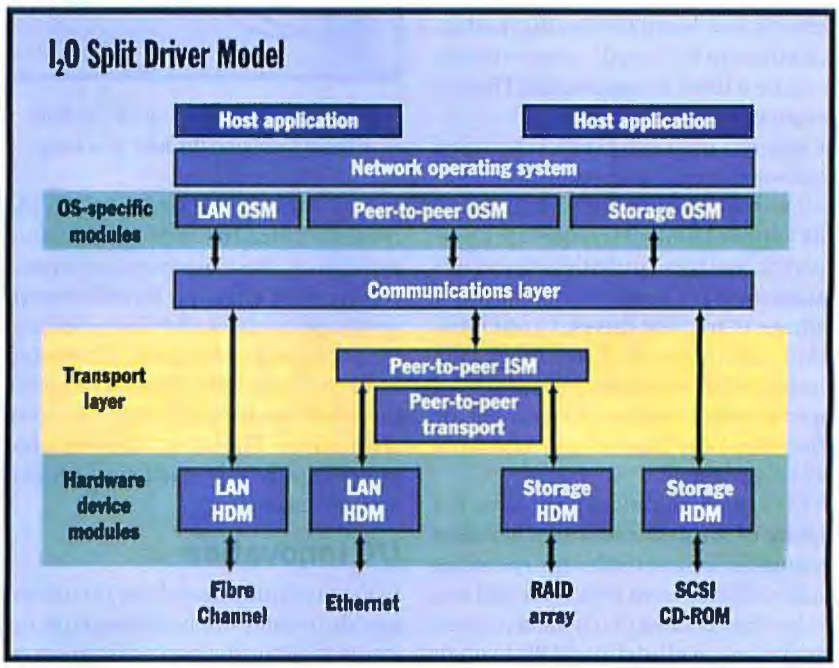
I_2O technology promises scalable server I/O and a new category of autonomous I/O management applications. By Chris Briggs

Smarter and Faster I/O for Servers

The computing environment continues evolving at a rapid pace. The biggest shift has been in how work gets done. Today, no computer is an island; instead it routinely draws information from remote databases, the Internet, and an intranet. This shift in operations in turn increases the throughput requirements for network I/O. Newer high-speed network protocols such as Fast Ethernet, Gigabit Ethernet, asynchronous transfer mode (ATM), and Fibre Channel promise to deliver the extra bandwidth and move data between servers at even faster rates. Complicating the situation is that in this highly interconnected environment, the data itself is becoming much more complex or "rich." Users are moving from simple e-mail and text-based file messages to larger and more sophisticated data transactions that include streaming digital video, visualizing 3-D data, and sifting through data warehouses.

Increasingly, data congestion occurs at the servers because of the I/O-intense demands made by this type of client/server transaction. This places pressure on server designers to improve system-level performance. While high-speed processors and bus architectures have managed to meet some of this demand, system I/O performance has not kept pace. Due to the high-capacity needs of modern networked applications, I/O is quickly becoming the bottleneck between end users and information. Adding more processors to the server in an attempt to scale up its capabilities through symmetric multiprocessing doesn't help because the real problem is in moving the data about, not processing it. Special high-end server designs from Tandem and Sequent use unique system architectures that place a distributed mesh of intelligent control logic throughout the server and thus improve its I/O capacity. (See "The Network in the Server," July 1996 BYTE.) However, these are expensive solutions. For mainstream servers based on off-the-shelf hardware, the trick is to get the system to work smarter—not harder—with I/O. Intelligent I/O is the means to break this bottleneck and enable scalable system performance.



A communications layer abstracts OS/device communications so that device interfaces "snap in" to multiple OSes.

I/O with Smarts

Intelligent I/O, also known by the label "I_2O," describes an industry standard I/O subsystem architecture. This standard, first promulgated by Intel, is now managed by a special interest group (SIG). I_2O's architecture is independent of both the peripheral devices being controlled and the host operating system managing them. More important, it reduces a host processor's overhead by off-loading device interrupts and I/O functions onto "smart" I/O subsystems. These subsystems are managed by independent I/O processors (IOPs). One representative IOP is Intel's i960 RP, which consists of a RISC processor with local memory, a PCI-to-PCI bridge, and built-in support for interrupt handling and DMA transfers. (For more information on the i960 RP, see "The Server's Helper," October 1996 BYTE.) Such feature-rich IOPs can handle all low-level interrupts and the DMA transfers between a PCI bus device and main memory, independent of the server's main processors. The IOP interrupts the host processor only when a specific I/O task completes. For example, the host OS can program an IOP so that it receives a specific number of incoming network packets, strips off the

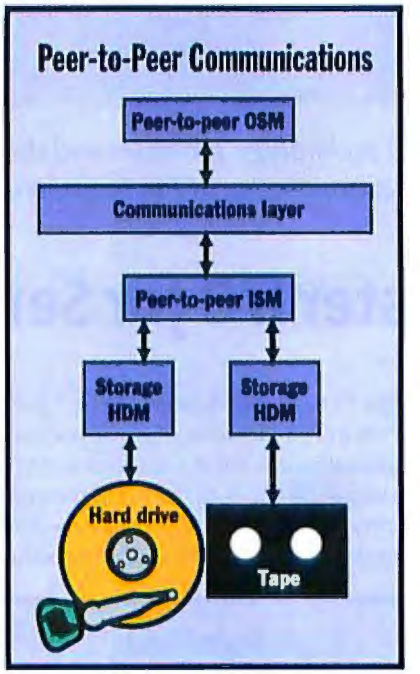
protocol headers, and drops off the resulting data in a specific section of the server's memory for use by a network application—all without intervention by the host processor.

Enabling such smart I/O subsystems requires a hardware-independent software infrastructure that communicates with intelligent devices. A new split driver model achieves this independence by logically separating the driver section responsible for the low-level device control from the driver section that manages implementation details for the OS it serves, as shown in the figure "I_2O Split Driver Model."

I_2O defines how these two driver sections converse with one another. Its specification describes a two-layered message-passing system through which the driver's host-based OS-specific module (OSM) and its IOP-based hardware device module (HDM) communicate. The appropriately named communications layer sets up a messaging session between the two sections, and a transport layer defines how information is shared among the various HDMs. Messages are class-specific, and they currently define operations for many devices including block storage (hard disk drives, CD-ROMs), RAID, LAN (Ethernet, Token Ring), tape storage, SCSI, system management, and peer-to-peer transfers. Extensions for clustering, Fibre Channel, and ATM/WAN are being defined.

I_2O's communications layer hides the nature of the data exchanges between various devices, and in doing so provides independence from processor and bus technology. Because the communications layer uses a well-defined API through which device drivers perform all I/O transactions, the driver becomes portable across multiple OSes, which drastically reduces device-driver development costs. Furthermore, because of this consistent interface, system engineers or network managers can use any type of I_2O-compliant hardware in a server, regardless of the network OS it uses. Both Microsoft and Novell are members of the I_2O SIG's steering committee, so you can expect to see Windows NT and NetWare support I_2O-compliant peripherals.

I_2O has a message-queuing structure that delegates I/O requests to multiple I/O subsystems instead of queuing the requests in the host's memory. This provides two benefits. First, the host processor doesn't poll or "spin" on I/O requests. Instead it continues with more useful work, thus making concurrent processing more effective. Second, overall system performance improves because I/O processing tasks can be distributed across multiple IOPs. This also achieves the much-needed scalability in a server architecture: The server's performance grows linearly as you add more processors and more IOPs.



Mirroring or tape backup can be done without involving the host processor.

I/O Innovation

I_2O's standardization of the I/O subsystem also creates an environment ripe for innovation in the two basic areas of server I/O: network and storage. By separating application processing from I/O processing, which is primarily data movement versus interrupt processing, dramatic performance improvements can be realized.

Why? As previously mentioned, the I_2O architecture allows for distributed processing. It also allows the creation of a stackable driver whereby special functions, encapsulated in the form of an intermediate service module (ISM), can be inserted between the OSM and HDM. RAID is one example of such an ISM. A dedicated RAID controller can be replaced by a disk controller that runs a RAID ISM on an IOP. This increases the capability of the disk controller while both improving its performance and reducing cost. Other ISMs might perform data compression/decompression on a block storage device, encrypt data packets going out a network interface, or implement firewall support for a Web server.

The most significant opportunity lies in I_2O's capability for direct message passing between multiple IOPs, also known as *peer-to-peer communication*. Peer-to-peer communication allows intelligent device-to-device transactions across the PCI local and system bus, independent of the server's host processor and OS. This is accomplished through autonomous I/O management applications that reside as ISMs in the transport layer, as shown in the figure "Peer-to-Peer Communications." For example, an I/O management application can accelerate I/O by directing data read from a hard drive straight onto a LAN interface. Other peer-to-peer application examples include direct disk-to-tape backup, dynamic load balancing, clustering, server fault tolerance with error isolation and recovery, and remote management.

I_2O's new driver architecture eliminates the I/O bottleneck in mainstream server designs. It does so by shifting the I/O load from the host processor onto intelligent peripherals. Its split driver model, with the communications layer, achieves hardware abstraction so that a network administrator can pick and choose from a wide variety of I_2O-compliant peripherals. In addition, this abstraction simplifies the device driver's design so that it can be readily modified to support different network OSes.

I_2O's queuing mechanism enables concurrent processing, which minimizes OS overhead. This mechanism also permits a server's capacity to scale up via symmetric multiprocessing and by the addition of more smart devices. Finally, the peer-to-peer communications can enable a new category of high-performance tasks through autonomous I/O applications. For more information on I_2O, check out the Web site at http://www.I2OSIG.org/. B

Chris Briggs is a market development manager for Intel's I/O Processor Division (Chandler, AZ). He has a BSEE from the University of Cincinnati and an MBA from Arizona State University. You can send e-mail to him at **chris_j_briggs@ccm.ch.intel.com.**

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This networking technology offers better throughput and compatibility with existing Ethernet devices. By Selina Lo

Inside Gigabit Ethernet

Nowhere is the need for speed more insatiable than in the world of computer networks. Intranet Web servers, centralized server farms, groupware, and a barrage of client/server applications are all pushing the limits of today's computer networks. As a result, networks are frequently congested, resulting in poor application response time and loss of productivity.

Network administrators grappling with this problem face a dilemma: How can you boost a network's throughput so that more work can be done, yet not jeopardize the huge investment made in network interface cards (NICs), hubs, routers, and servers? Since 80 percent of existing networks use Ethernet and TCP/IP, any solution must include Ethernet for it to be practical.

A new standard promises to deliver Ethernet data at 1 Gbps, or 100 times the rate of traditional Ethernet. Gigabit Ethernet, as the technology has now been dubbed, is a new twist on a long-established networking scheme.

Initial Applications

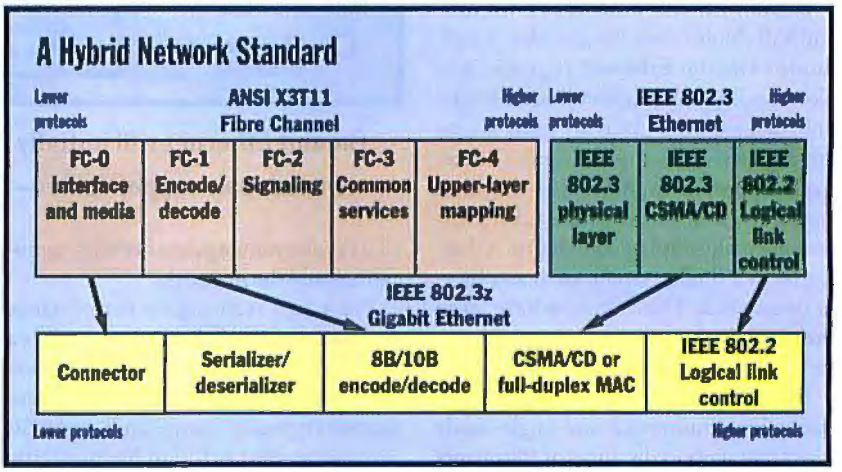
Because Gigabit Ethernet uses the same low-level protocols as traditional Ethernet, existing routers and hubs needn't be replaced. Thus, Gigabit Ethernet can easily fit into existing networks. The technology will be applied to three initial applications. First, connections for centralized file servers will be upgraded. Second, connections between Fast Ethernet switches will be upgraded. Finally, specialized, high-performance workgroups will be linked.

A common misconception is that Gigabit Ethernet requires gigabit-per-second traffic to justify its place on a network. In fact, Gigabit Ethernet makes sense anywhere users simply require more than 100 Mbps of throughput. Such requirements are already commonplace among enterprise servers.

Server network interfaces have been limited to 100 Mbps since the days of Fiber Distributed Data Interface (FDDI), and, at 155 Mbps, asynchronous transfer mode (ATM) doesn't provide any more bandwidth because of the overhead in its 53-byte cells. Many servers today have two or more 100-Mbps Ethernet adapters to satisfy traffic loads that a single Gigabit Ethernet adapter would readily handle. Besides offering performance, the technology lets you consolidate multiple 100-Mbps server connections into a single Gigabit Ethernet NIC, which frees up server I/O slots and simplifies network administration.

As Gigabit Ethernet routers and switches become available and validated with server applications, the technology will be quickly adopted as a solution for network backbone congestion. For a Fast Ethernet backbone, existing switches can be interconnected by the addition of Gigabit Ethernet links and switches to form a higher-capacity backbone network. This backbone can support numerous switched and shared Ethernet segments, all without displacing any desktop hardware or software. In replacing a congested FDDI backbone, Gigabit Ethernet delivers approximately 10 times the bandwidth while eliminating Ethernet-to-FDDI protocol translations.

Although Gigabit Ethernet won't be part of a standard desktop configuration anytime soon, it will be embraced by workgroups using high-performance applications, such as animation, visualization, CAD/CAM, and various graphics simulation programs. Previously, such workgroups relied on discrete niche technologies, such as HIPPI (High Performance Parallel Interface) and Fibre Channel, to implement high-speed connections to servers and server farms.



Gigabit Ethernet combines two proven technologies to make a standard that's compatible with 80 percent of existing networks.

A Hybrid Standard

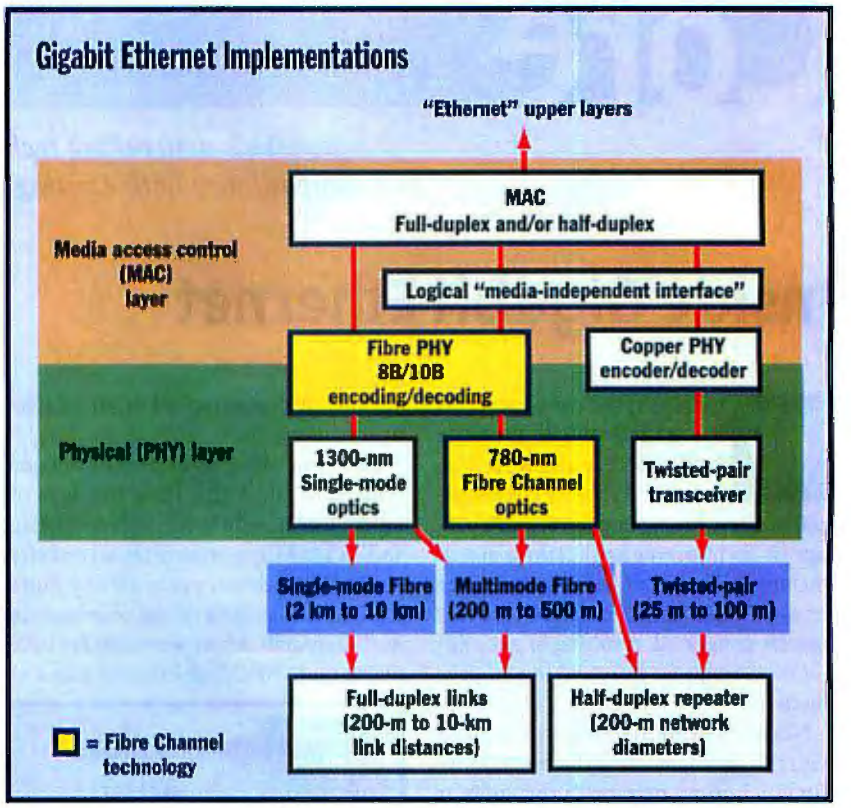
Under development by the IEEE's 802.3z task force, Gigabit Ethernet uses a combination of two proven network technologies. The standard adopts both the original IEEE 802.3 Ethernet specification and

the ANSI X3T11 Fibre Channel specification for the physical interface. Stated another way, Gigabit Ethernet employs Ethernet protocols to manage frame transfer and media access (layer 2), as well as Fibre Channel optics, connectors, and cables (layer 1) for the physical interface.

As illustrated in the figure "A Hybrid Network Standard" on page 55, Gigabit Ethernet retains Ethernet's link-layer protocol, maximum and minimum frame sizes, and frame format. It also employs Ethernet's traditional access method, known as carrier-sense multiple access/collision detection (CSMA/CD). This method essentially dictates the way devices share the wire, as well as the arbitration method used. A few new features were added to the protocol to address the physics of working with standard Ethernet frames in a high-speed environment, most notably carrier extension and packet bursting.

Gigabit Ethernet includes both full- and half-duplex operating modes. A half-duplex Gigabit Ethernet repeater acts like a traditional Ethernet shared-media hub, using CSMA/CD to arbitrate access among users. Full-duplex Gigabit Ethernet is supported on all switches and some repeaters. It doesn't require CSMA/CD because a full-duplex connection is dedicated to a single system, such as a server or a switch. These devices have large memory buffers to withstand temporary port contention.

Initial Gigabit Ethernet network products will use multimode and single-mode fibers that support distances of 500 meters and 2 kilometers, respectively. Standards are currently being developed for transceiver technology that support gigabit signaling over four pairs of Category 5 (shielded twisted-pair) wire, at a range of up to 100 meters, as shown in the figure "Gigabit Ethernet Implementations" above. This standard is expected to be finalized in 1998.



Gigabit Ethernet will initially use fiber-optic cables—and later twisted-pair copper cables—to connect servers and switches.

Getting Gigabit Performance

While at a certain level Gigabit Ethernet is "Ethernet, only faster," there are important issues to consider in achieving true end-to-end performance. With 32- and 64-bit PCI buses, desktop computers—particularly high-performance servers—can burst traffic at rates exceeding 1 Gbps. However, at these rates a computer's processor can potentially spend all its cycles moving data between applications and the network.

Therefore, realizing the performance promise of Gigabit Ethernet requires a new generation of intelligent adapters that minimize host involvement. These adapters typically feature on-board RISC processors that off-load host-specific functions, such as interacting with protocol layers (i.e., adding and removing protocol headers or generating checksums) and moving data within the memory subsystem.

These intelligent adapters can minimize interrupt-handling overhead by issuing a single host interrupt for multiple packets that arrive in proximity of one another. This not only enables faster throughput but also helps applications run more efficiently by freeing host CPU cycles for application processing. Furthermore, the frequency of host interrupts can be adjusted dynamically, depending on the burstiness of network traffic. In a lightly loaded environment, more frequent interrupts reduce latency, while in heavily loaded situations, fewer interrupts improve throughput. Intelligent adapters will evaluate network activity to dynamically determine which method to use at any time.

Since Gigabit Ethernet switches are either interconnecting centralized servers or backbone switches and routers, they have to offer a high degree of reliability and redundancy. Switches that are deployed on the backbone should also have the ability to transport not only data but also voice and video traffic. This means that traffic management, congestion control, and quality of service (QoS) are all important evaluation criteria. Up to now, only ATM switches have had to take on such duties.

Ethernet is here to stay. Gigabit Ethernet is a natural extension of this technology. Even so, users should look under the hood to ensure they are getting the maximum performance at the best price. This means taking a systems approach in selecting adapters, drivers, switches, and routers that together provide the best end-to-end performance. B

Selina Lo is the vice president of product management and marketing for Alteon Networks, Inc. (San Jose, CA). She can be contacted at **slo@alteon.com.**

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Circle 146 on Inquiry Card.

Digital Semiconductor's Alpha 21164PC delivers workstation-caliber performance to desktop PCs. By Peter J. Bannon

Alpha Arrives at the Desktop

Smaller, cheaper, and faster are the watchwords for semiconductor manufacturers today as they scramble to satisfy the enormous computing appetites of multimedia, CAD, and data-manipulation applications on the desktop. Businesses use desktop systems for videoconferencing, voice synthesis, and enterprise-wide data access. As each breakthrough drives the imagination toward new horizons, realizing these ideas requires an ever-increasing amount of processing power.

Digital Semiconductor's new Alpha 21164PC processor targets this broader desktop market while satisfying the conflicting goals of providing more power at an affordable price. Codesigned by Digital and Mitsubishi, the 21164PC is a derivative of the Alpha 21164, Digital's workstation processor.

Implemented in a 0.35-micron CMOS process, the 413-pin 21164PC features a die 8.5 by 16.2 millimeters that contains 3.5 million transistors. The 21164PC's die is 30 percent smaller than previous Alpha implementations, enabling significant cost savings in manufacturing. These savings translate directly to lower-cost CPUs, meaning more affordable PCs.

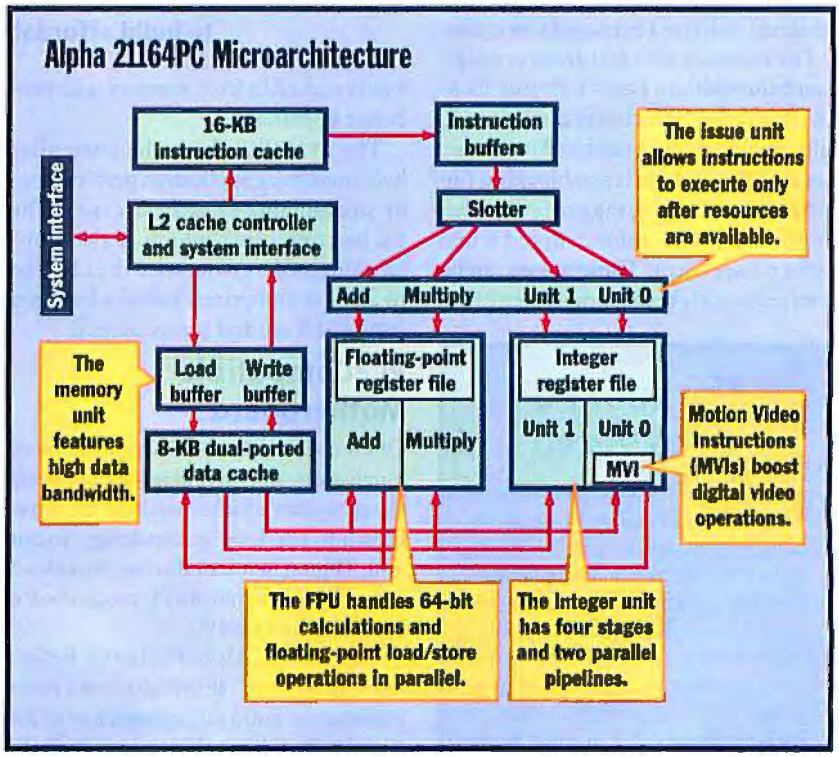
However, the smaller die doesn't imply that the processor is less capable in terms of speed and performance. At 533 MHz, the 21164PC supports 2.1 billion instructions per second (BIPS), or 2133 MIPS, and 1066 MFLOPS. A 21164PC that's configured with a 2-MB external cache and 125-nanosecond main memory at this clock speed delivers an estimated 14 SPECint95 and 17 SPECfp95. These characteristics and its price make an Alpha processor ideal for PCs running Windows NT.

The Alpha Architecture

The processor's microarchitecture, as shown in the figure "Alpha 21164PC Microarchitecture," is a 64-bit RISC processor designed with an emphasis on speed, multiple-instruction issue, and multiprocessor support. The registers are 64 bits long. Alpha instructions are 32 bits long, and load/store operations to memory can be 8, 16, 32, or 64 bits in length.

The 21164PC takes full advantage of the Alpha architecture in a quad-issue implementation, featuring a seven-stage integer pipeline and a nine-stage floating-point pipeline. The 21164PC has a large 16-KB instruction cache (Icache) and features a bandwidth of 8000 MBps to the instruction-issue unit. The Icache prefetches 96 bytes ahead of the current program counter, which provides significant performance improvements for long code sequences. The high-speed data transfer capacity, plus the aggressive instruction prefetch scheme, help keep the pipelines full.

The 21164PC's instruction unit consists of an instruction buffer, a slotter, and an issue unit. The simple instruction-issue design maximizes the 21164PC's high clock frequency with little impact on the number of instructions that can be issued per cycle. The instruction buffer holds two sets of four instructions, facilitating the chip's quad-issue operation. The buffer optimizes the flow of instructions into the slotter unit by removing "bubbles" from the pipeline. (A bubble occurs when a branch instruction is taken,



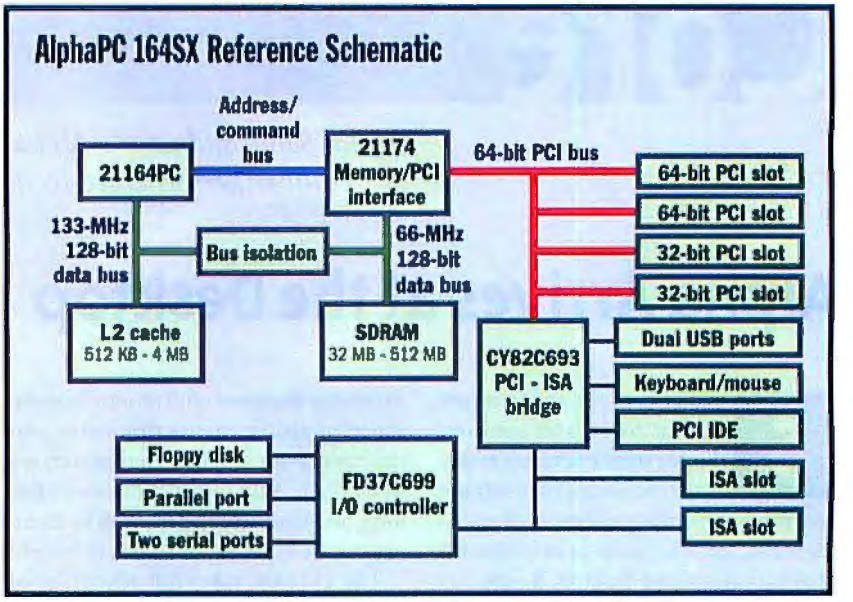
The Alpha 21164PC offers 64-bit processing at speeds of up to 533 MHz, at prices suitable for desktop-system designs.

changing the flow of execution.) The slotter attempts to assign four instructions to the pipelines each cycle and refills when all the instructions have been assigned. The issue unit lets the instructions execute after assuring the availability of the required system resources.

The integer-execution unit contains a register file and several function units in four stages of two parallel pipelines. The pipelines contain differing sets of function units, with the 64-bit adder, logical, and load units being common to both. Instructions normally execute in one cycle. The exceptions are the loads and the conditional move instruction, which require two cycles.

The 21164PC's FPU is made up of two 64-bit execution units. The first unit executes all floating-point instructions except multiplies; the second unit handles those instructions. Both units are fully pipelined and have a latency of four cycles.

The memory unit features very high data bandwidth to boost CPU use. Its 8-KB data cache (Dcache) is dual-ported, fully pipelined, and a nonblocking cache. Because the Dcache is nonblocking (up to 21 loads can miss), the processor continues to operate uninterrupted when cache misses occur. These misses can be resolved quickly because the design interleaves cache fills from memory with processor operations.



A cost-effective core-logic chip set enables vendors to build affordable desktop systems.

The 21164PC's L2 cache controller helps maximize application performance by streamlining L2 cache accesses. The cache controller, which is also nonblocking, orders requests to the L2 cache to achieve an optimal balance between bandwidth use and access latency.

PC-Compatible Motherboard

Of course, the 21164PC wouldn't be of much use if expensive glue logic connects the processor's high-speed 128-bit interfaces into a desktop-system design. To this end, Digital Semiconductor provides a reference schematic of a PC motherboard based on the 21164PC.

The figure "AlphaPC 164SX Reference Schematic" shows the basic parts necessary to build a PC system. Key to the AlphaPC 164SX's architecture is Digital's 21174 core-logic chip set. It reduces component costs by providing glueless, high-speed interfaces to memory and PCI devices. The 21174 features support for 16 or 64 Mb of synchronous DRAM (SDRAM) in configurations from 32 to 512 MB. The chip set's PCI interface accommodates a full range of I/O-device configurations.

To provide access to cost-effective, traditional ISA devices, the AlphaPC 164SX motherboard uses a Cypris CY82C693 PCI-to-ISA bridge ASIC. This part also manages on-board interfaces to universal serial bus (USB), IDE, and keyboard/mouse peripherals.

The AlphaPC 164SX can use a 400- or 533-MHz version of the chip. The motherboard accepts L2 caches that operate at speeds from 66 to 133 MHz and range in size from 512 KB to 4 MB. The motherboard satisfies all ATX design requirements for form factor, hole placement, component height, and component spacing. You can install the six-layer AlphaPC 164SX module in any ATX enclosure. It uses standard ATX power supplies.

Alpha 21164PC processors will be available from Digital Semiconductor this quarter. In lots of 1000, the 400-MHz part costs $295, and the 533-MHz part costs $495. The cost and performance that the Alpha 21164PC brings to the desktop will speed existing information processing for NT applications. As often happens, such high-performance systems will enable a whole new category of applications. B

Peter J. Bannon is a hardware consulting engineer with Digital Equipment Corp. He was a member of the Alpha 21164 architecture team. You can reach him at **bannon@rock.enet.dec.com**.

WHERE TO FIND

Digital Semiconductor
800-332-2717
508-628-4760
http://www.alpha.digital.com/

The 21164PC Does Video

Intel has its multimedia extensions (MMX) instructions that support 16-bit multimedia operations. The Alpha 21164PC has Motion Video Instructions (MVIs) that dramatically boost processing for digital-video applications. The new MVIs—`PERR`, `MAX/MIN`, and `PACK/UNPACK`—are implemented in the integer unit, saving die space and reducing cost. At a cost of only 0.6 percent of the 21164PC's die area, the MVI boosts digital-video operations such as MPEG-2 compression by four times. Because MVIs are an enhancement to the integer unit, there's no penalty for using them along with floating-point operations. The 21164PC's MVI capabilities can support compute-intensive applications such as full-frame-rate digital videodisc (DVD) playback and high-quality videoconferencing in software. This eliminates the need for dedicated multimedia hardware in systems design.

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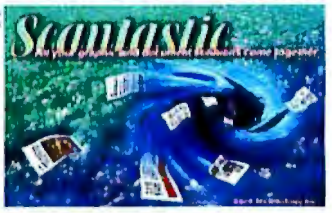
The Best Budget Scanner November,1996

March 17,1996

'very' good rating October,1996

Suggestion for Scantastic:
Scantastic is our all-in-one TWAIN compatible software that manages all of your desktop imaging needs. With Scantastic you can do away with desktop publishing, scan directly into your email, enhance your faxes match colors and much more, Scantastic gives you cutting edge text and image processing technology in a super value pack of eleven of the hottest software programs on the market!



Suggestion for FunScan:
Funscan consists of six user friendly imaging applications wrapped up in one awesome value added package. Funscan allows you to make your own greeting cards, draw pictures, make funny faces, create your own screensavers, play pazzle games, design your own T-Shirts, and home page. Using our state-of-the-art technology, having fun with your scanner is now intuitive and easy.

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Circle 173 on Inquiry Card (RESELLERS: 174).

A special file informs Web catalog and search engines to exclude specific pages on a Web site. By Tonya Engst

The Internet Robot's Guide to a Web Site

A visit to a Web catalog, such as Yahoo, or a search engine, such as Digital Equipment's AltaVista, makes you wonder how these sites track such enormous collections of Web pages. As a Web administrator, you might be surprised at the number of pages from your own Web server that are referenced by such sites. Although catalog sites often employ humans to verify and classify Web pages, many of them also harvest and maintain vast quantities of information through the use of automated programs called *robots*.

Robots typically start with a page of links and recursively follow all the links from that initial page. The robot itself doesn't traverse the Web; it merely requests pages from sites pointed to by the links. A robot's common starting points include sites that catalog the most popular sites within a topic, lists of links resulting from scans of Usenet postings or mailing-list archives, or lists of URLs submitted manually.

For each requested page, the robot records salient information. For example, it might scan for keywords in a META tag or look at the page's title. At other times it might record the first paragraph or so on a page or parse an entire page for keywords.

Although robots serve the useful purpose of adding sites to Web-search sites, they can also overwhelm a server's resources by barraging a site with multiple requests. Further, they might record Web pages that you don't want to appear in Web-search sites: Such pages may not be quite ready for the public eye (perhaps they're still under construction) or may constitute illogical site-entry points. In other cases, pages might contain information that's not private enough to place behind a password system but not sufficiently public to make readily available to Jane or Joe Websurfer. For example, clubs might place committee contact information on-line, yet pages of this type don't necessarily belong in generic worldwide search sites.

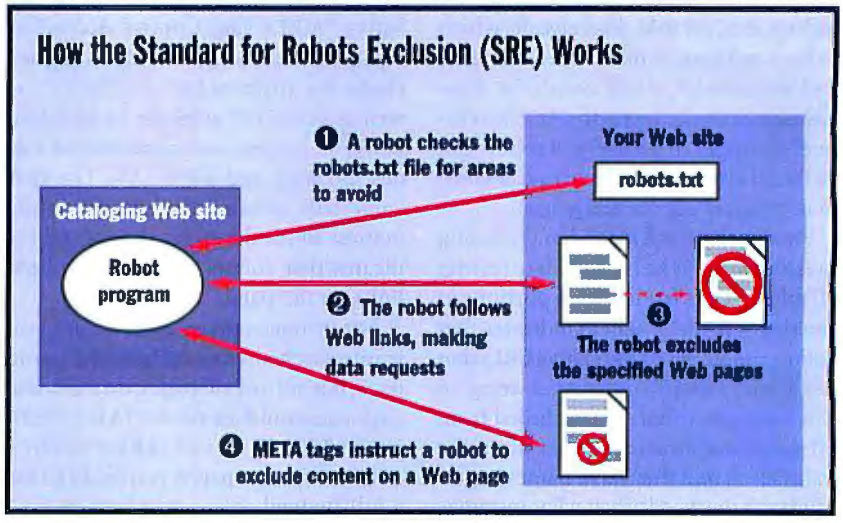
A Standard to the Rescue

Fortunately, robots can be steered away from certain pages through the use of the Standard for Robots Exclusion (SRE). Initiated by Martijn Koster in 1994, this informal standard makes it easy for Web administrators to exclude certain portions of a site from a robot's examination. Although many robots respect the SRE, it's not a formal standard, nor is it enforced.

Koster has created an Internet Draft of the SRE and plans to submit it to the Internet Engineering Task Force (IETF) for further discussion and standardization. Further information about robots and the SRE is available from Koster's The Web Robots Pages, at http://info.webcrawler.com/mak/projects/robots/robots.html.

Implementing the SRE requires nothing more than the creation of a text file called `robots.txt`. (Neophyte Web administrators might be puzzled by failed requests for this file, since polite robots attempt to request directions from it.) The `robots.txt` file acts as a guide to your site and highlights areas that robot visitors should avoid, as shown in the figure "How the Standard for Robots Exclusion (SRE) Works" below. You set up the file with return-delimited records, each containing one `User-agent` field and at least one `Disallow` field. (*User-agent* is jargon for a program—such as a robot—that handles networking tasks.) The SRE is flexible about end-of-line characters, so you need not worry about carriage returns, linefeeds, and the like; simply use whatever is convenient.

The easiest `robots.txt` file to use is an empty one. A blank `robots.txt` file stops errors from appearing in your log and tells robots they are free to traverse the entire site. The second-easiest `ro-`



The SRE steers robot programs away from a Web site's private material.

bots.txt file to use contains two lines and displays a no-trespassing sign for all robots:

```
User-agent: *
Disallow: /
```

The asterisk in the first line serves as a token to indicate all robots; the second line disallows the entire site. Although the asterisk in the User-agent field acts like a wild card for all robots, you cannot use wild-card characters in any other way within robots.txt.

The listing "Deluxe robots.txt File" at right uses multiple records to accomplish several tasks. First, it asks a particular program, roguebot, to stay out of the entire site. You might use a record like this if any program has a habit of rapidly hitting multiple pages on your site, effectively shutting down the site during that time. Second, it gives another program, in this case helpbot, complete site access.

Some real-world sample robot names include ibm, for IBM_Planetwide, which indexes and mirrors IBM-owned domains; and webcrawler, which builds the database search service owned by America Online. Identities of a variety of robots can be found at http://info.webcrawler.com/mak/projects/robots/active.html.

Finally, the third record in the listing uses a series of Disallow fields to restrict all other robots from certain portions of the site. A Disallow field indicates that robots should avoid all relative URLs that begin with a specified character string. In this example, robots are excluded from all pages and directories that sit on the main level, and they have names beginning with the word *private*. For instance, all pages and subdirectories in directories called private and private1 would be off-limits, as would a file named private.html. Additionally, personal.html in the sharon directory is off-limits, as are all pages that are located in the sam directory.

To make a comment, such as the one in the last line of the listing, precede it with a # character. Comments can also go on lines by themselves. You *must* place the finished robots.txt file in the root, or top-level, directory of your Web site; robots ignore robots.txt files located elsewhere. In the future, as ideas in the SRE's Internet Draft are solidified, robots might recognize an Allow field (which would act as an opposite to Disallow) within robots.txt records.

If you cannot modify the robots.txt file for your Web server and can't persuade anyone to modify robots.txt for you, you must resort to stating privacy requests in the META tags of individual Web pages. Such META-tag requests are not as commonly honored by robots, but they're still worth implementing.

As you are probably already aware, a META tag goes in the head portion of an HTML document, as shown in the listing "META Tags Control Access" at right. In this listing, the META tag includes the attribute NAME="ROBOTS", as well as a CONTENT attribute. In addition, CONTENT has the comma-delimited values NOINDEX and NOFOLLOW. The first value tells robots not to record information about the page; the second indicates that robots should not follow links on the page.

For instance, given a site where you want search sites to include the home page, but not any subpages, on the home page you would use the META tag <META NAME="ROBOTS" CONTENT="NOFOLLOW">. On other pages, you could go for a full-fledged <META NAME="ROBOTS" CONTENT="NOINDEX, NOFOLLOW">, but <META NAME="ROBOTS" CONTENT="NOINDEX"> would get the job done.

Security Issues

How secure is robots.txt? Most aboveboard robots use robots.txt files and respect their commands. Unsavory or poorly mannered robots might ignore robots.txt altogether. Furthermore, for robots seeking sensitive material, robots.txt can actually point them to where it's located on a Web site. Truly secret pages should be protected by traditional security, such as a password system or a firewall.

In the end, of course, data is most secure from robots if it resides on a system not attached to a network. In addition, products such as the $749 DynaMorph, from Morph Technologies (for the Macintosh and Windows), and the $195 NetCloak, from Maxum Development (for Macs), employ server-side extensions to HTML that enable Web administrators to limit access to pages based on an IP address or a User-agent.

The SRE certainly isn't a panacea for securing sensitive information. However, it uses a common-sense technique that keeps inappropriate pages out of many Web-search sites. The SRE also can improve the access to your Web site by reducing traffic due to a high number of search requests. If you haven't yet made a robots.txt file for your Web server, perhaps now would be a good time to start. B

Deluxe robots.txt File

```
User-agent: roguebot
Disallow: /
User-agent: helpbot
Disallow:
User-agent: *
Disallow: /private
Disallow: /~sharon/
  personal.html
Disallow: /~sam/ # marks sam
  with a no-trespassing sign
```

META Tags Control Access

```
<HTML>
<HEAD>
<META NAME="ROBOTS"
  CONTENT="NOINDEX,
    NOFOLLOW">
<TITLE>Private Musings and
  Private Links</TITLE>
</HEAD>
<BODY>
...
</BODY>
</HTML>
```

WHERE TO FIND

Maxum Development Corp.
Streamwood, IL
630-830-1113
fax: 630-830-1262
http://www.maxum.com/
info@maxum.com

Morph Technologies, Inc.
Reston, VA
703-716-0677
fax: 703-716-0691
http://www.morphtech.com/
MorphInfo@morphtech.com

Tonya Engst works as senior editor for TidBITS, *a seven-year-old electronic newsletter focusing on Macintosh and Internet topics. She writes frequently about Web- and HTML-related topics and has written HTML chapters for several editions of* Internet Starter Kit *(Hayden Books). You can contact her at* **http://www.tidbits.com/tonya/.**

"Five out of five stars"
BYTE Magazine, Dec. 1996

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A MEETING OF THE MINDS.

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Circle 149 on Inquiry Card (RESELLERS: 150).

NT 5.0 in the Enterprise

New distributed services give Windows NT a boost in large networks.

By David Chappell

What would happen if Bechtel built Hoover Dam out of Legos? Or if General Dynamics built the M1 Abrams tank with a windup motor? It wouldn't be a pretty sight. But that's what many IS departments do when they move applications off their mainframes. They build important, large-scale distributed applications with software that's often best suited to workgroups, sacrificing their mainframe's scalability, reliability, manageability, and security.

Microsoft aims to fix that. Windows NT 5.0 introduces X.500-style directory services, Kerberos security, and an improved Distributed Component Object Model (DCOM). Combined with the currently shipping Microsoft Transaction Server, the forthcoming Microsoft Message Queue, support for NT clustering, and built-in router technology, NT should prove to be a formidable force for enterprise computing.

Directory Services

Central to NT 5.0's new features is its directory service, called Active Directory. Due to be included in the NT 5.0 release in early 1998, Active Directory puts to rest complaints that NT doesn't have an enterprise-capable directory system.

Compared to X.500, NetWare Directory Service (NDS), or Banyan's StreetTalk, the less robust directory services in NT 4.0 were paltry. Rather than create something new, Microsoft built Active Directory entirely around the Domain Naming System (DNS) and Lightweight Directory Access Protocol (LDAP).

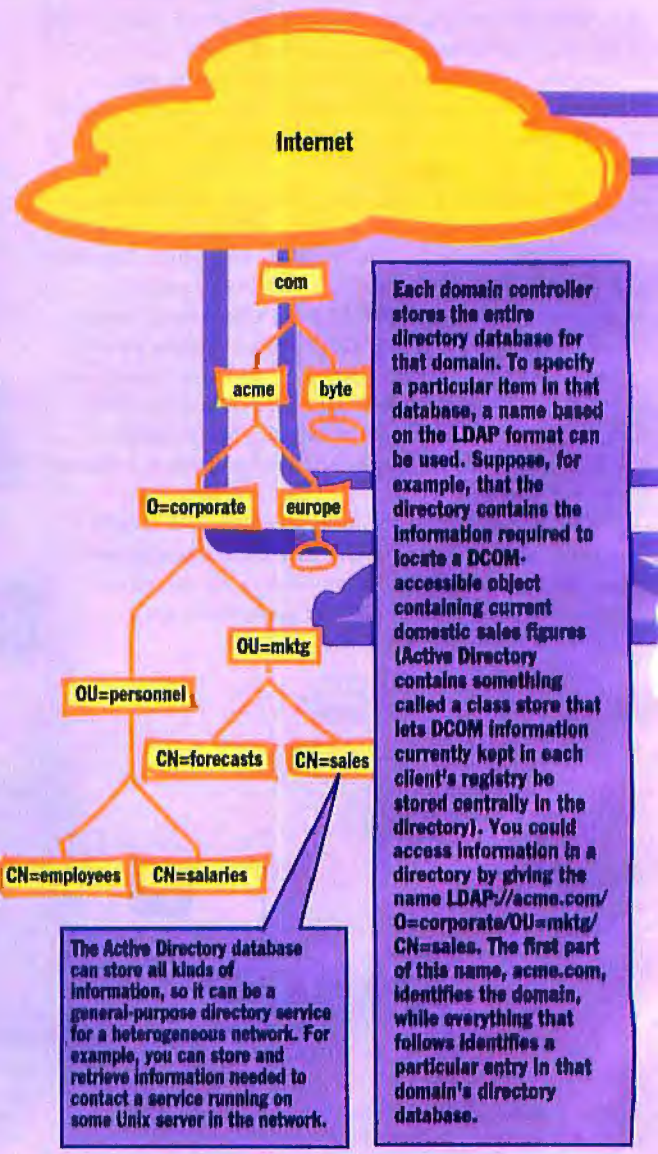
We're familiar with DNS as the hierarchical, replicated naming service on which the Internet is built. Although DNS is the backbone directory protocol of the largest data network in the world, it doesn't provide enough flexibility to act as an enterprise directory by itself. DNS is largely a service for mapping machine names to IP addresses. A full directory service must be able to map names of arbitrary objects (e.g., machines and applications) to any kind of information about those objects.

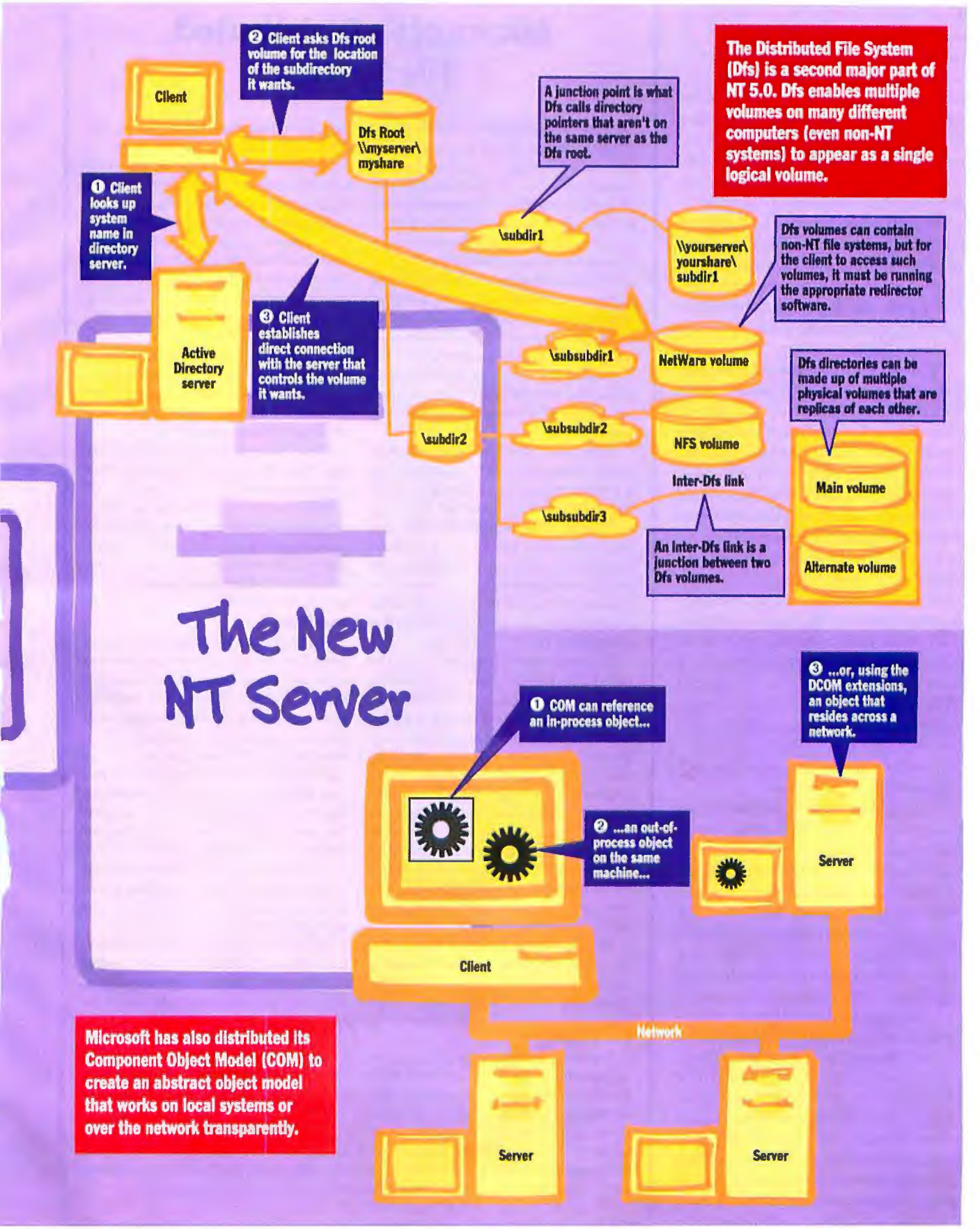
continued

The New NT

- Active Directory
- Distributed File System
- Distributed Component Object Model

Active Directory is at the root of many new features in NT 5.0. It combines DNS- and LDAP-style directory information to create a hierarchical, scalable directory system.




The Distributed File System (Dfs) is a second major part of NT 5.0. Dfs enables multiple volumes on many different computers (even non-NT systems) to appear as a single logical volume.
Client
❷ Client asks Dfs root volume for the location of the subdirectory it wants.
Dfs Root \\myserver\ myshare
A junction point is what Dfs calls directory pointers that aren't on the same server as the Dfs root.
❶ Client looks up system name in directory server.
\subdir1
\\yourserver\ yourshare\ subdir1
Dfs volumes can contain non-NT file systems, but for the client to access such volumes, it must be running the appropriate redirector software.
Active Directory server
❸ Client establishes direct connection with the server that controls the volume it wants.
\subsubdir1
NetWare volume
Dfs directories can be made up of multiple physical volumes that are replicas of each other.
\subdir2
\subsubdir2
NFS volume
Inter-Dfs link
Main volume
\subsubdir3
An Inter-Dfs link is a junction between two Dfs volumes.
Alternate volume
The New NT Server
❸ ...or, using the DCOM extensions, an object that resides across a network.
❶ COM can reference an in-process object...
❷ ...an out-of-process object on the same machine...
Server
Client
Network
Microsoft has also distributed its Component Object Model (COM) to create an abstract object model that works on local systems or over the network transparently.
Server
Server

Enter X.500, a hierarchical, replicated directory system that allows locating everything from systems to services. Despite years of availability, however, X.500 has not been widely used, largely because it's extremely complex. That's where LDAP comes in. A simplified version of X.500's DAP, LDAP has received promises of support from several directory vendors, leading to the possibility of a common way to access diverse directories.

Active Directory builds on both DNS and LDAP. It groups machines into administrative units called domains, each of which gets a DNS domain name, such as acme.com. Each domain must have at least one domain controller, which is an NT machine running the Active Directory server.

While an Active Directory domain controller must run on an NT server, any client with DNS and LDAP software can potentially access that controller's directory database. DNS is, and LDAP will soon be, a widely deployed industry standard. Thus, Unix, Mac, and OS/2 clients should be able to access an Active Directory server in the same way as Windows and NT clients (see the figure "How Active Directory Works" on page 69).

Furthermore, the Active Directory database can store all kinds of information, which means that you can use it as a general-purpose directory service for a heterogeneous network. For example, it allows storing and retrieving of the information needed to contact a service running on a Unix server in the network. For Microsoft to take an ecumenical approach to a key technology is surprising.

For improved fault tolerance and performance, a domain can have more than one domain controller, with each holding a complete copy of that domain's directory database. Active Directory implements multimaster replication, which means that an entry can be changed in any domain controller's replica of the database and that change will eventually propagate to all other replicas in the domain.

To accomplish this replication, Microsoft created a protocol to communicate between domain controllers. Active Directory also supports the X.500-defined Directory Information Shadowing Protocol (DISP) for interoperable replication with the outside world, but it's not clear how useful this will be. Achieving effective replication relies on both a common protocol and a common view of what is being replicated (i.e., on a common

Microsoft's Distributed File System

As the company seems so fond of doing, Microsoft has recently given a new name to an old technology. The SMB-based file access protocol used in Windows, Windows NT, and LAN Manager has been rechristened as the Common Internet File System (CIFS), and Microsoft is now actively encouraging other vendors to adopt this protocol.

NT's new Distributed File System (whose acronym is conventionally written as Dfs) is little more than an extension to CIFS. Unlike Active Directory and Microsoft's Kerberos, neither of which will be available until NT 5.0 is released, Dfs is available now. Posted on Microsoft's Web site in late 1996, it is freely available for NT 4.0 servers and Windows 95 clients.

In Microsoft's traditional approach to remote file access, a client can access files in a specific share (i.e., a remote directory hosted by a particular file server). To identify a remote file, the client usea a Universal Naming Convention (UNC) name such as \\myserver\myshare\subdir1\subdir2\myfile.txt. The client must know the machine name (myserver in this example), the share name (myshare), and the path name within that share (subdir1\subdir2\myfile.txt).

Dfs doesn't fundamentally change this basic model. Clients still supply UNC names to identify remote files, and an SMB-based protocol still accesses those files. A key difference, however, is that you can group shares on multiple machines into a single volume. To clients, everything in this volume appears to be in a single share. In our example, \\myserver\myshare\subdir1 might now identify a path on Dfs server A, while the rest of the name, \subdir2\myfile.txt, might be on Dfs server B. The name myserver identifies the root of the volume, called the Dfs root, while everything else in the name serves to identify a particular file in that volume.

The connection between the two Dfs servers is called a junction, and navigating across this chasm is a primary task of Dfs. To see how this is done, it's useful to walk through how the UNC name above is resolved by Dfs.

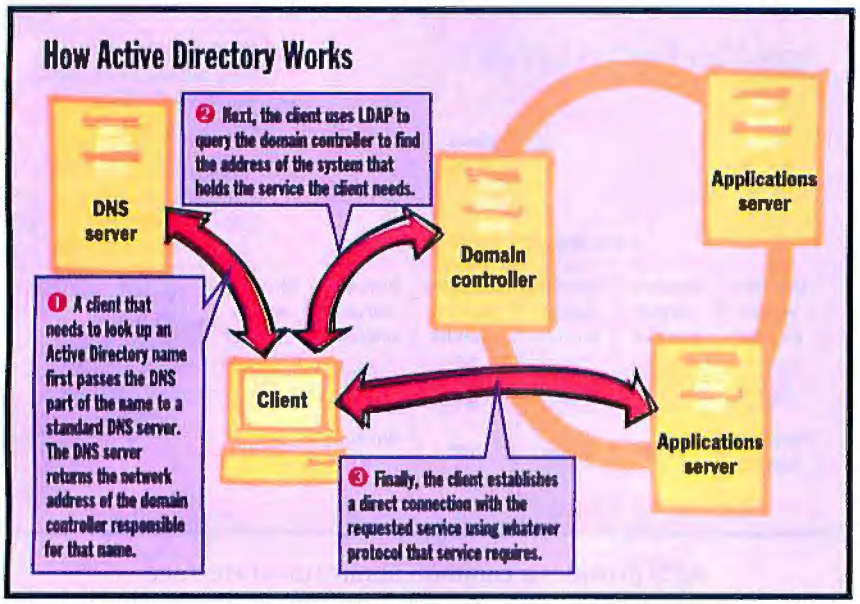
The first problem is to find the machine that contains the Dfs root for this volume. To do this, the client machine's Dfs redirector (i.e., the Dfs client software) looks up the UNC name's first element using the Windows Internet Naming Service (WINS). Although it's not shown here, UNC names can also start with names such as mymachine.acme.com, in which case the Domain Naming System (DNS) is used to look up the name.

However it's done, the lookup returns the network address of the machine that contains the Dfs root for this volume. The Dfs redirector contacts this root, passing in the UNC name supplied by the client application. If the name identifies a file in a part of the volume hosted on another Dfs server, the root server returns a referral to the client's redirector, telling it to contact that machine. The redirector then goes directly to that machine to access the file. The Dfs protocol used to do all this is just the traditional Microsoft file access protocol, now known as CIFS, with a small extension. Dfs adds two messages to support the referral process just described.

For NT (but not Win 95) clients, Dfs can also return referrals to file servers accessed using other protocols, such as Novell's NCP or NFS, the ubiquitous file-sharing protocol in the Unix world. As long as the client has the appropriate redirector software, it can transparently access files whose UNC names traverse different distributed file services, combining diverse servers into a single namespace.

Dfs also adds a few other interesting features. It's possible, for instance, to create replicas of the same information and store them on different Dfs servers. A client can access either one, improving fault tolerance. To a client application, this replication is invisible—the client still sees just one name for each replicated file. When the referral process occurs, however, the Dfs server holding the volume's root passes references to the replicated Dfs servers back to the client redirector. The redirector arbitrarily chooses which one to access. If the server chosen by the redirector goes down, it can silently begin accessing the other one. The client application won't know the difference.

For this to work, the data in the replicas must remain identical. Dfs has no built-in mechanism to maintain consistency among replicas, which makes replication useful primarily for read-only information. The version of Dfs scheduled to ship with NT 5.0, however, will provide a way to do this, making replication a more useful feature. This forthcoming technology will also use Active Directory to provide root-level fault tolerance, allowing multiple replicated Dfs roots for a single volume, and to give redirectors more information about the location of replicas, allowing them to choose the closest one.



Active Directory clients use standard DNS and LDAP protocols to locate objects on the network.

schema for the directory databases involved). Several largely independent efforts are in progress to define how those schemas should look. However, until this issue is resolved, standard replication protocols are of limited value.

For Microsoft, creating a proprietary replication protocol for use among domain controllers lets Active Directory be more flexible than it could have been relying solely on DISP. For example, Active Directory allows replication to occur using remote procedure calls (RPCs) over LANs, but it also allows domain controllers to exchange replication information using e-mail over links with slow or sporadic connections (users trying to build NT-based networks in countries with unreliable telephone systems will appreciate this second option).

For well-connected servers, such as those located in the same physical site, replication exchanges generally take place every 5 minutes. For servers that aren't so well connected, such as those that are connected by a slow WAN, you can configure the replication interval as needed. Also, whatever the interval, only the specific information that has been changed is copied—there's no need to copy the entire directory database.

Finally, Microsoft provides no shortage of different APIs for Active Directory clients. The preferred choice is the Active Directory Service Interface (ADSI), a generic COM-based interface usable with Active Directory, NDS, and other directory services. Other options include Microsoft's MAPI, LDAP's C API, and OLE Database, another COM-based interface that allows access to all kinds of data, whether it's stored in a relational database, an ordinary file, or even, as in this case, a directory service. Software developers are free to pick the one that best meets their needs.

Active Directory's most visible competitor is unquestionably NDS. Based on X.500, NDS is a powerful, flexible, and reasonably complex technology. Because it was developed several years ago, it's perhaps not quite as well integrated as it might be with DNS and LDAP, today's key directory standards. Still, NDS has legions of loyal fans, and it has been an effective selling point for Novell in marketing NetWare 4. It will be hard to argue that Active Directory is technically superior to NDS, so expect Microsoft to promote Active Directory's relative simplicity and conformance with standards in the company's attempt to counter what has been one of NetWare's greatest strengths.

Distributed Objects

Besides finding systems and people, Active Directory contains a class store that acts as a distributed version of the Windows Registry: Applications can use Active Directory to find the code for objects anywhere on a network. That capability implies that you can write applications that can exist on systems other than those from which they were called. Beginning with NT 4.0, Microsoft extended COM to work over networks, calling the result DCOM.

COM defines a standard way for one piece of software to provide services to another, regardless of what language

Supporting Multiple Security Protocols

Different security protocols can have very different APIs. These differences can create real problems for applications that might want to use more than one of them. Microsoft's solution to this problem for both Windows 95 and Windows NT is the Security Service Provider Interface (SSPI). SSPI is a not completely compatible version of the IETF-standard (Internet Engineering Task Force) Generic Security Services API (GSSAPI). Like GSSAPI, Microsoft's SSPI provides a standard way to access distributed security services regardless of what they happen to be.

Components called Security Service Providers (SSPs) implement security protocols. In NT 4.0, Microsoft includes SSPs for NT LAN Manager (NTLM) and Secure Sockets Layer (SSL)/Private Communications Technology (PCT). In NT 5.0, this list expands to include Kerberos and an enhanced version of the SSL/PCT provider. Also, because the interfaces required to implement an SSP are public, other vendors are free to implement their own if desired.

The users of SSPI are protocols. Among those that sit on top of this interface are HTTP, LDAP, the SMB-based extended Common Internet File System (CIFS) protocol used by Microsoft's Distributed File System (Dfs), and Microsoft remote procedure call (RPC). (Distributed Component Object Model [DCOM] exposes a separate security API built on top of the Microsoft RPC run time.) Any of these protocols can use any of the SSPs, letting each one make the most appropriate choice. By cleanly separating the users of distributed security services from their providers, this architecture allows supporting many options without creating unusable complexity.

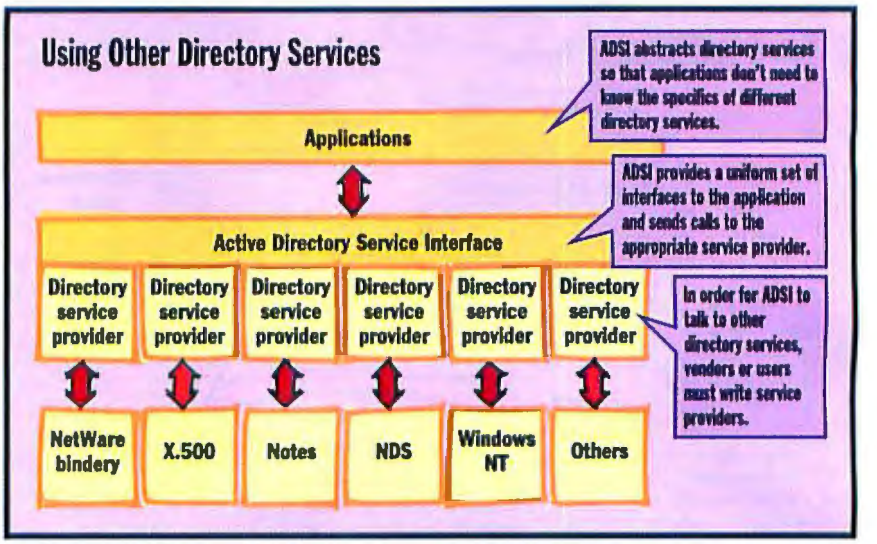
either is written in. A COM object lets a client access its methods through interfaces, each of which contains one or more methods. Client software using this object can acquire individual pointers to each interface and invoke that interface's methods.

COM itself lets a client remain unaware of whether the object it's using is implemented in a dynamically linked library or in another process on the same machine. DCOM extends that simplicity to COM objects running on other machines. When a client invokes a method on a remote object, DCOM locates the object on the network and issues an RPC to the destination system. The remote object's location can be supplied by the client, stored in the client's registry, or, in NT 5.0, looked up using Active Directory. Both the client and the remote object can behave just as in the local case. In fact, you can use the same code in both situations.

DCOM relies on Microsoft's implementation of the Remote Procedure Call protocol defined by the Open Group's Distributed Computing Environment (DCE). Renamed as Microsoft RPC, it has become commonly used in Windows and NT applications (although DCE itself is not especially popular). And because it ships with every copy of those OSes, it is almost certainly the most widely available RPC protocol today. Microsoft refers to the DCOM variation as Object RPC (ORPC), but the packets on the wire conform almost exactly to the original DCE specs.

Another plus for DCOM is integration with the Microsoft Transaction Server. MTS applications must be written as COM objects. For now, at least, direct remote access to those objects is possible only via DCOM. Because MTS applications must be COM objects (Microsoft calls them ActiveX components), independent software vendors (ISVs) can create applications that conform to the MTS standards and let users combine them to build complete solutions. The result of this is likely to be a server-side component market that's analogous to the market for ActiveX client-side components that exists today. No other transaction server has been able to do this, although several vendors, including IBM and Oracle, are about to make the attempt.

DCOM has been shipping since mid-1996 as a standard part of NT 4.0. A version for Windows 95 was released in January, and versions for other OSes are on the way. Software AG is the primary source for them. The company expects to release DCOM for Solaris, HP-UX, Linux, MVS, and several other OSes by the end of the year. Once this happens, DCOM will no longer be of interest solely to the Windows/NT community. (For more information on DCOM, see the Special Report in the April BYTE.)



ADSI provides a common application interface to many directory services.

However, DCE RPC (aka DCOM's ORPC) isn't the only multivendor standard protocol for invoking remote methods. As part of the Common Object Request Broker Architecture (CORBA), the Object Management Group (OMG) has defined an alternative called IIOP. IIOP is a little more than an RPC protocol—it also provides a redirection facility to let clients learn about objects that have moved—but it addresses the same basic problem as DCOM's ORPC. (OMG considered adopting DCE RPC as its required protocol, but after a bitter fight, it chose instead to create IIOP.)

According to Andrew Watson, who is OMG's architecture director, "OMG's CORBA and the rest of the Object Management Architecture (OMA) are supported by more vendors and implemented on more platforms than any other middleware design, DCOM/ActiveX included. OMG specifications have always been publicly available and were designed from the start to be platform-neutral, programming-language-neutral, and to support distribution, rather than having these features added piecemeal."

While diversity in directory and security services can be painful, diversity in RPC protocols isn't as bad. IIOP is sure to get some use. Netscape has adopted IIOP as its standard protocol for invoking remote methods and will ship it with every copy of Navigator. But the anti-Microsoft forces aren't united behind a single competitor to DCOM's ORPC. For communication between Java objects, Sun is shipping as part of the Java environment an alternative protocol known as Remote Method Invocation (RMI).

Which of these will get the most use remains to be seen, but Microsoft is the most likely beneficiary of the competition between them. Also, the company's ability to include its protocol in two hugely popular OSes confers some advantage. Microsoft joined with a multivendor standard—DCE RPC—is a powerful force, even when pitted against another multivendor standard.

Security Services

A directory service lets you find what you need, and a communications protocol lets you interact with it. However, not everybody should be able to find or interact with everything in the network. Controlling access is the job of distributed security services, and NT 5.0 brings new tools here, as well.

Effective distributed security has several aspects. First, and probably most important, it needs an authentication mechanism, allowing, say, a client to prove its identity to a server. Next, the client supplies authorization information that the

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server uses to determine what access rights that client has. It also needs data integrity. A cryptographic checksum included with all transmitted data lets the receiver of that data detect any changes made by attackers while it was in transit. For true paranoids (and those with CPU cycles to burn), data privacy can be accomplished by encrypting all transmitted data.

As with directory protocols, Microsoft has chosen to adopt the leading industry standards for distributed security rather than pursue a proprietary path. NT has supported the Secure Sockets Layer (SSL) for some time (along with its "enhanced" SSL, called Private Communications Technology, or PCT). However, the infrastructure required for public-key-based security such as SSL isn't completely in place. Furthermore, public-key encryption can be slow for some kinds of applications.

For those reasons, within the local NT world today, the primary protocol used for distributed security is NT LAN Manager (NTLM). NTLM is a reasonable security protocol for a single domain, providing authentication, data integrity, and data privacy. It's not perfect, however, nor is it popular outside the Microsoft environment.

Instead of enhancing and promoting its existing protocol, Microsoft is about to relegate NTLM to legacy status. As part of NT 5.0, Microsoft will begin shipping an implementation of MIT's Kerberos. Kerberos provides authentication, data integrity, and data privacy, but it also offers features that aren't in NTLM. For example, in NTLM, only clients can prove their identity to servers, which means that clients must trust that servers are whom they claim to be. Kerberos, on the other hand, offers mutual authentication, letting both parties verify the identity of the other.

Microsoft's Kerberos is a standard implementation of Kerberos Version 5. Each domain has its own Kerberos server, which in Microsoft's implementation shares the database used by Active Directory. Consequently, the Kerberos server must execute on the domain-controller machine, and like Active Directory servers, it can be replicated within a domain.

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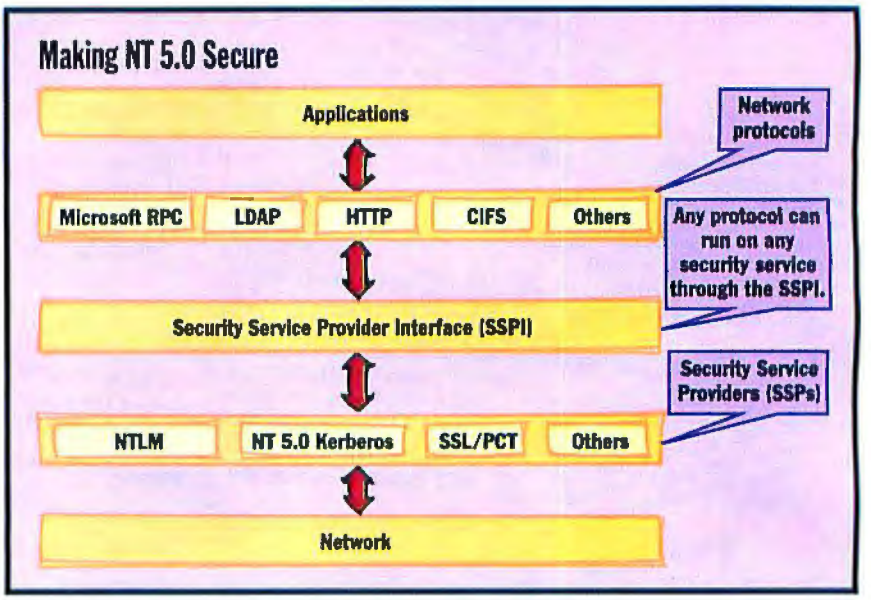

Windows NT 5.0 provides a unified API for programming to different security services.

Every user who wishes to securely access remote services must log in to a Kerberos server. A successful log-in returns a ticket-granting ticket (TGT) to the user, which can then be handed back to the Kerberos server to request tickets to specific applications servers.

If the Kerberos server determines that a user is presenting a valid TGT, it returns the requested ticket to the user, with no questions asked. The user sends this ticket to the remote applications server, which can examine it to verify the user's identity (i.e., to authenticate the user). All these tickets are encrypted in various ways, and various keys are used to perform that encryption. Providing distributed security is not a simple thing. Thus, Kerberos is reasonably complicated.

Microsoft choosing to promote nothing but standard security protocols seems almost too good to be true—and, unfortunately, it is. Even though Microsoft will implement the standard Kerberos 5 protocol, that protocol does not define exactly what should be sent to identify the client. Different implementations of Kerberos send different authorization information. Not surprisingly, the Microsoft version will send NT-specific security identifiers. This means that full interoperability with other Kerberos implementations will be problematic. It's hard to see what a better path might be, however, because there is no widely accepted multivendor standard to follow in this area.

NT Everywhere?

There are two main conclusions that users can draw from the forthcoming enhancements to NT. First, Microsoft is doing its level best to make NT function effectively in a distributed environment. Although we'll need to wait for the code to ship to see how well it has succeeded, adding serious directory and security services will fix a long-standing concern with the OS. Second, by choosing to implement standard protocols for distributed services, Microsoft is trying to let NT fit well into a multivendor environment, one that includes Unix, Macs, and even mainframes.

The scene isn't perfect. Problems with directory replication, Kerberos authorization information, and perhaps other yet undiscovered areas still exist. Nevertheless, by buying almost completely into multivendor middleware standards, Microsoft has made clear what the future will look like in this long-contested area. No other company has the power to create a proprietary middleware solution with even a chance of becoming a widely used standard. Somewhat surprisingly, Microsoft has chosen not to do this. By embracing standards, Microsoft has guaranteed their adoption. B

David Chappell is principal of Chappell & Associates, an education and consulting firm in Minneapolis, Minnesota. You can reach him at **david@chappellassoc.com**.

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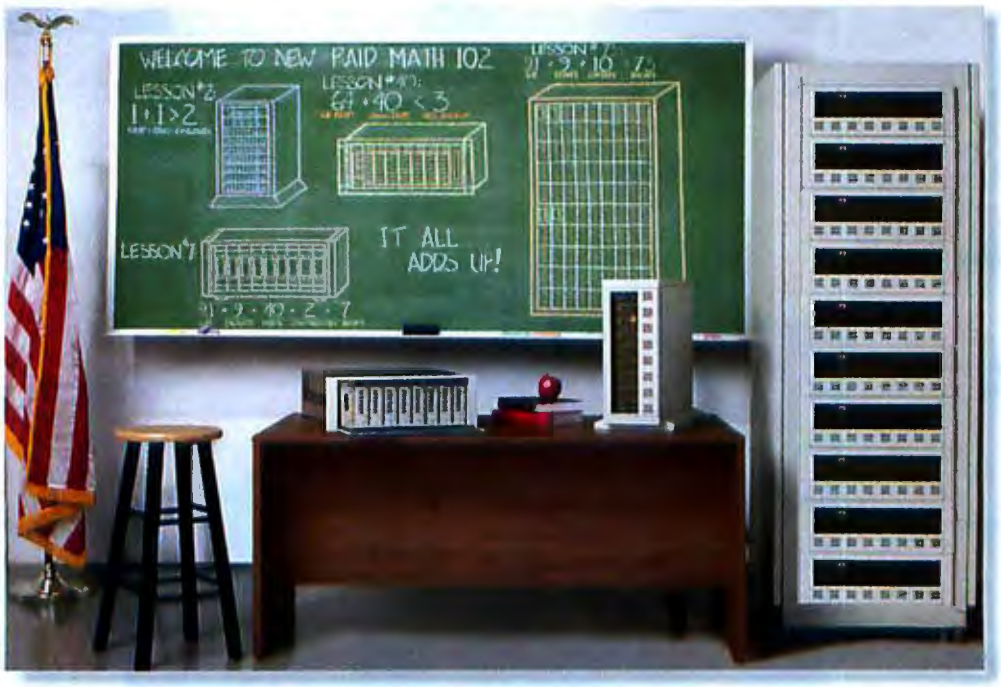

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A Blueprint for Managing Documents

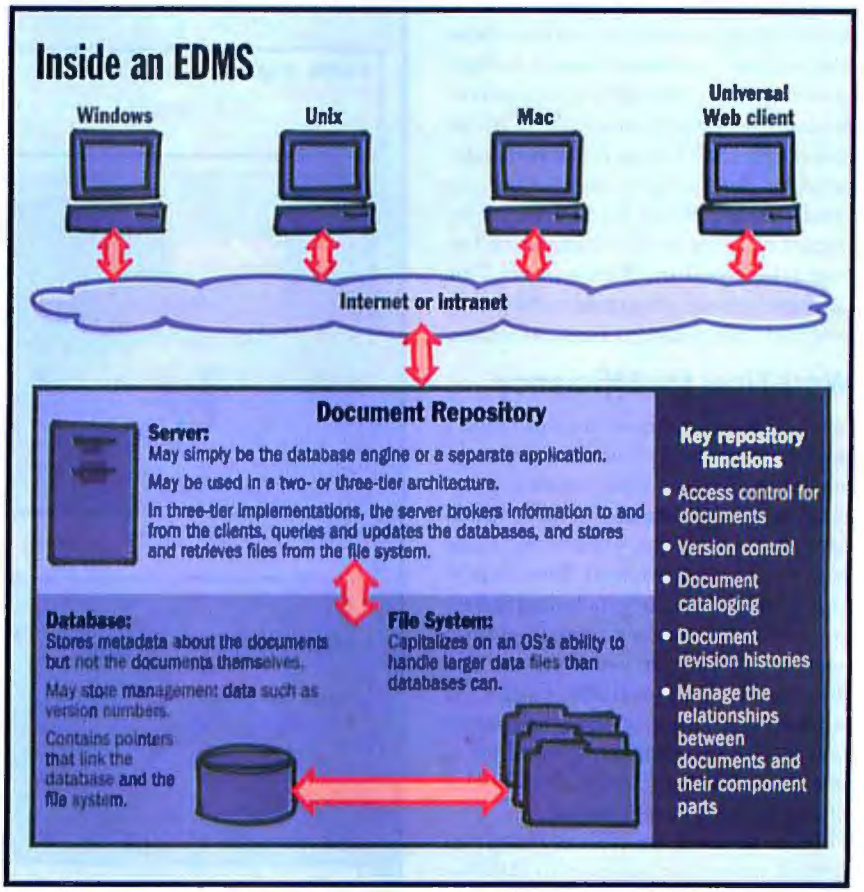
A good Electronic Document Management System can bring together document storage, work flow, and indexing. By James Boyle

In many Fortune 1000 companies, intranet development is moving from the skunk works to mission-critical operations. This breakneck pace comes because intranets quickly publish corporate information for delivery to users via low-cost and easy-to-use Web technology.

Unfortunately, the ease and speed of intranet publishing also create serious problems. Users become overwhelmed with the quantity of information when they can't find the data they need. Webmasters promise that intranet information is current, accurate, and complete, but they then must scramble to fulfill this dream. The result: Companies often base important business decisions on bad data.

How do you take control of corporate information in a Web world? For a growing number of corporations, the answer is an Electronic Document Management System (EDMS). An EDMS is not a single entity but a collection of complementary technologies. The three most crucial ones are the repository (see "Inside an EDMS" opposite), the work-flow engine, and the searching-and-indexing technology.

Every company that needs an EDMS doesn't necessarily need all three of the components. The flexibility and power of EDMSes are both a strength and a challenge. To implement the right system for your company, you need to know how EDMSes work and which document management features match your business needs and processes. Here's some help in making those decisions.



Repository: The Core Component

The document repository, the soul of an EDMS, stores, controls, and manages documents. Key repository functions include library services (e.g., controlling access to individual documents, document cataloging, check-in/check-out, and searching for and retrieving documents). Another key function is version control, including a history of all instances of a document as it changes over time.

Repositories also provide configuration management, control over the relationships between documents and their component parts (e.g., a manual and its chapters). This is critical to treating documents as true containers. It's an area where many repositories come up short. Each vendor's tools implement these technologies in slightly different ways, but the concepts are consistent.

The architecture an EDMS vendor uses determines if the repository is simply a database engine or a completely separate application. Each vendor designs its EDMS as either a two- or three-tier system, so your architecture choice is part of the decision you make when you select a vendor. You choose by analyzing the same tradeoffs as with any client/server system: cost versus performance and scalability. In a two-tier architecture (i.e., the database), the client performs more work than in a three-tier environment, where the server is the workhorse.

The database stores all the information about the documents but generally not the documents. The database contains a file

pointer—the link tying the database and the file system together. The server application controls the file pointer (see the figure "Using Metadata" on page 78). The document information—referred to as metadata or attributes—typically includes date, author, and title. The database may also store other attributes that the user does not directly provide. Examples include version numbers, or in the case of a document set, pointers that indicate which chapters belong to a particular manual.

Many desktop applications are OLE- or OpenDoc-compliant, which enables them to link content objects from one application to another without requiring you to do any cutting and pasting. EDMSes generally can recognize OLE documents and are intelligent enough to maintain these files and links as relationships in a document repository. Repositories let you create container objects and use the EDMS to link the pieces. How well this works depends on the tools you use to create, assemble, and publish the content. Also important is the level of integration between these tools and the repository. This is where a more integrated publishing-oriented system such as Interleaf shines.

Work Flow for Efficiency

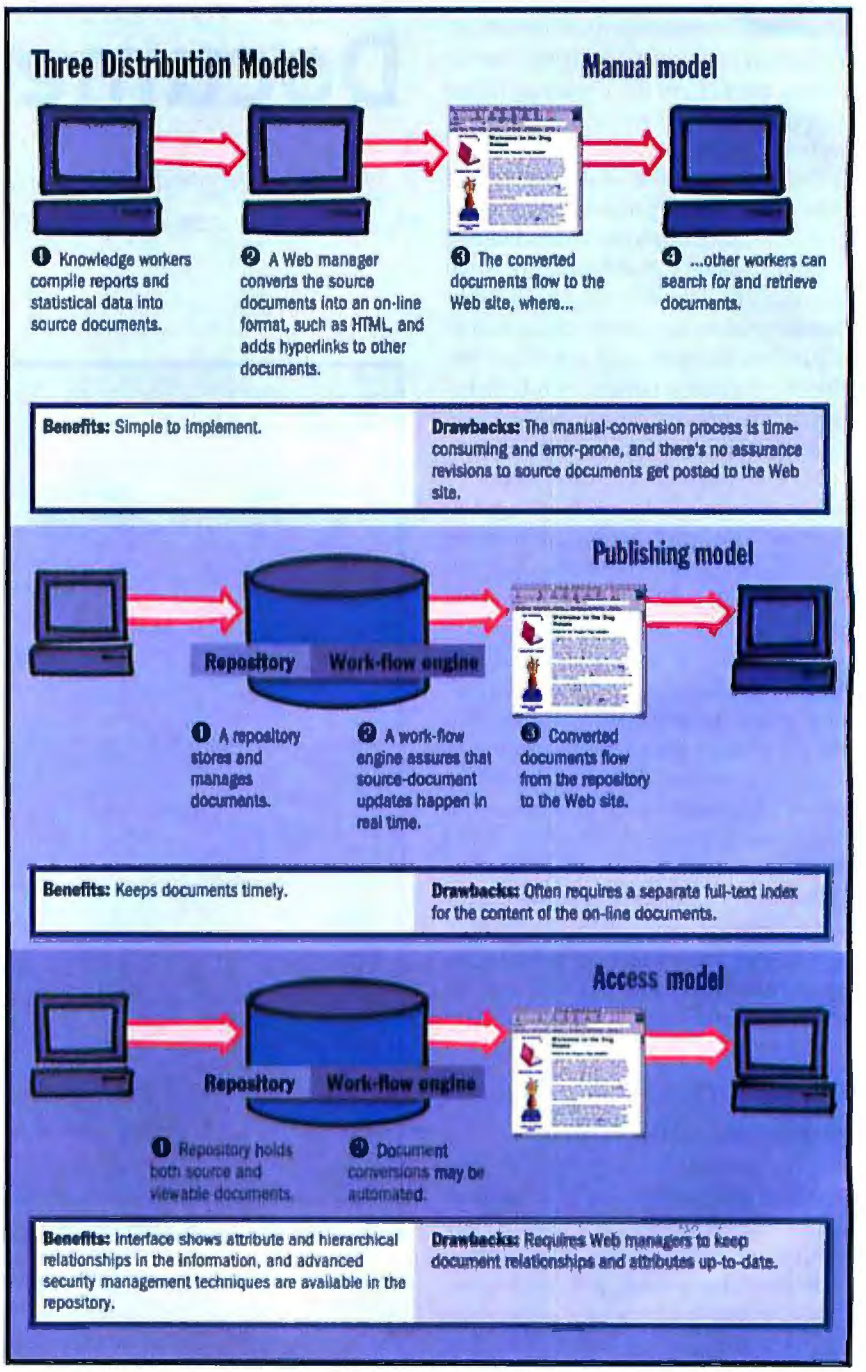
Work flow can eliminate any dead time a document spends in transit between workers. It can also let people review a document in parallel instead of serially, which saves time in the sign-off process. Coupled with a repository, work flow can provide a full audit history, including review comments. Work-flow systems might also notify workers when a new version of a document becomes available. Finally, the work-flow engine may drive the conversion process for documents you create in one format but distribute, via the Web, for example, in a different format.

Work-flow engines typically have two critical integration points in an EDMS—the repository and the e-mail system. Repositories that include work flow are Open Text and NovaSoft. Saros and PC Docs rely on third parties, such as FileNet or Action Technologies. In either case, the work-flow system must interact through APIs with the repository, because the work-flow system must have access to the documents and their security, attributes, and other information.

Most routing messages from a work-flow system go to a proprietary inbox. While they're fine for people who deal with document production (e.g., technical writers, graphic artists, and marketing departments), proprietary inboxes are inadequate for office workers who may already be burdened by assignments from multiple sources. Asking them to check yet another inbox is unacceptable. Instead, the system should route document-related messages to the e-mail system. However, it is important to note that the document is not attached to the message. For a repository to maintain data integrity, it cannot release documents to an uncontrolled system such as e-mail.

Finding Essential Data

An EDMS can provide more focused, and consequently, more efficient searches than standard full-text technologies by confining searches to specific attributes. Thus, instead of showing you all the documents that contain the words *engine* and *repair*, the system can search for those words in all documents of the type "Procedure" that were approved in the last year. The



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search returns a handful of entries rather than a list with hundreds of document names.

Repositories can add documents to a full-text index as they are checked in or via a batch job in off-hours to keep the index updated. The search interface executes attribute searches against a relational DBMS (RDBMS) and a word search against the full-text index. The system joins the two results to provide a granular approach to finding needles in haystacks.

EDMS vendors are combining this powerful search capability with Web interfaces to reduce search-engine maintenance from two (EDMS and Web site) to one. Two common EDMS search engines are those from Fulcrum and Verity. The full-text engines found on the Web, such as Open Text, Excite, and AltaVista, are also starting to appear in EDMSes.

Pull It Together

Armed with a basic understanding of the core EDMS technologies, let's look at putting together an infrastructure to manage a Web site. The biggest challenge lies in bridging the gap between creators of materials and consumers of information.

Three architectures address this challenge: manual, publishing, and access (see the figure "Three Distribution Models" on page 76). The manual model—the one used in most Web sites—provides a way to create documents, convert them to an on-line format such as HTML, and publish them to the Web site. The Webmaster receives any new content and converts these documents to the correct format. He or she then posts the documents to the Web site and adds hyperlinks to and from the documents.

Unfortunately, the manual process is error-prone and time-consuming. There is also no tracking or other type of document control, because no repository exists in this model. Information consumers must rely on the Webmaster to know that a source document changed and ensure that it is converted and placed on-line. This process is informal, and with a site set of any size, it usually breaks down.

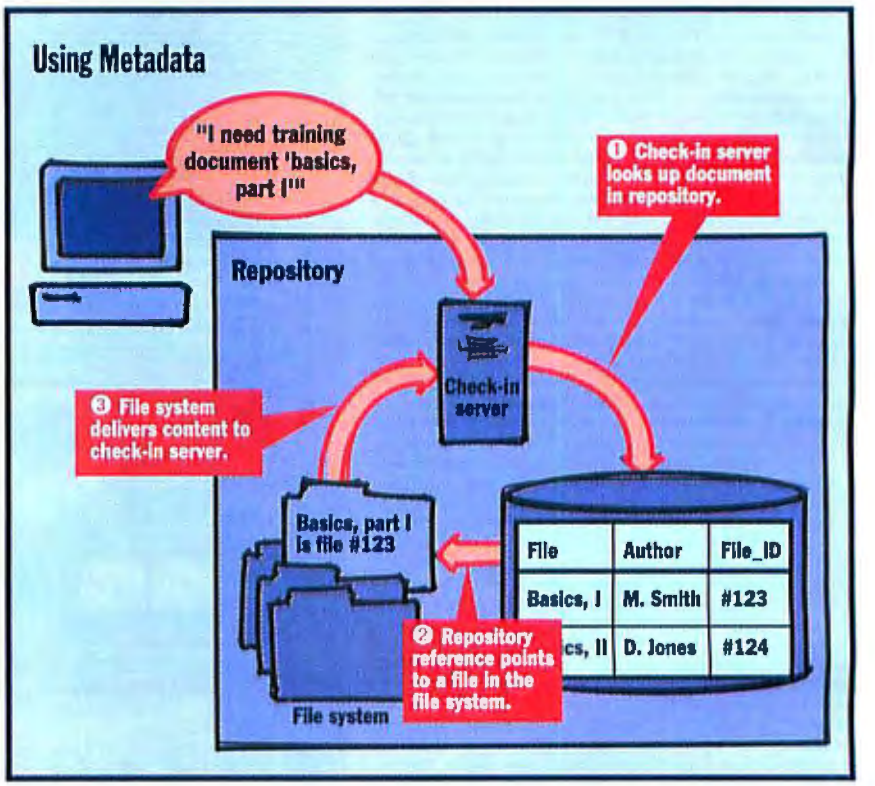
In the second approach—the publishing model—a repository stores, manages, and controls documents. The publishing step in the process extracts documents from the repository and puts them on the Web site. This is a batch process, and often the work-flow engine drives the publishing step, so updates happen in real time.

The problem with this approach is that information consumers can't use all the power of the repository, including attribute searches or security. In the publishing model, you often must build another full-text index using the content of the on-line documents. This results in a duplication of effort, and because the on-line documents are detached from the repository, the attributes are not available for searching. Nevertheless, this model can give you a high degree of confidence that the intranet information is current.

In the access model, all documents—native and viewable—are stored in the repository. The conversion process may be automated, depending on the tools you select. Many repository vendors have added a component to the repository that allows Web-based viewing access to the documents. From a user's perspective, the browser seems to be looking at the Web, but it is looking into a repository.

This new approach offers some advantages. Users can easily drill down to find the information they need, because the interface shows attribute and hierarchical relationships in the information. The complete search capability of the repository is usually available in this model, as are security schemes to control who can access secure documents.

By connecting an interface to the repository for viewing, the system lets you create much of the navigation layer on the fly, using the information a document knows about itself. In this way, there is significantly less work in on-line publishing, but it requires that relationships and attributes be kept up-to-date. However, there is only one place to keep the information current.



Technical Considerations

You must consider three main technical issues before committing to an EDMS: Choosing the right computing platform, dealing with network throughput, and designing the database.

Platform issues encompass both client and server decisions. If you have a multiplatform environment, find out how close the EDMS you're considering is to a unified code base. Don't just ask the vendor. Look at past release schedules across the platforms that matter to you to see how close product introductions for secondary platforms followed the primary platform. With a unified code base, there should be only weeks between platform shipments. However, with nonunified code bases, releases might trail each other by months, and even then, all versions may not include the same features.

Until recently, most repository servers

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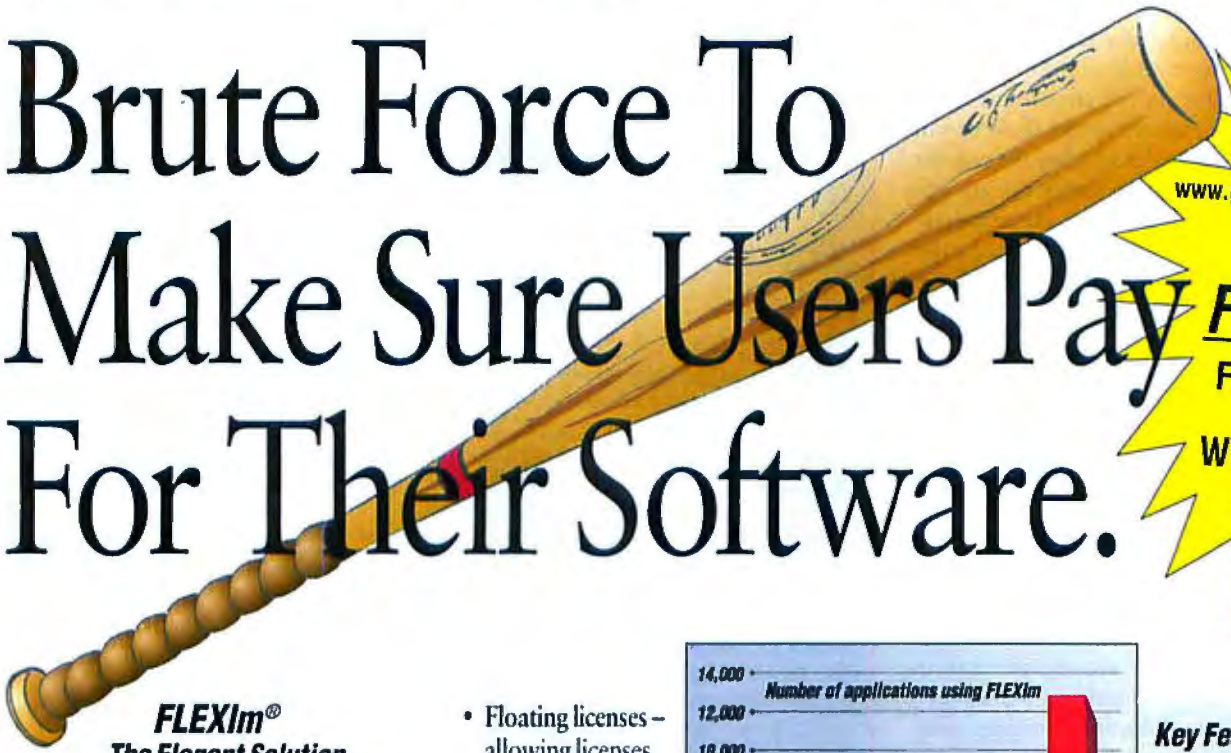

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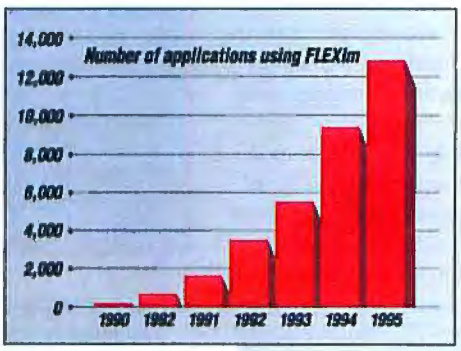

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ran only on Unix, because it offered the necessary processing power and security guarantees. Now, the availability of Windows NT means that repositories don't have to be confined to Unix to retain the necessary features for an EDMS system. However, before you choose an NT release that repository vendors have or will soon ship, consider whether the systems can scale enough to match the growth demands you expect for your organization. Find out if the server application takes advantage of symmetric multiprocessing (SMP) machines.

Repository databases can be relational or object-oriented. Today, most systems use the RDBMS because of its stability and performance. However, object-oriented DBMSes might replace them in the coming years. Most EDMS vendors support one or more of the following: Oracle, Sybase, Informix, and SQL Server.

Choosing a Solution

A number of tools claim to help manage your Web site. You can categorize them in these groups: site managers, Web servers, and compound-document management tools.

Site managers help Webmasters monitor a site. They check links, locate orphaned files, and summarize usage. These products also provide a graphical representation of the site. Some even provide authoring tools. Tools in this category include Adobe SiteMill, AOL Press, and Microsoft FrontPage.

Web servers are continually adding more features for document management. However, the most sophisticated management capability you'll get out of today's Web server is a basic check-in/check-out function. This capability is weak on security and can't handle multiple versions of documents, but for a small HTML-only document set, this alternative is helpful. However, organizations that need to manage native documents, work flow, or the relationships in a compound document should consider a full document management tool.

The most promising content management tools come from the traditional compound-document vendors, such as Documentum, Interleaf, Open Text, PC Docs, and Saros. Over the past 18 months, all these companies have revamped their tools to let them run over the Web. In so doing, they have shifted from the publishing model to the access model.

Where the Web site is both the means and the end, there may be another approach. Documentum designed RightSite to manage the content of Web sites. It can automatically move an entire site into a repository. The repository is then configured to add attributes, security, work flow, and searching capabilities.

Once the system is configured, you can rework static pages to contain queries and bring these pages to life. The user would never see the EDMS, but suddenly everything is current, and users see information relevant to them. Most interesting, RightSite can manage hyperlinks by treating them as another information type.

As intranets grow and mature this year, many organizations will be looking for ways to reduce the expense of managing these mission-critical document sets. Adding another Webmaster to the IS payroll certainly isn't the best answer. Document management can clean up after and help IS organizations cope with the largest revolution in corporate computing, the intranet. B

James Boyle is manager of electronic document solutions at RWD Technologies, a systems-integration and consulting company in Columbia, Maryland. You can contact him at **jboyle@rwd.com.**

Standards Will Shape the EDMS Future

As with any emerging industry, standards are vital to the successful growth of the market. Standards important to Electronic Document Management Systems (EDMSes) fall into two categories: interoperability and content-format standards.

Interoperability

ODMA: Open Document Management API is a set of interfaces between desktop applications (e.g., Microsoft Word) and document management clients, allowing access to a repository without running another application.

DMA: The Document Management Alliance is working toward a set of interfaces between document management servers, so users can access all repositories in an organization, regardless of the vendor who supplied them.

WfMC: The Workflow Management Coalition is a multipart specification including a common reference model and communications standards between work-flow engines, repositories, and mail systems driving toward the concept of the universal inbox.

Content Format

SGML: Standard Generalized Markup Language is an ISO standard for creating platform- and application-independent documents. In SGML, a document is divided into three parts, the Document Type Definition or structure, the content, and the formatting. SGML enables "intelligent" documents—ones that know of themselves by structure and attributes. It also simplifies information exchange between organizations.

HTML: Hypertext Markup Language is a subset of SGML, but it has evolved into a standard of its own. It is the standard format for Web documents.

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Cheaper Computing, Part 2: PCs Strike Back

Microsoft and Intel are defending their turf against NCs with Zero Administration and NetPC.

By Mike Hurwicz

It's war. Network computers (NCs) threaten to overrun the PC world with low-cost, capable machines that don't need Microsoft Windows or Intel processors. Microsoft and Intel are launching a counterattack. Their weapons include new technologies to simplify and reduce the costs of PC ownership. Plus, they are adopting some of the attractive features of NCs, such as Java functionality.

The network computer could reduce the total cost of ownership (TCO) for computer systems. That's important, as we discussed in last month's cover story. NCs could also liberate organizations from the Microsoft Windows/Intel stranglehold on personal computing. Although NCs probably won't replace many Windows PCs, Microsoft began a two-prong campaign last October to match the NC's TCO benefits. One prong is the NetPC Reference Platform, a specification for a new Wintel PC. The other prong is Zero Administration for Windows (ZAW), an initiative promoting centralized, automated management for desktops. Microsoft will build ZAW capabilities into Windows NT and, to a lesser extent, into Windows 95.

The biggest cost associated with owning personal computers is support time (see the figure "Real PC Costs" on page 82). Users tend to create problems by inadvertently deleting their system files or changing configuration settings, requiring tech support, or the nearest geek, to spend time fixing the problem. The NetPC minimizes opportunities for users to go in and modify their system configurations in the following ways:

- No end-user expansion slots
- Lockable case
- Local hard disk only for caching; users' ability to install or modify programs is limited by network security.
- Might not have local floppy or CD drive; software installation or upgrades take place at the server.

Because users can't change the hardware or software configuration, IT staff can ensure that all versions of operating systems, DLLs, and applications software are identical. In fact, the same exact shared files can go to each NetPC when the machine boots. If that level of homogeneity is not desirable, IT staff can easily keep track of whatever differences there are, since they make the changes themselves. Increased homogeneity and predictability make computers easier—and cheaper—to troubleshoot, upgrade, maintain, and swap.

The "System Requirements for NetPC" table (page 84) lists the recommendations that Microsoft set forth last October. Most of the features simply describe a minimal desktop machine for running Windows NT or Windows 95. Still, there will be a range of NetPCs. The low-end machines will have 100-MHz Pentium processors and 16 MB of RAM. High-end machines will have the fastest Pentium Pro processors available at the time and 64 MB or more of RAM. So when the spec says *minimum*, take it seriously. Don't assume that a NetPC has to be feeble.

The NetPC BIOS will support Plug and Play, allowing automatic device configuration. No more manually configuring hardware, setting switches, or running separate installation utilities. All NetPC devices should support Plug and Play, including integrated devices such as network cards and external devices (e.g., tape drives, removable media, CD drives) attached

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to the Universal Serial Bus (USB), FireWire, or other ports. Although users have had mixed experiences with Plug and Play, many problems stem from devices that do not support the Plug and Play standard. The NetPC should minimize those problems.

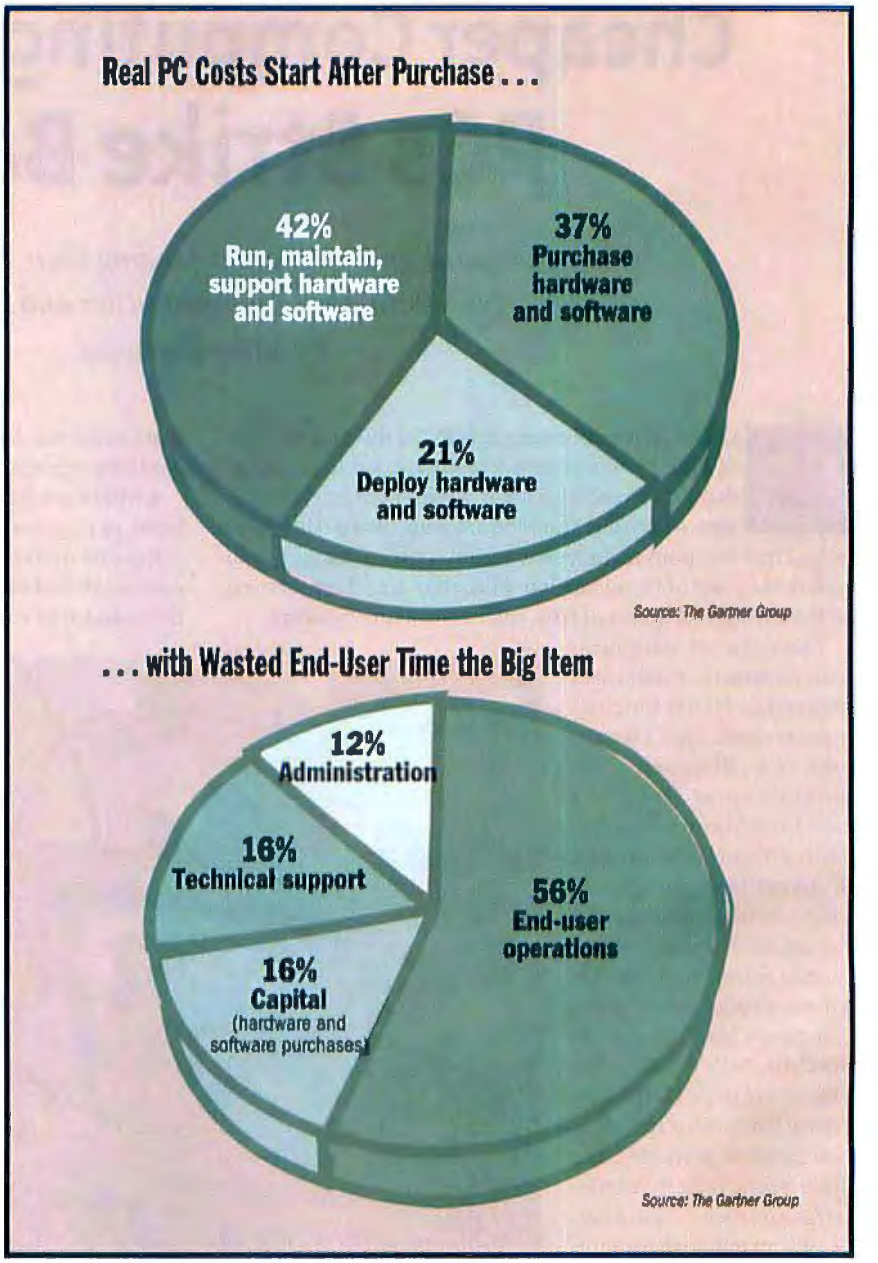
Central Control—with Options

Note that the NetPC case is lockable—not sealed—to keep users from mucking about inside. Yet despite no end-user expansion slots in a NetPC, there may be upgrade options, such as memory expansion or a larger hard disk, that require opening the box. In fact, the guidelines include an optional floppy drive and CD player. Most of the discussion about the NetPC has assumed no local removable storage. However, because totally diskless PCs have proven unpopular almost to the point of extinction, Microsoft and Intel are hedging their bets in defining local removable storage as an option. With NetPCs, IT staff, not end users, would typically perform these kinds of upgrades.

Users won't be able to connect devices incorrectly because ports will be few and easy to distinguish. Note that the guidelines developed in October do not mention standard serial or parallel ports. These will be optional, according to Phil Holden, product manager at Microsoft's Personal Business Systems group. "In all likelihood," says Holden, "standard serial and parallel ports will give way to USB and FireWire over time."

Eventually, USB and FireWire will probably offer as many expansion options as current slots do. However, this does not have to open up possibilities for end-user expansion of the NetPC. NT already provides the ability to turn off any port. With ZAW, it will be possible to configure or disable ports remotely and centrally. Unfortunately, Windows 95 does not provide an elegant and safe method for disabling ports.

The machine-readable unique ID will be in the BIOS, much as a MAC address is in an Ethernet chip. The unique ID will aid in functions such as inventory and automatic software distribution, making it easy for central programs to identify each machine. Today, central management software typically uses a number of different clues to establish a machine's identity. For instance, Microsoft's Systems Management Server (SMS) uses a combination of the machine's name (configurable in software at the client), the NT domain, and the MAC address of the network card. If a user changes the machine name but the domain and MAC address remain the same, SMS crosses its fingers and assumes it's still dealing with the same machine. A unique ID in the BIOS will eliminate such guesswork. A unique ID could be useful in ordinary adaptable Windows PCs as well, Holden notes, and it may be easier for BIOS manufacturers to include the feature in all future chips.



NetPC and Zero Administration for Windows are both aimed at cutting costs stemming from PC configuration difficulties.

The NetPC requirements listed in the table are a guideline for a complete specification. At press time, Microsoft, Intel, and PC manufacturers hoped to agree on a complete specification. In that case, the first NetPCs could start appearing around the middle of this year. Manufacturers who have committed to producing NetPCs include Compaq, Dell, Digital, Gateway 2000, Hewlett-Packard, Packard Bell, NEC, and Texas Instru-

Central Administration a Plus

Even if most files sit on servers, it is impossible to run some programs from a local machine unless you run a local installation program," says Greg Scott, IS manager for the College of Business at Oregon State University. When there is an application-related problem with such programs, tech support personnel often have to reinstall at the workstation. This can be quite an involved process. For instance, Word has eight to 10 file locations you must set because the defaults are not correct for College of Business users.

"It is a constant source of irritation for us that Microsoft requires so much of their software to be installed locally," says Scott. "This whole area is a really burning issue for me, irrespective of the Network PC hardware platform. I've never believed that technology should constrain what users can do. I don't think that people are untrustworthy and you have to lock things down because of that. Hardware limitations don't interest me, but central administration interests me greatly."

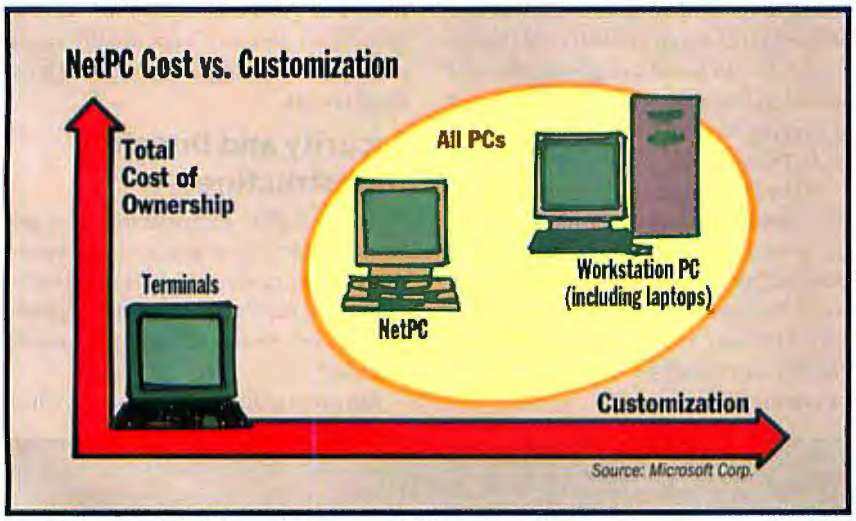
"Microsoft actually seems to have regressed in this area in recent years," Scott notes. For example, you used to be able to install Microsoft Office applications, such as Word, entirely on the server, he says. Now that is impossible, with the result that the College of Business spends tens of thousands of dollars a year in support costs to update drivers and the like on every PC. In addition, it is much more difficult to protect local disks from viruses. At one point, the College of Business was seeing 500 to 600 new infections a day, mostly variants of the Word macro virus, the concept virus.

Local installation also eats up disk space, a serious problem for Scott, who has to support a number of older 486 machines with 200-MB hard disks. In labs, local installation allows students to change the configuration of a program, so the next user finds an unfamiliar environment. This became a serious problem for Scott with the Access database in Office 95. "We struggled with Access and finally became convinced that we had to go to a local installation," he recalls. "It was the biggest disaster I have ever seen. Students changed settings, and it was absolute chaos."

"We have some really bright individuals here, and we all struggled mightily to get Microsoft's FrontPage Web-authoring application to work from a network installation," says Scott. "The consensus we reached is that you can't do it. I have 25 copies of FrontPage on a shelf, and I am going to throw it away. I am not going to support local installations of this product."

Along with support snafus, roving users have problems when configuration information resides on the local machine. In practice, people may have to work from their own machines to access the proper devices, default directories, and files. Windows 95 and Windows NT Workstation 4.0 introduced user profiles that allowed roving users to have a consistent system environment, such as which applications appear on the Windows desktop and which devices are available. However, these versions of Windows did not address application configuration issues.

"The vast majority of our users are rovers," says Scott. "They spend a little while working in the office, a while in an electronic classroom, in a student lab, in a faculty lab. They might be on four different machines in the course of a day. We want them to be able to see the same desktop and tool settings, including access to files. Every time a user logs in on a new machine, Windows wants to create a local profile. We support 2500 business students plus another two- to three-thousand nonbusiness students. Under this scenario, I'm looking at a couple of thousand profiles per machine at a minimum. Instead, we have lab assistants that clean the profiles off local hard drives once a week. This is progress?"



NetPCs sit between terminals and standard workstation PCs, in both customization and total cost of ownership.

ments. Even once the first NetPCs appear, the spec could change based on market reaction. Moreover, some key characteristics of the NetPC may actually be customer configuration options. For instance, the NetPC guidelines say that the local hard disk is only for local caching. However, that is likely to be a configuration option rather than a requirement, Holden says.

A Better NC Than NC

Microsoft is trying to steal the NC's thunder by also incorporating Java and Internet standards into Windows. There are other solutions, such as the Citrix client, that allow NCs to run Windows applications. Thus, the NC and the NetPC may not be worlds apart functionally. Rather, the NC will be more Java-optimized, while the NetPC will be Windows-oriented. There are also NC-like solutions, such as the Wyse WinTerm, that run Windows applications through remote presentation technology, and they run Java, too (see the figure "More Flexible Than Java?," page 88). One advantage of NetPCs over NCs and WinTerm-like devices is that you can reconfigure NetPCs to run as stand-alone machines, so they can function even if the network is down. NCs and WinTerm-like machines are both fundamentally network-dependent.

The NetPC will cost more to administer than the NC, according to Neil MacDonald, research director in network computing for the market research firm the Gartner Group (Stamford, CT). Compared to a typical Windows 95 workstation today—which costs $9784 annually, including capital costs and support, according to the Gartner Group—

a NetPC will cost 26 percent less to administer. But NCs will cost 39 percent less, while WinTerm-style solutions will cost 31 percent less, according to Gartner's figures.

Interestingly, the Gartner Group estimates that by implementing existing best practices in centralized and automated management of desktops, organizations can save 25 percent today, with no change in their desktop hardware whatever. "The NetPC is basically a physical embodiment of best practices," says MacDonald. "It's mandatory best practices." (See "NetPC Cost vs. Customization" on page 83.)

The cost of migrating from Windows to Java is not a factor in Gartner's calculations. That cost would be a killer for heavily Windows-oriented environments. "If you're an all-Microsoft environment, then you should look at NetPC," says MacDonald. "The NC doesn't make sense."

Gartner's numbers represent averages. The NetPC may be much more valuable for certain kinds of users and applications than for others (see "Who Needs a NetPC?"). Microsoft says the NetPC targets task-oriented users who do not require the flexibility and expandability of the traditional PC. In other words, like the NC, the NetPC is best for people performing repetitive single-user tasks or server-centric groupware-oriented functions.

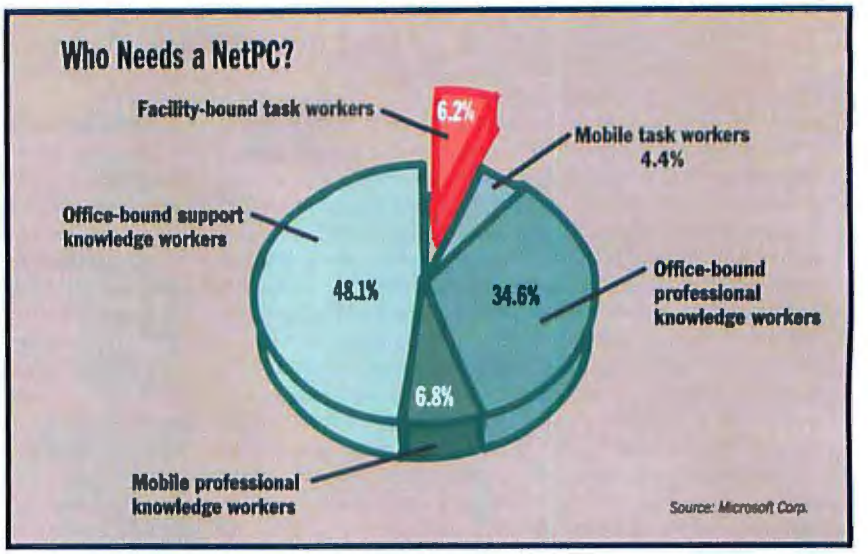
Message taking, order fulfillment, customer service, invoice processing, insurance claims, airline reservations, and other types of procedure-oriented work can all easily happen on a network computer, says MacDonald.

Users Just Want to Have Freedom

On the other hand, for general-purpose computing, the NetPC is unlikely to take the world by storm. The same reasons that terminals are not terribly popular apply: The typical user wants the maximum in power, freedom, and flexibility. The main idea of the NetPC is to constrain users.

"The NetPC may be better for the CIO, but it's not better for end users," says David Folger, program director for the workgroup computing strategies service at the Meta Group consultancy (Stamford, CT). "In many companies, the CIO would end up getting hung by a lamppost for trying to take users' floppy drives and CDs away."

Many PC administrators would agree. "Our users stay at least up with the IS people as far as what they want, if not ahead of them," says Charlie Eberly, a senior network engineer at Unocal (El Segundo, CA), a Fortune 500 oil company. "I think NetPCs are probably too limited for most of our users."



Only a small fraction of all current PC users are good candidates for rival network computers, Microsoft says.

"Even for terminal replacement," says Bruce Barnes, an IT strategist with Unocal, "at this point, the company would be more likely to use a real computer than a NetPC."

The NetPC is also unsuitable for road warriors, who need disconnected operation to work on airplanes and in hotel lobbies. The NetPC is cranky about low-speed lines, too, so it's not usually a good choice for working from home or from hotel rooms.

Security and Directory Infrastructure

"It will probably be a few years before network-based technologies such as Java and ActiveX are really secure," notes Folger. "For now, increased downloading from the network means increased exposure to viruses."

Just as critically, the NT directory, which

System Requirements for NetPC

- Minimum microprocessor: 100-MHz Pentium or equivalent
- Minimum system memory: 16 MB
- Internal hard disk for caching
- External keyboard connection
- External pointing-devices connection
- Display adapter minimum resolution: 640x480, 8 bytes per pixel, VGA-compatible
- Support one of: 10-Mbps Ethernet, Token Ring, 28.8 K-bps modem, ISDN, T1, or ATM
- Each bus and driver complies with current Plug and Play specifications
- Unique Plug and Play device ID for each system device and add-on device
- Devices and buses support hot plugging if using Universal Serial Bus (USB), FireWire, PC Card
- User protected from incorrectly connecting devices
- Minimal user interaction needed to install and configure devices
- Device driver and installation meet Windows and Windows NT standards
- Audio
- Machine-readable unique ID per machine
- Audible noise quieter than 35 dBA
- PC case is lockable
- No end-user expansion slots

Options: floppy drive, CD-ROM, PC Card, Universal Serial Bus, FireWire (1394)

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stores all the information about each PC's hardware and software configuration, may itself hold up NetPC/ZAW implementation, at least in the short run. The NT directory today is adequate for mid-size organizations to centralize all their desktop management functions, notes MacDonald, but it does not scale up to enterprise networks.

One strategy for getting around this limitation is to manage only NetPCs centrally, at least at first. In the long run, the solution will be the Active Directory that's coming with NT 5.0, promised for the second half of this year. That is one reason why Microsoft promises to deliver full-fledged ZAW only with NT 5.0. Most estimates are that within a year or two, 5 to 15 percent of the boxes running Windows may be NetPCs.

Zero Admin

A PC that the user cannot manage has to be centrally manageable, so Microsoft's Zero Administration for Windows is critically important to the NetPC. But ZAW is not exclusively for the NetPC. In fact, ZAW will find wider use with ordinary adaptable or fat PCs than with thin NetPC clients.

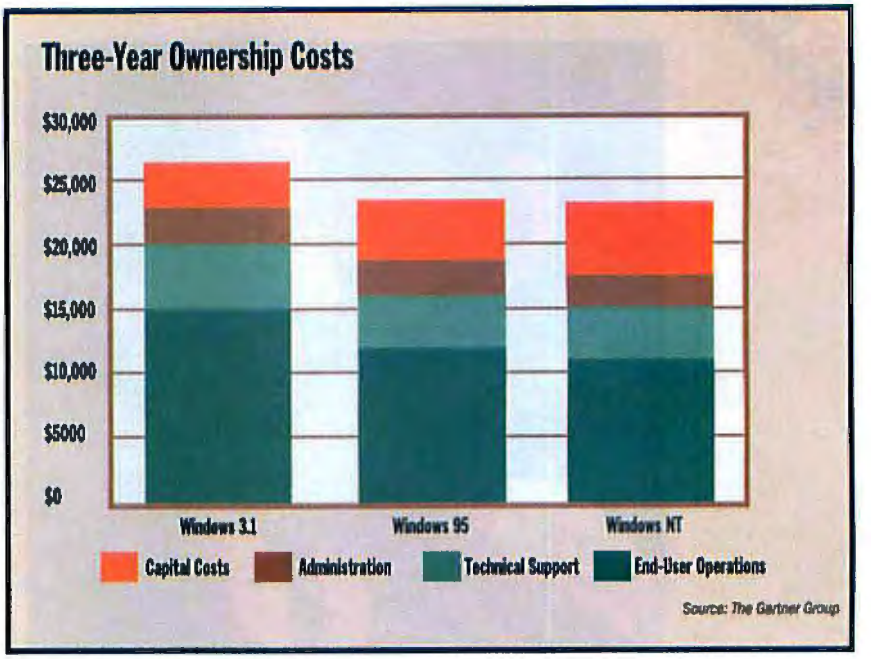
ZAW includes three main capabilities: 1) automatic system update and application installation; 2) persistent caching of data and configuration information; and 3) central administration and system lockdown. Microsoft will deliver these capabilities in varying degrees in future versions of Windows 95, NT Workstation, and NT Server (see "Three-Year Ownership Costs" at right).

Windows will be able to boot in a minimal network configuration and check on the Internet or your intranet for updates of system components, device drivers, applications, or even the whole OS. If there is an update, the system would update itself without user intervention. A history of the system state will reside on both the workstation and the server. This makes it possible to return a workstation to its last known good state despite any errors that may occur at the workstation, on the network, or on the server. For instance, if an application upgrade fails, the workstation can roll back to the previous version.

Storing client data and configuration information on the server allows a truly network-centric architecture for Windows. Today, Windows applications typically store state and configuration information in the local registry. Often, a significant number of files reside locally by default as well, even for a network installation. "With Office 97," complains Unocal's Barnes, "one ends up with 20 MB of software on the hard disk even with a network install. Until recently, the vision of the average Microsoft programmer didn't extend beyond the C drive."

ZAW will permit stateless clients that get all their configuration information and data from the server when they boot. Stateless clients make it possible for users to move from machine to machine and see exactly the same environment wherever they go. In addition, caching client information on the server facilitates recovery for failed software updates.

Central administration and system lock-down permit Windows to hide devices, such as the floppy drive, hard disk, and CD-ROM drive, from users. Instead of individual physical storage devices, each person will see a single virtual drive rooted in their home directory on the server. In addition, access control lists (ACLs) can secure critical software resources such as system files. The administrator will also be able to specify which applications each user can



NT systems cost about $3000 less to run than 3.1 systems (over three years), largely due to features that Zero Administration will bring.

PCs vs. NCs

Categories	PC	Network Computer
Operating system	Windows	Proprietary/incompatible
Mobile support	Excellent	Requires optional equipment
Applications	Over 100,000	Limited/ incompatible
Development tools	Many choices	Limited to Java
Device support	Thousands	Proprietary/incompatible
Device model	Windows	None/incompatible
Manufacturers	Over 2500	Few
Networking	Choice	Requires high-speed net
Availability	Now	Limited
Printer support	Thousands	None
Scalability	Excellent	Poor

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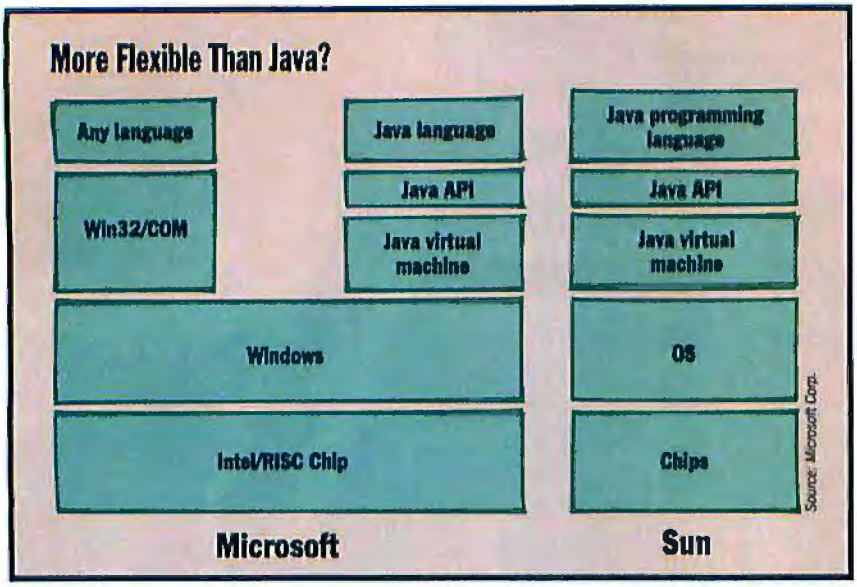


While vendors such as Sun have a Java-centric architecture, Microsoft supports Java and other languages via the Win32/COM API.

access and at what granular level, even down to the component (such as an ActiveX component).

The NetPC and ZAW will reduce support costs for PCs (see the figure "Real PC Costs" on page 82). ZAW, however, will have much wider applicability, once the NT directory evolves to support it. "The vast majority of corporate PCs are going to be centrally managed PCs," says Kirk Schlegal, an analyst with the Meta Group. "There is also a definite, though more limited, role for NetPC, which is fundamentally a managed PC that doesn't allow you to do software installs locally."

This isn't the end of "personal" computers. Customers will be able to choose, says Microsoft's Holden. "NetPC and ZAW are very much based on choice for customers."

In reality, Microsoft really doesn't care what the hardware platform is—as long as it keeps customers in the Windows fold. And Intel is mainly concerned about selling microprocessors. Count on Intel and Microsoft to promote themselves with whatever hardware platform does the best job of minimizing the impact of the NC on Wintel environments.

Mike Hurwicz is a writer and consultant living in Brooklyn, NY. You can reach him at **mhurwicz@attmail.com**.

VARs and systems integrators are solving problems at the forefront of the intranet-development maelstrom. ***By David Baum***

Intranet Politics and Technologies

The Web is reinventing the software industry. Client/server architectures are starting to rely more on powerful host servers and less on overloaded desktop PCs. Vendors, systems integrators, and consulting outfits of all sizes are lining up for a free-for-all as they compete for the business of companies moving to the Web. Most of this business will be developing *intranets*—private corporate networks that use Internet and Web technologies and infrastructure.

Intranet development is too new to be an exact science. But one thing is sure: There's no slowdown in sight. Forrester Research reports that two-thirds of all midsize and large companies either have an intranet already installed or are in the process of implementing one. Dataquest predicts that intranet-reengineering projects could well top the $1 billion mark by the turn of the century. While bigger firms, such as Andersen Consulting and KPMG, get situated, more nimble firms are jumping in and landing contracts.

"It's a whole new ball game," says Jon Brovitz, director of marketing at Epoch Networks (Irvine, CA). "Companies have invested millions of dollars in their legacy systems. Now these systems need to be scaled up, and the most efficient way to do that is through intranets. In many cases, one of the big-six accounting firms did the initial work, but small- to medium-size shops like ours are jumping in to do lots of the intranet work."

"An intranet can provide vast amounts of internal and external information that competitors don't have," adds Sam Vinson, owner of Intra-Link Intranets (San Diego, CA), a VAR and software-development firm. "Intranets can capture data from suppliers, business partners, customers, and salespeople and present it all in a very usable fashion."

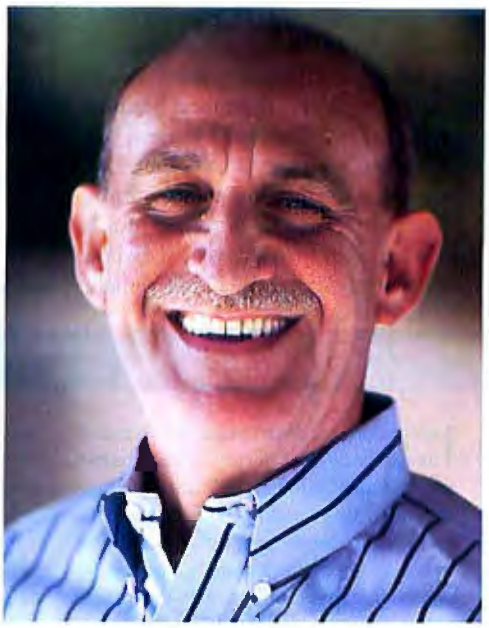
Prior to the advent of the Web, the integration challenges involved with pulling all this disparate information together were too great to make such efforts worthwhile. Now integration is just a hyperlink away, and VARs and integrators are first in line to deliver the goods. Take, for example, Intra-Link's sales-automation software. The company supplies a middleware data broker to simplify the process of grabbing information from legacy data stores and generating HTML code to the Web. Its main market is small- to medium-sized financial brokerage houses that are looking to intranet technology to simplify communications between headquarters and the field.

"Account reps and brokers need to connect with account data, determine commissions, and locate myriad documents—often from remote locations," Vinson explains. "With a properly designed intranet, they can click on a hyperlink in a Web-browser screen to access all this and more."

Companies contract with VARs and integrators for intranet-development services because these firms have not only basic Web-development expertise but also integrated solutions to solve some of the thorniest tasks facing corporate developers. "That's the whole idea behind bringing in a VAR or reseller in the first place," explains Troy Troxler, Web-development manager at Epoch Networks. "We don't just provide the tools piecemeal; we integrate solutions to entire business problems."

Epoch offers custom software solutions for Internet security, dial-in access, fax broadcasting, chat/conferencing systems, and on-line transactions. "Having a product bundled with your services helps customers understand just what an intranet can do for them," Troxler says.

continued



PHOTOGRAPH: MARSHALL HARRINGTON © 1997

"An intranet can provide lots of internal and external data that competitors don't have, as well as capture data from many sources and present it in a very usable fashion."

—Sam Vinson

Other companies are turning to VARs and integrators to jump-start intranet projects because of their targeted market expertise. VARs can come in with a more seasoned perspective than internal IT folks have, since they've seen how a number of companies and organizations have solved similar problems.

Perspective is important in the intranet realm because it's so difficult to come by. With the Web, anyone can gather ideas by moving from one site to the next. But most of the best intranet systems are behind firewalls. Furthermore, because many of these systems are so new, the stories about their capabilities have not yet spread to the developer community.

"Many intranet systems are much more compelling than what you see when you browse the Web," says Bryan Menell,

Integration Challenges

Problem	Solution	Representative products
Build Web processes to extract information from existing databases	Custom middleware; Web-enabled DBMSes	Proprietary "data brokers"; Oracle Web Server; Bluestone's Sapphire/Web; Computer Associates' CA-OpenIngres
Internet security	Hardware-based firewalls; tunneling software	Digital Equipment's AltaVista Firewall and AltaVista Tunnel software
Content management and distribution	Information servers and repositories	Vantive's Customer Asset Management tools; Dazel's Output Server and MetaWeb
HTML conversions	Information servers; customer middleware; HTML generators	Dazel Output Server; proprietary programs

Security First

Integrators and VARs wading into the intranet space don't get in very deep before the "S-word" comes up. More than anything else, they need to be familiar with the various intranet security options and how to implement them. "Intranets must be designed first and foremost with the idea of safeguarding the information resources of the client," says Troy Troxler, Web-development manager at Epoch Networks.

In addition to being a first-tier national Internet service provider (ISP), Epoch does Internet/intranet consulting and applications development. The company's customers include the American Red Cross, Mirage Resorts & Hotels, Motorola, and Virgin Interactive. Epoch developers employ a combination of hardware-based firewalls and tunneling software to secure important intranet communications.

"A big company should start with a big firewall," says Powell Hamilton, Epoch's director of systems and applications. Software solutions are fine for a small LAN, he adds, but large corporate intranets need a dedicated firewall server stationed at the gateway point. Hamilton and his colleagues are currently in the process of developing an intranet at a telecommunications company that wants to use the public Internet to transmit sensitive financial information from the company's remote locations. They are recommending the Digital Equipment AltaVista Firewall on an AlphaServer platform for the job, in conjunction with the AltaVista Tunnel software.

"This client wants all communications to be secured—e-mail included," Hamilton explains. "AltaVista is a compelling firewall solution because it works on both Unix and Windows NT platforms. Coupled with the tunneling software, it's an outstanding combination."

Tunneling software like AltaVista is also inexpensive because it allows companies to use public Internet lines instead of leased lines to securely connect disparate internal networks. "You can use this type of software to create a secure intranet through the dial-up network—in effect, creating a virtual private network," Hamilton says.

Tunneling technologies aren't new. Such two-key encryption systems have been around since the mid-seventies. Most of today's solutions work in a client/server configuration. "The server side will encrypt something that can't be decrypted without the software on the client, and vice versa," Hamilton explains. "So, even if you intercept a packet of information, the data is no good without the other key."

Many VARs use browser-based encryption schemes, such as Netscape's Secure Commerce Server. But these solutions are not nearly as comprehensive as tunneling software. "Tunneling works at the IP level, so all traffic is encrypted—telnet, FTP, gopher, what have you," Hamilton says. "Netscape does encryption at the application level, meaning only Web information is encrypted."

Security is important, but a word of caution is also in order. "Don't get carried away putting in protection that you don't really need," Troxler advises. "The more locks you put on the front door, the longer it takes to get through." He also notes that as security increases, so does the performance hit on your system. "We always take a careful look at what really needs to be secured and what doesn't. We also use a fast 64-bit hardware platform to host the firewall and tunneling servers, which makes all the difference," he adds.

Intranets must first and foremost safeguard data, says Troy Troxler of Epoch Networks.

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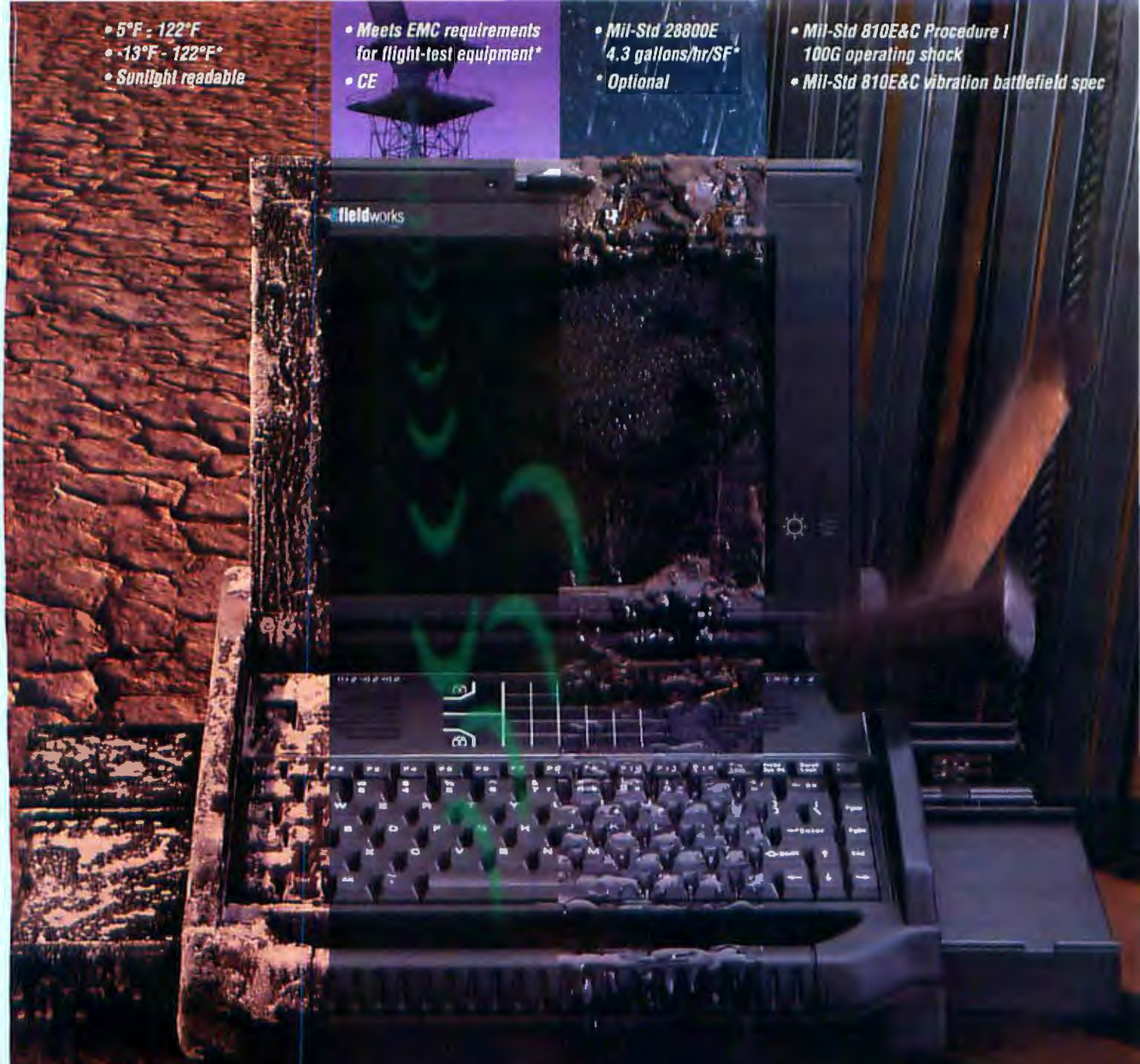

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customer-management-initiative leader at BSG (Austin, TX). The systems are carefully integrated with an organization's key business processes and back-office systems, he adds.

Menell's group focuses on customer support. BSG uses the Vantive Enterprise suite of client/server applications to help its clients leverage customer information on an enterprise-wide basis (see the text box "Is Anybody Watching?" below). BSG uses Vantive Enterprise for two primary reasons: It's a comprehensive product line, and its open architecture simplifies systems-integration issues. Many of BSG's customers are telecommunications companies, such as MCI and Southwest Bell, but the 65-person consulting division does work for other large companies as well, including American Express and Merck.

continued

Is Anybody Watching?

The goal of any publishing venture is to establish a direct connection between the producers and the consumers of information. That's the raison d'être for most intranets: As Web content gets published, anybody with access to a Web browser can receive it. This might be a quantum leap over the rigid information systems of the past, but some VARs say that it's only a beginning.

"What's lacking is a publish-and-subscribe metaphor that can handle not just publication, but delivery of relevant information tailored to individual needs," says Bryan Menell, customer-management-initiative leader at BSG. Menell and 65 other people in BSG's Customer Management group are chartered with creating customer-service and sales-automation solutions, many of them built around the Customer Asset Management family of tools from Vantive. "Our charter is to supply turnkey, Web-enabled customer-management solutions that offer proactive notification of important information and events," Menell explains.

Consider the interplay between the sales and support teams at most organizations. Sales reps need to be continually made aware of problems within their regions. But because technical support is handled by another department, and because many sales reps work far from headquarters, communication about these problems sometimes doesn't occur until it's too late.

"When customers spend all day on the phone trying to get a problem resolved, there's nothing worse than a sales rep calling to try and sell them something," Menell says. "Yet this happens a lot more often than most companies would like to admit."

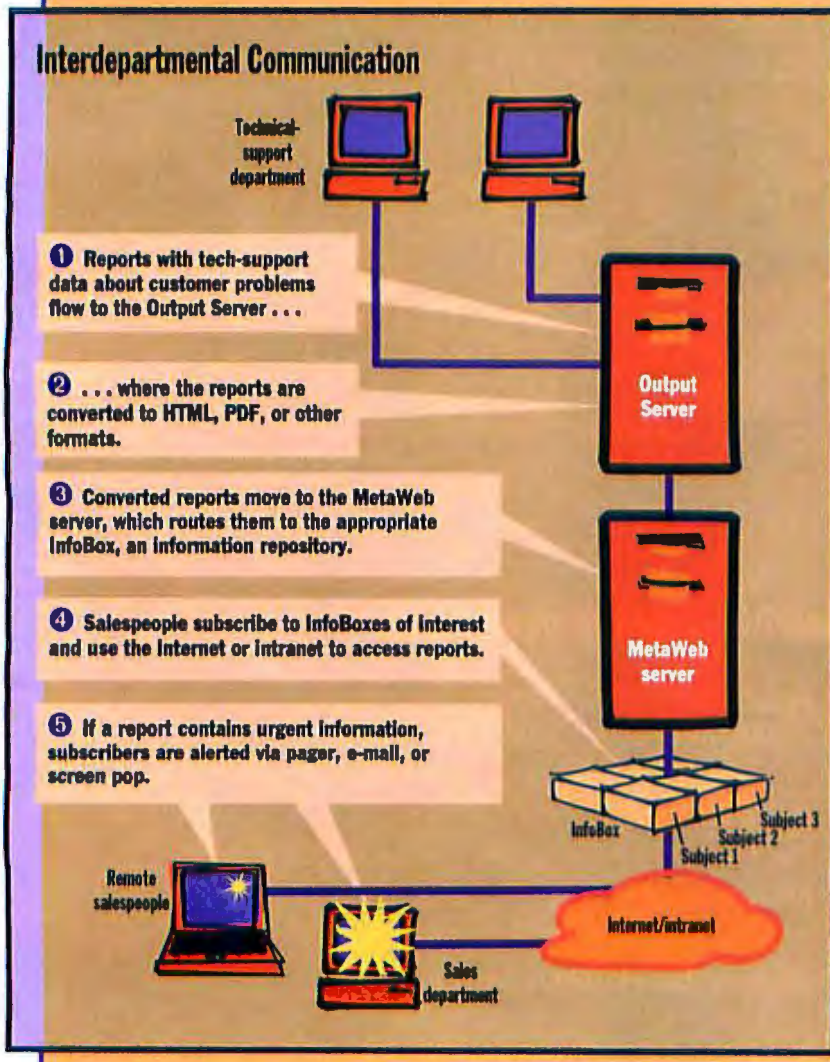
The solution? Don't ask sales reps to go looking for the information they need; let the information find them. Menell and his colleagues are establishing the infrastructure for such a cross-departmental interplay with a new product from Dazel, called MetaWeb. This product is an add-on to the Dazel Output Server product line, a server-based infrastructure for delivering and managing output from client/server and desktop applications to a variety of destinations in the enterprise, including printers, faxes, pagers, files, e-mail addresses—and now the Web.

Users and applications directly publish information to the Web by putting it in designated MetaWeb InfoBoxes—information repositories set up on intranet Web sites. From there, the information gets formatted and propagated automatically to all individuals who subscribe to it. Sales representatives, for example, might choose to subscribe to reports on priority-one technical-support problems occurring in their regions.

Vantive Customer Asset Management software can generate reports from the data entered by technical-support personnel or from embedded business rules. The reports are picked up by the Dazel Output Server, which ensures that each type of document receives the necessary transformation for its intended destination—such as HTML and PDF formats for the Web, or PostScript for laser printers.

From there, MetaWeb distributes those reports to the appropriate InfoBoxes, which are tied to specific URLs. Because InfoBoxes are serv-er based, they can receive information automatically whether or not their owners are online. Important events can trigger reactions, such as an immediate notification of an InfoBox's owner via e-mail, a pager, or a pop-up window on his or her screen.

Interdepartmental Communication



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"Integrators and VARs can bring highly targeted expertise to customers in their chosen vertical markets," Menell says. "They continually see what's on the leading edge, which helps them arrive at a workable understanding of 'best practice' within their problem domains."

Troxler concurs. "After you've seen eight or 10 companies devise an innovative approach to a particular problem, you're able to bring a very broad, very knowledgeable perspective to that problem," he says. "It's rare that customers would arrive at that same level of understanding on their own."

Building the Apps

Most VARs say the biggest issue they face when implementing intranets is security (see the text box "Security First" on page 88B). The second-biggest concern is content management. "We often spend more time assessing needs than actually producing a site," Troxler says. "Companies might know their own business systems well yet still not have the experience to pick the right pieces and put them online. That's one of the things we find lacking—the ability to organize."

Others say the number-one issue with regard to Web applications development is having a well thought-out vision of the application. "A lot of firms see the technical and financial benefits of running an application on a Web server, but few of them can visualize what that application will look like," explains Douglas Mow, manager of Web channel sales at Information Builders (New York). "It's

Keeping Information Fresh at Seafood Credit

Reengineering was starting to become a dirty word until intranets came along. "We felt badly burned from two previous attempts at implementing information technology that failed to deliver as promised," explains Frank Martino, president of Seafood Credit—a privately held firm in Hicksville, New York, that provides credit reports to companies in the seafood industry. "But we lacked the time and expertise necessary to bring our information systems up to date."

Seafood Credit maintains files on more than 50,000 companies, which puts it in a position to offer an important service to companies attempting to gauge the financial health of prospective business partners. With offices in five states, the 16-year-old company serves hundreds of customers throughout North America.

Unfortunately, a recent reengineering effort left Seafood's credit information scattered among a network of PCs. There was no central storehouse of information, despite the tens of thousands of companies the firm tracks on a monthly basis. "It was a paper-based, document-centric system," Martino explains. "When customers requested information, analysts scrambled to dig out the latest two-page summary and send it by fax to the requester."

Cry Web

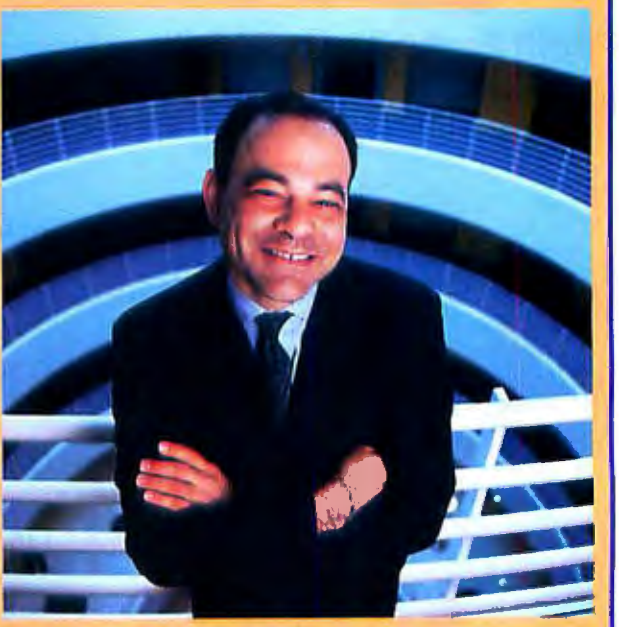
Martino, a Long Island native, contacted the Long Island–based Computer Associates (CA) to help integrate a Web-based solution. "We liked the firm's comprehensive approach," he recalls. "Not many companies will design your Web site and then go on to deploy it, host it, provide management tools, market it, and even help you link it to your back-office systems."

CA's NetHaven division contracted to build a new database-driven Web site and then handle all the complex monitoring and maintenance that such sites invariably require. Says Martino, "We wouldn't have to hire database programmers, system administrators, or Webmasters. This was a tremendous load lifted."

The solution called for collecting all the credit files in a single CA-OpenIngres database that could be accessed both locally and remotely, via graphical Web browsers. Seafood Credit's analysts and customers would have instant on-line access to information about any company in the database, just as they would access any other Web site.

"The Web pages have a clean, crisp design that makes it easy to find information," Martino says. "It works on two fronts: as an intranet for our analysts and as an 'extranet' for customers who want self-service access to the same information."

Getting an intranet on-line is only half the battle, however. Customers also look to integrators to keep the sites up and running. Unlike the static information that Seafood Credit had maintained in the past, the Web site is continually fed with new information from the CA-OpenIngres database. Any changes in the database can be made on a continuous basis with browser-based content-management tools. The new information is immediately reflected in the Web pages.



"Seafood Credit's Web site is generated entirely from the database—even the graphics," says Steve Mann of Computer Associates.

"System administrators typically have to change the HTML files to change the Web pages, something that nontechnical users can't do on their own," explains Steve Mann, director of product strategy at CA. "Seafood Credit's Web site is generated entirely from the relational database—even the graphics. We exploit relational technology to drive Web content."

Martino says the new Web-based credit service catapults his company to the forefront in delivering the very-latest information to its customers. "People everywhere are intrigued with the Web, especially when you can demonstrate a truly useful service," he says. "The new system will also help us reduce our production costs by eliminating almost all the manual work that analysts used to do to access, update, and send files."

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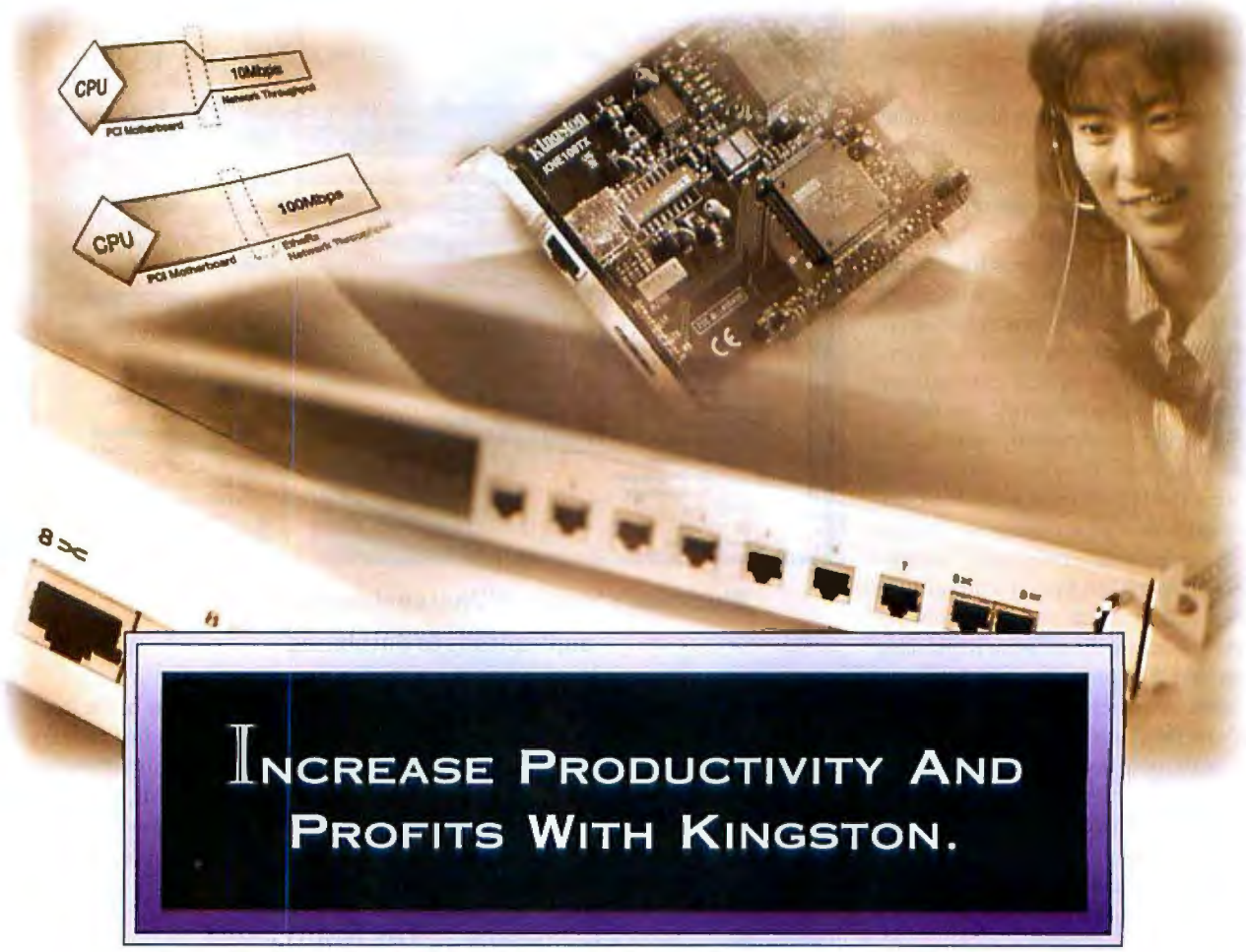

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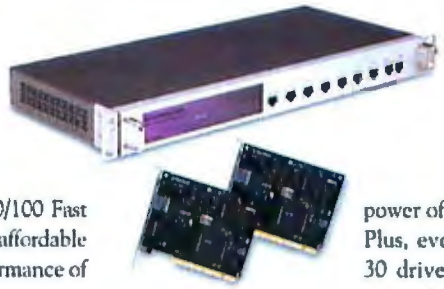

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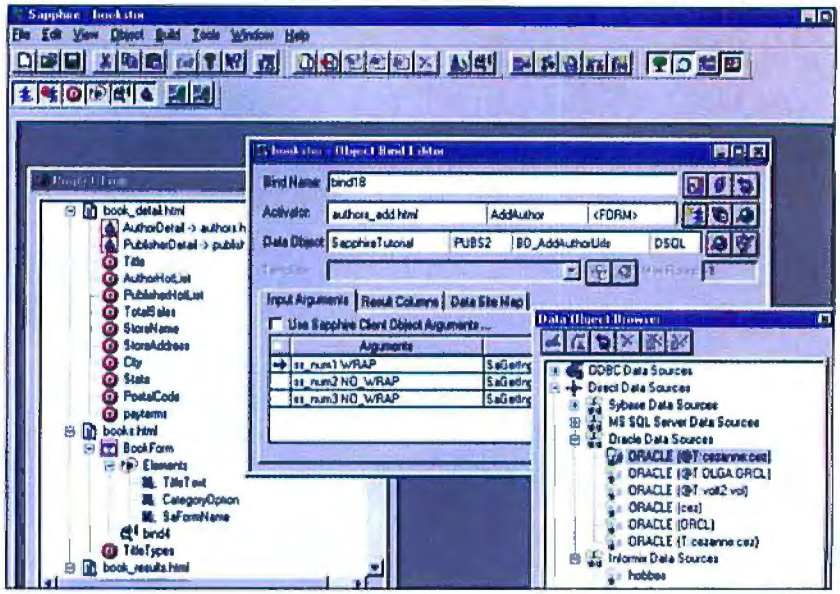
the job of the integrator to flesh that out."

Once the infrastructural issues are dealt with, the actual Web-site development is often fast by comparison. "Low-cost, high-speed development cycles make long debates over design a waste of time," says Forrester Research's Eric G. Brown. "The new push will be to get applications into end users' hands fast."

"There's usually no need for lengthy analysis-and-design stuff," adds BSG's Menell. "The highly structured, step-by-step approaches just aren't effective anymore. The idea is to get something up there fast. If it doesn't work, you fix it."

With regard to development tools, most corporate developers agree that writing the HTML layer is the least-important aspect of the process. "All the tools can do that pretty well," admits Powell Hamilton, Epoch's director of systems and applications. "Far more important to us are the tools for interfacing front-end Web processes with back-end database activities." Members of Hamilton's team favor the Oracle Web Server for this purpose because they believe Oracle has a cohesive vision for network computing. He also stresses the importance of knowing C++, Java, Perl, and CGI scripting to establish high-performance transaction-processing environments.



Bluestone's Sapphire/Web enables you to easily link applications to databases.

Staying Afloat

Another big issue that customers face is deciding how to manage their intranets after the developers are gone. Frank Martino, president of Seafood Credit (Hicksville, NY), says that this was a prerequisite for his firm's intranet project—and one of the main reasons it hired consultants from Computer Associates (CA) (see the text box "Keeping Information Fresh at Seafood Credit" on page 88F).

CA brought its CA-Unicenter tools to the task—an end-to-end systems-management environment now tailored to Web servers and the intranets they support. It handles security, event and storage management, resource accounting, and database monitoring. "We can focus on the business issues and outsource all the technical stuff," Martino explains.

Intra-Link's Vinson believes that effectively linking an intranet with legacy applications and databases is the best way to simplify content management. "There are usually administrators in-house who are comfortable with existing systems," he says. "The idea is to leverage what's already there, to establish an intranet that dynamically updates the Web site based on changes to the underlying databases."

Intra-Link relies on Bluestone's Sapphire/Web for this purpose because of its native database connections. Sapphire/Web is a rapid application development (RAD) tool set designed for Internet/intranet development. "Many of the legacy systems being placed on-line are very proprietary," Vinson explains. "It's not always easy to integrate HTML with these systems. You need a Web-development environment that's open enough to handle this integration for you."

The Right Skills

Information Builders' Mow cautions companies who are hiring small integration outfits to look not just for astute Web developers, but for good project managers as well. "Project management is an essential tool, but it's something that many smaller firms don't have," he says. "Some of these intranet applications start small but can end up massive. Scope-creep is common."

What will the future hold? The vision is constantly shifting, but there's an excitement that most VARs say they've never experienced before. "Just look at something that's fast becoming routine, like ordering products over the Web," Vinson explains. "Customer orders and inventory updates can go directly into a database. Think of all the time that saves; phone calls, faxes, data entry, and file searches can now all be automated with intranet technology. It's opening up a whole new world of opportunities." B

David Baum (Santa Barbara, CA) is a freelance writer specializing in business and technology. You can reach him at **dwbaum@silcom.com.**

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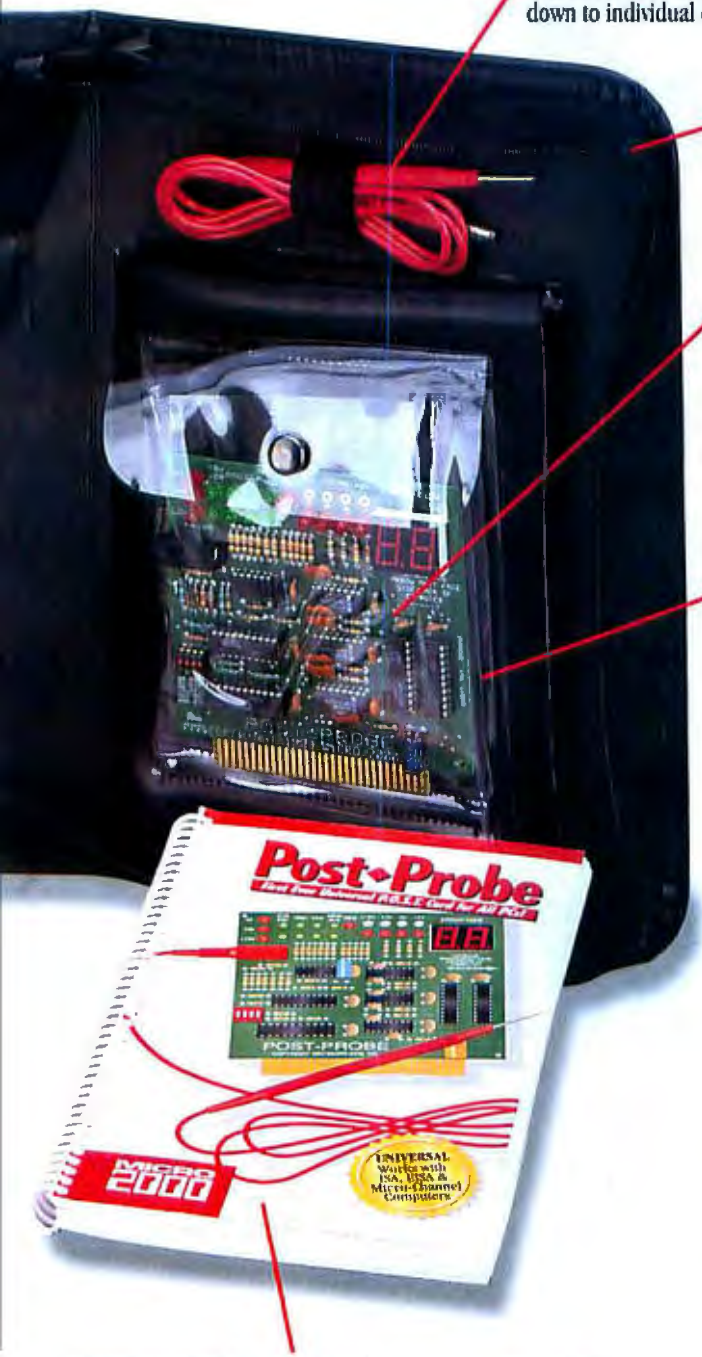

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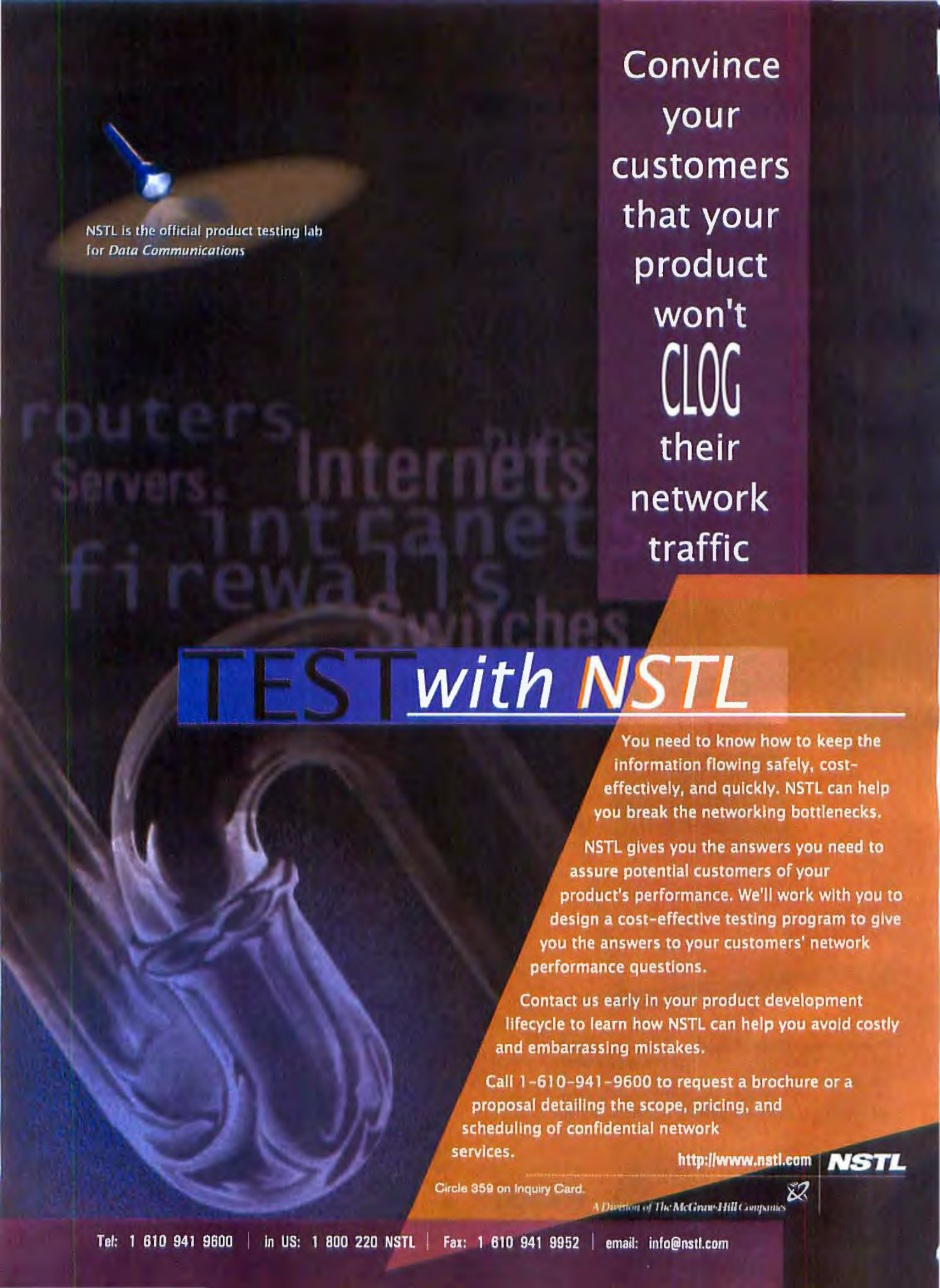
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As providers take the knife to cost, they're counting on information technology to reduce paperwork and trim inefficiencies. By Cate T. Corcoran

Cutting-Edge Health Care

The knee bone may be connected to the thigh bone, as the old jingle goes, but in the world of health care, patient data is seldom connected to anything other than a paper chart. That information doesn't follow the patient around. When a patient sees a new doctor, a doctor refers a patient to a specialist, or an insurer wants to analyze historical data on patient care, patient data may be unavailable. The apparently simple act of transferring a patient's chart down the hall to the lab or pathology department can occupy multitudes of hospital administrators.

If there's one umbrella concept, one goal that characterizes the direction of health-care technology now, it's improving access to patient data. Internally, hospitals, insurers, and HMOs want to connect their disparate systems and make better use of the information they have. Externally, they want access to competitors' records to run their businesses more efficiently and improve the quality of care.

Large providers—hospitals and health-care networks—are replacing paper records with computerized systems to cut administrative costs. Most of them are using commercial software to do this, from integrators (e.g., HBO and Company and IDX Systems) and software developers that specialize in health care (e.g., Cerner and Meditech).

Some providers in remote locations are betting on telemedicine. They're setting up WANs that will let them consult faraway specialists. Also, insurers and HMOs hope someday to be able to access patient records that predate their coverage. They can then analyze them to determine the most cost-effective treatment plans and coverage. They are already putting data-mining technology in place to analyze their own data.

However, the main action now for integrators in the health-care market is providing access to largely plain text over private links, be they intranets or Virtual Private Networks (VPNs) on the Internet, because of the privacy requirements of health-care companies.

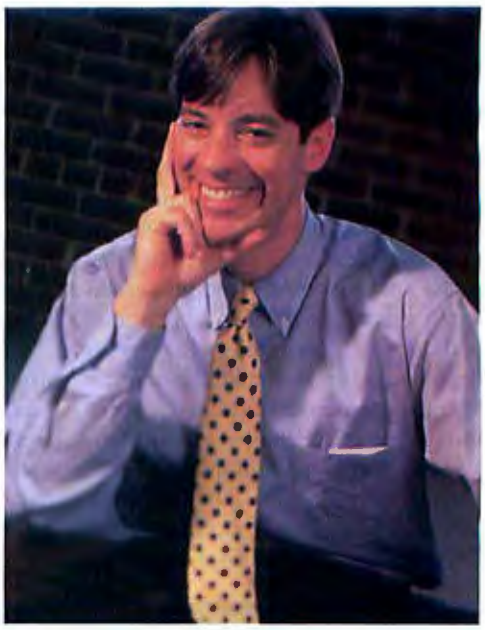
Internet: A Fast Fix

Most large hospitals have Internet connections for research purposes, integrators say. However, few health-care companies are using the Internet or intranets to do business. Integrators expect intranet projects to increase dramatically in six months, and some are starting to line up projects in this area. The health-care industry has been slow to jump on the Internet bandwagon because of security issues.

Many integrators expect health-care companies to shy away from using the Internet to send patient information. However, they expect companies to use intranets behind firewalls to exchange encrypted data. Most firewall products come with encryption, and it's also available from third-party companies such as Viacrypt, says Seth Nichols, manager of the health-care market for systems integrator Charter Systems.

HBO and Company (HBOC) has several intranet pilots planned for the next few months. Some of them will let doctors search for patient information on an intranet within an enterprise.

"It will return some demographic information to identify the person with an address and phone number, and physicians will be able to look at clinical results in a grid format," says Rusty Lewis, HBOC's vice president of research and technology. The advantage of using a browser to



"You can use telemedicine to do an x-ray, and say 'yes, it's serious, send them up' or 'no, it's not, take two aspirin.' The goal is to provide the highest-quality care in the most efficient manner."

—Seth Nichols

PHOTOGRAPH KELLIE WALSH © 1997

access the data is that it expands the number of desktops that can access the information, because hospitals can use old systems with little memory and an external modem. You can also access information remotely, saving a trip to the emergency room, from an office or a home, for example.

HBOC plans to add a Web-browser interface to its existing pharmaceutical application, which checks for conflicts between drugs and allergy reactions and manages drug orders. Again, the Web browser will let hospitals have more access points to the application, Lewis says. HBOC is using Java to allow interaction with the program, and the company also uses HTML and ActiveX in its intranet projects. For example, it is using ActiveX to give doctors read-only access to test results from different laboratories.

Cambridge Technology Partners is deploying intranets for similar reasons. The company just launched a Web-browser interface to the Disease Management System application it developed for a large hospital in PowerBuilder. Using the browser interface, physicians can look at documents such as referral letters, educational materials, and guidelines attached to patient records, which are stored on heterogeneous systems in a variety of formats.

The Disease Management System itself—the first electronic record system that all the departments can access—lets the hospital change the way it treats patients, allowing a group of specialists to treat each patient as a team. The hospital has also been able to track patient treatments and outcomes to determine the best courses of treatment for a particular disease.

IDX Systems, which is one of the leading health-care integrators, recently began shipping a browser interface for its line of clinical management, billing, scheduling, and managed-care software. IDX has installed the interface, called OutReach, at four customer sites. Authorized physicians can dial into the application using any Internet connection and view certain kinds of patient information,

Diagnosing Health-Care IT

What does health-care information technology look like? Here's a snapshot:

- Expect hospitals and integrated health networks to use mainframes, AS/400s, and/or Unix servers with PCs used as the client front end.
- Small doctors' offices will use PCs only.
- Windows NT is not yet widely in use because it's too new of a product, although some integrators are attracted by the Microsoft connection.
- Big insurance companies generally use the IBM 390 mainframe.
- Development tools are the usual grab bag of everything from C++ to Visual Basic. However, hospitals are not big on developing applications. They use packaged applications from such companies as HBO and Company and IDX Systems. There is little to no customization beyond changing fields in databases.

Medicine's Not a Desk Job

Doctors and nurses move from room to room and floor to floor, frequently practice in more than one location, and occasionally visit patients at home. They scribble notes as they go, all of which eventually, in the best of all possible worlds, need to be entered into a computer for later reference.

Medical Communications Systems has put together hand-held systems and wireless networks for group practices. A patient checks in with a bar code card, which automatically pulls up any existing information onto the receptionist's desktop screen. The patient answers the usual questions about why he or she is seeing the doctor, allergies, and former illnesses. Later, the doctor accesses that same information on a hand-held computer—usually a Fujitsu tablet connected via a Proxim wireless network—and enters diagnostic notes into the system. The application is menu-driven and doesn't use handwriting recognition, which is still unreliable, says Saleem Desai, MCS's president.

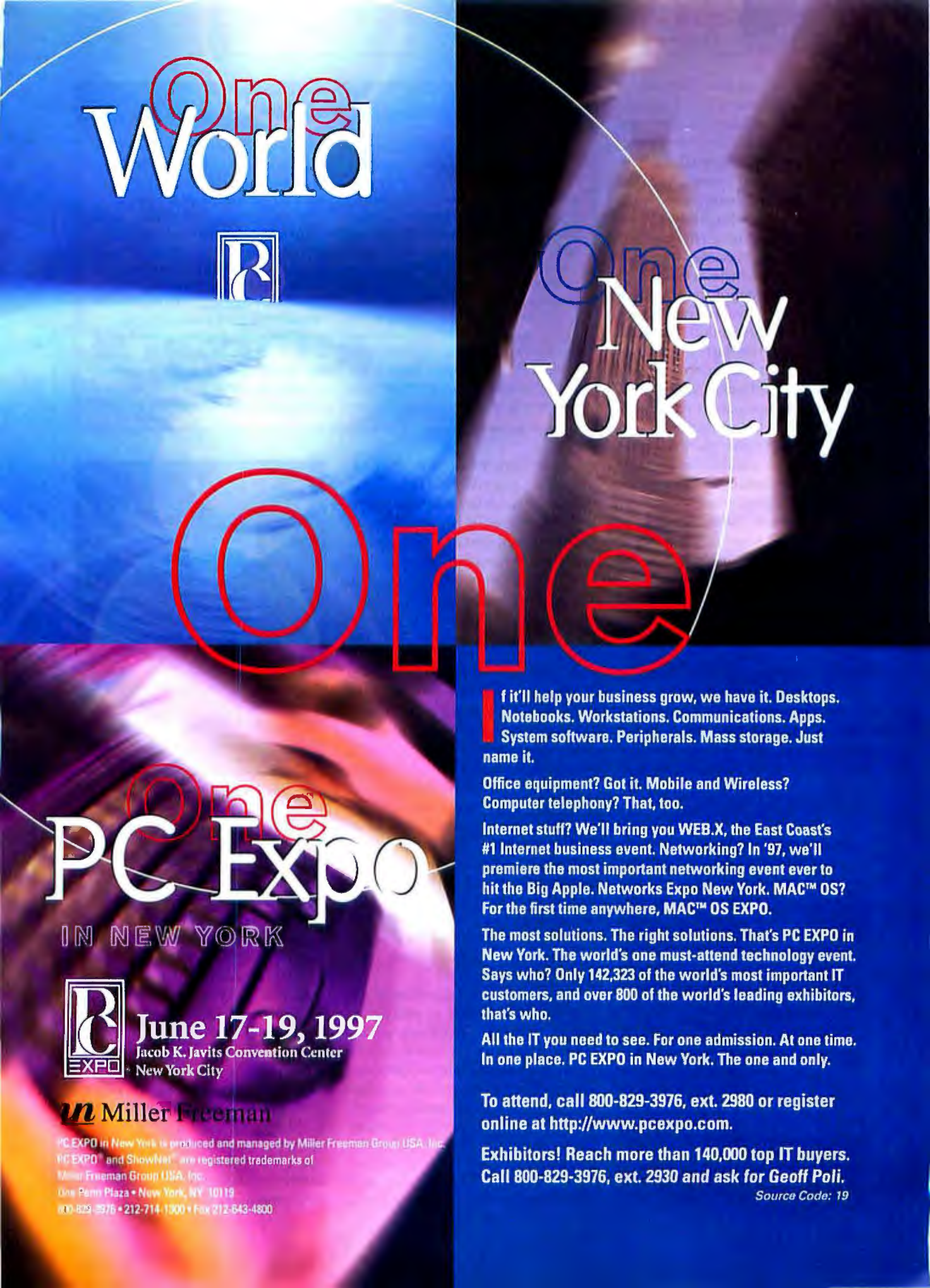
You can integrate the software, which MCS writes itself, with a custom billing module or existing Electronic Data Interchange (EDI) systems to reduce administrative work and improve access to data. The company can customize the application to accommodate different types of doctors. An entire system with desktops and hand-held devices for three to four users would cost about $25,000.

MCS is working with partners in the defense industry and elsewhere to develop full-motion video on hand-held computers and pattern recognition. With full-motion video, a doctor could interpret a CAT scan or MRI on a hand-held device, or paramedics in an ambulance could consult doctors remotely. Such a product might be available in two years, Desai estimates.

PHOTOGRAPH KELLIE WALSH © 1997

"Hand-held computers can reduce administrative work and improve access to data." –Saleem Desai

The company is also researching using computers to recognize patterns and count cells in pathology slides, pap smears, and blood tests. Pattern recognition won't replace physicians, who are necessary to diagnose illnesses, but it could replace some technicians and improve accuracy, Desai says. The technology will need FDA approval and might be available in three to five years.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even if they don't use IDX's software.

It will be useful when IDX's clients refer their patients to outside specialists, says Ken Kaufman, IDX's director of product marketing. Typically, when this happens, the specialist doesn't have the patient's chart and doesn't know what procedures the referring HMO covers. Sometimes, the referring physician will send a partial chart by courier. OutReach will give specialists instant access to financial and coverage information. A future version will provide patient-care history.

Other health-care products that make use of the Internet are starting to emerge. Charter Systems is keeping its eye on Health Vault from Healtheon (Palo Alto, CA). This electronic patient-record software is aimed at HMOs. Healtheon is also creating an application that employees can use to compare health-care packages offered by their employer. The program will be interactive, letting users enter the names of their doctors, number of dependents, and where they live to compare benefits. They can also enroll and change benefits using the application.

Electronic House Calls

Videoconferencing and multimedia are being used to deliver specialized expertise to patients in remote areas or who are difficult to move, such as prisoners.

One of the most interesting projects in the videoconferencing area is a pilot that was put together by Charter Systems for Fletcher Allen Healthcare (Burlington, VT). The project—Fletcher has just received funding for it and put out a Request for Proposal (RFP)—will create a regional health network linking about 750 doctors in the area with telemedicine, e-mail, and Internet access for research.

The pilot system Charter created used PC-based teleconferencing products from V-Tel and PictureTel along with Intel's ProShare. Physicians can attach medical appliances such as a stethoscope to a Pentium PC and transmit the information. The teleconferencing system, which used two 128-Kbps ISDN lines, can also transmit x-rays, full-motion video, and ultrasound images. The video runs at 30 frames per second and has a latency of less than one-tenth of a second. Each telemedicine PC will cost approximately $11,000, Charter estimates. Fletcher plans to put one on every physician's desktop so they can consult remotely.

"If someone bumps their head skiing at Stowe, and you're not sure how serious the injury is, traditionally you throw them in an ambulance and drive them to Burlington, which is expensive," says Seth Nichols. "You can use telemedicine to look at the head, to do an x-ray, and say 'yes it's serious, send them up' or 'no, it's not, take two aspirin.' The goal is to provide the highest-quality care in the most efficient manner."

Being able to record these sessions and store the information in relational databases is crucial for record keeping and later analysis, integrators say. System Concepts Associates sells a telemedicine Pentium PC with software that can record verbal comments, heartbeats, and images, saving them in a Watcom database so they can be accessed or augmented later according to the patient's or doctor's name.

Integrators may be surprised to learn of such cutting-edge projects in health care. Historically, this industry has been slower to computerize than others. That's partly because of the multimedia nature of its data, which requires more expensive and advanced technology than, say, the numerical information that's bandied between banks. Health-care companies are also under pressure to save money, not spend it. However, if a technology can be shown to cut costs and deliver better care at the same time, health-care providers will chart their course right to it. B

"The Web browser will let hospitals have more access points to applications." -Rusty Lewis

Cate T. Corcoran writes about information technology from San Francisco. You can reach her at **cake@hooked.net.**

Rx for Data Warehousing

Data warehousing is a big trend among health-care companies, especially insurers. They have information that has been shut up in mainframes or scattered among disparate systems for years. These giant integration efforts often fall to the big guys, such as EDS, which have custom methodologies to determine business needs and system architectures. They use these to create a model and then use a variety of custom and commercial programs to extract data from existing systems and transform it into a common format.

HBO and Company, for example, has written software to reconcile different ways of representing health-care data. You can write female, for example, as F, fem, or 1. IDX Systems has a program called ConnectR. It will send data between incompatible environments in any messaging format.

Playing in this arena will probably mean using health-care-specific messaging standards such as Common Object Request Broker Architecture (CORBA) Med, HL7, and Hewlett-Packard's Andover Working Group (AWG). HL7 is the most widespread, covering messaging formats for admitting and discharging patients, scheduling, billing, and other activities. It specifies a simple medical record and may evolve to cover more complexity and more managed-care data and areas of clinical care.

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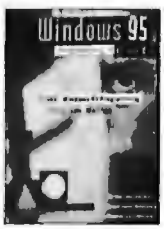

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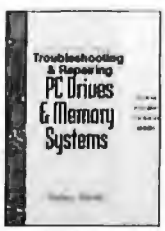

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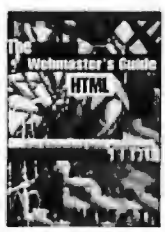

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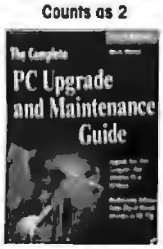

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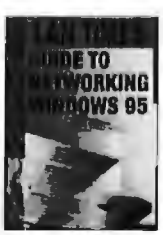

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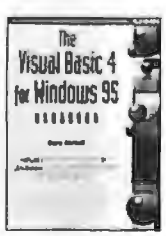

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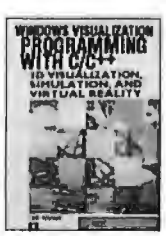

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Parallel Goes Populist

Parallel computing finally sheds its supercomputing shackles and helps ordinary PCs find the processing power they crave.

By Dick Pountain

"When will parallel processing arrive in mainstream computing?" It's one of those infuriating questions that always seems to require the answer, "Next year."

We continually need more and more computing power to run applications such as 3-D graphics, MPEG video, and huge SQL queries. Using multiple processors seems an obvious way to supply that power. The problem is software.

Although operating systems such as Windows NT support multiple processors, desktop PC applications have yet to fully exploit this capability through internal multithreading. Even with more-sophisticated enterprise-level software, a portability problem exists: Until recently, parallel programming techniques have been so hardware-dependent that a program that runs on one parallel architecture needed to be rewritten to run on a different architecture.

The result? Parallel processing remains within the realm of supercomputing, a technology for defense departments, aircraft designers, physicists, and weather forecasters. These groups write their own code and budget accordingly; their world is a long way from the world of shrink-wrapped software.

But that profile is changing. Today, commercial applications ranging from multimedia servers to data warehousing systems are demanding the power that parallel processing offers. At the same time, three main technical developments—new hardware designs, clustering, and advances in program-code portability—are allowing parallel processing to break through into wider markets.

Change is coming at a critical time. Parallel computing's supercomputing shackles, combined with a shrinking defense market, created a crisis in recent years that sent technology leaders like Thinking Machines and Kendall Square Research to the wall and even forced a famous name like Cray to merge with Silicon Graphics. At the same time the desktop PC market is groping its way toward parallelism.

ILLUSTRATION RALPH BUTLER © 1997

Switching to Success

The first of the three important trends—hardware innovations—sees designers moving to high-speed switched interconnects. These interconnects can make distributed-memory massively parallel processing (MPP) machines appear to programmers like shared-memory symmetric multiprocessing (SMP) machines, which enormously simplifies programming them.

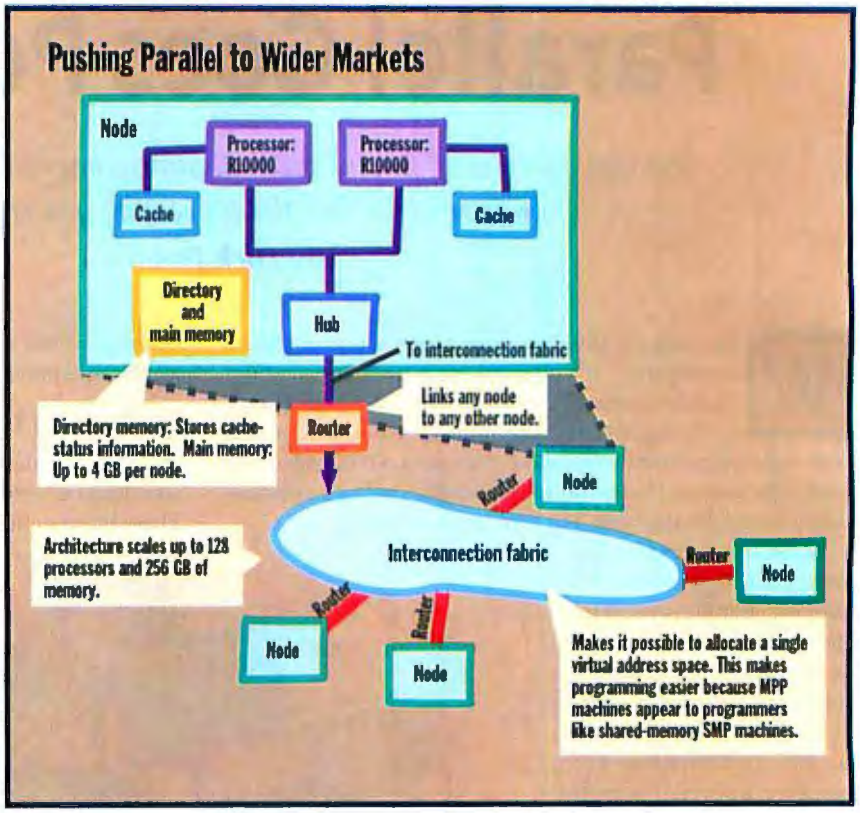
The key to success in designing a parallel computer is to get the right balance between the processing power of the CPUs and the communication bandwidth between them; any imbalance here will mean that some of the CPUs will be starved of data and the advantage of parallelism lost. The crucial metric is the *bisectional bandwidth* of the whole system, which you derive by conceptually dividing the network of CPUs in half and measuring the data rate across this divide. The result reflects the potential performance on real-world problems when the data is not optimally placed. Early designers of parallel computers experimented with exotic topologies like 3-D toruses and higher-order hypercubes to optimize this balance. Today, the emphasis has moved to architectures where the CPUs are connected via digital crossbar switches so that any node can be connected quickly to any other. In this way, each CPU can be just a hop or two away from any other, regardless of the physical topology.

Such switched-interconnect fabrics make it possible to allocate a single large virtual address space to all the separate memories of a physically distributed system. Thus, the machine appears to programs as a shared-memory machine but without the bus-contention or arbitration bottleneck because when two

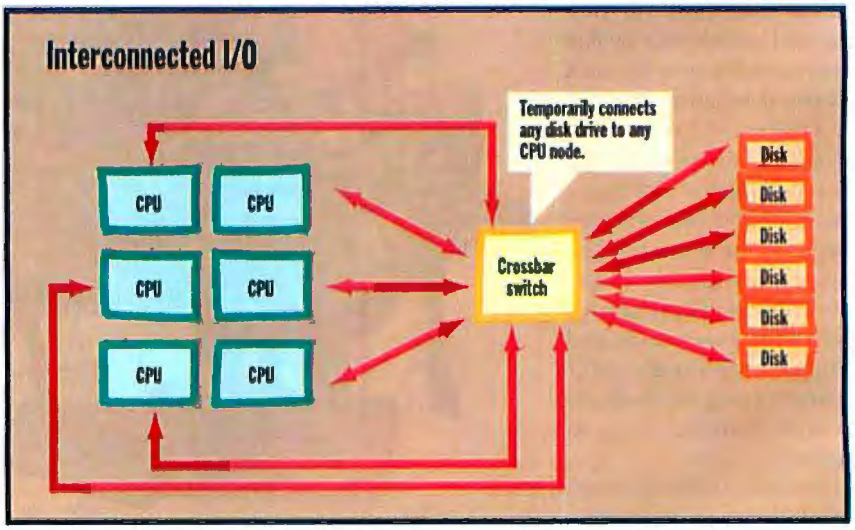
nodes are actually connected, they alone have access to that piece of interconnect. By placing crossbar switches on every processing node, you can make the bisectional bandwidth scale linearly—every time you add more processing power, you are also adding more communications bandwidth. The same technique applies equally to I/O, so disk drives may also be connected via crossbar switches, allowing you to momentarily attach any disk to any CPU node.

To see how switched interconnect works, consider Silicon Graphics' new S2MP multiprocessor server technology, employed in the Origin2000 multimedia server. SGI describes S2MP as a distributed shared-memory architecture. It scales up to 128 processors (MIPS R10000 RISC chips) and 256 GB of memory. This physically distributed memory—up to 4 GB per node—appears to the Irix operating system as a single shared memory, thanks to a pair of custom ASICs, the hub and the router containing six-way crossbar switches, and a superfast point-to-point wiring called CrayLink (which SGI inherited from Cray Research). A third ASIC, called Crossbow, provides switching to I/O devices. Every node board contains one or two CPUs and a hub, and they connect via CrayLink through router boards that can link any node to any other. Each hub also controls a separate directory memory to store information about the cache status of all the main memory within its node. The hub uses this information to provide scalable cache coherence and migrate data to a node that accesses it more frequently than the present node. As a result, the bisectional bandwidth scales linearly, at least up to 32 processors:

8 processors	1.25 GB per second
16 processors	2.5 GB per second
32 processors	5.0 GB per second



Silicon Graphics' new multiprocessor server technology, S2MP, eases some formidable programming problems.



The same switched interconnection technique used to link processor nodes can also join processors to storage devices.

Clustering for Comfort

The trend toward clustering, where groups of workstations or PCs employ a middleware layer to make them behave like a single parallel computer, means that companies can leverage their existing hardware investment by using the LAN as a "supercomputer" during off-peak periods, and thus lower the entry barrier to parallel computing (in theory, anyway). Clustering treats a network of separate computers as if it were a single computer. This approach has been used for many years in the minicomputer sector by firms like DEC, Tandem, and Pyramid for high-availability, fault-tolerant servers.

You can implement clustering using software alone, a concept made popular by PVM (Parallel Virtual Machine), a message-passing environment. There are implementations of PVM for many flavors of Unix and now for Windows PCs (see "Parallel Computing Windows Style," May 1996 BYTE). This approach created the "supercomputer"—actually

Sorting Out SMP and MPP

The great divide in the parallel computing world has always been between shared-memory and distributed-memory architectures. With shared memory, all the CPUs are connected via a shared bus to the same pool of memory. In distributed-memory architectures, each CPU has its own private memory, so processing nodes must communicate by sending messages over an interconnecting network.

Shared-memory systems are commonly called symmetric multiprocessing (SMP) systems, and distributed-memory machines referred to as massively parallel processing (MPP) or message-passing systems. The main advantage of SMP systems is that they are easy to program; all the variables live in the same memory space so that the machine looks like a single CPU to the program. The downside of SMP systems is that the bus becomes a bottleneck as all the CPUs contend for access to the memory. This essentially limits the scalability of pure SMP systems to tens rather than hundreds of processors. Most commercial multiprocessor servers with four to eight processors are SMP designs.

MPP systems don't suffer the bus-bottleneck problem because there's no shared bus and so no contention for memory access; using the fastest interconnects, they scale up to hundreds or thousands of processors. However, programming a pure MPP computer is difficult, as each node must be loaded with a separate program segment, which contains lots of extra communication code to send messages to code running on other nodes; this also makes the overall application depend on the exact topology of the interconnecting network. From the point of view of running parallel applications, a simple network of workstations behaves like an MPP machine, with all the same programming difficulties.

There's an equivalent divide in the realm of disk I/O, between shared-disk and "shared-nothing" architectures. An SMP system will typically share disk drives between processing nodes, which requires special disk drivers and a distributed lock manager (DLM) to prevent different processors from simultaneously trying to write to the same location. An MPP system typically will attach disks to individual nodes, so neither memory nor disk are shared (hence "shared nothing").

a network of 117 Sun workstations—used to render frames for the movie *Toy Story*.

The Message Passing Interface (MPI), with language bindings for C++ and Fortran, lets you build portable parallel applications to run on clusters of workstations. It consolidates the best features learned from PVM, the European PARMACS, and several proprietary systems from IBM, Intel, and nCube. The second version, MPI 2, has just been released and adds advanced features like dynamic process management, parallel I/O, and real-time extensions.

For problems like rendering, in which computation outweighs communication, a cluster will deliver acceptable performance even over an Ethernet. But other problems need a faster transport more closely matched to the power of modern CPUs. A typical example is the Alpha AXP cluster at Tampere University in Finland; 21 DEC Alpha workstations connected via an optical asynchronous transfer mode (ATM) switch operating at 10 Gigabits per second and delivering supercomputer performance of 4.6 GFLOPS. Such message-passing clusters are suitable for scientific and engineering applications, where the use of PVM or MPI can result in a great deal of code portability for semi-custom software. But in the commercial sector, where accelerating SQL database queries is the main task, there's a new emphasis on SMP clustering.

Basically each node in a cluster becomes an SMP computer in its own right, with a smart interconnect designed to make the whole cluster look to software like it's a single SMP machine, thus there's no need to change any application software when you add more nodes. This sort of architecture is often referred to as nonuniform memory access (NUMA) because the speed of a memory reference is different within an SMP node and between nodes. NUMA promises to combine the easy programming benefits of SMP with the scalability of MPP and it's likely to be the future for parallel computing, especially once Microsoft supports it through its Wolfpack technology.

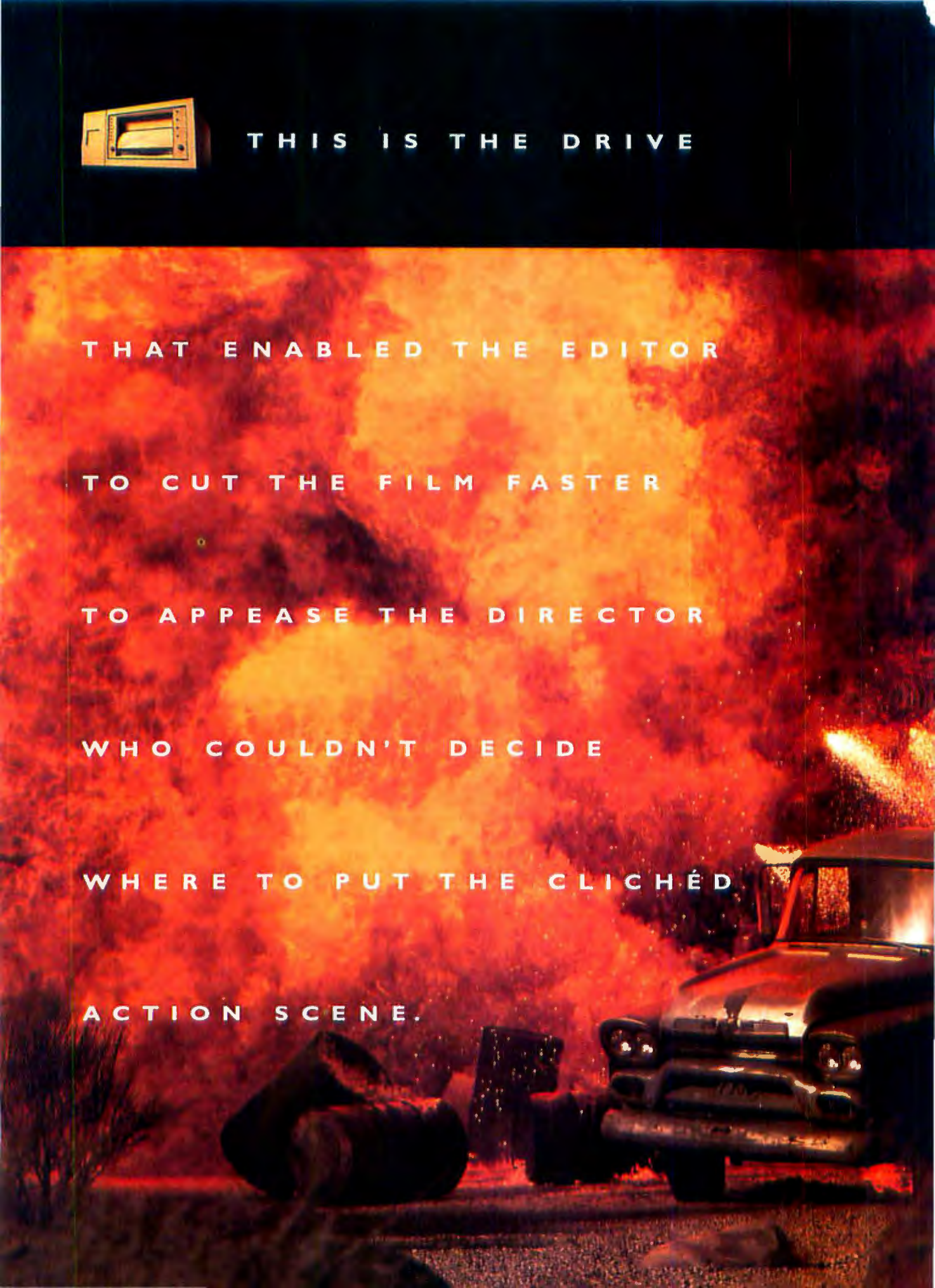
A good example of clustered SMP is Sequent's NUMA-Q architecture (see "The Network in the Server," July 1996 BYTE). NUMA-Q is built out of nodes called "quads" that are complete SMP computers, each containing four Pentium Pro processors on a 500-MBps shared bus and a proprietary 1-GBps interconnect called IQ-Link. You could use IQ-Link for message passing, but Sequent has developed middleware that makes the links memory-coherent so that the whole cluster appears to be one large shared memory. IQ-Link monitors the Pentium Pro processor bus and so knows when it must respond to requests for memory locations outside the range of memory addresses assigned to this quad. The *link* examines its own large cache and, if the requested data cannot be found there, forwards the request to the other quads quite transparently to the database and application software.

Tandem's ServerNet implements a somewhat similar NUMA architecture, using a packet-switched interconnect based on 800-Mbps six-way crossbar switches and a "worm-hole" routing algorithm (i.e., message headers may leave a node before the tail has arrived) to minimize latency. The great advantage of these clustered-SMP architectures for commercial database operations is that they will work with common software like Windows NT Server, SQL Server, or Oracle, and the Intel-based node boards should be relatively inexpensive.

Portability

The lack of portability of program code between different parallel architectures remains a major stumbling block for new commercial customers, companies that typically place great importance on after-sales support. Parallel computing is caught in a vicious circle: The lack of commercial software hinders parallel hardware vendors from selling machines, while software vendors will not spend money porting their code to parallel machines because the market is too small.

However, newly invented software layers now disguise the underlying machine's topology and allow programs to be more easily ported between machines. For example, *bulk synchronous parallelism* (BSP), a new parallel programming model, can allow the same parallel application to run on an SMP machine, a cluster using PVM or MPI, or a distributed-memory MPP machine. Several of these trends may combine within one architecture, as in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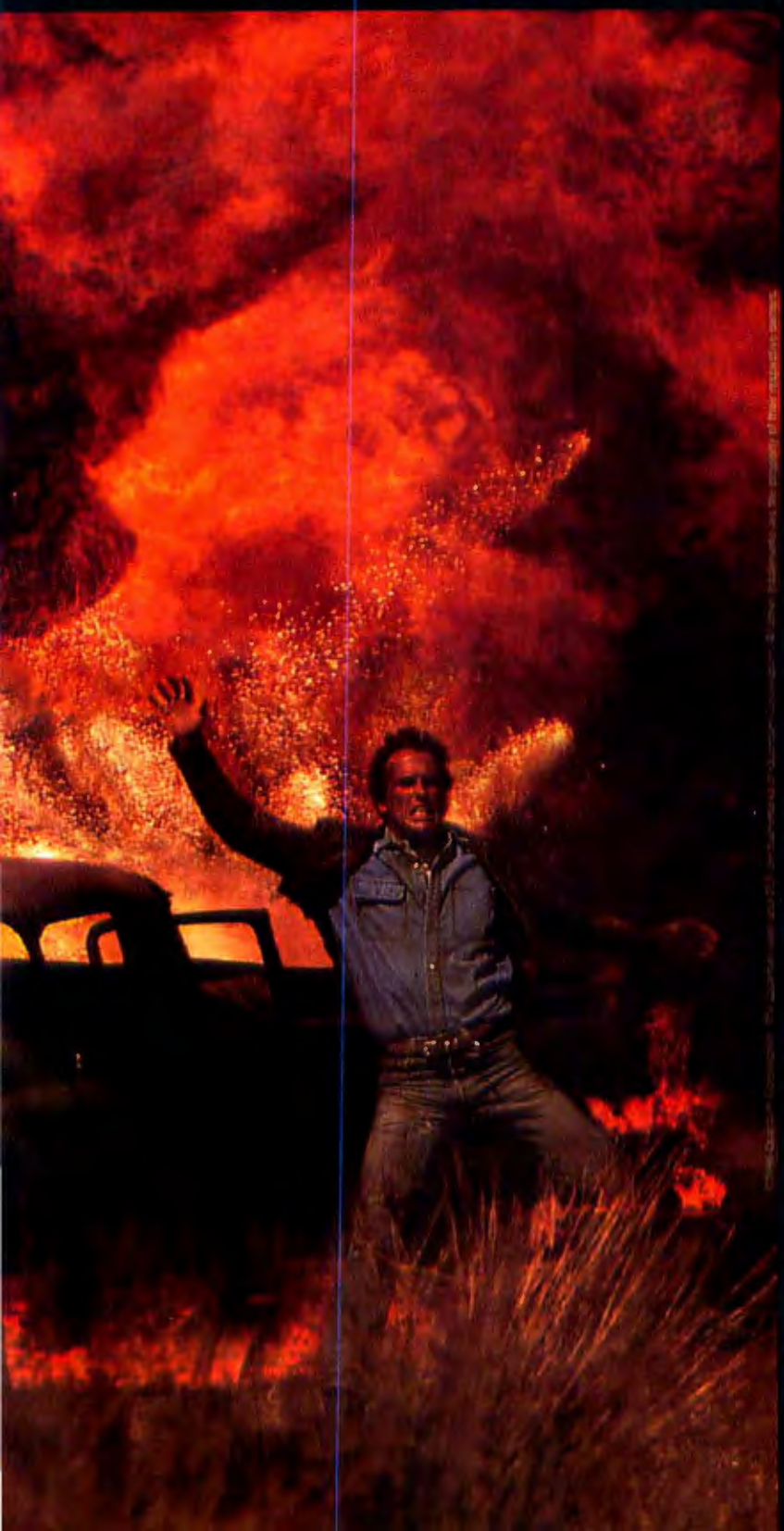

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Sequent's NUMA-Q architecture, which employs clusters of SMP machines with a fast switched interconnect.

Grand Strategy

Don't think that the traditional supercomputer market has gone away completely; supercomputers are a strategic resource for the defense industry, so no government would let that happen. There are still several manufacturers working on MPP machines to solve the Grand Challenge problems in particle physics, fluid dynamics, and atmospheric modeling. In the United States, MPP activity is concentrated around the current main source of funding, the Department of Energy's Accelerated Strategic Computing Initiative (ASCI) program, which was set up to develop simulation technologies that can check the safety of nuclear weapons without underground testing. The chief centers for ASCI are the Sandia, Los Alamos, and Lawrence Livermore laboratories.

Intel's huge MPP machine, called ASCI Red, made headlines last November when it performed more than 200 GFLOPS on the MP Linpack benchmark. When complete, the machine should exceed the elusive teraFLOP barrier. The 11-cabinet configuration (out of an intended 86) contained 688 compute nodes with 1376 200-MHz Pentium Pro processors and more than 80 GB of memory. It recorded 213 GFLOPS, a peak performance of 400 MFLOPS from each two-processor node. IBM is also involved in ASCI with its RS/6000 SP system.

In San Francisco, Tera Computer builds what some believed to be an extinct species: a parallel supercomputer based on proprietary computing nodes. The Tera is a shared-memory machine that uses a clever multithreaded CPU architecture and a packet-switched interconnect fabric; each processor switches context every 3-ns cycle among as many as 128 distinct instruction streams ("hardware threads"). Each stream may issue as many as eight memory references without waiting for earlier ones to finish, which hides much of the memory latency. At the 333-MHz clock speed, each processor has a peak memory bandwidth of 2.67 GBps, and the machine can support up to 256 processors (700 GBps in total), which Tera claims is 95 percent sustainable.

A European Community initiative called Europort (part of the ESPRIT program) has successfully encouraged the porting of some of the most widely used industrial design applications (for automobiles, aerospace, pharmaceuticals, and cartoon animation, among others) to a variety of parallel computers. The projects have proved that the performance increases more than justified the cost. Europort's success stems from its uniform programming approach based on message passing with PVM. But also contributing was the initiative's organizational structure: Each porting consortium had to include not just the code vendor but several end users of the code and a parallel programming specialist.

Perhaps asking when parallel computing will hit the mainstream isn't the right question. Rather, we should ask if one declining and one growing industry sector—supercomputing and PC-based client/server computing, respectively—can combine to make parallel computing viable for general business. Thanks to the three important technical innovations we're seeing today, the answer appears to be "Yes, they can." B

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What Wolfpack Means for Parallel Computing

Microsoft's clustering enhancement for Windows NT Server, code-named Wolfpack, aims to extend the operating system's symmetric multiprocessing (SMP) capabilities in two key areas: high availability (i.e., fault tolerance) and scalability. Mark Wood, product manager for Wolfpack, is quick to point out that "Wolfpack clusters aren't a substitute for RAID or regular backups—they're a part of server protection."

Wolfpack will be introduced in two phases. The first phase, which should be available about the time you read this, emphasizes high availability for traditional server applications. It supports only twin-processor clusters, with a fail-over capability so that if one processor fails, the system will recover automatically by migrating all its workload onto the other CPU. These clusters are initially going to be built by connecting two systems through a SCSI bus using SCSI-2's multi-initiator connection. Because not all SCSI host adapters support the SCSI Release/Reserve command the same way, Microsoft has created a hardware certification program. Initially, Microsoft will be certifying only complete configurations (including servers, storage, and the interconnect). "When it becomes practical," adds Wood, "we will certify individual components." But at first, Microsoft wants to make sure things go smoothly.

Once you've set up your hardware, you use a wizard in Wolfpack Manager to create sets of applications that you want to cluster. These sets are called cluster groups. Each cluster group gets an IP address. Using IP addresses like this enables off-the-shelf applications to take advantage of Wolfpack without any special client software.

Phase two of Wolfpack will be more interesting from a parallel computing viewpoint. The technology will support clusters of more than two nodes over interconnects such as Fibre Channel. In addition, Wolfpack will offer dynamic load balancing over and above fail-over. This will enable the OS to migrate work from one CPU to another to maximize throughput rather than to just recover from a crash.

Beyond this stage, NT with Wolfpack will become a tempting choice of OS around which to design a clustered-SMP computer since it will support all the important high-speed interconnect technologies like asynchronous transfer mode (ATM) and Fibre Channel through its standard driver model. Phase two, scheduled for 1998, will support SQL Server in shared-nothing disk configurations but will not contain a distributed lock manager (DLM) for shared disk access (which Microsoft was considering at one time). However, many parallelized enterprise databases like Oracle have already implemented distributed locking at the application level.

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Avoiding Hostile Applets

How to minimize the risks of executable content.

By Gary McGraw and Edward Felten

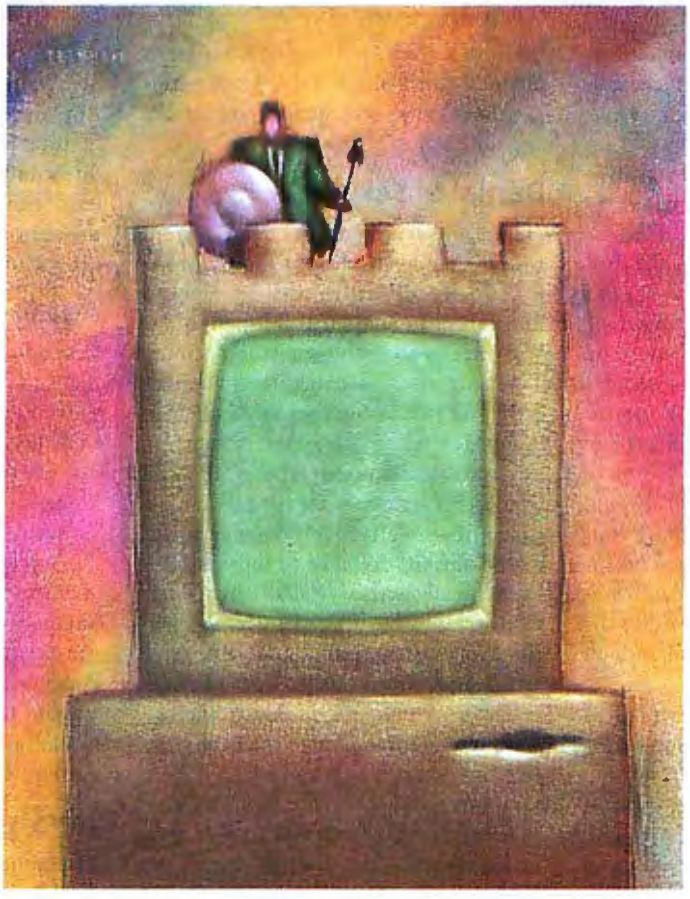
Java promises to relieve many of the headaches developers encounter when they migrate code among different types of machines. Its built-in portability also gives rise to *applets*, special Java programs that can enliven a Web page. Java-savvy browsers, including Netscape Navigator and Microsoft Internet Explorer (MSIE), automatically download and "interpret" (i.e., run) any Java applet they find embedded in a Web page. Java code's ability to run on many diverse platforms makes such magic possible.

However, this technology also allows unscrupulous applet designers to invade your machine. Realistically speaking, there is no such thing as a 100 percent–secure computer system. But because Java applets are exceptionally easy to download, users might be exposed to significant risks without even knowing it. These days, with Java applets everywhere and with millions of people using Java-enabled browsers, you need to know where you're pointing your browser.

The problem is that there is no pat solution here. The bad news: There are risks. The good news: Java's designers were well aware of these risks and did their best to limit them. For instance, the increased use of digital signatures (which authenticate code as coming from a trusted source) in JDK 1.1 helps with risk reduction.

Still, you *are* vulnerable, and for now there's not a lot you can do. Although Java marketing hype tends to ignore and gloss over the risks, you're better off knowing about them, even if there's little that you as a Java user can do except to limit your exposure to Java and other forms of executable content (e.g., ActiveX, JavaScript, Safe-Tcl, and Telescript).

What potential problems does executable content raise? There are four basic categories: attacks that modify a system, attacks that invade a user's privacy, attacks that deny legitimate use of a machine by hogging resources, and attacks that antagonize a user. (See the table "Four Classes of Attacks" on page 90.) Keep in mind that this table only gives a flavor of the kinds of things that are possible and is by no means complete.



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System Modification

A programming language as powerful as Java has the ability to modify data—whether it's in a computer's memory or in the file system. Java includes predefined classes with methods that can delete and otherwise modify files, modify memory that's in use, and kill processes and threads. This power has the potential for abuse.

System-modification attacks make up the most critical risks. Java's designers have given much thought to disallowing this class of attacks. In contrast, ActiveX has *no* limitations on its behavior once it's invoked.

In the most serious cases, system modification involves intrusion into the system itself. Java misuse can create an avenue of attack. Given that system crackers will use any tool available to compromise security (thus gaining entry and user privileges), Java's designers and implementers must ensure that Java does not provide new ports of entry into a machine. (Users can't do anything but be careful about their Java use.) And because Java works on many different platforms, a successful attack on, say, Solaris machines will also be successful on Windows NT machines. Never before have cross-platform attacks been such a distinct possibility.

The bad news is that using Java to break into a machine is certainly possible. Attack applets—ones that implement system modifications—have been demonstrated in the laboratory. Princeton University's Safe Internet Programming Team, which has discovered many of Java's known security holes, has created attack applets that exploit these holes. Patches have been developed that make these attacks impossible, but the possibility of

other sophisticated attacks always presents a risk.

With today's mission-critical computers, system-modification attacks could corrupt financial records in a seemingly secure database, leading to financial loss and corporate bankruptcy, or modify hospital patient records, possibly leading to incorrect treatment and even death. Care must be taken not to expose critical systems to new lines of attack. Since crackers flock to the latest and greatest vulnerabilities, it's important that Java not become a cracking tool.

Four Classes of Attacks

The four basic types of security attacks, ranked in order of severity. Hostile applets fall into two types: attack applets, serious system-modification attacks; and malicious applets, the three less-serious-risk classes.

Attack class	Explanation	Consequences	Java defense
System modification	The most severe attack applets; seen only in labs so far.	Severe	Strong
Invasion of privacy	Malicious applets; includes mail forging.	Moderate	Strong
Denial of service	Malicious applets; can bring a machine to a standstill. Many examples on the Web. May require rebooting.	Moderate	Weak
Antagonism	Malicious applets; annoying. Most commonly encountered. May require restart of browser.	Light	Weak

Invasion of Privacy

A second general type of attack discloses confidential information about a user or a host machine. For example, in Unix, access to the `/etc/passwd` file (which contains user names and encrypted passwords) makes it possible to mount a password-cracking attack that can open a machine to attackers.

A system can also leak other sensitive information: Consider an unscrupulous company's being able to steal a competitor's secret business plan through corporate espionage. Individual users should consider whether they would want their private e-mail or financial records to be made public. Any confidential information that can be e-mailed or otherwise transferred over a network is subject to an invasion-of-privacy attack.

With Java, the standard mail-forging attack is much more serious because doubly forged e-mail is a possibility. The applet uses a patsy system to send fake messages, disguising its actual origin. (See the figure "Doubly Forging E-Mail with an Applet" on page 92.)

Finally, the sound capability present in many systems today opens up a new kind of eavesdropping. If an attacker can gain control of a system's microphone, it's possible for him or her to listen in on the area immediately surrounding the system. More subtle eavesdropping includes monitoring process tables and file access. A Web-based version of eavesdropping might include keeping track of which links a particular user follows.

Java successfully defends against some of these types of attacks. For example, file I/O has especially tight controls. However, this is countered by the fact that applets always have a channel over which to send back information. That's because applets can always talk back to the server where they originated. Mail forging is harder to defend against. Short of disallowing contact to a client's ports, mail-forging attacks are not likely to go away.

Denial of Service

Denial-of-service attacks make system resources unavailable for legitimate purposes. They occur when a process siphons more than the standard allotment of resources, essentially hogging the machine. There are many subcategories of denial-of-service attacks. Some examples include completely filling a file system or using up all available file pointers; allocating all of a system's memory, creating thousands of windows—effectively denying access to the output screen or to the window-event queue; and using all of a machine's CPU cycles by creating many high-priority threads. Although denial-of-service attacks are of real concern, Java's designers have not properly addressed them.

There is some debate over the relative importance of stopping denial-of-service attacks. In most cases, denial of service comes closer to the category of attacks that antagonize the user than to any other category. This is because recovering from a denial-of-service attack is usually easy: You just reboot the machine. Even so, denial of service for mission-critical computers can be serious; you certainly don't want to be rebooting crucial links in your system chain. For example, imagine the mayhem that would erupt if an applet clogged the machines that run the stock market: The resultant losses could be staggering.

Denial-of-service attacks are one of the most common Java security concerns. For live examples, see Mark La Due's Hostile Applets Home Page at http://www.math.gatech.edu/~mladue/HostileApplets.html. Implementing such an attack is not hard; however, stopping one is, because the current Java security model does not offer a good solution to this problem.

Antagonism

Less odious, but still of concern, are attacks that merely annoy a user. Playing unwanted sound files through a speaker or displaying obscene pictures on a monitor are two examples. Other seemingly antagonistic attacks can be the result of simple programming errors.

As mentioned above, some denial-of-service attacks can be classified as merely antagonistic. A window-popping attack, for example, can be just an annoyance, depending on the window manager in use. Judging the severity and category of a particular attack is always a subjective and context-sensitive problem.

Java's Lines of Defense

To combat all four classes of attacks, Java security relies on three prongs of defense: the Byte-Code Verifier, the Applet Class Loader, and the Security Manager. Together, these prongs perform load- and run-time checks to restrict access to file-system, network, and browser internals.

Each of these prongs depends in some way on the others. For the Java security model to function properly, each part must do its job properly. (For more on the Java security model, see "Java Security and Type Safety," January BYTE.)

continued

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Using Java More Safely Now

It's all well and good to talk about classes of attacks and how the Java security model tries to protect you. But hostile applets do exist, and you can't just trust the Java security model to protect you in all cases. Things are improving, but the security model is not perfect. What can you do in the meantime? Are there guidelines for using Java as it exists today that might result in better security?

In fact, there are several straightforward things that you can do to make your use of Java safer. Most of these involve old-fashioned common sense; others require a bit of knowledge about Java. What follows is a list of guidelines.

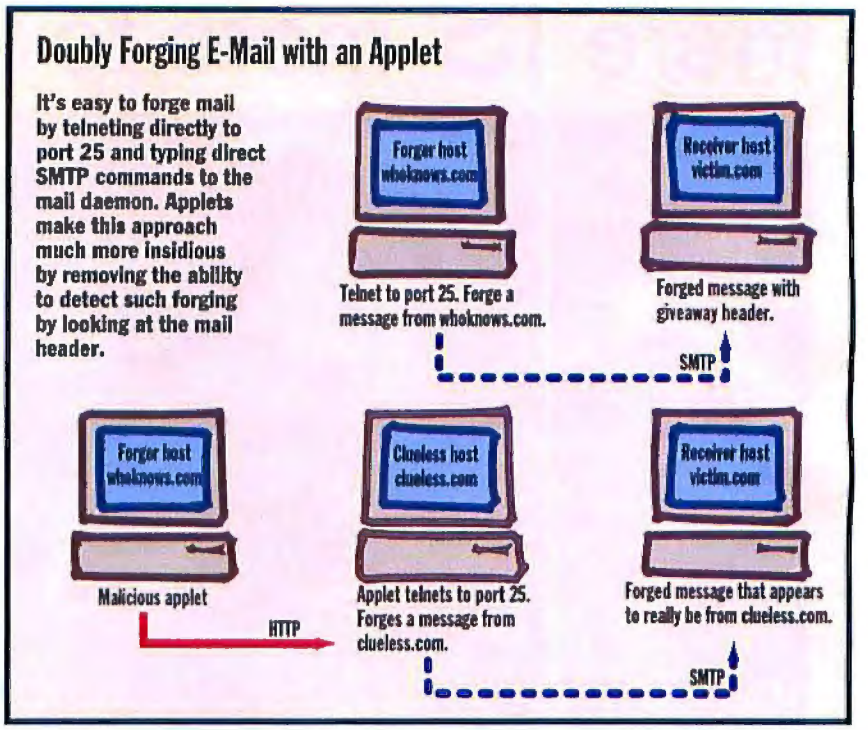
Administrators must take the lead in assessing risks and making policies regarding possible exposure to hostile Java applets and other executables on the Web.

Know your own Java environment. Know which vendor's Java virtual machine (VM) you're using. Netscape's security policy and implementation differ from Microsoft's. Be aware that there are many Java licensees. Some will provide better security solutions than others.

Know what Web sites you're visiting. Just as you shouldn't drive your minivan into certain dangerous neighborhoods, you shouldn't surf your browser into unfamiliar—possibly hacker-prone—neighborhoods on the Web. The Sun Microsystems Web site is probably OK, but think twice about visiting a site known as Vinny's Nasty Surprises Java Joyride. Like the real world, the Web is mostly safe, but it can also get dangerous in other parts. If you have critical information to protect, you should surf with Java enabled only to sites that you know and trust.

Use up-to-date browsers with the latest security updates. Security problems often get fixes only in the latest version of a browser—and this is often a beta version. If you're using Netscape Navigator 2.0 now, you have some very serious security holes in your browser. Get a new one; your security depends on it.

Be aware of new products that attempt to fill security gaps. WebCrusader, from Gradient Technologies (Marlborough, MA), is designed to authenticate the server your browser is pointing to, according to Joe Uniejewski, Gradient's vice president of marketing. With this package, your security administrator authenticates users and internal *and* external servers in a registry, providing fine-grained control, according to Brian Schimpf, Gradient's director of product development. Other products, such as InterScan WebProtect (Trend Micro, Cupertino, CA), Gauntlet (Trusted Information Systems, Glenwood, MD), and SurfinGate and SurfinShield (Finjan Software, Cleveland, OH), are also claimed to block Java applets, although recent research indicates this may not be technically possible.



A malicious applet runs on a clueless host to send messages that seem to originate from that host.

Keep a lookout for security alerts. One good way is to subscribe to the Computer Emergency Response Team's (CERT's) mailing list (see http://www.cert.org). It alerts Internet users of security problems that are particularly serious. Vendors try to provide this information but are not always the best source of data. In addition, the Java Security Web site (http://www.rstcorp.com/java-security.html) includes a form where you can sign up for notification about our work. We use the resulting list to inform users of new Java security problems. The popular press often covers new holes as well—when they're serious. For example, news of the Princeton Safe Internet Programming Team's work has appeared in *USA Today*, the *Wall Street Journal*, the *New York Times*, and a number of trade publications.

Apply drastic security measures if your information is truly critical. If it's ultra-critical, get off the Internet entirely. Otherwise, stop using the Web on essential machines. Turn Java off. Don't use a Java-enabled browser on a machine containing key business data. But try not to throw the baby out with the bathwater; some degree of risk is usually acceptable.

Finally, assess your risks: What do you have to lose if your data is compromised?

Because everyone's situation is unique, there is no one answer to the question "Should I avoid using Java because of the possible risks that applets might pose?" Those running a business on the Internet need to think about exposing their data to possible robbery or corruption. A home user with no critical data, on the other hand, probably has no worries. But if your information is valuable or if you're highly visible, you make a good target. B

Gary McGraw is a research scientist at Reliable Software Technologies Corp. (Sterling, VA). Edward Felten is the leader of Princeton University's Safe Internet Programming Team. They are the coauthors of Java Security: Hostile Applets, Holes, and Antidotes *(John Wiley and Sons, 1996) and the Java Security CD from MindQ. You can reach them at* **http://www.rstcorp.com/~gem** *and at* **http://www.cs.princeton.edu/sip**, *respectively.*

The Component Enterprise

The thoroughly Webbed, fully componentized applications of the near future will create a newer, more flexible client/server architecture. By Dick Pountain

A whirlwind of new software technologies has blown away most of our preconceptions about how applications will work. The Web, Java, object databases—that's just a short list of new technologies we're having to absorb. Each has its own virtues, but how do they fit together? How will we build application systems using these new technologies?

One thing we won't do is create static systems. Current client/server models want to classify tasks rigidly as being "client side" or "server side." To more fully exploit the power of distributed processing, application designers have to learn to move code, in the shape of applets, to execute in the most appropriate place. Similarly with data, it should not be a stark choice to keep everything on your local disk or everything on the server; you need to choose dynamically which data would be better stored locally for quicker access. Systems like Marimba's Castanet are pointing to the way to do that.

Another thing we won't do is ignore the integrity of connections that we currently have; being arbitrarily dumped from a Web site while you're in the middle of a banking transaction will just not be acceptable. There's an urgent need to learn lessons from the transaction processing technology used by automatic bank tellers and other mainframe applications.

But if we were to sum up this new direction for software in one phrase, it would have to be "Components everywhere." Note that word *components* rather than the word *objects*. Behind this change of terminology lies a profound technical shift. In its earlier incarnations, object-orientation was purely a programming discipline, which delivered its benefits to programmers directly (for example, easy code reuse through inheritance) but only indirectly to end users. Unlike a C++ class library that you must compile into a program before you can use it, a component is a ready-to-run package of code that gets dynamically loaded and linked into your system to extend its functionality. ActiveX controls and Java applets are components in this sense. Components share many of the characteristics of objects, particularly the need to hide their internal workings behind a well-defined interface, that is, a set of access methods.

Perhaps less obvious is the shift that *everywhere* signals—to distributing components. Cuno Pfister, managing director of Oberon Microsystems, in Zurich, sums it up this way: "Distributed objects are attractive because they promise complete local/remote transparency. You can develop software for local use first and then later partition it onto several machines. Components are often equated with distributed objects, but while both share important properties, such as the necessity of clearly separating interface from implementation, components make sense even where distribution doesn't. Componentware is the mature way of constructing software systems, such that markets in ready-made components can emerge. Components need to be sufficiently independent that they can be developed, sold, and installed independently, and yet they need to be interoperable so that they can leverage each other's functionality. In other mature engineer-

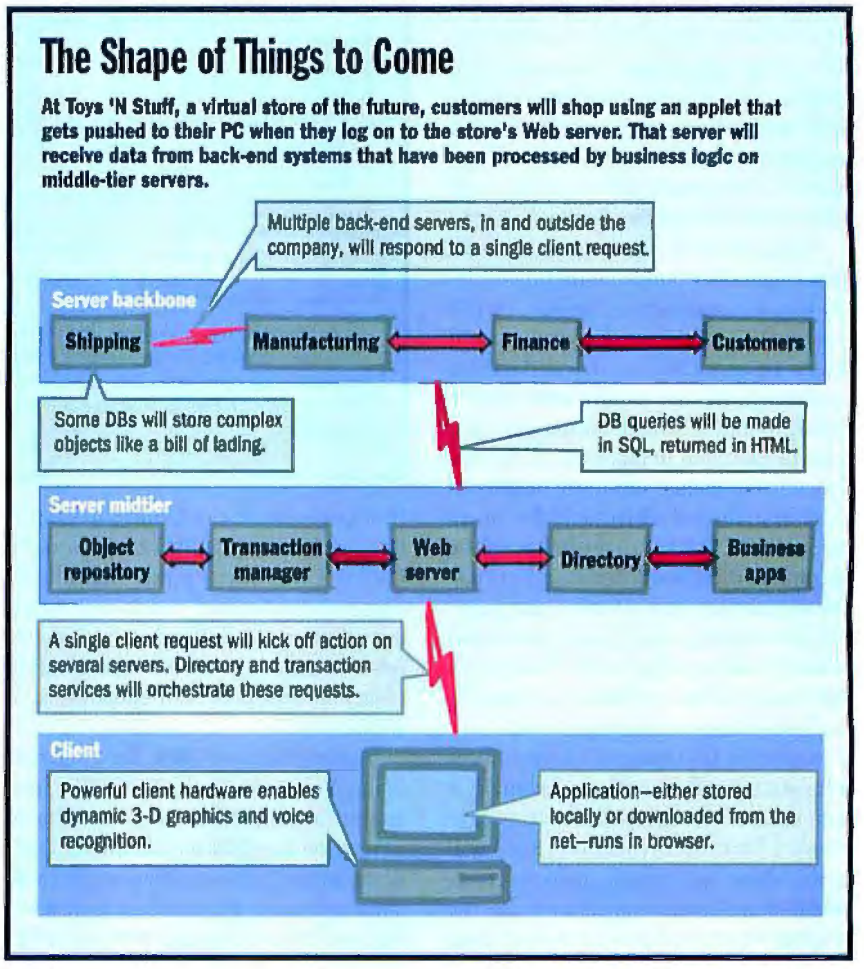


ILLUSTRATION: JOE GALLAGHER © 1997

ing disciplines, a component approach is now a matter of course, but in software engineering the dust hasn't settled yet."

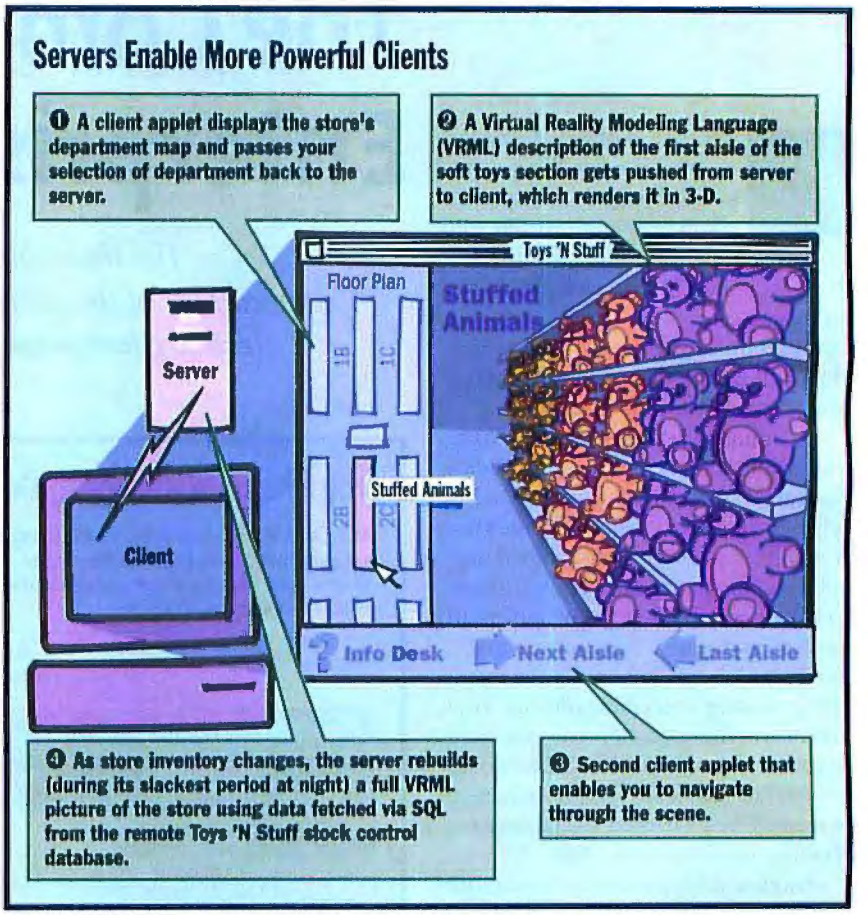
We are moving beyond the stage where components are just user-interface widgets or cutesy dancing heads. Their real import is that you can reuse them to form new "applications" without having to recompile anything.

The four main component models—ActiveX, Java, OpenDoc, Netscape's LiveConnect—are not plug-compatible, but there's progress toward making them all work together. For example, the forthcoming Java Beans API will allow components written in Java to execute inside ActiveX and OpenDoc containers, while Netscape has pledged to build ActiveX support into its future browsers. It won't be long before you'll be able to mix Java and ActiveX components in the same palette in a development tool like Borland's Latte.

While this kind of component-based, lightweight distributed computing is ideally suited to systems based on desktop PCs and low-bandwidth networks, there will always be applications, such as database search engines, that require large objects too big to shuffle around the network and must be executed in place on the servers they inhabit. Hence you'll still need both fully distributed objects and remote method calls. The key to the future will be to combine these two different styles of distribution in the most effective way possible, downloading what is easily moved and remotely calling what is not. Fortunately the standards that will make this possible are being hammered our right now.

SunSoft's Java version 1.1 introduces some strategically crucial new features for communication with remote objects. Java Remote Method Invocation (RMI) will enable client-side applets to drive server-side Java applications and vice versa, the way the VR viewer does in my toy store example. Java Database Connectivity (JDBC) will provide a standard API into SQL databases; and Object Serialization converts Java objects to and from data streams, so you can move data across the network as easily as code.

Equally significant is the Object Management Group's late 1996 release of the specifications for General Interoperable ORB Protocol (GIOP) and Internet Interoperable ORB Protocol (IIOP). These protocols specify the message formats and data structures for communicating between Object Request Brokers (ORBs) that conform to the Common Object Request Broker (CORBA) 2 standard. An ORB is a software engine that allows objects from different vendors on different platforms to call each other's methods by translating between their different object models, processor endianisms, or whatever.



Already there are ORBs, like Visigenic's Black Widow and Iona's OrbixWeb, that enable Java applets to talk to distributed objects on any CORBA-compliant ORB. Black Widow automatically generates both client and server side Java code from interface definition language (IDL) interface descriptions, and the resulting applets provide bidirectional access between any Java-enabled browser and CORBA objects on a remote system. (IDL is the abstract language used to specify object interfaces under CORBA and Microsoft's Common Object Model, or COM.)

Both Netscape and Oracle have adopted IIOP as the basis of their network computer architecture. Microsoft remains coolly detached from CORBA and has placed its own Distributed COM (DCOM) distributed object technology in the public domain to promote it as an alternative, but compliant ORBs will be able to absorb DCOM objects just as well as any other.

Repositories of All Wisdom

Before it can become a reality, "components everywhere" needs to deal with a very large fact of life, namely that almost all the most important data in the world, from census records to telephone directories to corporate business information, is stored not in objects but as rows in relational databases, or even in old COBOL-based flat-file systems. That's why my Toys 'N Stuff example employs a three-tier structure, where the stock control data is kept in the same database system it has been in for the last decade, and a middle tier of software accesses it via SQL. At the moment there's a veritable flood of products, like Microsoft's ActiveX Database Object, dbWeb, Internet Database Connector (IDC), and SQL Server Web Assistant that let you link your Web site to legacy databases and generate HTML pages on-the-fly to display the data.

While an HTML representation is a good place to start, eventually we will want databases to return proper objects. Those who have the luxury of starting

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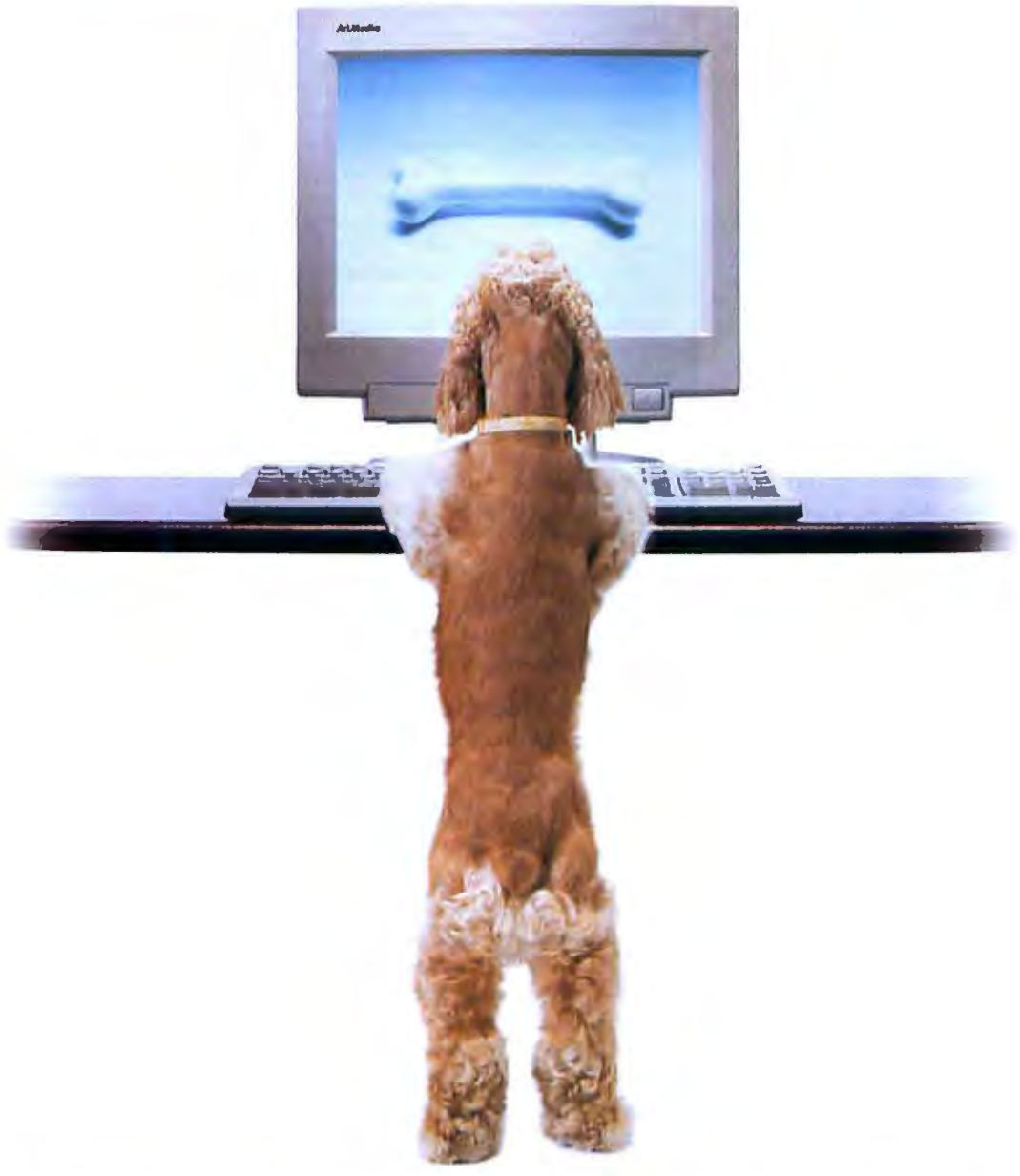

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from scratch, like Time-Warner with its Pathfinder site, can employ a fully OO database (essentially a repository of persistent objects with executable methods) like Object Design's ObjectStore as a back end, but anyone who has legacy data needs some kind of compromise formula. Proponents of pure object databases have been bickering with the relational database establishment for several years, but now such compromise looks within reach. A great strength of relational databases, over and above their ubiquity, is that they make it easy to accelerate queries using multiple processors because they retrieve data in logical sets rather than one record at a time. Their weakness is that they cannot easily handle complex multimedia objects like video and compound documents. The pros and cons of object databases are the reverse, so there should be complementarity.

Hybrid object-relational databases are now gaining support from all the leading database vendors, including Oracle, Sybase, and IBM. There are various ways you can meld object and relational databases together, including object wrappers, class libraries, and mapping toolsets.

A wrapper is an object containing a query in SQL (or some other data manipulation language) that accesses a relational database and bundles the retrieved data into the form of an object; the downside is that the wrapper will need to be rewritten whenever the database structure changes, and it may degrade performance, too. By employing a class library that separates interface from implementation, you can avoid this rewriting problem. Products like DBtools++, from Rogue Wave Software, and SQL Objects++ 2.0, from Objects++ Software, are typical, and future CORBA-compliant systems will use such libraries.

Mapping toolsets are programs that take an object model and a relational database schema and generate a layer of mapping code that converts data automatically between the two. While wrappers and libraries can normally make only "table=type" mappings (i.e., each row of the relational table becomes one object), a mapping tool can perform arbitrarily complex translations that go beyond data relationships and add value to the retrieved data. Examples of such tools include Persistence, from Persistence Software, and Object Integration Server, from Ontos.

Some object-relational database products like IBM's DB2, Informix's Illustra, and UniSQL's UniSQL/X extend a conventional RDBMS by adding support for user-defined types and functions, large and composite objects, and multiple inheritance.

There's no knowing yet which of these hybrid technologies will triumph, but whichever it is, a big part of its job will be to support transaction processing (TP). A real on-line economy cannot tolerate the haphazard way most of us currently experience the Internet, where you attempt to log on, maybe you succeed (or not), maybe you get thrown off without warning after 5 minutes. The mainframe world has been using TP for years to protect the sort of transaction you make when you draw money from a cashpoint machine, where it would be disastrous to lose contact after your account has been debited but before you've got the money. TP is a whole design philosophy for client/server systems in which a transaction becomes a contract temporarily binding a client to one or more servers, while imposing the disciplines of atomic updates, committal, and roll-back to undo unwanted actions should the transaction fail. When a transaction ends, all the parties involved must agree that it either succeeded or failed.

TP monitors are control programs that manage transactions from the point of origin, typically on the client, managing their routing, load-balancing, and restarting after failure. Mainframe TP monitors have evolved within a model of few huge servers supporting thousands of clients each, but a component-oriented future will mean many more but smaller servers, with far more complex connectivity. Future TP monitors will need to be very smart indeed, able to support long-lived transactions that cross many different servers and can spawn nested subtransactions (with a parent-child hierarchy of committals.)

Microsoft's forthcoming Transaction Server already shows a subtle evolution of the TP monitor. TS doesn't have all the features of, say, CICS, but it strikes out in some newer directions. For example, Transaction Server will help distributed applications reliably connect with remote objects, even when no transaction is being performed.

Perhaps the most suitable place for a TP monitor will eventually be right inside your Web browser. Future browsers may need to expand their functions from merely rendering HTML pages to becoming general network resource managers that can knit together remote resources of various kinds (e.g., e-mail, database queries, directory searches, calls through ORBs) and assure the integrity of transactions involving such multiple sources. Keeping

Beating the Bloat

A powerful motivator of the shift to component software is the revolt that has been brewing in corporate IT departments against the expense and difficulty of maintaining modern PCs. Currently the debate rages over whether the network computer (NC) is a viable alternative. One way you might view the contest between the NC and PC camps is as two ends of a continuous spectrum of software location.

"Local storage is just a replacement for bandwidth—it's caching," says Miko Matsumura, Java Evangelist at JavaSoft. "On a stand-alone PC (zero bandwidth) you need to store your entire universe locally, while at the other extreme (infinite bandwidth) you'd never store any code locally but get just what you need off the network."

Matsumura sees a third way to go: "Nobody today has unlimited bandwidth, but solutions like Marimba's Castanet allow you to mix and match the functions you want to store locally—a 'build your own' OS."

Castanet distributes Java software using a radio metaphor, "transmitting" programs down "channels" to a "tuner" installed on your PC. Each Java program has an associated channel, and when you first subscribe to this channel the software gets downloaded to your local disk; however, the code isn't discarded as usual when you finish using it but remains on your hard disk. Whenever an update to this software is released, patches containing just the changes will be automatically downloaded and applied next time you tune to the channel. This mechanism can equally work for data updates, like changing stock prices or news items. After using Castanet for a while you'll find just the data and programs you use a lot have become stored on your local hard disk, though much more is still available on the Web at the cost of a little more download time; it's a kind of persistent caching (similar in principle to the way that America Online distributes its screen graphics). Microsoft and Netscape have made deals with the PointCast on-line news network, which offers a roughly similar kind of service, and this may figure into Microsoft's Zero Administration initiative.

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the TP code at browser level rather than OS level would make sense, since you will often want to make less secure and more lightweight connections without incurring its overhead. Traditionally building TP monitors has been a very difficult software engineering task, but that could change now that Microsoft has its own COM-based TP tool in the Distributed Transaction Coordinator, which is intended to open up transaction processing the way that ODBC has done for database access. The CORBA standard also defines transactions as part of its ORB Services, and they should be supported by most ORBs.

As networks become fatter, proper use of this technology will become key. "Much more control will be required for a future ATM-based broadband communications network," predicts Dr. Andy Hopper, director of research, Olivetti & Oracle Research Laboratory (Cambridge, U.K.). "What will need controlling will be the end points (i.e., browsers and servers) and the data streams themselves. A promising way of doing this is to provide a CORBA-compliant interface to the network. Because CORBA is also available for use with most computer operating systems, this would allow the whole telecomm system to be orchestrated in a consistent way. Present Web browser technology cannot exploit the richness of such a high-speed network, and by introducing CORBA and appropriate quality-of-service control to the endpoint software, better and fancier use of resources will become possible—for example, live video and audio streams as part of the user interface."

Who Pays? And How?

In the future you will get more and more of your software components over the network, but the software industry cannot survive by giving it all away for free. Unfortunately, much of the work in developing e-commerce is appropriate only for making major purchases like an office suite. For new-style applets or information bites, the cost of validating the transaction is likely to be far larger than the sum transferred.

A research group at Digital Equipment is working on one elegant solution, a lightweight commerce protocol, called Millicent, that has overhead low enough to handle transactions of less than a cent. The key to Millicent is that every vendor issues its own private digital cash, called scrip, which it can authenticate locally (i.e., without having to call a bank or credit card bureau) since the vendor issued it itself. You buy the scrip that you will spend from a broker who buys and sells the scrip of many different vendors. You settle your account with your broker in real cash, by which time your many small purchases have accumulated into a sum big enough to eat up the transaction overhead. Vendors will have to settle accounts with only a handful of brokers rather than with thousands of customers, and you will have to deal only with one or two brokers instead of dozens of different vendors. Millicent employs a simple cryptographic key system that provides a reasonable level of security, adequate to the small sums transferred.

Meanwhile SunLabs is working on JavaWallet, a software framework that can incorporate and organize all these different types of electronic commerce and consolidate all their bills into one; you might use Millicent for micropayments and Secure Electronic Transactions (SET) for big purchases. JavaWallet would let you set a limit (say, $10), and it then rings a bell when you've spent that much during casual browsing.

Think Small and Think Net

One thing is now certain: Software will get smaller, more modular, and more network-oriented. That said, the future of software that I've outlined here is subtly different from the road maps that the major software vendors were following even a year ago. We were promised distributed OSes that would let you construct applications consisting of communicating objects running on many different machines. That hasn't happened yet, and maybe it never will. What has intervened is the notion that in most cases it's easier to just move the software to where it is needed—the downloadable component. This idea was sparked off by Sun's Java language, originally developed for use in TV set-top boxes rather than PCs, and it's been fanned into flame by the popularity of the Web. All the preparation that's gone into distributed objects is not wasted, though, as components use essentially the same technology of compound documents, embedding, and containers. The result should be better, more manageable software, easier maintenance and cheaper computing, and a new level of transparency in network communication.

The only thing that might hold up the spread of "components everywhere" is the lack of sufficient Internet backbone bandwidth to satisfy all the new demand that will be created, and that factor is beyond the control of all but the largest telecom companies. In the meantime, having to treat bandwidth as a scarce resource will favor the small and the clever, which is no bad thing. B

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

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Jon Udell

Web Project

JavaScript Revisited

JavaScript, though still not completely solid, offers help for making clients smarter.

When Rex Baldazo wrote an installment of this column back in August 1996 (http://www.byte.com/art/9608/sec9/art1.htm), he concluded that JavaScript was "a frustrating work in progress." I agreed and held off deploying JavaScript on The BYTE Site. Because JavaScript was buggy and not universally available, I've kept our site in pure HTML mode—until now.

Times change. JavaScript today is less buggy and more available. I can't give it an unqualified thumbs-up yet, but now there are some compelling reasons to use it. JavaScript (like its isomorphic cousin, VBScript) is really a natural extension of HTML. When you load a page with JavaScript enabled, the browser reflects all the objects on the page—frames, links, form widgets—as a corresponding set of JavaScript objects.

The result is an HTML page with extra smarts. Scrolling marquees are a silly way to use that intelligence. Site navigation and form validation, on the other hand, are two extremely practical uses, which I'll explore this month.

BYTE Site Finder

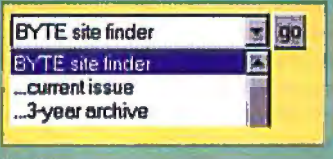
I've replaced many of the static links on our home page with a JavaScript-aware pick list. You've seen lots of these around on the Web—an HTML SELECT widget coupled with a "go" button. Drop down the list, pick the area you want, and click on go to load the page. It's a nifty way to conserve precious screen real estate; I may even regenerate our on-line archive to include an instance of this widget on every page.

This jump widget doesn't require JavaScript. You can do it in straight HTML, with the help of a CGI script (see the figure "Finder version 1: Pure HTML/CGI"

PHOTOGRAPH KELLIE WALSH © 1997

Three Versions of the BYTE Site Finder

Finder version 1: Pure HTML/CGI



In this version, the go button is handled by the server, which returns an HTTP location header that refers the browser to the target page.

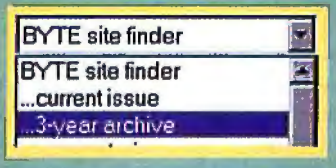
The form:

```
<form name="jumpform" action=
"/cgi-bin/goto.pl">
<select name="jumplist">
<option value="http://www.byte
.com/"> BYTE site finder</option>
</select>
<input type="submit" value="go">
</form>
```

The CGI script:

```
require 'cgi-lib.pl';
&ReadParse(*input);
print "Location:
$input{'jumplist'}\n\n";
```

Finder version 2: Pure HTML/JavaScript

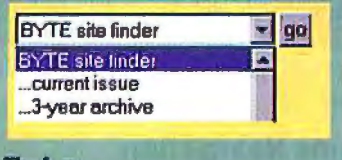


In this version, there's no CGI script and no button. The SELECT widget's onChange handler does the referral directly. This method is lots faster if JavaScript is available, but won't work otherwise.

The form:

```
<script language="JavaScript"> <!-- // cloak
function gotoUrl(url) { location = url;  } // uncloak --> </script>
<form name="jumpform"><select name="jumplist"
onChange="gotoUrl(document.jumpform.jumplist.options[document
.jumpform.jumplist.selectedIndex].value)">
<option value="http://www.byte.com/">BYTE site finder</option>
</select>
```

Finder version 3: Hybrid CGI/HTML/JavaScript



If present, JavaScript dispatches to the given URL. If the browser doesn't speak JavaScript, the CGI script runs.

The form:

```
<form name="jumpform"
action="/cgi-bin/goto.pl"
onSubmit="gotoUrl(...);return
false;">
...
<input type="submit" value="go">
```

The CGI script:

```
require 'cgi-lib.pl';
&ReadParse(*input);
print "Location:
$input{'jumplist'}\n\n";
```

on page 99). The advantage of this approach is that it's guaranteed to work for everyone—even those using Microsoft Internet Explorer (MSIE) on the Macintosh or Lynx. The disadvantage is that you saddle the user with an extra round-trip to your server, and the server with an extra bit of work.

The whole point of distributed computing is to use the CPU that's closest to hand, if it can meet the need. Yes, you can refer users back to your server, which can run a program that can send back the address of the next page. But should you? Client intelligence exists so that you can *do these things locally.*

The figure "Finder version 2: Pure HTML/JavaScript" on page 99 shows the first version of the JavaScript-aware Finder. Notice that there's no go button, only a drop-down listbox. Why no button? I realized that there were two ways to wire JavaScript to the listbox. You can write a handler for the form's `onSubmit` event; it will run when the user clicks on the go button. Or you can write a handler for the listbox's `onChange` event. In that case, you can skip the button entirely and save the user a mouse-click.

The no-button approach was elegant, I thought, but users were quick to point out its flaws. "I have two concerns," wrote Brett Musser. "First, you need an alternate access route for those people who don't run JavaScript; second, people aren't used to pop-up menus causing actions." He was right on both counts. Although my stats indicate that over 90 percent of our audience runs JavaScript-capable browsers, you can't simply write off 10 percent of an audience. Furthermore, as Alan Shutko noted, "You're assuming that we turn on JavaScript." He doesn't, because he's concerned about security (see the text box "Could JavaScript Steal a Cookie?" at right).

The final solution (see the figure "Finder version 3: Hybrid CGI/HTML/JavaScript" on page 99) was a happy compromise. To support the non-JavaScript crowd, the button had to be there. Was it possible to overload the button so the page would give JavaScript first crack at handling it but fall back on CGI if necessary? Yes. You need only migrate the `gotoUrl` function call from the SELECT widget's `onChange` handler to the form's `onSubmit` handler. The trick is this: The `onSubmit` handler must return false to preempt the button's CGI script.

Could JavaScript Steal a Cookie?

In my March column on digital IDs, I mentioned in passing—as one reason why client certificates are superior to cookies—that certificates are more secure. I said that was so because a server could inspect a browser's request and grab a cookie that was not one that the server had placed in the browser's cookie file.

This is *wrong*, and I apologize. Here's how the mechanism actually works. Given a cookie file beginning with

```
.infoseek.com    InfoSeekUserID …cookiedata…
cgi.netscape.com NETSCAPE_VERIFY …cookiedata…
```

the browser will send InfoSeekUserID's data only to addresses matching .infoseek.com; that is, only to servers in the domain from which the InfoSeekUserID cookie was sent. Similarly, NETSCAPE_VERIFY will go only to cgi.netscape.com, the server that created that cookie.

I got this wrong because I thought that, when parsing the client's data, the server ended up with an environment that looks like this:

```
InfoSeekUserID data
NETSCAPE_VERIFY data
```

The server could get at any cookie's data by matching its name, if known. In fact, there's only one cookie-related CGI variable, HTTP_COOKIE, whose value is the concatenation of cookie entries *that match the server's domain.* Unfortunately, since the machine I happened to test on had only cookies I had put there, and no others, I got the wrong impression that the browser sent *all* cookie data, not just that matching the server's domain.

Another reason I got this wrong was that I'd been told by a hacker whose skills I respect that it was trivial to pick off unauthorized cookie data. Maybe so, but it's not as trivial as you might think. Out of curiosity, I tried to see how I could steal unauthorized cookie data. I got as far as the following three steps:

1 I noted that JavaScript can do file:/// URLs, so you can, for example, do this…

```
document.location = "file:///c:/program files/netscape/
  navigator/cookies.txt"
```

…and cause a browser to load the cookie file on a Windows box running Navigator.

2 I remembered from Rex Baldazo's column (http://www.byte.com/art/9608/sec9/art1.htm) that you can create a hidden frame. So, step 1 could occur invisibly.

3 I learned that JavaScript can call the Submit method on a Submit-button object so that a form executes all by itself when it loads.

This was starting to smell like a way to steal local files. But it's not so simple. JavaScript cannot actually build a page itself on the fly and then load that page. Nor can it grab material from the screen or write a local file. I could not find a way to get JavaScript to construct a form that pulls in a local file and then sends it somewhere.

If, on the other hand, such a form were placed on your machine in a known location by some other means, then JavaScript could load and execute it, causing transmission of a local file. Of course, if your disk's been compromised in that way, all bets are off anyway.

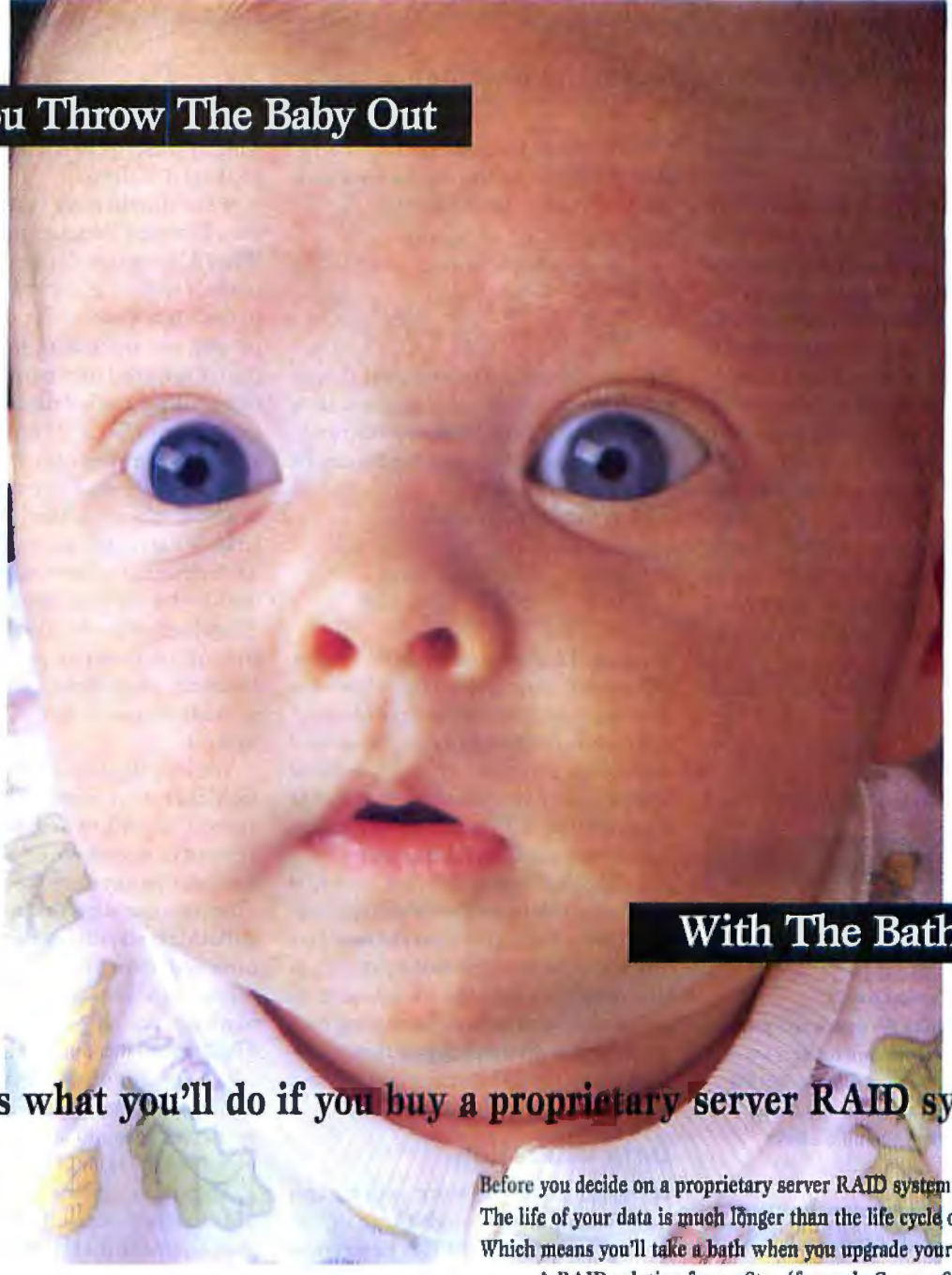
I don't think JavaScript is the security disaster some folks say it is. I still think that digital IDs will supplant cookies, but not because cookies are easy to steal. They're not. At least I don't think they are. If someone has convincing proof otherwise, I'd love to see it.

Now everybody's happy. JavaScript users get quick response, and the non-JavaScript folks get the same result a bit more slowly.

Frame Navigation

In last December's column (http://www.byte.com/art/9612/sec9/art2.htm), I demonstrated how to use HTML to create a two-pane, frame-based display that's synchronized in both directions. You can see this at work in the Web views of our site's conferences. Clicking on links in the index pane loads the message pane, as you would expect. Clicking on Next and Prev in the message pane causes the index pane to synchronize to the current message. (This is something that you might not expect, but I think it's nifty.)

In the original solution, my HTML generator created not only a unique frame page per message, but also a corresponding unique frameset page per message. This was wasteful because it created a large



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number of little files, but manageable because it was all automatic.

The problem was that it was always necessary to reload the whole frameset. This created an annoying flicker, but it was otherwise OK, so long as the index page stayed in cache. But the conferences outgrew that method, and the index began to tediously reload on every Next or Prev action.

The answer? JavaScript to the rescue, as one reader wisely suggested. I stuck with my original solution as long as I did because it was 100 percent pure HTML, and thus browser-independent. But that became counterproductive. I decided to tweak the HTML generator to emit the JavaScript that's needed to reposition the index when you click on Next or Prev from a message page in frame view.

Here's how the old Prev link worked:

```
<a href="fi001.html"
   target="_top">[Prev]</a>
```

If you clicked on this link from message 2, the frameset for message 1 would replace the entire contents of the browser's window. Here is that frameset:

```
<frameset cols="35%,*">
<frame src="fthreads.html#001"
   name="indexpane">
<frame src="fmsg0001.html"
   name="docpane">
```

It means, "In the index pane, load (hopefully from cache) the index page and then set message 1's header to top-of-frame. Load message 1 itself into the document pane."

Here's the new Prev link:

```
<a href="fmsg001.html"
onClick="parent.indexpane
   .location='fthreads.html
      #001'">[Prev]</a>
```

It means, "Load message 1 into the current (document) pane and tell the other pane to set message 1's header to top-of-frame."

This way is subtly different. Now there is only one document being fetched and loaded—the new message. The frameset page remains, so it's possible to reposition it without causing any disruption.

Unlike the Finder, this new feature is not transparently available to non-JavaScript browsers. Those users just won't see any adjustment of the index pane when they move forward or backward using the document-pane controls. Since many people probably wouldn't expect that behavior anyway, I lazily argue that it's OK to not support it in the non-JavaScript case.

Data Validation

In our January cover story, senior editor Tom R. Halfhill discussed OscarCalc BallotMaker, a Java applet that he wrote to collect entries for his yearly Oscar-awards contest. When Tom asked me to host the applet on The BYTE Site, I asked, "Why is this a Java applet?" The applet presents forms, validates them, and stores data for later analysis.

HTML/JavaScript offers a simpler, faster way to get the same job done. Tom wrote the applet primarily to learn about Java-based GUI programming, and it was useful in that regard. But after I hosted the applet on our site, I decided to compare the Java solution to an equivalent HTML/JavaScript solution.

I had always relied on CGI for validation, never JavaScript. The JavaScript code to validate the HTML/JavaScript BallotMaker is quite simple because the bulk of the validation can be accomplished by iterating through the elements array in which JavaScript enumerates the form's 24 SELECT widgets.

What should have taken a few minutes, however, stretched to over an hour. Why? A Navigator 3.0 bug. On my first attempt, I wired the `validate()` function to the form's `onSubmit` event without passing any arguments. Inside the function, I referred to the form's elements using fully qualified names (e.g., `document.oscarform.elements[0].options.selectedIndex`). This should have worked—and, in fact, it does work in MSIE—but it confused Navigator horribly. What finally did work was to pass a reference to the form as an argument to the `validate()` function.

Squirrelly behavior like this prevents me from recommending JavaScript wholeheartedly. Nonetheless, when JavaScript is an appropriate solution, it makes sense to use it.

The HTML/JavaScript version of BallotMaker is far simpler than the applet version. There's an irreducible minimum amount of information required for BallotMaker (or any form-based application). That information is the form itself. Since BallotMaker's job is merely to display the form and transmit its results, the optimal solution adds as little coding as possible to what's required to create the form itself. The BallotMaker applet's HTML wrapper uses a long list of `<param>` statements to define the form widgets that the applet renders. These add up to nearly the complexity of the HTML/JavaScript form.

Then there's the applet itself—a chunk of Java code to render the widgets and send their output. In the HTML/JavaScript case, once you've enumerated everything in the form, you're done: You've got the data-collecting and data-transmitting widgets. No need for a separate program to do that.

The public Web applications that I rely on to do my daily work, as well as the ones I create, expect no client-side intelligence. Java can deliver a lot of local smarts, but today you and your users pay a price: slow development and heavy resource drain. JavaScript creates an important middle ground. It delivers enough local smarts to solve certain important problems—notably navigation and form validation—yet plays comfortably to the majority of the installed base. 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.**

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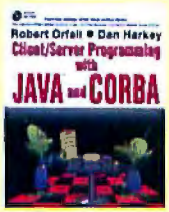

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When the new Netscape clients and servers hit the streets, there will be a stampede for information about how to use the embedded Java ORB. Here's the tutorial you'll want. It's an authoritative discussion of Java-based CORBA programming vis-à-vis sockets, CGI, RMI, and ActiveX/DCOM, plus lots of sample code.

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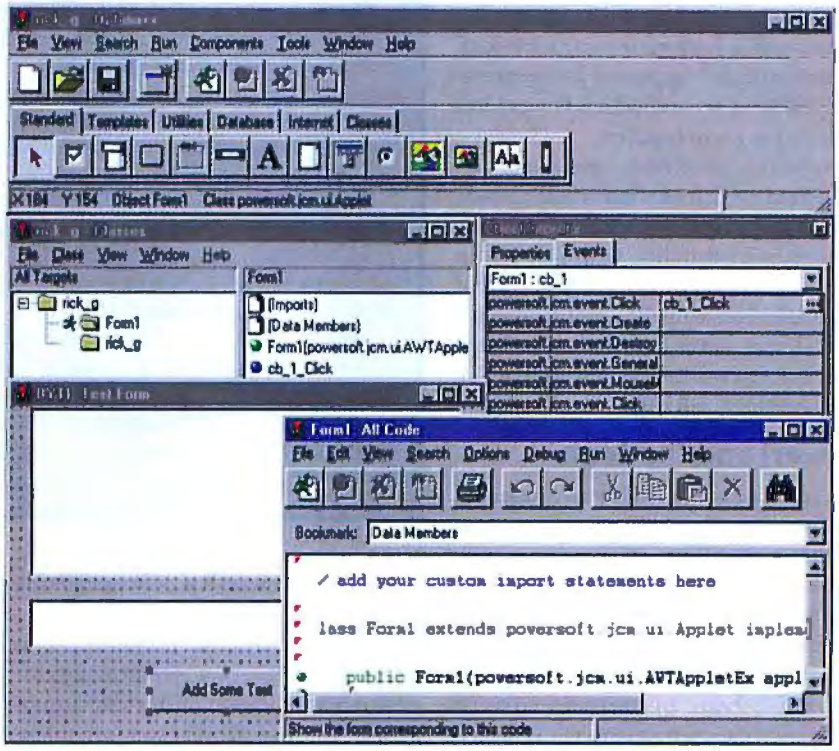
Optima++ developers will feel at home in Powersoft's PowerJ for Java.

The notion of an integrated development environment (IDE) as a host for multiple guest languages is not new. Both Microsoft and Metrowerks have leveraged off IDE reuse. Microsoft's Developer Studio will accept C/C++, FORTRAN, and Java. Metrowerks' CodeWarrior accommodates C/C++, Pascal, and Java. PowerJ, Powersoft's new Java IDE, doesn't yet let you build in both Java and C++. But it leverages technology from the company's Optima++ and provides a hint of a future Java/C++ IDE.

PowerJ wears an Optima++ coat with Java inside. In case you're not familiar with Optima++ (see "Client/Server C++: Write Fast, Run Fast," March BYTE), it's a C++ client/server IDE that is Powersoft's answer to the likes of Blue Sky's Visual SQL, Microsoft's VC++ EE, and Borland's C++Builder. For now, PowerJ is Powersoft's answer to Java-centric IDEs such as Microsoft's J++, Symantec's Visual Cafe Pro, and Borland's soon-to-be-released Visual JBuilder. But a future PowerJ may add C++ as well.



PowerJ is the spitting image of Optima++. Notice that—in this prerelease version—the IDE still thinks it's Optima++.

Optima++ Outside, Java Inside

On the surface, PowerJ looks and works much like Optima++. Its application construction uses the ubiquitous "form with tool palette" paradigm. The prerelease version of PowerJ I tested had about two dozen components on the tool palette. I suspect there will be more by the time Powersoft releases PowerJ.

PowerJ includes the reference-card programmer-assistance mechanism well known to Optima++ developers. When you drag a component from the form and drop it into the source code window, the reference card opens, positioned to the list of event-handling methods that the selected object can accept. If you choose to call a method, the parameter wizard guides you through entering that method's required parameters. The parameter wizard is a kind of "active lint." It verifies not only that you have filled in all the requisite parameters, but that you've used parameters of the proper type.

PowerJ manages events for visual components in a manner that's almost an inverse of the technique that the new JDK 1.1 supports. For example, in PowerJ, when you place a button on the form, you identify which events that button will handle (e.g., click) through the button's property inspector window.

Once you've named a handler for the event, PowerJ will pour an empty skeleton for that handler into your source code. Therefore, if I had named the click handler `btn1_click`, PowerJ would write an empty `btn1_click` method into the source. I would then populate that method with the code that I would want executed whenever I clicked on that button. Typically, the code would modify data members of other objects in the form: Clear a text box, for instance.

However, JDK 1.1 uses a "delegation"

PHOTOGRAPH: KELLIE WALSH © 1997

event model, wherein events propagate from source objects to listener objects. To recast the above description in the delegation model, the button would become a source object and the text box would become a listener object. The text box would register itself with the button, informing the button that: "I want you to call this method of mine whenever you're clicked on." The code for clearing the text box, rather than appearing in the `btn1_click` method, would be written into the listbox's listener method.

This dissimilarity is ungainly but not disastrous. Even version 1.1 of the JDK's Abstract Windowing Toolkit (AWT)—which is where all this event handling takes place—will be backward-compatible with the event model supported by the previous JDK (and around which PowerJ has wrapped its event handler).

Happily, at press time, officials at Powersoft told me that its event-handling code was undergoing some rewriting, specifically to bring it in line with JDK 1.1. In any case, one of PowerJ's benefits is that it insulates you from the event model. It's unlikely that—even after the rewrite—the mechanics of working in PowerJ that I've described here will change.

PowerJ and the Bean

PowerJ is open-minded in its treatment of components. PowerJ applications can employ either ActiveX components or Java bean components. The balance is not perfect, however. Though PowerJ programs can interact with ActiveX controls, the PowerJ environment does not let you build them. In contrast, you can build Java bean components with PowerJ.

Building a Java bean with PowerJ is straightforward, as is incorporating beans into your IDE. PowerJ's documentation guides you through the necessary methods and properties you must incorporate into your bean. Once your bean is built, programmers can add it to their palette of components, at which time they can treat the bean the same as PowerJ's supplied components (i.e., the bean's object inspector provides access to the bean's properties, and its methods and parameters are available to the reference card).

However, PowerJ has only partial true bean support. Specifically, it does not support the Java bean customization class (as defined in JDK 1.1), which provides for design-time modification of a bean's properties. Nor does PowerJ support "pickling" a Java bean, which means adding persistent storage of a specifically configured bean for later use. (Pickling is dependent on the customization class. Without the latter, you cannot have the former.)

None of this means that you cannot modify PowerJ beans at design time, nor pass them from one PowerJ project to another. However, PowerJ beans may not be fully compatible with JDK 1.1 beans. (I say "may" because the 1.1 specification is still in beta testing as I write this.) I was told that the PowerJ engineers are considering support of customization classes and pickling, so they may be in PowerJ now.

On the Launchpad

Powersoft expects to ship PowerJ in this second quarter, and it will be available on Windows 95 or NT 4.0. Additionally, the release version will provide client/server development tools not yet in the version I saw, including jdbcConnect—which provides a "thin-client" Java Database Connectivity (JDBC) API—and NetImage Dynamo—a server-side product that can accept SQL queries passed in from a Web server, process them against any ODBC database, and return an HTML-formatted query result.

PowerJ is an admirable Java IDE. Anyone familiar with Optima++ will slide easily into the PowerJ seat. Furthermore, PowerJ and Optima++ share identical IDEs. The company says that it may integrate the two products into one environment. If this happens, you could use the same environment to build either C++ or Java code. B

WHERE TO FIND

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Visual Java Models

As Java continues to mature, all sorts of side projects are evolving around the language, including a standard for visually modeling Java programs. This is the idea behind the JG visual-modeling language, which is the brainchild of Kari Kaitanen of the Technical Research Centre of Finland, a government-sponsored research organization that investigates everything from industrial to information sciences.

JG is still in the birthing stage. Kaitanen maintains a Web site that includes a good description of JG, several sample JG diagrams applied to example programs, and a questionnaire. Kaitanen is (as of this writing) still soliciting feedback on the JG notation, though he told me he doubted the design would change much from what was on the site in early March. (You can find the JG Web site at http://www.vtt.fi/cic/java/java-g/.)

The JG visual-modeling language is a database description language (DDL) for Java programs. Because it is a DDL, JG is geared toward producing visual descriptions of Java data components: classes, class relationships, objects, and data structures.

The JG specification includes standardized notations for interfaces, classes, objects, instance data, object and class relationships, and the other data-centric entities in a Java program. Note that the emphasis is on Java. JG is not a general-purpose DDL. (JG is based on Express-G, a general-purpose modeling language defined by the ISO.) It was its designer's intent that JG have such a close affinity with the Java language that you cannot model anything in JG that you cannot implement in Java. Conversely, you cannot write any Java code that you cannot model in JG.

Because JG models only data, it provides only a kind of static snapshot of one aspect of a Java program. That is, though you can use JG to specify the methods within a particular class, it provides no syntax for describing the behavior of those methods. This limitation isn't a character flaw within JG. Rather, it's the result of JG's being a DDL. JG is not designed to describe behavior, only data structure.

Nevertheless, this points out a missing adjunct to JG that program designers would need to be able to completely specify a Java program. Indeed, Kaitanen is already thinking about adding some type of dynamic model to accompany JG. He hopes to soon begin work on a dynamic-modeling language built on the best ideas derived from existing modeling techniques. What the final result looks like remains to be seen. I shall be watching the JG Web site closely.

Rick Grehan is an editor at Computer Design *magazine in Nashua, New Hampshire. He writes BYTE's Javatalk column and until recently was a BYTE senior technical editor. You can contact him at* **editors@bix.com.**

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BY-597

NT servers challenge Unix systems on intranets—and prove equal to the task.

By Robert L. Hummel

Multiprocessor Intranet Servers

The mainstreaming of Internet technology into everyday applications is fueling a radical transformation in corporate information systems. The Internet has given birth to intranets, which clearly will figure prominently in your network's future.

As intranets begin to grow within an enterprise, they demand resources that can strain existing network infrastructures. True, you can splice casual intranet service onto most any existing system if performance isn't your primary goal. But proper support for Web-based information technology requires an investment in new servers, optimized to process URL requests, deliver HTTP documents, serve FTP and mail, and perform other Web-related tasks.

Browsers are nearly standard equipment for any serious operating system. Whether for configuration, intranet navigation, or venturing onto the Web, the browser is evolving into an indispensable tool. And if you believe even part of the fanfare surrounding Java, your browser will soon be the interface to all applications. So what exactly does your network need to satisfy all this browsing?

Makers of high-end servers are racing to provide part of the answer. For this Lab Report, we decided to sample and evaluate symmetric multiprocessor (SMP) systems and determine how suitable they are to the emerging role of intranet servers.

The six systems we tested are from manufacturers that already have solid reputations in the server market: Compaq, Digital, Hewlett-Packard, Intergraph, Sun, and Silicon Graphics. During our evaluation, each of these systems proved itself quite capable. We exercised them in the role of both high-load intranet servers and in the more traditional functions of database servers.

The first three systems—the Compaq ProLiant 5000, HP LX Pro 6/200 SMP, and Intergraph InterServe MP-660—are quite similar. Each is built around four Intel Pentium Pro processors in a fairly standard Intel-architecture implementation. These machines came with Microsoft Windows NT Server 4.0 installed.

BYTE BEST
INTRANET SERVERS

Digital AlphaServer 4100
is the fastest Unix server as well as the best overall, turning in the top performance in both Web and database benchmarks.

Compaq ProLiant 5000 and HP LX Pro 6/200 SMP
tie for honors in the Wintel arena, both besting the Intergraph InterServe MP-660 by a hair in the Web benchmark.

The other three systems provide a challenging mix of RISC chips and different versions of Unix. The Digital AlphaServer 4100 runs OS/F, powered by four Alpha processors. The Sun Netra i 4000 server is equipped with four UltraSPARC CPUs and runs Sun's Solaris OS. Irix is the Unix of choice for SGI's quad MIPS 10000-based Origin 200 system.

Heavy Hardware

At first it seemed natural to segregate these half-dozen servers into two categories based on their processor architecture and operating system. But as we discovered, these six machines are similar enough in performance to make such distinction artificial.

The goal of our evaluation was to rank the hardware: Specifically, we wanted to see how the multiprocessor intranet server behind the IP connection played. Typically, computers like these sit on a large corporate intranet, serving and searching a large collection of in-house documents. To handle those tasks, we specified a base server configuration built around four high-end CPUs configured for symmetric multiprocessing. Each system came equipped with 512 MB of RAM.

Because we didn't want the hard-disk subsystem to become an artificial bottleneck and bias the test results, we requested that each system come with at least 10 hard drives holding 2 to 4 GB each. We specified that they be configured as a five-drive striped data set and mirrored—an unexceptional setup for a high-reliability server.

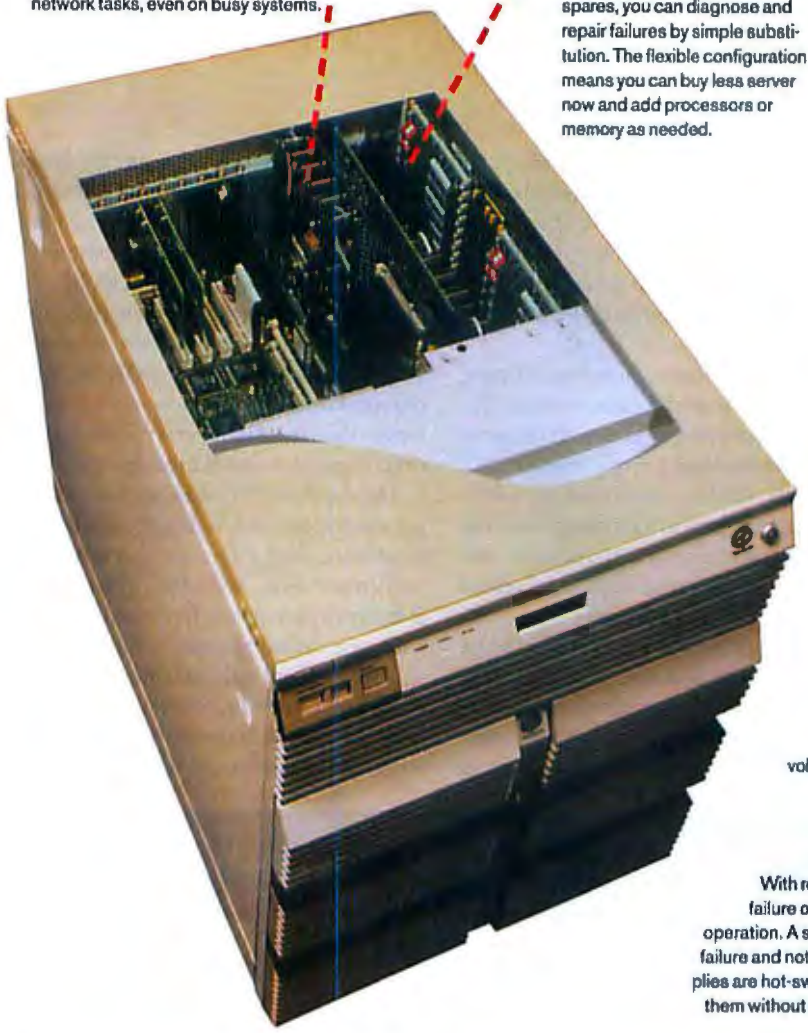
The unfettered flow of network traffic is obviously a key part of any intranet system. To ensure that we had more than adequate bandwidth to carry our Web activity, we specified that each machine be equipped with two 100Base-TX Ethernet ports. Clients were split evenly between the two backbones during our testing.

Beyond these minimum and necessary criteria, we allowed each manufacturer leeway to configure the system as it felt an intranet server should be equipped. This led to much customization and an interesting variety of elective equipment, as described in the features table on page 114.

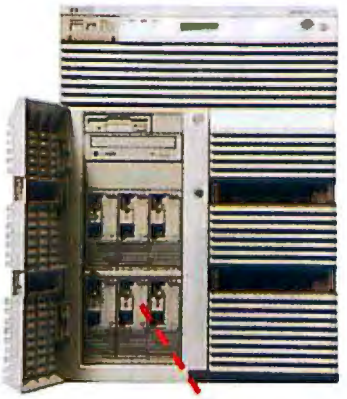
Among the optional equipment that

CPUs
Symmetric multiprocessing means there's plenty of power to rapidly service a huge number of Web requests and associated tasks. Packing in four CPUs leaves enough capacity to handle mail and other network tasks, even on busy systems.

DAUGHTERCARDS
Putting processors and memory on removable cards makes sense. By stocking populated spares, you can diagnose and repair failures by simple substitution. The flexible configuration means you can buy less server now and add processors or memory as needed.

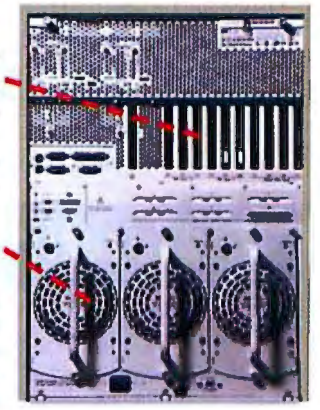


FRONT PANEL



DRIVE SUBSYSTEM
Large, fast hard drives provide the storage required for HTML documents, mail, databases, and other server-based information. To protect critical data, the drives are both striped and mirrored. Hot-swappable drives can be replaced in the disk array without taking the server off-line.

BACK PANEL



HIGH-CAPACITY BACKBONES
Twin 100-Mbps network ports ensure that a high volume of Web requests can be accommodated.

RELIABLE POWER
With redundant power supplies, failure of one supply cannot affect operation. A smart server will detect the failure and notify the operator. If the supplies are hot-swappable, you can replace them without ever turning off the server.

distinguished some systems were hot-swappable redundant power supplies, a built-in UPS, and a fiber-optic link. Physical form factors also varied widely, from a 6-foot-tall rack-mount system to a double-wide floor model to linked pairs of aerodynamic indigo towers.

As a direct result of this variation, prices for these servers ranged widely. The features table enumerates the details on each configuration; you'll have to decide if the extras justify their cost.

We didn't test systems from ALR, HP (PA-RISC), IBM (RS/6000), or NetFrame because units weren't available in time or because new models were close to introduction. Polywell supplied a system, but we were unable to get it running in time.

More Than Speed

Speed is an easily understandable metric, and it's natural to want the fastest performance possible. These quad SMP servers are, by definition, destined for heavy-traffic environments. Speed will obviously figure heavily in your decision. We found an 89 percent difference on the Web benchmark between the fastest and slowest members of our testing group. On the database test the spread was about the same, with the slowest system taking about 86 percent longer to complete the job than the fastest system.

In the real world, raw performance is weighed against costs. Bang for the buck in a pure HTML environment means serving the largest number of URL requests for the least amount of money in the shortest period of time.

A final, but by no means trivial, consideration is that of architecture and OS. Despite the generally heterogeneous nature of a typical network infrastructure, systems are not necessarily interchangeable on a practical basis. To install and manage your server, you'll need one or more experts who are familiar with the OS and architecture you choose. Developing or acquiring this expertise is often expensive.

Unless your business is a dedicated Unix shop, an NT-based server may offer a cost-effective solution for intranet serving applications. Despite its shortcomings in many areas, the general familiarity of NT Server, its growing role as a part of heterogeneous networks, and its more limited configuration options make it worth considering as a solution in this role.

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Best Overall

INTRANET SERVERS

To determine our Best Overall winner, we relied primarily on performance as a selection criteria. The indisputable champ was the Digital AlphaServer 4100, which turned in the overall best results in both tests—but only by a nose.

In the Web test, for example, we measured how fast the servers could satisfy a collection of URL requests. Under our heaviest load (5600 URL requests), the AlphaServer, LX Pro, and ProLiant servers came in first, second, and third, respectively, representing a spread of only 1.5 seconds. This difference amounts to less than 5 percent of the overall execution—an amount that we consider to be a statistically insignificant variation. Clearly, any of these systems will provide excellent performance.

Of the remaining systems, the InterServe MP-660 claimed fourth place, taking about 5.5 seconds longer than the ProLiant to complete the 5600-URL test. The Sun Netra and the SGI Origin required nearly twice the time of the other servers, trailing the leader by 26.8 and 30.3 seconds, respectively.

The elapsed time required to complete the Web test is a valid measurement. But equally interesting is how well the server accommodates a rising level of URL requests. All the servers we tested responded similarly to increasing loads. For each 700 additional URL requests, for example, the time to complete increased on average by 3 to 4 seconds.

The AlphaServer again proved to be the performance leader in the database test, besting its nearest competitors by 25 percent in both single and queued query conditions. Second place was split among the NT/Intel-based servers: the LX Pro, the ProLiant, and the InterServe MP-660. Not unexpectedly, all three turned in nearly identical times in the database test under all loads. The Netra and Origin 200 posted the slowest times when asked to perform four or more database queries. To process 12 queries, the Origin 200 required over 367 seconds—86 percent longer than the AlphaServer and 40 percent longer than the Wintel systems.

The database test measures both computation speed and, indirectly, the overhead associated with each system's SMP implementation. With four CPUs available, we expected that the time to process from one to four requests would be fairly close, with all tasks able to run simultaneously. Generally, this was true. However, the Origin 200 was the exception, with times increasing from a speedy 69

Interpreting Performance

We measured the performance of these servers by sending them a number of tasks and timing how long they took to complete the exercise. Between tasks, we rebooted the servers, thus the time for the server to come up to speed on the tasks, filling caches and so on, figures heavily in the scores.

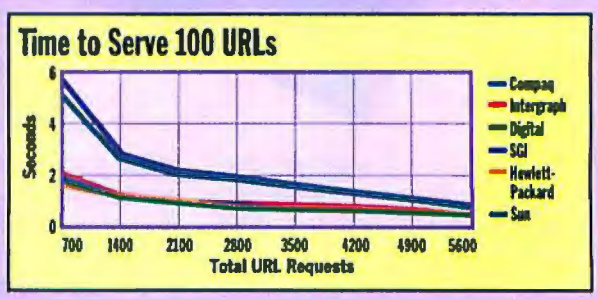
Under normal conditions, servers aren't usually run in such a one-shot mode of operation. Once they're up, they stay up and running. The measure of their performance indicated here, therefore, must be tempered by how they react to increasing work loads. To more effectively cast the results in this light, we've transformed the testing results from time to complete to time per task.

In the database test, for example, we've divided the total execution time by the number of queries. As the graph shows, when the servers are fielding more than four queries, the time required to process each additional query is essentially a constant low value.

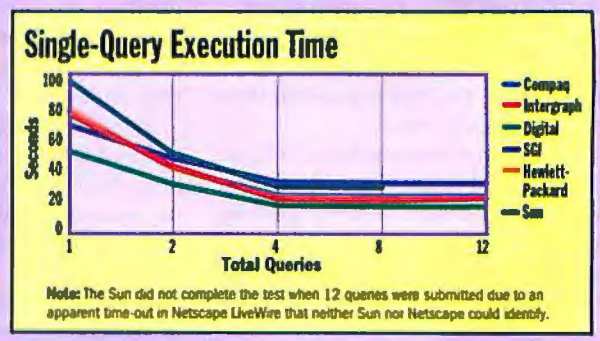
A similar situation occurs when the average time to serve 100 URL requests is derived from the Web test data. As the number of URLs served increases, the start-up overhead of the test becomes less significant. The response to additional requests again becomes a proportionate increase in time.

Both Sun and SGI were at a loss to explain the extra 20 seconds or so that their servers took to handle each Web test compared to the other machines in the review. If you don't count this "start-up" time, the servers responded similarly to increasing load. In this case the SGI required only 3 seconds to handle each additional 700 URLs—the least time of any machine in this review. For the same increase in load, the Sun required the longest additional working time: 4.17 seconds.

The bottom line is that these servers like to work hard. The more you load them up—until you hit a bandwidth limit somewhere else in the system—the more efficiently you use them.



Once a server begins to deliver a heavy load, its performance suffers little from start-up overhead.



When all four processors are kept busy, the time to process additional queries is relatively constant.

LAB RESULTS

INTRANET SERVERS

BEST UNIX/RISC and BEST OVERALL

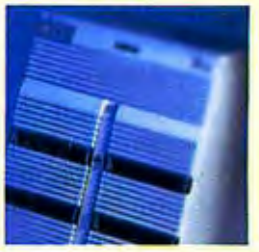
Digital AlphaServer 4100

The AlphaServer is the best of the bunch. It outperforms the other systems consistently, although not by a great margin. Among Unix boxes, it is the clear winner, but it does get some stiff competition from the Wintel side. Compared to the Wintel servers, the AlphaServer is a questionable call on a cost-benefit basis. It delivers only a slight throughput advantage at nearly triple the price of the least-expensive Wintel box.

BEST NT/INTEL

Compaq Proliant 5000 and HP LX Pro 6/200 SMP

The ProLiant and LX Pro turned in results that were practically identical in both the Web and database tests, edging the Intergraph InterServe MP-660 out of a three-way tie in the Web test. The Compaq and HP machines are serious and cost-effective competition for the AlphaServer 4100.



	PRICE	TECHNOLOGY	IMPLEMENTATION	PERFORMANCE	FEATURES	USABILITY	OVERALL RATING
Digital AlphaServer 4100	**$113,201**	★★★★	★★★★	★★★★★	★★★★	★★★★	★★★★★
HP LX Pro 6/200 SMP	$49,300	★★★★	★★★★	★★★★★	★★★★	★★★★	★★★★★
Compaq ProLiant 5000	$41,724	★★★★	★★★★	★★★★★	★★★	★★★	★★★★
Intergraph InterServe MP-660	$70,500 *	★★★★	★★★★	★★★★	★★★★	★★★★	★★★★
SGI Origin 200	$83,310	★★★★	★★★★	★★★	★★★★	★★★	★★★★
Sun Netra i 4000	$143,595	★★★★	★★★★	★★★	★★★★	★★★★	★★★★

★★★★★ Outstanding ★★★★ Very Good ★★★ Good ★★ Fair ★ Poor * with monitor

seconds for a single task—second only to the AlphaServer's 51 seconds—to the slowest response of 123 seconds for four tasks.

As the number of tasks was increased to eight and 12, the time required to complete approximately doubled and tripled for each system, respectively. Under heavy loads, both the MP-660 and the Netra i 4000 dropped behind the rest of the pack. A time-out in the Netscape LiveWire program expired before the Sun system could complete processing 12 queries, so we were unable to record a finish time.

NT Comes of Age

Windows NT has suffered from a second-class image when compared to Unix servers. And traditionally, differences in OS and server software have made it difficult to compare the two. But using Netscape Enterprise Server as a common test platform allowed us to minimize the distinction and concentrate on the effect of the processor architecture and the OS on overall system performance.

When we pitted these machines head to head, we were somewhat pleasantly surprised to find that the NT/Pentium Pro combination was potent competition for the Unix systems. After years of playing the bridesmaid to RISC/Unix, Wintel boxes are showing that they can hold their own in the intranet server field.

The three Wintel servers we tested in this Lab Report are all powerful, sporting quad processors and wide network bandwidth. Each is quite capable of running your intranet Web service with plenty of muscle left over for mail and other background tasks. And the combination of processor power, plenty of RAM, and huge disk arrays equips them to speed through large database tasks with capacity in reserve.

Other Considerations

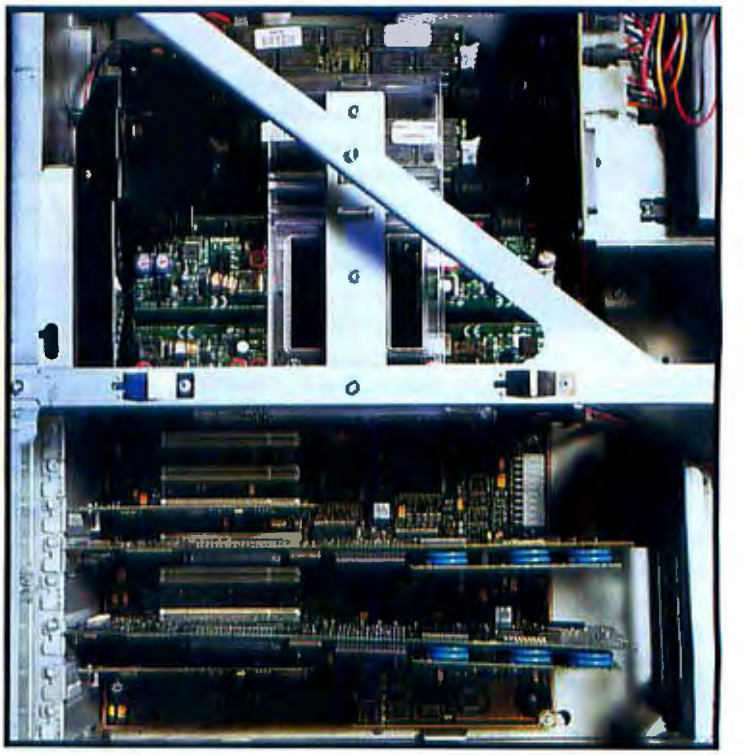
With performance between the systems comparable, price will take on a more significant role in any purchase decision. But there are other factors, both subjective and objective, that you should take into account when selecting one server over another.

Before adding a Unix server to a predominantly Windows NT network, for example, you'll have to weigh how much expertise your company has with that particular brand of Unix, RISC architecture, and system vendor. Acquiring operational expertise can be an expensive proposition, especially when you consider the investment you'll have to make in setting up, tuning, and maintaining the system. You may also have to spring for a new suite of development tools and applications.

On the other hand, even dedicated Unix shops should consider the less-expensive Wintel servers as alternatives to new Unix servers. Chances are good that some form of Windows already has a significant presence on your network in at least a client role. In that case, making the transition to NT Server isn't such a big leap.

Reliability is also something that's difficult to benchmark. But how valuable is a really fast server that doesn't stay up when you need it? Characteristics that contribute to reliability include the ability to swap failed components, including power supplies and hard disks, without bringing the system down. And even if you can't swap things like CPU, RAM, and network cards, being able to go inside the box and easily replace a bad component is important, because you know you'll have to do it someday.

Details



Bar the Door

The Compaq ProLiant 5000 makes extensive use of daughtercards. Two cards hold a total of 16 sockets for memory expansion. The CPUs are held on two more cards, packed two processors per card. These cards are locked in under a bracketed see-through plastic hold-down. Plan your upgrades carefully, as you'll have to work hard to get at these cards.

Rugged Good Looks

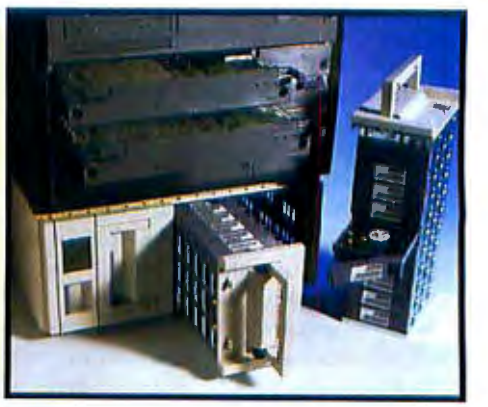
The interior of the HP LX Pro will look familiar to anyone who's ever peeked into a desktop PC. But the construction of the LX Pro belies HP's heritage of commercial test equipment. The machine is ruggedly built and uses modular technology where appropriate, yet it provides easy access to components.

The HP also makes use of dual-CPU daughtercards. A third card holds 16 memory sockets, all of which were populated in our review unit. A dedicated fan blows air in the general direction of this expansion cage.

Plug and Play

The Sun Netra i 4000 may be the ultimate in modular design. If you're used to the open nature of Intel-based systems and enjoy poking around inside your server, put away your screwdriver. Be warned that the Sun should be stamped "No user-serviceable parts inside."

Other than perhaps adding memory, the Sun's construction clearly discourages tinkering. On the other hand, if you own enough Netra systems, you can stock a variety of spares for each of the critical modules. Potential server downtime is thus reduced to the time it takes to unlock, swap, and lock.



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Test Specs

We tested using two different patterns of Web and processing activities. A combination HTTP/FTP test determined what to expect in a Web-oriented intranet capacity. We used a second test, consisting of large database queries, to examine each server's ability to perform large-scale data management and manipulation.

Servers must have clients, so we built a test bed of eight dual-Pentium Pro (200-MHz) systems. Each client was equipped with 64 MB of RAM, a 3-GB hard disk, a 100-Mbps Ethernet interface, and NT 4.0. The clients were divided into two groups, four systems connected to each of the server's 100-Mbps backbones.

Three systems ran standard NT Server, while three ran different versions of Unix (Irix, Solaris, and OS/F). To level the playing field, we employed Netscape Enterprise Server 2.01 as the core Web software. FTP server software was the exception; the standard OS release was used. Netscape LiveWire Pro, which includes the Informix database system, sat on top of Enterprise Server. Netscape Mail Server handled all mail service.

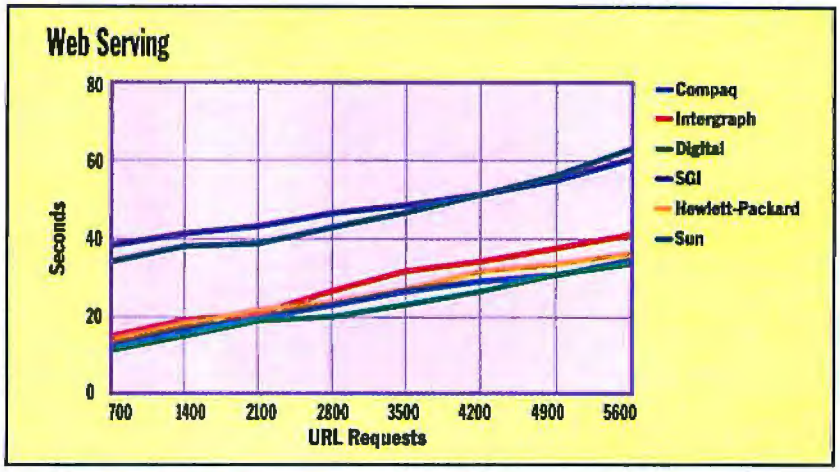
Installation defaults were left largely unchanged. We made minor adjustments to tune the system for database or Web service activities as appropriate. We configured Informix shared memory to provide a reasonable balance of allocation of primary memory between Informix and other OS-related activities. Likewise, we modified processor and thread limits for each of the two test scenarios.

In the first scenario, we examined server performance under a Web load. Each of the eight clients executed from one to eight concurrent tasks. Each task in turn requested a series of URLs (95 percent HTTP, 5 percent FTP) from the server. The requests were made into FTP and HTTP trees encompassing several thousand files that filled over 200 MB of disk space. The entire tree was cached in system memory—a situation not uncommon in large server installations.

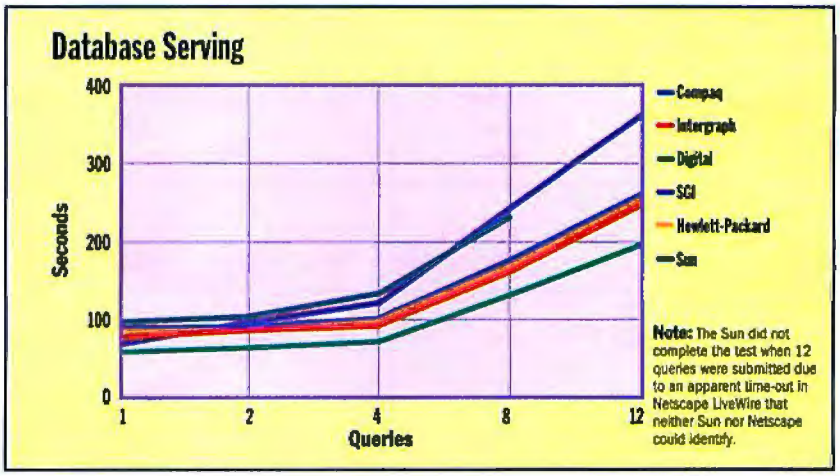
The Web test determined the server's ability to create and break network links, search cached file data, and transport information from memory to the network interfaces. We use standard "keep-alives" to simulate realistic browser interaction patterns. During all tests, a moderate, nonmetered mail processing load was placed on the server. This load represents common background noise and external server activities.

Our second scenario treated the servers as back-end database servers fielding complex queries into a midsize, highly cacheable database. A single query sorted, indexed, and summed a one-million-record database.

We configured all four processors in parallel, allowing Informix to dominate the system. We ran the test with one, two, four, eight, and 12 concurrently initiated queries. Ideally, execution times for one, two, and four queries should be identical. Any increase in time represents OS or system overhead.



The time required to serve the URL requests increased linearly as more load was added to the system.



Service is speedy when the systems are running up to four queries. Beyond that, time increases proportionally.

Evaluations in this report represent the judgment of BYTE editors, based on tests conducted by NSTL, Inc., as documented in a recent issue of their 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.*

INTRANET SERVERS FEATURES

	Compaq Computer Corp. ProLiant 5000	Digital Equipment Corp. AlphaServer 4100 5/400	Hewlett-Packard Company NetServer LX Pro 6/200	Intergraph Computer Sys. InterServe 660	Silicon Graphics, Inc. WebForce Origin 200	Sun Microsystems Netra i 4000
Test configuration price without monitor	$41,724	$113,201 (list)	$49,300	(not specified)	$83,310	$143,595
Test configuration price with monitor	$42,123	$113,796 (list)	(not specified)	$70,500	(not specified)	(not specified)
Overall rating	★★★★★	★★★★★	★★★★	★★★★	★★★★	★★★★
PROCESSOR						
Model	Intel Pentium Pro	Alpha 21164	Intel Pentium Pro	Intel Pentium Pro	MIPS R10000	Ultra-SPARC
Number of processors in test system	4	4	4	4	4	4
Processor speed (MHz)	200	400	200	200	180	167
Cache bus speed (MHz)	on-chip	on-chip	on-chip	on-chip	130	167
Instruction cache (KB)	16	8 KB primary/ 96 KB secondary	16	16	32	16
Instruction cache associativity	4-way set	3-way set	4-way set	4-way set	2-way	2-way
Data cache (KB)	16	8 KB primary/ 96 KB secondary	16	16	32	16
Maximum number of processors	4	4	4	4	4	14
SECONDARY PROCESSOR CACHE						
Total installed in test system	2 MB	16 MB[1]	2 MB	2 MB	4 MB	4 MB
Standard per processor	512 KB	4 MB[1]	512 KB	512 KB	1 MB	512 KB
Maximum per processor	512 KB	4 MB[1]	512 KB	512 KB	1 MB	1 MB
Speed (ns)	on-chip	9	on-chip	on-chip	7	6
Associativity	4-way set	(not specified)	4-way set	4-way set	2-way	Direct-mapped
SYSTEM RAM						
Amount in test system	512 KB	512 KB	512 KB	512 KB	512 KB	512 KB
Standard amount	128 KB	512 KB	128 KB	128 KB	128 KB	64 KB
Maximum amount	4 GB	8 GB	2 GB	4 GB	4 GB	14 GB
Speed	60 ns	60 ns	60 ns	60 ns	60 ns	60 ns
EXPANSION/BUS SLOTS						
Bus architecture	PCI, EISA	PCI, EISA	PCI, EISA	PCI, EISA	PCI, XIO	Two S-Buses
Number of slots	7 PCI, 3 EISA**	8 PCI, 3 EISA***	6 PCI, 4 EISA	11 PCI, 3 ISA**	6 PCI, 10 XIO	3
HARD/FLOPPY DRIVES						
Number of hard drives installed in test system	10	6[3]	10	10	10	20
Maximum number of hard drives (internal/external)	11	21	12	8/112	12	2/18
Total hard-drive capacity in test system	21 GB	21.5 GB	21 GB	40 GB	36.4 GB	42 GB
Maximum hard-drive capacity (internal/external)	17.2 GB/361 GB	90.3 GB/7.5 TB	109.2 GB	72 GB/ 1080 GB	109.2 GB	18.2 GB/2 TB
Interface	Fast-Wide SCSI-2	SCSI	Fast-Wide SCSI	Ultra-SCSI	SCSI, Fibre Channel	SCSI, Fibre Channel
Hot swappable	✔	✔	✔	✔	✔	✔
Standard 3½-inch 1.44-MB floppy drive	✔	✔	✔	✔		
NETWORK ADAPTER						
Ethernet adapter manufacturer	Compaq	Digital	HP	Intel	SGI	Sun
Ethernet adapter model	Netelligent 10/ 100TX PCI UTP	DE-500	DeskDirect	Pro100-B	N/A	Fast Ethernet 2.0
Ethernet adapter location	Expansion cards	Expansion card	System board	Expansion card	System board	System/ expansion board
Ethernet connectors	RJ-45	RJ-45	RJ-45	RJ-45	RJ-45	RJ-45
DRIVE BAYS						
Total 3½-inch drive bays	4 hot-pluggable	1	0	8	12	2
Total 5¼-inch drive bays	3 removable	21	6 + 12 pluggable	2	4	0
External drive unit	✔			✔		✔

= BYTE Best ✔ = yes; N/A = not applicable. **Warranty:** P = parts; L = labor; ★★★★★ Outstanding ★★★★ Very Good ★★★ Good ★★ Fair ★ Poor

	Compaq Computer Corp. ProLiant 5000	Digital Equipment Corp. AlphaServer 4100 5/400	Hewlett-Packard Company NetServer LX Pro 6/200	Intergraph Computer Sys. InterServe 660	Silicon Graphics, Inc.. WebForce Origin 200	Sun Microsystems Netra i 4000
ADDITIONAL INSTALLED EQUIPMENT						
CD-ROM drive (speed)	4X	4X	4X	12X		4X
Tape backup drive					✔	
WORM drive						
Redundant power supplies		✔	✔	✔		✔
Hot-swappable power supplies		✔	✔	✔		✔
UPS			✔	✔		
Remote administration card	✔	✔	✔	✔	✔	
Other			Redundant cooling fans	Hot-swappable, redundant cooling fans	Redundant cooling fans	
SECURITY						
Power-on password	✔	✔	✔	✔		✔
Keyboard password	✔	✔	✔			
Setup utility password	✔	✔		✔	✔	
Chassis lock	✔	✔	✔	✔	✔	✔
Keyboard lock			✔	✔		
Secure remote log-in	✔	✔	✔	✔		✔
DIMENSIONS						
Height (inches)	25.8[2]	29.5	24.6	19.25	23[2]	13.5
Width (inches)	8.75[2]	19.3	16.6	16.8	9[2]	19.7
Depth (inches)	22.4[2]	35.4	25.3	30	26.5[2]	22
Weight (pounds)	59.8[2]	250	187	125	59[2]	150
Form factor	Twin towers	Pedestal	Pedestal	19-inch rack	Twin towers	19-inch rack modules
INSTALLED SOFTWARE						
Web software	Netscape Enterprise Server	Netscape Enterprise Server	Netscape Enterprise Server	Netscape Enterprise Server	Netscape Enterprise Server	Netscape Enterprise Server
Operating system	Windows NT Server 4.0	Digital Unix	Windows NT Server 4.0	Windows NT Server 4.0	IRIX 6.4	Solaris 2.5.1
E-mail software	Netscape Mail Server	Netscape Mail Server	Netscape Mail Server	Netscape Mail Server	Netscape Mail Server	Netscape Mail Server
Database system	Netscape LiveWire Pro	Netscape LiveWire Pro	Netscape LiveWire Pro	Netscape LiveWire Pro	Netscape LiveWire Pro	Netscape LiveWire Pro
SALES AND SUPPORT						
Length of standard warranty (years)	3 years on-site	3 years on-site	3	3	1	1
Extended warranty available		✔	✔	✔	✔	✔
Sales and distribution channels	VARs, resellers	VARs, direct	VARs, direct	Direct, dealers	Direct, VADs, Integrator	VARs, direct
On-line support available	✔	✔	✔	✔	✔	✔
Free technical support after purchase	✔	✔	✔	✔	✔	Conditional
On-site service available	✔	✔	✔	✔	✔	✔
On-site service cost (first year)	Under warranty	Under warranty	Under warranty	Under warranty	Under warranty	Under warranty
Phone	N/A	508-493-5111	N/A	205-730-2000	415-960-1980	415-960-1300
Toll-free phone	800-345-1518	800-DIGITAL	800-752-0900	800-763-0242	800-800-7441	800-USA-4SUN
Toll-free support number	800-652-6672	800-DIGITAL	800-322-4772	800-543-1054	800-800-4SGI	800-USA-4SUN
On-line address	http://www.compaq.com	http://www.digital.com	http://www.hp.com/go	http://www.intergraph.com	http://www.sgi.com	http://www.sun.com
Inquiry number	**1064**	**1065**	**1066**	**1067**	**1068**	**1069**

* One slot is shared. ** Two slots are shared. *** Three slots are shared.
[1] Tertiary cache; primary and secondary are on-chip. [2] Each tower. [3] Drives not mirrored.

Put Your E-Mail on the IMAP

Server-based Internet Message Access Protocol e-mail delivers speed, convenience, and flexibility.

By David Seachrist and Tom Yager

While the Internet has brought about simple, inexpensive e-mail transport and access, systems using the Post Office Protocol (POP) haven't offered the extensive features of the e-mail systems available from Microsoft, Lotus, and Novell. Those go well beyond simple storage and delivery, offering database-driven technologies that accommodate document sharing and other collaborative computing technologies. Until recently, setting up an enterprise-wide e-mail solution required investing in proprietary systems and cumbersome gateways.

Internet Message Access Protocol (IMAP) is an alternative that addresses the problems that crop up when you regularly access Internet e-mail from more than one computer, and it makes marvelously efficient use of dial-up connections. You can call in to the mail server, download just the new mail headers, and disconnect. IMAP4 understands Multipurpose Internet Mail Extensions (MIME), so even when you download only headers you can see which messages have attachments. While off-line, you can browse select messages for downloading into your local cache. If a message has attachments, you can download only the text, or select individual attachments, or download everything. That's real power and convenience.

For this report, we evaluated four mail servers that support IMAP4, the latest full standard. We tested three running under Windows NT and one under Unix. The NT servers are AltaVista Mail Server 97 version 2.0B, Netscape Mail Server version 2.02, and Fujitsu Software's TeamWare Mail version 5.1 beta. The Unix server is SunSoft's Solstice Internet Mail Server 2.0. (Most of these servers are not restricted to the platforms we tested on.) We concentrated on features, ease of learning, and ease of administration. We didn't test specifically for performance because that, along with scalability, is more a function of the overall network than of the server software.

How Do I Access Thee?

For most users, an e-mail program's abilities to store, retrieve, and manipulate e-mail are what matter most. The most widely used protocol, POP, is supported by the mail clients bundled with Netscape Navigator and Microsoft Internet Explorer, as well as by Eudora. IMAP, an alternative to POP, has features and extensions that make it more robust and ultimately much more convenient in client/server computing environments where multiple clients need to access the same mailbox.

BYTE BEST
IMAP SERVER

TeamWare Mail 5.1 (beta)

Our combined ratings for these products came out very close when all our testing was done, but Fujitsu Software's entry won by a nose. It was the easiest to use and offered the widest array of features.

While all four tested products support the latest version of POP (POP3), and all qualify as compliant with IMAP4, they differ in what features and extensions they support (see the table on page 119 for details). Three main functional areas make IMAP a better choice than POP:

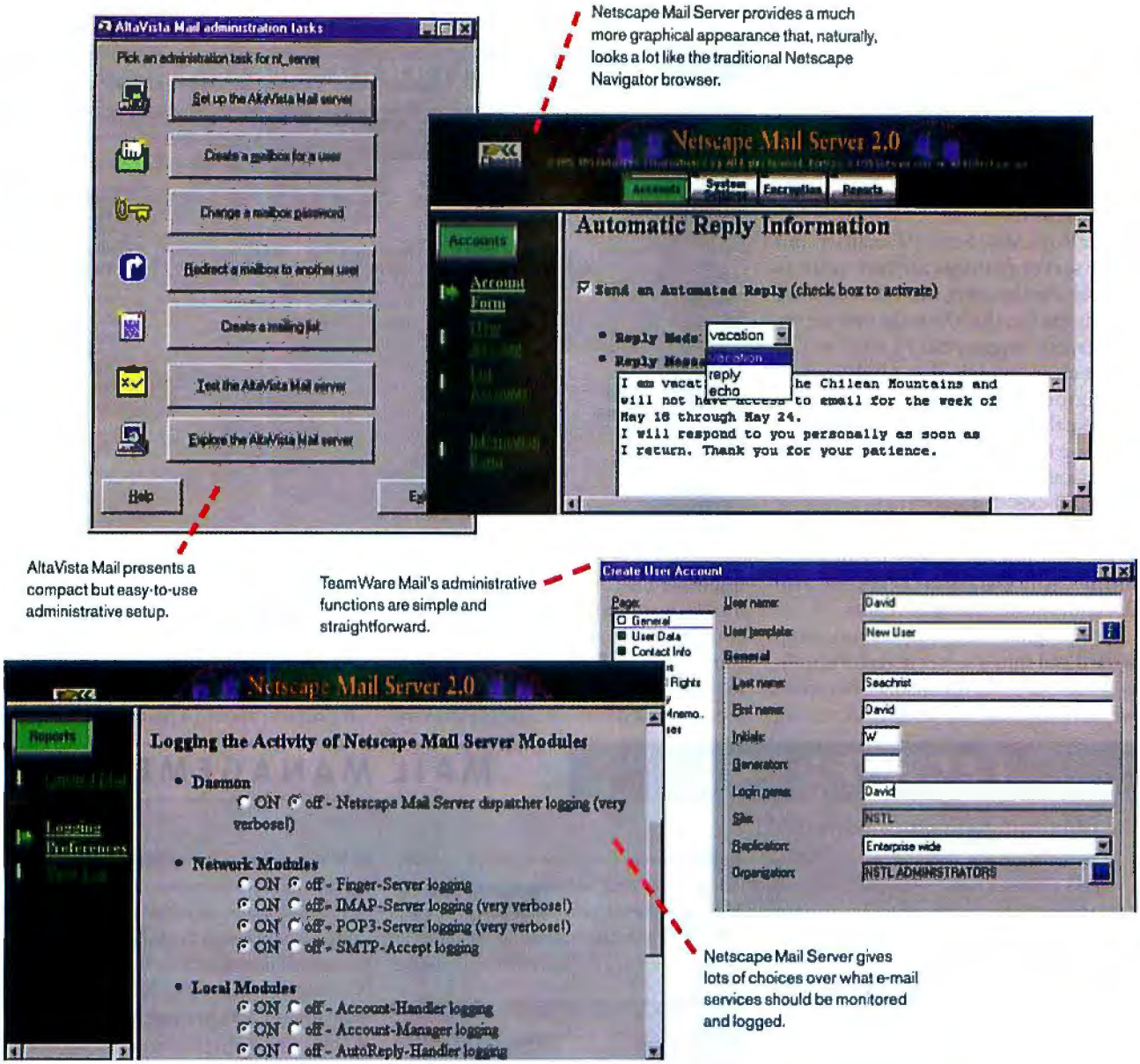
1. IMAP offers better remote access.
2. IMAP supports folder hierarchies and folder sharing, while POP does not.
3. IMAP allows searching and selection of messages and message parts, and searching is done on the server, not on the client.

Until recently, the primary reason not to use IMAP was the abundance of POP mail client software, which is included in the two most popular Web browsers. However, Netscape Communicator will have an IMAP-capable mail client, and Microsoft Internet Explorer will surely follow suit.

Most of the differences between IMAP and POP are in how they allow access to e-mail messages. There are three typical access methods: off-line, on-line, and disconnected. The most common mode on the Internet today is the off-line paradigm ("off" referring to "off the server"), where messages are retrieved by the mail client and deleted from the server. The mail client may be on-line in that it's connected to the Net, but in fact it "connects" only with the mail server long enough to download a new message. The user performs all message access and manipulation on the client, not on the server.

The on-line model reverses this. Messages remain on the server, and the client software manipulates them remotely.

Disconnected access is essentially a hybrid of the first two. The original message files remain on the server and can be manipulated remotely. In addition, copies are cached on the client, where they can also be manipulated. Once the user reconnects to the server, the message



Three of the IMAP mail servers we tested provide you with extensive collections of tools to make server administration simpler and easier.

files are synchronized to make sure that both machines have the most current version of each message.

POP is a store-and-forward protocol that was never designed to employ a client/server computing environment very effectively; it fully supports only the off-line access model. POP does have a pseudo-on-line mode in which mail messages can be left on the server, but this mode lacks fundamental manipulation features. Even so, the off-line method works fine for users who always retrieve their mail from the same client computer. But if the user typically checks mail from more than one computer, their messages can become dispersed among several client computers. This makes it hard to keep all the mailboxes up to date because the user has to copy messages manually from one computer to another.

IMAP supports all three types of access, so it's better suited for nomadic mail users, such as sales representatives who may have a desktop computer at the office and a laptop on the road. With IMAP the user's mailbox is central to the server. Regardless of location, they will always be accessing the most current version of the mailbox. And they won't have to log unnecessary connect time because any off-line deleting or marking of messages they do will be synchronized at the next server log-in. All the servers in this report support all three types of message access, but not all IMAP clients support disconnected operation.

AltaVista Mail Server 97 2.0B

AltaVista Mail Server's most impressive assets are its administrative interface and its price. The program offers three administrative interface choices: a menu for accomplishing routine tasks like creating new user mailboxes, an Explorer-style interface for getting a bird's-eye view of the mail server's organization and for monitoring its access, and a Web browser interface for remote administration. For a $495 license fee, 250 clients can access the server. (AltaVista Software does not pro-

duce an IMAP client, so you would need to supply your own.) As with all three NT products we tested here, a single snag in an otherwise smooth installation process took hours of troubleshooting and a long phone conversation with technical support to resolve.

AltaVista Mail Server's security and IMAP server features are not quite as complete as the other two NT programs, despite the fact that this is the only server to currently support IMAP4 revision 1. It seems clear, though, that AltaVista was willing to sacrifice some bells and whistles to make the program easier to learn.

A case in point: AltaVista Mail Server 97 lacks an adequate means of importing user mailboxes. It does offer a protocol for accomplishing the task, but it is not as easy to use as the other programs' import capabilities. AltaVista Mail Server 97 also does not allow automated replies.

The program uses a very smooth setup wizard and runs a server diagnostic utility at the end of the installation. But when we ran the setup, the diagnostic testing results scrolled by so quickly that we didn't see a warning that the server's Domain Naming System (DNS) MX records weren't found. When our testers started to use the mail server, the lack of the MX records caused mail messages to loop and eventually end up in the dead-letter mailbox. While users of AltaVista Mail Server 97 who employ a dial-up connection to an Internet service provider should never have the problem with MX records, it's still important; about 10 percent of the ques-

IMAP4-COMPLIANT E-MAIL SERVERS

BEST OVERALL

TeamWare Mail

It's close, but easy-to-use features make this the winner.

	AltaVista Mail Server 97 2.0B	Netscape Mail Server 2.02	Solstice Internet Mail Server 2.0	TeamWare Mail 5.1 (beta)
PRICE	$495 for 250 users; $3995 for unlimited license	$995 for 100 users	$495 unlimited users	$595 for 5 users; $595 for an additional 10 users
TECHNOLOGY	★★★	★★★	★★★	★★★
IMPLEMENTATION	★★★	★★★	★★★	★★★
EASE OF LEARNING	★★	★★	★★	★★★
EASE OF USE	★★★	★★★	★★★	★★★★
INSTALLATION	★★	★★	★★★	★★
OVERALL EVALUATION	★★★	★★★	★★★	★★★

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

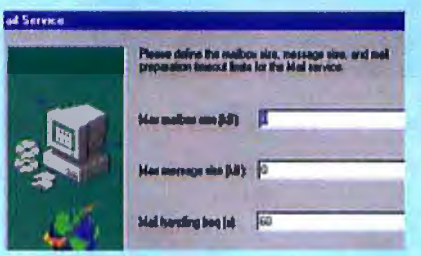
TECH FOCUS | MAIL MANAGEMENT

Managing Messages with IMAP

Internet Message Access Protocol (IMAP) allows clients to remotely create and manipulate mailboxes on the server and to have a folder hierarchy. This gives clients better control over the way mail is organized. IMAP also allows shared access to mail folders. For example, you could set up a mailbox for the sales department for mail that is of interest to that group. Such a setup would also allow more than one client to access the mailbox at once. AltaVista Mail Server doesn't support IMAP shared folders, but an add-on product called Forum serves as a bulletin board/collaborative service.

Since IMAP and Post Office Protocol (POP) both use Simple Mail Transport Protocol (SMTP), IMAP users can receive messages created with POP clients and vice versa. Be advised, though, that while it's easy to change over an existing POP mail system to use IMAP exclusively, reverting back from IMAP to POP is an administrator's nightmare. Moving IMAP folders back to POP dumps all mailbox subfolders into a single root folder. And while it's possible to maintain both POP and IMAP mailboxes in the same mail system, this approach largely negates the reason for using IMAP in the first place.

Probably IMAP's slickest feature is its built-in database capabilities, which allow defining rules for searching, selecting, and deleting mail based on values in the message header or body. IMAP also permits selective downloading of message parts, so you can retrieve a message without a file attachment. Some e-mail client packages also allow attaching rules to folders. Opening the server folder displays only the mail messages that meet the rule criteria. Rules allow actions to be assigned to the criteria, which helps users administer their mailboxes. For example, a rule could be set to delete all messages received before a certain date. All the server packages support searching and rules defining, but all clients do not.



TeamWare gives administrators full control of configuration parameters.

The IMAP specification allows for negotiated extensions to be added to the list of IMAP's basic functionality. At present, none of the tested programs supports the access control list (ACL) extension of IMAP. An ACL allows limiting mail access by a list of IP addresses set by the mail administrator. This is similar to Windows NT's use of ACLs, but it's specific to IMAP services. Both Netscape Mail Server and TeamWare Mail offer proprietary methods of limiting access by domain names. All four programs offer password encryption of mail account log-ins using MD5 or Authenticated POP (APOP). Netscape also supports S/KEY authentication and supports Secure Sockets Layer (SSL) when using a Web browser to administer the server. None of the programs currently implements encryption of messages on the server, but TeamWare Mail offers an add-on cryptography client package.

Two other extensions that aren't supported are Quota and Annotate. Quotas let you limit the size of IMAP mailboxes and mail messages. Annotation allows groupware-style collaboration, but differences in client platforms make it extremely hard to implement.

There's a list of IMAP4 clients at http://www.imap.org/products.html. This site also includes a list of other IMAP4 servers. You can download the source code for the University of Washington's IMAP4 server for free.

tions in the AltaVista Mail Server 97 tech support forum deal with looping messages and missing MX records. The other programs didn't balk at the lack of MX records and seemed to use another method to supply the missing DNS information to the mail server.

Netscape Mail Server 2.02

In addition to solidly supporting standard IMAP features, Netscape Mail Server offers the best printed documentation of the group. Its most unique features are its ability to allow users to administer their mailboxes via e-mail forms and its choice of three automatic-reply modes: vacation, echo, and reply.

The $995 price gets you a license for up to 100 clients per server. Client software and licenses for Netscape Messenger should be shipping by press time with Netscape Communicator (the new upgrade to Netscape Navigator) for about $50 per client. Netscape Mail Server currently supports only Finger as a directory-access protocol, but the next version of the program, which will change its name to Netscape Messaging Server 3.0, will add Lightweight Directory Access Protocol (LDAP) directory services.

Netscape Mail Server offers the greatest number of service log files, but it lacks the server diagnostic utilities found in the other programs. The sole means of GUI-based administration is via a Web browser (the others also offer administration software for Windows).

After we installed Netscape Mail Server, the administrative program wouldn't run. After a long conversation with tech support, we finally figured out that our browser software failed because it was configured to access a proxy server. Troubleshooting this problem was difficult, for neither the software nor the documentation hinted at plausible causes of the error message. This particular problem stopped testing dead with Netscape Mail Server because the only way to administer the program initially is to use a Web browser. The other programs supply Windows-based administrative clients.

Solstice Internet Mail Server 2.0.

We tested two versions of SunSoft's Solstice Internet Mail Server: one on a Ross Technology SparcPlug workstation running Solaris 2.5.1, the other on a Dell Pentium-based PC. Installation isn't difficult

FEATURES

	AltaVista Mail Server 97	Netscape Mail Server	Solstice Internet Mail Server	TeamWare Mail
Minimum CPU	486 or Alpha	486/33	SPARC or 486	486 or Alpha
RAM	32 MB	32 MB	32 MB	64 MB
Disk space	5 MB	100 MB	4 MB	150 MB
Versions available	NT	NT, Unix	Unix	NT, Unix
Client software included			✔	✔
Client for Windows 95, 3.1		[C]	✔	✔
Client for Macintosh		[C]		✔
PROTOCOL AND GATEWAY SUPPORT				
IMAP4 revision 1	✔			
IMAP4 (RFC 173)	✔	✔	✔	✔
IMAP extensions: ACL, Quota, Annotate				[P]
POP3, SMTP, MIME	✔	✔	✔	✔
LDAP	[A]			✔
Finger		✔		
X.400				✔
Lotus cc:Mail	✔			
Microsoft Mail	✔			
Novell MHS				✔
IMAP SERVER FEATURES				
Remote folder management (list/create/delete/rename)	✔	✔	✔	✔
Multiple folders per mailbox, folder hierarchies	✔	✔	✔	✔
Shared mailboxes		✔	✔	✔
Search messages on server	✔	✔	✔	✔
IMAP, POP on same server	✔	✔	✔	✔
List server included				[A]
Use third-party list servers	✔	✔	✔	✔
SERVER SECURITY				
Limit access by domain name		✔		✔
Password encryption	✔	✔	✔	✔
Mail encryption				[A]
Account locking	✔	✔		✔
SERVER ADMINISTRATION				
Graphical mailbox directory	✔			
Server diagnostic utility	✔			✔
Finger response		✔		
Automated reply		✔	✔	✔
Forward to a mailbox or group of mailboxes	✔	✔	✔	✔
Number of service logs	7	13	8	1
Turn individual logs on/off	✔	✔	✔	✔
Remote administration via browser	✔	✔		✔
Remote administration via e-mail		✔		
GROUPWARE SERVICES				
Bulletin/forum services	[A]	[A]		[A]
Document management	[A]	[A]		[A]
News services	[A]	[A]		[A]
Group scheduling services	[A]	[A]		[A]
Work-flow services				[A]
Directory services	[A]		✔	✔
IMAP CLIENT FEATURES				
Supports MAPI, VIM, AOCE				✔
On-line operation		[C]	✔	✔
Off-line operation		[C]	✔	✔
Disconnected operation		[C]	✔	✔
Private/shared address books		[C]		✔
Maintain multiple user profiles		[C]		✔
Selective message retrieval		[C]	✔	
Retrieve header, body, or attachment separately		[C]	✔	✔
View mailbox/folder hierarchy		[C]	✔	✔

✔ = yes [A] = Extra-cost add-on product [C] = Will be in Netscape Communicator
[P] = Proprietary support, not an IMAP implementation

and usually takes only a few minutes (less than 5, in our case), but in true Unix fashion it's all command-line-driven and not very graphical. Inserting the CD triggers the automounter; the disc's contents appear beneath the /cdrom directory. Then you can use the `kgadd` command to load the mail server's components onto your hard drive.

The post-installation script adds IMAP4 and POP3 server entries to your Unix host's inetd.conf and services files. The inetd daemon will spawn IMAP4 and POP3 server processes when client requests come in. After that, there's still one more step before it will run: You need to call Sun for a software license. The IMAP4 server won't operate unless it finds a license key. This can be frustrating, especially for administrators accustomed to Microsoft's wide-open licensing. But the call doesn't take long, and when it's done you get an e-mail message containing your license key. Copy the key file to the specified location and the IMAP4 server is ready to process requests. In use, we found that administration was rarely necessary except to occasionally clear a jammed lock file. Sun provides on-line documentation in PostScript and Adobe Acrobat formats.

Solstice includes Solaris (x86 and SPARC) and Windows IMAP4 clients, called "roam" clients. These clients have somewhat clunky user interfaces, but they fully exploit IMAP4. Users can access public mailboxes, create new mailboxes, and copy messages between mailboxes by dragging and dropping. The roam clients are quite smart about managing off-line sessions, queuing user actions until the next connection to the server. Roam identifies and decodes multiple MIME attachments per message.

Users accustomed to more attractive-looking e-mail clients may feel demoted if you tell them they now have to use roam clients. It might be wise to investigate other IMAP4 clients before investing in Solstice Internet Mail Server.

IMAP Strategies of the Big Three

It's hard to review Internet Mail Access Protocol (IMAP) mail-server technology without considering what plans Microsoft, Lotus, and Novell have for implementing it in their enterprise mail products.

Lotus: At the Lotusphere 97 convention in January, Lotus announced that its Domino server will act as a path for converging existing cc:Mail and Notes messaging customers. Lotus outlined aggressive plans to add support for Lightweight Directory Access Protocol (LDAP), IMAP4, and Internet Calendar Access Protocol (ICAP) in its Domino server line and to simplify deployment for mail-only users. Lotus will extend Domino's support for Post Office Protocol 3 (POP3), Simple Mail Transport Protocol (SMTP), and Multipurpose Internet Mail Extensions (MIME) messaging to cc:Mail users with cc:Mail Release 8.

Microsoft: With the release of Exchange Server 5.0, released late in 1996, Microsoft added support for LDAP, POP3, Hypertext Transfer Protocol (HTTP), and Net News Transfer Protocol (NNTP). IMAP4 support is scheduled for this year.

Novell: An update to Novell's GroupWise 5.1 should be available by the time you read this. GroupWise 5.1 is scheduled to natively support open Internet standards such as TCP/IP, HTTP, HTML, SMTP/MIME, and LDAP (client). Support for IMAP4, POP3, NNTP, Secure MIME (S/MIME), and LDAP (server) is due shortly.

PRODUCT INFORMATION

AltaVista Mail Server 97 2.0B
$495 for 250 users
AltaVista Internet Software
Littleton, MA
508-486-2700
http://altavista.software.digital.com/
Circle 1058 on Inquiry Card.

Netscape Mail Server 2.02
$995 for 100 users
Netscape Communications
Mountain View, CA
415-937-2555
http://home.netscape.com/
Circle 1059 on Inquiry Card.

Solstice Internet Mail Server 2.0
$495 for 50 users
SunSoft
Mountain View, CA
415-960-3200
http://www.sun.com/solstice/
Circle 1060 on Inquiry Card.

TeamWare Mail 5.1
$595 for 5 users
Fujitsu Software
San Jose, CA
800-545-6774
408-432-1300
http://teamw.com
Circle 1061 on Inquiry Card.

TeamWare Mail 5.1 (beta)

We tested TeamWare Mail, scheduled for a March release, in beta form. Installation was more difficult because it requires a separate operation for the administrative software, a step not necessary with the other servers. Even so, the program's large feature set makes it somewhat easier to use once you've learned it. And features like mailbox and message quotas, mail database backup and restore, and LDAP services make the program easier to maintain from an administrative point of view. TeamWare Mail is the only server we tested that currently supports LDAP. Client e-mail software comes bundled with the server.

TeamWare Mail's GUI isn't as clean as AltaVista's, but it's the only program that lets the administrator limit mailbox size and message size. The program comes with its own backup and restore programs, which can be useful when users relocate mailboxes to a central server.

Groupware and Beyond

Each of these mail servers is just one module in a list of servers that are part of each vendor's groupware line. Add-on modules for bulletin board-style forums, group scheduling, document management, and news services are available from all four software vendors. From the way these companies are organizing their product offerings, and adding IMAP to their mail services, it's clear that IMAP or a technology that offers similar features is required to enable open, standards-based collaborative computing via the Internet.

All these products are worthy contenders. However, since each server has some unique features and lacks some others, you might just want to wait for the next round of upgrades. If you must move to IMAP immediately, look for the available features that are most important to you. The three products we tested under NT were more complete than SunSoft's Unix-only server. Fujitsu's Teamware Mail is currently the best of the bunch. B

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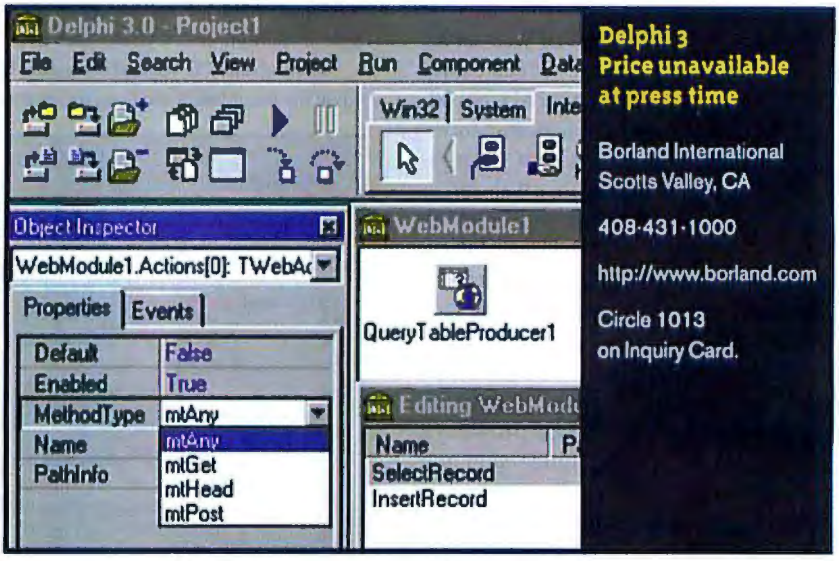
Evaluations in this report represent the judgment of BYTE editors, based in part on extensive tests conducted by National Software Testing Labs, as documented in a recent issue of NSTL's monthly Software Digest. To purchase a copy of that report, with NSTL's own evaluations and data, contact NSTL at 625 Ridge Pike, Conshohocken, PA 19428; 610-941-9600; fax: 610-941-9950; editors@nstl.com. For a subscription, call 800-257-9402. BYTE Magazine and NSTL are both operating units of The McGraw-Hill Companies.

Borland's breakthrough development environment goes distributed in a big way. By Rick Grehan

Redesigned Delphi Masters Networked Apps

The explosion of the Internet has triggered collateral explosions in development software, particularly among purveyors of client/server development tools who are eager to couple their products with the Web. Borland, fresh from its release of C++Builder (the first C++ version of the Pascal-based Delphi), is unleashing a much-evolved, redesigned version of its premier client/server development package.

Where the earlier version of Delphi was a powerful two-tiered client/server development system in its own right, the new version—Delphi 3—boasts multitiered development capabilities. However, Delphi 3 does not stop there. Borland has carefully engineered its new multitiered technologies to connect seamlessly with Web-aware components. The result is that little effort turns an "ordinary" Delphi application into a Delphi Web-server application. However, that's just the beginning.



Delphi 3's Internet components and Web-applications builder make creating Web-server applications easy.

New Insight

To say that Delphi 3 is loaded with new features is to underuse the word *loaded*. The Delphi documentation boasts of 50 enhancements.

Developers are met at the front door by Delphi's new Insights, a collection of development aids and wizards. Code Insight is much like Visual Basic 5.0's IntelliSense features (see "The Basics of Web Development," April BYTE).

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

Code Insight is actually a collection of features. The template wizard, activated by a keystroke, fills source code with the skeleton of control or looping structures. The code-completion and code-parameter wizards are closely related. The former automatically concludes partially typed keywords; the latter responds when you type a method, providing a template for that method's parameters. Finally, during debug sessions, the tool-tip expression evaluator allows you to position the cursor over a variable, constant, or expression and receive a pop-up window that shows the assigned value.

Delphi 3's Business Insight is a set of three components (i.e., for data tables, 3-D graphics, and reports) intended for the business user. Active Insight makes building ActiveX components nearly a one-step process.

Brokers

Delphi 3's support for multitiered applications rides on the backs of its new brokers, independently executing objects that shepherd an application's tiers during execution. The remote data broker acts as a layer between the client front end and the database back end. Clients connect to the remote data broker, which in turn connects through the Borland Database Engine to the database back end. This moves the Borland Database Engine close to the back-end database server, allowing truly thin clients.

Working in concert with the remote data broker is the business object broker, which manages objects that encapsulate an application's business logic. Instead of a client binding directly to a business object, the client binds to the business object broker, which locates and binds to the business object on the client's behalf. In fact, the business object broker can maintain multiple remote data brokers for fail-over safety. If a client tries to connect to a remote data broker that is for some reason unavailable, the business object broker can locate and bind to a replacement (shadow) data-broker object instead.

The constraint broker manages data

consistency and validation checks. The constraint broker can pass validation rules from the database back end to the client, rather than requiring that the rules reside on the client or that the data be passed to the server for validation.

Web Services

Delphi's new Web technologies let Delphi developers easily migrate client/server applications to the Web. Delphi 3 makes the creation of Web-server applications a matter of selecting an application type at creation time.

You can build four types of Web-server applications: an Internet Services API (ISAPI) DLL, a Netscape Server API (NSAPI) DLL, a console Common Gateway Interface (CGI) application, or a WinCGI application. Consequently, Delphi's Web-server applications are compatible with any Web server that supports at least one of these application types (which is just about every Windows-based Web server on the face of the planet).

Delphi does a good job of insulating you from the details of Web-applications building. For example, WebBridge provides a common API for both ISAPI and NSAPI. You can concentrate on the application and let WebBridge worry about the underlying Web server's API.

Also, Delphi includes a number of Internet controls that can create HTML from records retrieved from a database. For example, `TDataSetTableProducer` can generate HTML to display the records of a data-set object in tabular form. Simply hook `TDataSetTableProducer` to a database table, and records read from the table are formatted into HTML, ready for posting on the Web.

SQL Support

There are two elements to Delphi 3's enhanced support for SQL development. First, the SQL explorer is Delphi 3's answer to Microsoft's DataView pane, found in both Visual C++ EE and Visual InterDev. The SQL explorer is a one-stop SQL database management tool that lets you view all your system's databases and access their internals. You can modify indexes and fields, examine referential constraints, edit validity checks, and more.

Second, Delphi's SQL monitor is a kind of SQL equivalent to Windows' event-queue "spy" debugging tools. In effect, you can attach the SQL monitor to the connection between a client and SQL server and watch the exchange of SQL queries and responses. The monitor includes an adjustable buffer—it can even spool buffer overruns out to disk—so even if a bug is hiding in a lengthy session, you can capture the exchange and go digging for the error afterward.

Delphi Forever

Delphi 3 is full of so many new things that I'll still be exploring it long after this review appears in print. Its distributed-broker technology is strong stuff; it places the power of multitiered applications development into the hands of Delphi developers. Similarly, the ease with which you can erect a Delphi Web-server application means that those developers can now be turned loose on the Web—instantly. B

Rick Grehan is an editor at Computer Design *magazine (Nashua, NH). He writes BYTE's Javatalk column and until recently was a BYTE senior technical editor.*

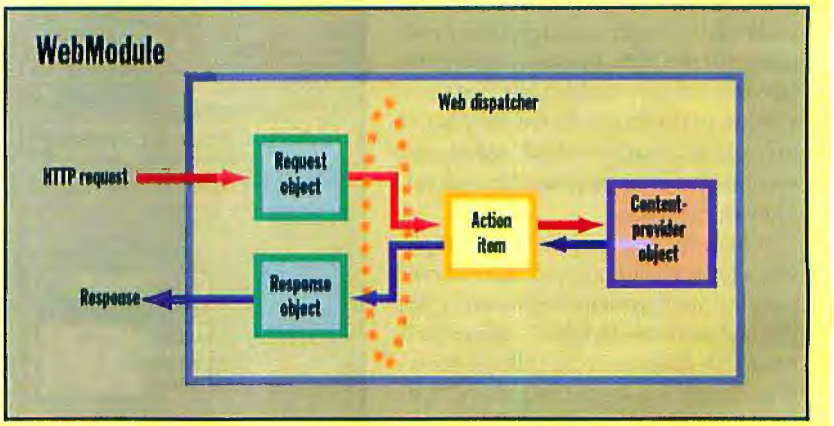
TECH FOCUS OBJECTS

Delphi Web Applications

Delphi 3 contains a number of new application types, one of which is the Web application. All Web applications begin with an empty Web module (automatically built when you create a new Web application), which is simultaneously a container and a dispatching service. As a container, the Web module holds nonvisual components that—in the final application—generate Web-ready content in response to incoming HTTP requests. As a dispatching service, the Web module serves as a switching center that routes HTTP requests to the proper handler.

At design time, you can treat the Web module as a specialized kind of form. Simply select appropriate nonvisual objects from the tool palette and drop them in the module. Typically, the objects you select will be content producers: Delphi components that can produce HTML code or Multipurpose Internet Mail Extensions (MIME) content.

How a given HTTP request is handled takes place through action items—specialized methods in the WebModule that you create through the action item editor and then flesh out with



Delphi 3 uses a new WebModule container to handle communication between the Web server and client/server components.

Object Pascal code in the source editor. An invisible piece of code in the WebModule—the dispatcher—routes each HTTP request to the proper action item. In turn, action items can call on content-provider objects to generate HTML or MIME data for the response.

To see how this works at run time, see the figure "WebModule." An HTTP request arrives from the Web server, and the WebModule builds a request object to hold that request, as well as a response object that will ultimately carry the response. Next, the WebModule's dispatcher kicks in, determines which action item will handle the request, and calls that action item's `OnAction` event handler. The action item's code reads the request, performs whatever processing is necessary—possibly calling on a content-provider object to assemble a response—and deposits that response in the response object. The WebModule passes the contents of the response object back to the Web server.

The latest volley on the Web-server front benefits Webmasters, content creators, and end users alike. By Pete Loshin

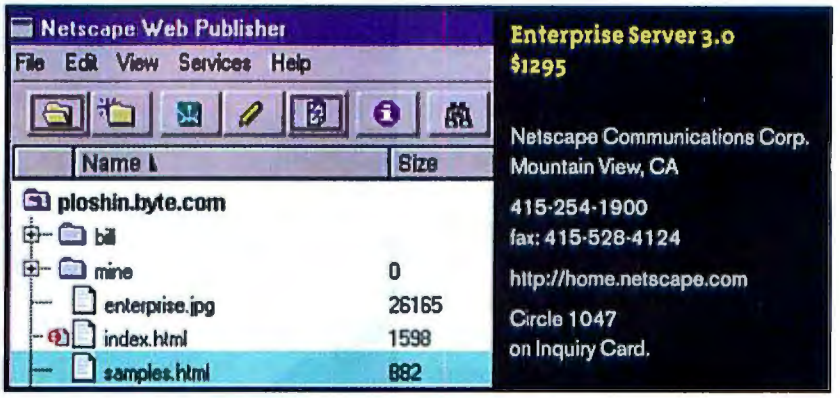
Netscape's Enterprising Server Upgrade

Netscape is toe-to-toe with Microsoft in the server arena, and it's hard to say who's winning. Clearly, though, Netscape's new Enterprise Server 3.0 has some impressive new features, including Advanced Web Publishing, which is a Java-based UI that lets end users securely perform content management and creation tasks. The Server Administration tool can now configure multiple servers, and new LDAP directories allow one-time user and group management across servers. Also new are user-configurable, server-based agents that generate e-mail notification of content changes, for example; an automated indexing and search tool; and component architecture based on the IIOP, which enables heavy-duty three-tier distributed applications for the first time.

The beta 2 release I installed on a Windows NT 4.0 server was up and running in minutes. It included on-line documentation that was actually useful. The Server Administration tool, with its horizontal top frame showing broad configuration categories and left-side vertical frame for subcategories, should be familiar to users of other Netscape servers. The new features were ridiculously easy to set up: Clicking on the Server Administration tool's top frame opens the Web Publishing configuration window, and another click toggles it on.

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

Building a site index through the default search page was a matter of a few mouse-clicks, as well. (In later releases, Netscape plans to add automatic reindexing as content changes.) A less intuitive task was turning on the server agent, which sits in a suboption under the Programs category along with the server's Java, Common Gateway Interface (CGI), and LiveWire configurations. It also requires an e-mail address for the agent administrator, and you must set such parameters as maximum number of times the agent can be triggered and the agent's "lifetime."



Authorized users can create and manage their own content in Enterprise Server 3.0's Web Publisher, a Java GUI applet.

IIOP support for distributed objects (see "Net Applications: Will Netscape Set the Standard?," March BYTE) is provided in the form of Visigenic's licensed object request broker (ORB) bundled into Enterprise Server 3.0 and in the Communicator client. Although it is tricky to evaluate without a serious programming effort, the IIOP will likely simplify getting distributed applications up and running.

Enterprise Server 3.0's Web Publishing feature helps Webmasters delegate content-creation tasks to content owners, while version control and document check-in/check-out make it easy to back out of sticky situations. You can drop new content into a site from any Web-enabled host; a Java applet lets you view directories and select files for editing.

Users can juggle files between directories. Although Netscape plans automatic link referencing, it was not implemented in this beta version. Also not yet implemented is the ability to open HTML and image files in the appropriate editor, through the Web Publisher applet. Web Publisher will ultimately be a digitally signed Java applet, though the beta applet was unsigned and required a special plug-in to write changes to disk.

While it's true that Enterprise Server 3.0 can't offer the same degree of integration with Windows NT Server that Microsoft's Internet Information Server (IIS) does, IIS won't run under Unix. Also, although IIS 3.0 offers centralized user administration through NT, Enterprise Server 3.0's support for LDAP provides cross-platform directory compatibility.

Netscape apparently believes it added value to Enterprise Server, because it bumped the price up to $1295. The extra money is worth it. Enterprise Server 3.0's ease of administration, across-the-board support for open standards, and likable new functions should keep Webmasters happy and Microsoft on its toes. B

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

Epson's newest ink-jet delivers great color at reasonable speed. Who could ask for more? By Russell Kay

Color That's Simply Amazing

At first glance, the Epson Stylus Color 800 seems like just another midpriced color ink-jet printer in a highly competitive market. What sets it apart is its amazing output resolution: 1440 by 720 dots per inch (dpi) in color. This produces images of true photographic quality that clearly surpass most color lasers.

Finer resolution obviously comes at the expense of slower output, but Epson's multiple, proprietary piezoelectric nozzles, plus some fast up-front processing, speed up the print process significantly. The Stylus printed a 5- by 7-inch color photograph (a 900-KB .JPG file) in 57 seconds at 360 dpi, 165 seconds at 720 dpi, and 341 seconds at 1440 by 720 dpi. By comparison, a Canon BJ-4550 (not quite direct competition to the Stylus, but close) printed the same page at 720 by 360 dpi in 324 seconds, and with noticeably inferior image quality. In fact, the Epson's poorest-quality 360-dpi print was smoother than the Canon's best output at 720 by 360, and the Epson took less than one-fifth the time. As another measure, the Epson generally started printing within 20 seconds from the final mouse-click, whereas the Canon sometimes took more than a minute.

Epson's Stylus Color 800 delivers high-resolution images in near record time.

TECH FOCUS

A Piece of the Pie-zo

Most ink-jet printers use heat to boil the ink and form a localized bubble that is spit out onto the paper. Epson, however, uses a proprietary piezoelectric nozzle that gives the printer finer control over how much ink it puts on the paper. Applying current to the piezo element puts immediate mechanical pressure on the ink in the nozzle, forcing it out quickly. But switching off that current instantly removes the pressure, sucking back any excess ink, which results in much more precise spot size and reduced splatter. Each cartridge has several piezoelectric nozzles, which accounts in part for the printer's increased speed.

The Stylus, like most color ink-jets, uses a four-color process with two ink tanks—one for black, plus a three-part cyan-magenta-yellow cartridge. I found the Stylus to be somewhat paper-sensitive, as are most ink-jets. Epson supplied samples of its own brand paper (in both matte and glossy finishes); these worked far better than glossy photo-quality ink-jet paper from Kodak. On the Kodak paper, the ink seemed to pile up on top, and even when it was dry you could plainly see "topographic" lines of ink when holding the page at an angle. Plain copy paper worked surprisingly well in the Stylus, even at 720 dpi, though not at the printer's highest resolution.

The printer's consistent color reproduction and overall light/dark balance from one type of paper and print resolution to another are excellent, although the output had a slight yellowish tinge when I used Epson's glossy paper. When I printed some charts from Excel, the on-screen color didn't match the printer output—something that didn't happen when I printed photos and other types of images.

It's hard to think of the Epson just for printing text—though in high-resolution mode it does a great job with fine-serifed type. The only other printer we've seen lately that comes close to the image quality of the Stylus Color 800 is the Alps MD-2010 (see November 1996 BYTE, page 50), but that unit took far longer to produce a similar page. In sum, Epson's compact and capable Stylus Color 800 is an excellent and economical choice if you need high-quality color output. **B**

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

Russell Kay is a BYTE technical editor. You can reach him at **russellk@bix.com.**

PHOTOGRAPH BRIAN WILDER © 1997

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

The first DDS-3 DAT drives pack up to 24 GB on a cassette. By Stan Miastkowski

Maximum DAT Backup

With their reliability, high speed, and low media cost, drives based on digital audiotape (DAT) have become a popular backup medium for small- to medium-size businesses. The latest DAT incarnation, DDS-3, triples the native capacity to 12 GB (24 GB with "typical" compression). Hewlett-Packard is the first to come out of the gate with a DDS-3 drive, the SureStore DAT24.

The SCSI-based DAT24 is available in both external and internal versions. I found the external unit I tested to be a solidly built device that should stand up to heavy use.

Setting up the drive was a painless operation. I plugged in the AC power cord, connected the included SCSI cable to the Adaptec AHA-390UW SCSI controller in my NT 4.0 server, and pressed the power buttons. After logging in as Administrator, I clicked on the Tape Devices icon in Settings, and NT then found the drive and installed the driver. The whole process took less than 10 minutes.

SureStore DAT24 Internal, $1947; external, $2101; DDS-3 cartridges, $40 each

Hewlett-Packard Co.
Palo Alto, CA

800-826-4111
970-635-1000
fax: 800-353-1917

http://www.hp.com

Circle 1049 on Inquiry Card.

HP's SureStore DAT24 offers capacity, speed, and manageability.

Although NT 4.0 comes with its own backup utility, NTBackup, HP warns that it can't deliver data as fast as the DAT24 can handle it. I found that to be true; on my 750-GB test setup, NTBackup achieved a backup speed of 1.5 MBps using the drive's hardware compression, and 0.8 MBps without compression. But when I switched to Seagate's Backup Exec 6.11 for NT software (which is included with the DAT24), the speed jumped to just under 2.0 MBps with compression turned on and 1.1 MBps without. The drive also comes with the NetWare version of Seagate Backup Exec, along with versions of Cheyenne's Colorado Backup for both Windows 95 and 3.x.

This drive's performance is impressive, but what sets it apart is HP's new TapeAlert technology. Although HP has offered TapeAlert as an open technology standard to other DAT manufacturers, it makes its first appearance in the DAT 24 and will eventually be incorporated into other HP drives.

TapeAlert is firmware in the drive that works with enabled backup software (currently Cheyenne's and Seagate's) to continuously monitor drive and tape status; it reports problems in detail and suggests solutions. TapeAlert can work stand-alone on the server, but if you have HP OpenView, you can remotely monitor and manage backups from a workstation or a remote location.

HP DDS-3 cartridges sell for about $40 each, a more-than-reasonable price for their storage capacity. If you have existing DDS or DDS-2 DAT cassettes, the DAT24 can also read and write to them.

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

At about $2000, the SureStore DAT24 isn't an inconsequential investment, but it's a sound means to serious backup. Its raw speed means that backups can be done with minimal network downtime, and the drive's technology won't soon become obsolete. B

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

TECH FOCUS

Pack DAT Data

With a 12-GB capacity before compression, DDS-3 cassettes deliver three times the storage of the DDS-2 standard. Most of this increase comes from doubling the bit density on the tape. DDS-3 uses partial response maximum likelihood (PRML) data decoding, a technique first used in hard drives. DDS-3 drives uses a 14-stage algorithm to read the tightly packed data, deciphering whole strings of bits at a time instead of interpreting each in isolation.

To increase capacity another 50 percent, DDS-3 uses a slightly longer tape and removes the subcodes and Automatic Track Finding (ATF) zones found at the beginning and end of each track in other DDS formats. Instead, embedded timing marks allow precise head/track alignment.

Fujitsu proves it doesn't take an Armada to make a thin, full-featured modular notebook. By Peter Wayner

Throw Me a LifeBook

If you are a bit too rich and would like a notebook that is extremely thin, then Fujitsu's LifeBook 600—one of the thinnest and lightest notebooks to hit the world—may be for you. (And the starting price of $3999 won't make you poor, either.) Fujitsu managed to create a 1.2-inch-thick, 4-pound package by stripping out the CD-ROM drive and floppy disk drive and leaving only the essentials. Despite the notebook's svelte form, it contains a 12.1-inch screen and 33.6-Kbps internal modem.

Of course, computers need to have disk drives, and Fujitsu provides two solutions. The basic unit comes with a 3.5-inch floppy drive that attaches to the main unit through a short cable. For more storage, you can buy an enhancement unit that comes with stereo speakers, an 8X CD-ROM drive, a 3.5-inch floppy drive, and a MIDI/joystick port. This unit has roughly the same dimensions as the main system and attaches nicely to the notebook's bottom, doubling both the thickness and the weight. I used the computer with the enhancement unit, and it felt like a normal, albeit thick, notebook machine.

Fujitsu sells the enhancement option at a low price in the apparent hope that people will buy one for home and one for work. This is a great idea, but most people probably won't mind toting the 8-pound package.

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

The LifeBook's greatest competitor may be the Compaq Armada 4100, another thin, lightweight notebook with an expansion unit. The Fujitsu is even lighter than the Compaq (4.1 versus 5 pounds), but only if you leave off the extra battery pack, which you must have to get more than 2 hours of continuous use. The Armada offers a few more configuration schemes, but it isn't clear that the extra flexibility buys you anything. I think most people will want either the lightest configuration possible or the most feature-rich model—and the LifeBook lets you have both.

Fujitsu LifeBook 600 Series
635T, $3999
655Tx, $4299
(133-MHz Pentium in 635T, 150-MHz MMX in 655Tx)

Fujitsu PC Corporate
Milpitas, CA

888-466-8434

Circle 1057 on Inquiry Card.

Fujitsu takes notebook modularity to new levels, compressing lots of features into a compact chassis.

Other design details are nicely done. An additional (and standard) battery pack adds 1.5 inches to the back half of the unit, effectively propping up the entire computer and making it easier to type. (The computer comes with a new ASIC that lets you change power consumption on the fly. You can switch between the settings that either maximize usability or maximize battery life.)

The 12.1-inch screen is quite bright, though I found it looked better from slightly off-angle. The keyboard is perfectly easy to use and is accompanied by substantial palmrests. The touchpad, on the other hand, felt a bit sticky, and I quickly resorted to plugging a mouse into the back slot.

Now that I've been using the system for a while, I've come to the conclusion that the LifeBook's two-part design is a definite win. Fujitsu has done an excellent job of making the enhancement unit blend in with the total notebook package. If you attach the enhancement unit, you have a fat, fully loaded laptop. If you strip it off, you have a notebook that's extremely slim and suddenly almost 3 pounds lighter. Those extra pounds can make a huge difference to a tired road warrior. ■

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

PHOTOGRAPH: BRIAN WILDER © 1997

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

Jerry Pournelle

Chaos Manor

Two Heads Are Better Than One

Two processors plus two monitors make for an impressive graphics display.

The flu season has been and gone, but it was grim for a while. Chicken soup may not be the best remedy for the flu, but it can't hurt. My recipe is to fling a whole chicken, onions, carrots, celery, garlic, and some seasonings into a pressure cooker and cook at 15 pounds overpressure for an hour or more. The high temperature softens the bones, and since it's all sealed, none of the flavor gets out.

My small pressure cooker has lost its safety plug, and the big one is old enough that the worn seal ring leaks. I've had them a long time, and I had no clue where to get replacement parts. The label says they were made by National Presto, but it gives no city or state. A Web search did not produce any hits.

Time for PhoneDisc PowerFinder. I have several other sets of phone numbers on CD-ROM, but I just got an updated PhoneDisc set, and it has always worked. I've changed machines since I used it last, but the installation is simple. It took only 30 seconds. Now to search, but where? PhoneDisc comes on six CDs. I started with the Northeast. Nothing. Next, I tried the business search button. That demanded that I tell it what kind of business. I hadn't the faintest notion, and there were a lot of categories, so I went back to names.

Change to the Atlantic States CD-ROM. I found that while PhoneDisc has a way to force a refresh when you change discs—actually it's obvious, being a CD-ROM icon and first on the toolbar—I did not see how to do it. I also found that if you act as if you haven't changed discs and just proceed, you can lock up Windows 95 (Win 95) to hardware reset. Or at least I can, because I did it. What you must do when you change discs is hit the CD-ROM icon or else exit the program and restart it.

There was no National Presto in Atlantic States. Change to Midwest, click on the change disc icon, type in National Presto, and bingo. National Presto of Eau Claire, Wisconsin. It gives complete contact information. It also tells you the company is business category 363404, Electric Appliances, Small. I'd never have guessed that, because my pressure cookers aren't electric.

The important thing is that I found it, and that reminded me that somehow last month I forgot PhoneDisc PowerFinder in my User's Choice Awards. I shouldn't have because this is one of the most useful tools I have.

PhoneDisc gives you almost every listed phone number in the U.S., along with addresses, ZIP codes, fax numbers, and Web sites if known. I haven't used the Web-launcher feature yet, but it's a way to launch your browser and go to a Web site in one operation. The indexing is amazing, with thousands of business types. I don't see how anyone gets along without it, and PhoneDisc PowerFinder gets a belated User's Choice Award.

Last month I forgot PhoneDisc PowerFinder in my User's Choice Awards.

Once I had the fax number of National Presto, I tried to use Symantec's WinFax Pro to send them a message. It didn't work: I kept getting the message that there was a printer error. I thought perhaps it was because I had upgraded Microsoft Word from 6.0c since I'd used WinFax Pro last, but that wasn't it. When I went to tell Win 95 that WinFax Pro is the default printer, I discovered no WinFax printer icon: the printer driver was gone. I've no idea how that happened, but I am always messing with this machine on the theory that if I have problems, I may save you some trouble.

Anyway, there's probably a way to install that printer driver without reinstallation of WinFax Pro, but I went back to square one. The result was awful.

Before I go through my tale of woe, a conclusion: once it's properly installed, WinFax Pro is still the best of the Windows fax programs. However, I truly believe the installation program was designed by fiends.

My troubles came when WinFax Pro offered to make use of Microsoft Access. The default is "don't do that." I don't use Microsoft Access or Microsoft Mail, but I thought it might do no harm to learn, so I foolishly checked the Yes box.

The rest of the installation seemed to go all right, except that when it came time to shut down the machine and restart, it wouldn't shut down properly. Microsoft Internet Explorer hung up, and I had to use a hardware reset.

It came back up all right. I opened the Printers folder and found the WinFax icon, set that to the default printer, and opened Word to send my fax to National Presto. Up came a box demanding that I tell it the path to the Microsoft Post Office. It also kindly informed me that if I didn't know that path, I should ask my mail administrator. I have neither Post

Office nor a mail administrator, so I tried to cancel it. Nothing happened. Tried to go back. Nothing. Closed Word in hopes that would close the whole mess. Word closed, but that box remained, covering 25 percent of my desktop. It wouldn't move, and it wouldn't close, and I couldn't start any other programs. Back to hardware reset again.

I tried once more, this time invoking WinFax Pro rather than Word and looking for a way to tell it I don't have a mailbox. Pretty soon I was right back there with that box open, and it was hardware reset time again.

At this point, I must have taken leave of my senses. When the program came back up, I told it to uninstall WinFax Pro. It did that, although it gave me some problems when trying to exit, and once again I found myself doing Ctrl-Alt-Del. Then I installed WinFax Pro again, this time paying attention to what was going on.

First, WinFax Pro's installation program plays "music" I don't want to hear. If I want music when I work—I generally do as a matter of fact—I turn on KUSC (now that they've gone back to the classical format). I don't need an installation program trying to amuse me. When it got to the question about Microsoft, I carefully left it unchecked. The rest went well, or at least I thought it did, but when I invoked Word, I got a General Protection Fault. This is serious. I can live without WinFax Pro but not without Word.

This time I pressed the power switch, waited for a count of 30, and brought the system up again. Invoked Word. No problems. Went to the Printers folder and set WinFax Pro as the default printer, brought up my document, and sent my fax. It was then I realized that I had clobbered my phone book when I did the uninstallation. That fax phone book didn't have anything I don't have in another place, but it was convenient. I manually put in the number for National Presto, told it to add it to the phone book, and sent the fax.

Of course, it wouldn't send. If you retrieve a number from the phone book, WinFax Pro adds the 1 to the dialing string if the area code is different from your area code. However, if you manually type a number in TO, it tries that exact number, and that failed, giving, interestingly enough, a line busy message. I tried again, this time bringing in the number from the phone book. It worked just fine, connecting at 14.4 Kbps. I really love that U.S.

Robotics Courier V.Everything modem.

I'm running Norton System Doctor on this machine, and that has a protected recycle bin. Perhaps I could recover the phone book.

Not a chance. There's nothing that calls itself a phone book. I kept mucking around hoping to find the phone book, but it's simply not in any file I can identify.

Coincidentally, Roberta wanted to send 40 faxes about new developments in her reading program. She has WinFax Pro 7.0 on her Gateway 2000 P5-200XL downstairs. She'd forgotten that you have to set the default printer to WinFax Pro. Once that was done, we built up a list of numbers to send faxes to and let WinFax Pro take over, which it did perfectly. Meanwhile, I've had no more problems at all. WinFax Pro is a very good program if you survive the installation.

For years I have avoided setting up a computer to receive faxes. That's part sloth and part paranoia. My security system is 100 percent certain: I've never allowed any computer on my network to answer a telephone, not even for voice mail or a fax. Our fax system was a simple box with its own phone number. It receives faxes, prints them on a whacking great roll of thermal paper, and cuts them more or less to size.

That worked for years, but lately I am getting far more faxes, enough that I have to change paper rolls nearly every day. Most of them are annoying messages about products I cannot possibly find interesting, and often are duller than that. There are announcements that someone I never heard of has been promoted to a post I care nothing about. There are also investment opportunities, press releases I actually find interesting, messages for Roberta about the Opera League, exceedingly long messages from people whose bread isn't fully baked, and much more. In a word, the situation has gotten out of hand, and it's time for a change.

I've never allowed any computer on my network to answer a telephone.

To that end, I've put Win 95 on Super-Cow, the Gateway 2000 486DX2 VL-Bus machine that for years served as my Windows 3.11 test-bed, and prepped it to take over as the fax server. I intend to read incoming faxes on-screen and print only those that need paper copies. Most faxes will be sent from within Word. From previous experience, my own and others I trust, I've decided on WinFax Pro as the software.

I have an elderly but serviceable Mannesmann Tally printer to attach to the system, so the only thing I need is a scanner. I have a couple of fax-scanning devices, including a Lumina unit that looks serviceable, so all that remains is to set it up. If it all works, I'll network it into the system.

When that's done, I intend to use the Network Systems Security Router as a firewall and sentinel to another phone line, giving me access to my network when I'm on the road. I've wanted to do this off and on for years, but it has never been urgent because I've always carried laptops with enough disk capacity to hold nearly everything I need on the road.

continued

Last month, though, I was the guest of honor at a small convention in Denver. Larry Niven was there, and I wanted him to see some work I'd done on *The Burning City* just before I left home. Only when I went to show it to him, I found I'd copied the wrong darned file. It sure would have been convenient if I could have dialed Chaos Manor and downloaded the file. That incident moved this project up a notch, and when I get the fax server installed, I'll work on remote access to my network. A full report when I get it done.

THE *REALLY* GOOD NEWS IS THAT WE have a new Compaq Professional Workstation 5000, a dual-processor Pentium Pro/200 with 256 MB (really) of error-checked RAM and two 4.3-GB hard drives run by an on-board Ultra-Wide SCSI controller. It comes standard with on-board 10-/100-Mb Ethernet, an eight-speed CD-ROM drive, and "business" (basically Sound Blaster 16) sound.

Ours came with twin very-high-end Elsa Gloria-L OpenGL-accelerated video boards, each board driving a different monitor. The result is awesome: David Em, our artist associate, astonished Yat Chan, the Compaq representative who came with the system (you probably won't get quite that level of support). I'll get back to that in a moment.

Those huge Pentium Pro chips were warm, but I could put my hand on them.

Compaq is known for their high-quality engineering. This box is built like a tank. It's a desktop configuration. It is easily "tower-able"; just flip it on its side. The CD-ROM drive even has "flippers" to hold the CD-ROM in place when you insert it vertically. The Professional Workstation 5000's card cage connects with a riser card, which plugs into the motherboard. You can pull the whole thing out and disassemble the entire machine in under 2 minutes with no tools. Given that each Elsa board costs more than many entire systems, the extra work room is worth having.

The cage design caused Alex a minor problem. He first set the system up at David's house. Unless you get the card cage well and truly seated, the machine won't boot up, and it didn't. When they brought it here to Chaos Manor, I solved the problem once and for all by using Stabilant 22, the miracle all-purpose contact enhancer. It not only makes for better electrical contacts—a major use of Stabilant 22 is to get all the electrical noise out of hi-fi systems—but also lubricates connector insertions. If you don't use Stabilant 22, I bet you wish you did.

Given that you seat the card cage properly, the Professional Workstation 5000 is as solid as a rock. You can change disk drives through the front bezel. I let the system stay on displaying really complex graphics and no screen saver while we went to dinner. I then had it do a lot of disk operations. Next, we opened it immediately for heat tests.

There wasn't any heat. Those huge Pentium Pro chips (no fans, just heat sinks) were warm, but I could put my hand on them, and they were the hottest spots in

the box. It didn't overheat when we ran it with the cover off, and although it's not recommended, Compaq runs their lab rats with the tops off all the time. The bottom line is, this is one well-designed and well-made box. It also performs.

David works graphics systems hard. To challenge the Professional Workstation 5000's abilities, he brought over some huge graphics files on Iomega Zip cartridges. Once we had the dual screens working properly, we needed to get those files into the Compaq. I could have gone up to my monk's cell to get the parallel-port Zip drive, but given the size of the files, a SCSI connection was preferable. My SCSI Zip drive is attached to the Cyrix 6x86-P166's external SCSI-2 port with a Granite Digital SCSI-2-to-DB-25 cable. The Professional Workstation 5000 comes with Ultra-Wide SCSI built in, so the only problem was to find the right cable.

We needed an Ultra-Wide-SCSI-to-DB-25 cable. A search through the cable room turned up plenty of Ultra-SCSI-to-SCSI-1 and SCSI-1-to-DB-25 cables, but no SCSI-1 sex changer. Then Alex realized that all SCSI-1 (DB-50) devices *are* SCSI-1 sex changers, so we brought out an old Maximum Storage Duette optical drive. The connection went Compaq to Duette, Duette to Zip drive. When we started up the Professional Workstation 5000, its onboard Ultra-Wide SCSI controller instantly recognized both devices. We hadn't installed any drivers for the Duette, but the Zip drive was immediately available.

David transferred some of his complex graphics files, and we began the experiments, using Adobe Photoshop, 3D Studio Max, and other graphics programs. I was fascinated: I've never seen anything like that. Neither had Yat Chan.

Bottom line: this system soars. I rather reluctantly let David take it home with him; after all, he's the one who can use all that capability. The good news is that I'll get my Doubleshot 133 back. The bad news is I fear the only way I'll get that Professional Workstation 5000 back is to pry it out of David's cold, dead fingers. For now, all I have are his first observations.

We had some problems, none particularly serious. Under NT, with the right drivers, the screens are logically connected—you can drag things from one screen to the other. The center of the viewing area is therefore divided between screens. Installation programs tend to center their presentations and dialog boxes, and most have no provision for moving that stuff around. The result is you can get walleyed looking at divided installation displays.

Some programs get confused as to where an image is, and when you drag from one screen to the other, there's some smearing, or artifacts are left behind. Yat Chan was sure no one at Compaq or Elsa had tried really high-end graphics software on a setup like this and is certain it will be corrected by the time you see this.

Meanwhile, we concluded that none of the problems matter much compared to the benefits of having both screens. As David says, "Two heads are better than one." Here's his preliminary report:

"I've found at least three immediate improvements in productivity: I can shove all the palettes, tear-off control panels, and related hoo-ha onto the second monitor. I can see a full version of an image on one monitor and a zoomed version on the second one, letting me work on detail areas while not losing sight of the original composition. I realize now that the reason I've had trouble finishing some of the high-resolution pictures I've been working on is that *I couldn't see what I was doing.*

continued

"With two full-screen applications open, I can make adjustments to an image in one program and update it almost immediately in the other, creating a very productive feedback loop. Right now, I am working on a children's book that's called *James the Dinosaur*. With Photoshop on one monitor and PageMaker on the other, I can import a picture into PageMaker, see how it looks on the page, send it back to Photoshop, make adjustments, and reopen it in PageMaker, all without opening and closing windows or applications. Of course, this is RAM-intensive, but these days RAM is cheap.

"Also, this has given me a chance to use my Nanao Trinitron T2-20 and the ViewSonic P815 MegaMonitor next to each other in the current resolution of choice of 3072 by 1152 pixels, and while the Trinitron still is best for color fidelity, the P815 *really* pays off in text clarity. When font sizes get this teeny, the Trinitron text gets unacceptably mushy."

Clearly, David is in love. This is all very high-end stuff. It's also astoundingly cheap for the capabilities; you couldn't have touched this much graphics power for less than six figures a few years ago. We'll have much more about the Compaq Professional Workstation 5000 and how it performs with different graphics packages in future columns.

Meanwhile, for yourself or for your company, think hard about real costs. Computer equipment in this class costs money, but it's cheap if it increases your creative abilities. Years ago, I borrowed $12,000 to buy my first computer, Ezekial, which was a Z80. I made back every cent of it in six months by turning out a second book that year—and that doesn't count the columns that resulted from having a computer to write with. It's the same with graphic artist talent: it doesn't take much of an increase in work to pay for something like this Compaq machine.

The Compaq Professional Workstation 5000 with Elsa Gloria-L boards can do both 2-D and 3-D, and the extra CPU power isn't just nice to have, there are tasks you simply cannot do without it.

Of course, you don't need this much equipment if you're not doing really high-end graphics. Multiscreen adapters from Colorgraphic Communications let you run multiple monitors off a single PC, and while the resolution/color won't be up there with the Compaq/Elsa systems under NT, they're good enough for stockbrokers or page-layout work.

However, if you're looking for professional graphics capabilities, you won't go wrong with a dual-processor Compaq driving dual screens.

For yourself or for your company, think hard about real costs.

Finally, lest my Mac-using readers feel slighted, just at column deadline we got a high-end Power Mac 9500 with dual 180-MHz processors, 256 MB of RAM, and a 4-GB hard drive. Plugged it in. It had to have its permanent memory zapped before it could see our "generic" monitor, but then it ran with the ViewSonic without problems. We're now collecting hot video cards, software, and other goodies for it. It works. Details in months to come.

SEVERAL COMPUTER BOOKS THIS month, all on a theme: Todd Stauffer's *Using HTML 3.2* (ISBN 0-7897-0985-6) in Que's *User Friendly* series is good for beginners and as an intermediate reference. Aaron Walsh's *Java for Dummies* (ISBN 1-56884-641-X) is a good introduction to that subject. IDG Books' *Dummies* series is uneven in quality, and I wonder if they haven't tried to publish too many books for their editorial supervisory capabilities, but this one is quite useful. Finally, Arthur van Hoff and Sami Shaio's *Hooked on Java: Creating Hot Web Sites with Java Applets* (Addison-Wesley, ISBN 0-201-48837-X) isn't an introductory work, but once you know a bit about Java, this book will take you quickly through intermediate to beginning and advanced levels. If you're just getting into Web-page design, get all three books.

The CD-ROM of the month is Corbis's Leonardo da Vinci. Corbis is known as "Bill Gates's other company," and they consistently produce high-quality CD-ROMs on important subjects. Their first, A Passion For Art: Renoir, Cézanne, Matisse, and Dr. Barnes, was a milestone, offering the general public an unrestricted view of Dr. Albert C. Barnes's collection of modern art.

Gates clearly has directed Corbis to spare little expense in maintaining quality, and I suspect the company is as much a labor of love as a profit center for him. Some time ago, he acquired Leonardo's *Codex Leicester*, his coded notes on science, architecture, and geometry. Gates calls himself the steward of this important piece of history. The CD-ROM is based on it and is as good a way for Gates to share it as any I can think of. If you have any interest at all in the history of science and art, you will find the Leonardo da Vinci CD-ROM utterly fascinating.

I still have a huge pile of stuff on my ready table, but I've already written more than can be printed. Be sure to visit BYTE's Web site for the Web Exclusive part of the column. Next month, we continue with the latest in arts and graphics programs and equipment. I also have some script-writing tools that need discussion. B

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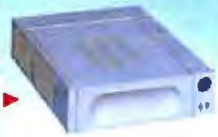

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NEC's High-Quality, Low-Maintenance Laser Printer

Prices for high-quality laser printers continue to drop. NEC's Windows-only SuperScript 660Plus provides crisp 600- by 600-dpi printing, a speedy 6-ppm engine, and other appealing features that make it suitable for home-office and general-business use—at an affordable price of about $350.

The SuperScript 660Plus produces rich text and graphics output. The printer's software driver lets you add watermarks and graphical overlays or put multiple document pages on a single printed page. The included Solutions CD offers useful SOHO software for creating business forms and products. NEC even throws in a printer cable, a rarity among printer vendors.

Laser printers are generally easy to set up these days, but NEC's Quick Install guide reduces even further the likelihood of installation woes. Despite strong competition at the entry level of the laser printer market, the SuperScript 660Plus's quality and features—plus its low price of $349—make the unit worthwhile. Highly recommended.

–Jon Pepper

PHOTOGRAPH: BRIAN WILDER © 1997

Add-Ins

Upgrade Your SparcStation 5

BASED ON FUJITSU MICROELECTRONICS' 170-MHz TurboSparc processor, the Crescendo 5T ($1995) boosts your SparcStation 5's performance by as much as twofold to threefold. The upgrade module, which replaces the SparcStation 5's original processor, also adds up to 1 MB of secondary cache and has a power-management facility, which shuts down the CPU during idle periods.
Contact: Opus Systems, Cupertino, CA, 408-342-1060; http://www.opus.com.
Circle 979 on Inquiry Card.

Communications

DSVD Modem Cards

WITH THE BABY TIGER-288R AND TIGER-288R modem cards, you can share applications and data files while talking on the same telephone line. Designed for PCs running Windows 3.1 or 95, the Baby Tiger-288R ($229) includes a 28.8-Kbps modem, 14.4-Kbps fax capability, and a full-duplex speakerphone. The card supports multiple voice mailboxes, caller ID, speed dialing, phone-book dialing, call and fax forwarding, and paging. The Tiger-288R ($269) has the same features plus 8-/16-bit sound record and playback, a joystick port, a microphone port, a speaker-line-out port, and an IDE CD-ROM interface.
Contact: Shark Multimedia, Inc., Santa Clara, CA, 408-987-5400; http://www.sharkmm.com.
Circle 980 on Inquiry Card.

Internet Access Through a LAN

A HARDWARE AND SOFTWARE PRODUCT, Team Internet (base model, about $1495) gives up to 60 users simultaneous access to the Internet over a single dial-up line or a dedicated line to an ISP. You connect the Team Internet hardware unit to

your LAN using the built-in Ethernet port, plug an analog or ISDN phone line into the back, and run the Web browser–based administration utility from any PC on the LAN. The product works in popular LAN environments, including NetWare 3.x and 4.x, Windows NT and 95, Windows for Workgroups, Mac OS, and Unix.
Contact: Apexx Technology, Inc., Boise, ID, 800-767-4858 or 208-336-9400; http://www.apexxtech.com.
Circle 981 on Inquiry Card.

PC Card 28.8-Kbps Fax Modems for Mobile Computers

MGV MEMORY'S 28.8-KBPS ($169) AND 33.6-Kbps ($198; cellular-ready version, $219) PC Card modems feature V.42bis data compression and V.42 error correction, 14.4-Kbps send-and-receive fax transmission, low-power standby mode, and hot-swapping capability.
Contact: MGV Memory, Irvine, CA, 800-440-4648 or

714-453-1965; http://www.mgvgroup.com.
Circle 982 on Inquiry Card.

Data Acquisition

Portable Scope-Utility Systems

FOR APPLICATIONS SUCH AS REAL-TIME monitoring (oscilloscope mode), data acquisition, and rapid record (burst mode), the EZ-View-SA (12-bit version, $149; 16-bit version, $199) includes gain adjustments; bias offsets; scale selection; sampling-rate and run-time selection; and channel-labeling, triggering, auto-scaling, and remote-start options. You simply connect the cable to your DOS-based PC's printer port and insert the floppy disk.

Contact: Mid-Atlantic Systems Co., Fenton, MI, 810-750-4140.
Circle 984 on Inquiry Card.

A/D Board for the PCI Bus

CAPABLE OF PERFORMING AT SAMPLING rates up to 500 million samples per second, the CompuScope 8500/PCI ($6995) includes up to 2 megasamples of on-board memory; streaming of A/D data to PC memory at 100 MBps; programmable input gain and coupling; and drivers for DOS, QNS, and Windows 3.1, 95, and NT. You can store, analyze, and print your data, as well as convert it to ASCII format for exporting to spreadsheets and mathematical software packages.
Contact: Gage Applied Sciences (U.S.), Inc., South Burlington, VT, 800-567-4243 or 514-337-6893; http://www.gage-applied.com.
Circle 983 on Inquiry Card.

Peripherals

Landscape Flat-Panel Color Display

THE FP1610HBMAX ($12,000) IS compatible with most PCs and workstations operating at resolu-

tions of 1280 by 1024 pixels at 60 Hz. The flat-panel display uses a 16.1-inch-diagonal active-matrix LCD that provides a 12¼- by 10-inch viewing area.
Contact: Image Systems Corp., Hopkins, MN, 800-462-4370 or 612-935-1171; http://www.imagesystemscorp.com.
Circle 985 on Inquiry Card.

Workgroup Laser Printers

WITH THE MARKVISION PRINTER-MANagement utility, you can monitor the PrintPartner 10V ($899) and PrintPartner 14AV ($1349) workgroup printers from a remote location, including monitoring paper supplies and adjusting memory allocations and language settings. The PrintPartner 10V prints at a speed of 10 ppm and handles up to 250 sheets in its main paper tray, or up to 850 sheets with the optional multifunction feeder and universal paper tray installed. Providing 14-ppm performance, the PrintPartner 14AV has a 500-sheet main paper tray and, optionally, can hold up to 1100 sheets.
Contact: Fujitsu Computer Products of America, Inc., San Jose, CA, 800-626-4686 or 408-432-6333; http://www.fcpa.com.
Circle 986 on Inquiry Card.

32-bit, 600-dpi Color Photo Scanner

NOW YOU CAN QUICKLY SCAN PHOtographs into digital format. The FotoTak-6 ($199) lets you create digital photo albums, get photos ready for uploading to Web sites, and add visual appeal to reports, presentations, and newsletters. You can also scan items for faxing and convert hard-copy documents into editable files.
Contact: Spot Innoscan, Inc., Santa Ana, CA, 800-611-7768 or 714-434-6743; http://www.spot.com.tw.
Circle 988 on Inquiry Card.

Convert Your Monitor into a TV

NOW YOU CAN WATCH YOUR FAVORITE TV programs from your multimedia PC. A compact tuner that you plug into a standard VGA monitor, the Proview TV Box ($119) provides access to 181 TV channels and comes with a 23-key hand-held remote, from which you can control power, channel selection, and volume. Available options include teletext

functions and a closed-caption module.
Contact: Proview Technology, Inc., Garden Grove, CA, 800-776-8439 or 714-379-4455; http://www.proviewtech.com.
Circle 987 on Inquiry Card.

Removable-Cartridge Hard Drive

THE 1.5-GB SYJET DRIVE OFFERS A 7-MBps maximum/3.7-MBps minimum sustained read/write data transfer rate, a 10-MBps SCSI burst rate, and a 12-ms seek time. Available models include an internal SCSI unit ($399), an external portable SCSI unit ($499), and a Par-

allel Port package ($529), which includes an external portable SCSI drive bundled with a parallel-port converter cable.
Contact: SyQuest Technology, Inc., Fremont, CA, 800-245-2278 or 510-226-4000; http://www.syquest.com.
Circle 989 on Inquiry Card.

Storage

CD-Mastering and Production Systems

BASED ON QUAD-SPEED CD-R DRIVES, 1-GB hard drives, and intelligent system controllers, the Crossfire CD Mastering System ($5995) and the Replicator automated CD-production system (without software, $7995) support host-independent, error-free recording and production of HyCD CDs. The Crossfire CD Mastering System supports single-session and multisession recording; the Replicator's auto-loading bin holds up to 50 recordable CDs.
Contact: Cygnet Storage Solutions, Inc., San Jose, CA, 800-729-4638 or 408-954-1800.
Circle 990 on Inquiry Card.

CD Library for PCs

ELMS SYSTEMS HAS ADDED CD-R SUPPORT to its Digital Versatile Library (from $6995) to enable unattended duplication of up to 100 CDs. A basic DVL configuration includes one CD-R drive with five magazines, Panorama+ software, and a SCSI connector kit. You can configure DVLs with up to four drives.
Contact: Elms Systems Corp., Irvine, CA, 888-356-7385 or 714-461-3200; http://www.elms.com.
Circle 991 on Inquiry Card.

Systems

Alpha-Based Personal Workstations

THE PERSONAL WORKSTATION 433A (FROM $4995) and 500a (from $9517) come with Digital's 433- and 500-

MHz Alpha 21164a processors, respectively; 32 to 384 MB of synchronous DRAM with ECC support; an ultra-wide SCSI controller; a 2.1-GB hard drive; an eight-speed EIDE CD-ROM drive; integrated 10Base-T/10Base-2 Ethernet; integrated 16-bit audio; and your choice of Matrox Millennium, AccelGraphics AccelPro Series, or Digital PowerStorm 3-D graphics.
Contact: Digital Equipment Corp., Maynard, MA, 800-344-4825; http://www.digital.com.
Circle 1045 on Inquiry Card.

Notebook PCs with MMX Processors

BASED ON INTEL'S MMX-ENABLED 150- or 166-MHz Pentium processor, the TransPort XPE notebook (from

$4599) offers 32 MB of EDO memory (expandable to 80 MB), 256 KB of L2 pipeline burst cache, a 12.1-inch active-matrix display, a 64-bit graphics accelerator with 2 MB of video memory, two swappable bays, an eight-speed CD-ROM drive, and an integrated card bus with zoom video capabilities. Other features include the Pick-a-Point dual pointing device; a removable 1.4- to 3-GB hard drive; a 3½-inch modular floppy drive; Sound Blaster 16-bit stereo sound; and a PC Card slot.
Contact: Micron Electronics, Inc., Nampa, ID, 800-515-9197 or 208-893-3434; http://www.mei.micron.com.
Circle 992 on Inquiry Card.

THE PCV-100 AND PCV-120 NOTEbooks combine accelerated 3-D graphics, 33.6-Kbps DSVD modems, and 16-speed CD-ROM drives with Sony's MPEG decoding and Multiscan multimedia display. The PCV-100 (about $1999) includes an Intel 166-MHz Pentium processor with MMX technology; 32 MB of EDO RAM, expandable to 128 MB; a 2.5-GB hard drive; and S-Video and Composite Video out. The PCV-120 (about $2399) comes with the same features except a 200-MHz Pentium processor with MMX technology and a 3.8-GB hard drive.
Contact: Sony Electronics, San Jose, CA, 800-476-6972 or 408-432-1600; http://www.sony.com/pc.
Circle 993 on Inquiry Card.

Mobile Computers

Rugged PC Has Flash Memory

HUSKY'S LATEST RUGGED FIELD COMPUTER, THE FS/3, is powered by a 25-MHz Intel 386 processor. The system includes 10 MB of flash memory (in the form of SanDisk's CompactFlash technology). The unit also has 2 MB of standard RAM. A built-in infrared port eliminates awkward external cables and simplifies communications between office and hand-held PCs. Its internal Type II PC Card slot offers access to standard PC peripherals.
Price: £1999. Husky Computers, Ltd., Coventry, U.K., +44 1203 604040; fax: +44 1203 603060.
Circle 1042 on Inquiry Card.

SOFTWARE
Business

Web Information Management

WEB-RECALL (SINGLE USER, FROM $189; multiuser with database, from $1475; multiuser without database, from $975) allows you to log, retrieve, and index your organization's Internet/intranet sites of interest. You can use popular Web browsers, such as Netscape Navigator and Microsoft Internet Explorer, to search the Internet and then add a particular site to Web-Recall's in-house database. A Backward Glance feature creates an audit trail of captured Web-Recall sites and Internet/intranet sites that are visited after the captured site.
Contact: TSP Companies, Atlanta, GA, 770-457-0703; http://www.tspco.com.
Circle 995 on Inquiry Card.

Multimedia Presentations

NOW YOU CAN CREATE PRESENTATIONS with playback that makes them look just like TV productions. With Scala Multimedia MM200 ($299), you can use a PC monitor, TV, or video projector to show your finished product. You can also use the program's publishing feature to pre-

pare your presentations for reproduction and distribution via CD-ROM, removable-media cartridge, or the Internet. The Windows 95/NT program supports DirectX and ActiveMovie and includes Anim Clips, which you can copy and paste into presentations. Scala Multimedia MM200 also offers 16-/24-bit color support.
Contact: Scala, Inc., Herndon, VA, 800-947-2252 or 703-713-0900; http://www.scala.com.
Circle 996 on Inquiry Card.

Group-Productivity Software

AN INTEGRATED SUITE OF GROUPWARE services for Internet/intranet and extranet environments, Crew (call company for prices) allows users to share information, schedules, and other data via a Web browser. The product includes Crew CardFile, which provides links to other Crew

services and their data; Crew Calendar, for scheduling appointments with individuals and groups across the Internet or in intranet/extranet environments; Crew Messenger, for viewing e-mail from a universal inbox; Crew Locker, for transferring or sharing files and graphics; and Crew Office, for viewing data from other Crew services.
Contact: Thuridion, Scotts Valley, CA, 888-439-2739 or 408-439-9800; http://www.thuridion.com.
Circle 997 on Inquiry Card.

Toolkit for Scheduling Applications

A PROGRAMMING TOOLKIT, POWERSCHED (from $300) includes three primary modules: daily, weekly, and monthly appointment scheduling; maintenance for defining and managing complex schedules; and report generation. Two versions are available: a Microsoft Access database version, for peer-to-peer networks, and a client/server version, which is compatible with Oracle, SQLserver, and SQLBase database-server architectures.
Contact: Principal Design Systems International, Irvine, CA, 800-850-7374 or 714-474-7374.
Circle 998 on Inquiry Card.

CAD

Mechanical CAD

AVAILABLE FOR WINDOWS 95 AND NT, CADkey 97 ($1195) combines the flexibility of wireframe modeling with Spatial Technology's ACIS solid modeling. You can convert a wireframe to a solid model; construct solid primitives; dynamically rotate shaded models and produce models with hidden lines removed; perform Boolean operations; extrude, sweep, or revolve geometry into a solid; and apply constant and variable fillets, chamfers, and blends to solid models. You can import or export 2-D or 3-D data to other CAD/CAE/CAM applications that support the ACIS solid-model kernel.
Contact: Baystate Technologies, Inc., Marlborough, MA, 800-372-3872 or 508-229-2020; http://www.cadkey.com.
Circle 999 on Inquiry Card.

3-D Mechanical Design Software

SOLIDWORKS 97 ($3995) INTEGRATES parts-modeling, assembly-modeling, sheet-metal-design, and drafting and detailing capabilities. The Windows program also offers Internet HTML, ActiveX, and VRML capabilities. You can preview mating conditions; manage large assemblies; pattern and replace components; construct a part from selected assembly components; create partial-section views, broken views, and aligned-section views; insert or create thread representations in drawings; and hide dimension lines and witness lines.
Contact: SolidWorks Corp., Concord, MA, 800-693-8000 or 508-371-2910; http://www.solidworks.com.
Circle 1000 on Inquiry Card.

Communications

32-bit Fax/Telephony Product

THE 32-BIT VERSION OF COMMUNICATE (US$179), a stand-alone, integrated fax, voice/telephony, Internet e-mail, paging, and data-communications package for Windows 95 and NT, also integrates a contact manager, a color graphics editor, and OCR capabilities. The contact manager acts as the central communications hub. You can create targeted lists by simply clicking on selected search criteria to broadcast voice, fax, and e-mail messages. A universal inbox manages inbound and outbound messages and lets you access voice messages, faxes, e-mail, and data.
Contact: 01 Communique Laboratory, Inc., Mississauga, Ontario, Canada, 800-668-2185 or 905-795-2888; http://www.01com.com.
Circle 1001 on Inquiry Card.

Embedded Systems

Windows Apps for Embedded Systems

DESIGNED FOR BRINGING WINDOWS-BASED applications to embedded systems, Willows RT (about $5000 per developer) lets you select real-time OSes and Windows applications. The program's modular design includes a Platform Abstraction Layer, which contains the system-dependent code, and an embeddable library, which you can compile and link for the target environment, allowing applications running at native executive speeds to call API functions, receive messages, load resources, and launch other Windows applications and DLLs.
Contact: Willows Software, Inc., Saratoga, CA, 800-814-6351 or 408-777-1820; http://www.willows.com.
Circle 1002 on Inquiry Card.

ASIC Verification Tool

EAGLEV (NODE-LOCKED LICENSE, $30,000; floating license, $35,000) allows embedded-systems designers to verify the ASIC-design interaction with the rest of the hardware before they build hardware prototypes. EagleV supports multiple hardware descriptions, such as VHDL, Verilog, Behavioral HDL, RTL, and gate-level models, plus C models. In addition, EagleV supports a library of popular virtual software-processor models, including ARM, Intel 960 and x86, and Motorola 68040 and PowerPC microprocessors.
Contact: Eagle Design Automation, Inc., Beaverton, OR, 503-520-2300; http://www.eagledes.com.
Circle 1003 on Inquiry Card.

PREVIEW

Lumiere Suite
US$495

Circle 994 on Inquiry Card.

Corel Corp.
Ottawa, Ontario, Canada
800-772-6735
613-728-3733
fax: 613-728-9790
http://www.corel.com

Video Editing for the Mainstream from Corel

Slowly but surely, video editing is moving into the mainstream of desktop computing, just as desktop publishing did several years ago. Corel's Lumiere Suite for 32-bit Windows is designed to compete against high-end products, such as Adobe Premiere ($750), and low-end products, such as Ulead's Media Studio ($299). In the Corel tradition, Lumiere not only does the job but offers plenty of goodies.

Although video editing can be an intricate task, Lumiere simplifies many of the job's complexities. The program uses familiar, VCR-like controls for many functions and lets you drag and drop video, sound, and still clips to assemble a project.

The built-in video and audio slides make it easy to trim clips to the length you want, something that can be tricky in other software. There are more than 60 transitional effects, such as wipes, fades, and zooms, to help spice up your project. You can add titles, credits, and other professional-looking finishing touches, too. A transparency function lets you superimpose images, and several software wizards assist you. For example, the Smart Sound Wizard helps you create music and sound effects. To help you get started, Corel includes a host of photos, images, and music and video clips.

In addition to Lumiere, Corel includes in this package its Photo-Paint 6 image-editing software, which lets you retouch any still frames or add effects to them in 2-D or 3-D. However, Photo-Paint 6 is a separate installation and isn't integrated directly into Lumiere as a module.

Lumiere's $99 introductory price makes it a good buy. It will eventually rise to $495, but Corel isn't sure when. **–Jon Pepper**

Encryption

Secure Your Data

A DATA-ENCRYPTION PROGRAM, Authentex-DataSafe (US$79) functions like a combination safe, enabling you

to lock up and protect your data. The program lets you store, receive, or transmit information securely over the Internet, World Wide Web, or an intranet using any mail system that supports file attachments. You can also use Authentex-DataSafe to send secure data via e-mail by providing recipients with the combination of the safe.
Contact: Authentex Software Corp., Kanata, Ontario, Canada, 800-667-8228 or 613-599-5584; http://www.authentex.com.
Circle 1004 on Inquiry Card.

Macintosh

Layout, RIP, and Print Package

A 32-BIT MACINTOSH NATIVE PROGRAM, PhotoPrint for Power Macintosh ($2995) outputs full-color images to ink-jet and thermal color printers. With a built-in PostScript Level 2 interpreter, the package lets you import from 17 file formats or scan directly into the program. PhotoPrint features automatic tiling, on-screen text layout, color correction, and multiple RIP options.
Contact: Amiable Technologies, Inc., Philadelphia, PA, 610-521-6300; http://www.amiableworld.com.
Circle 1005 on Inquiry Card.

Software Updates

PC-Xware 5.0 tightly integrates NCD's PC-X emulation software with the Windows 95 and NT user interface and features the Connection Wizard, which walks you through the steps of creating network connections. Two versions are available: PC-Xware Classic, the PC-X server software; and PX-Xware Suite, which combines the server software with TCP/IP utilities. Classic package, $395; Suite package, $545.
Contact: Network Computing Devices, Inc., Mountain View, CA, 800-800-9599 or 415-694-0650; http://www.ncd.com.
Circle 1010 on Inquiry Card.

A component-based visualization tool for IT professionals, **Visio Professional 4.5** includes Visual Basic, Applications Edition, which lets you create solutions based on ActiveX technology and integrate Visio Professional diagrams into Web browsers. About $349.
Contact: Visio Corp., Seattle, WA, 800-248-4746 ext. 93W or 206-521-4500; http://www.visio.com/.
Circle 1011 on Inquiry Card.

With **netDeploy 1.2**, you can deploy real-world applications, whether they are developed in conventional languages, 4GLs, client/server tools, Visual Basic, or Java; manage downloading, installation, and version updating; and retrieve and install the correct versions of dependent components that are not already present on users' systems. Single netDeploy Packer, from $295.
Contact: Open Software Associates, Nashua, NH, 800-441-4330 or 603-886-4330; http://www.osa.com/.
Circle 1012 on Inquiry Card.

The Web

Network-Wide Internet Access

NOW MULTIPLE NETWORK USERS CAN simultaneously access the Internet through one modem and one Internet connection. Available for Windows 3.x, 95, and NT, WebEtc ($149) provides Web browsing, FTP file transfers, newsgroup participation, and Internet e-mail; it's compatible with popular Web browsers, e-

mail packages, and newsgroup readers. The program's Weblink feature gives laptop users high-speed Internet access via a simple serial connection to an ISDN-linked WebEtc PC. WebEtc Pro ($295) adds user-access controls, usage reports, audit logs, and restriction controls for specific network users and sites.
Contact: Microtest, Inc., Phoenix, AZ, 602-952-6400; http://www.microtest.com.
Circle 1006 on Inquiry Card.

Convert Word Documents to HTML Pages

AN ADD-IN TO WORD 7.0, WORDTOWEB ($279) automates the conversion of Word documents to linked HTML pages. An intuitive wizard interface lets you convert multiple Word documents to HTML and link them together into a single on-line publication or break long Word documents into a series of smaller linked pages. You can set HTML page properties for each page, insert navigation buttons to link pages together, and add a signature with contact information or a date stamp to each page.
Contact: Solutionsoft, Sunnyvale, CA, 408-736-1431; http://www.solutionsoft.com.
Circle 1007 on Inquiry Card.

Create On-Line Multimedia Productions

USING ENLIVEN, YOU CAN COMBINE THE elements of sight, sound, and motion to deliver full-screen multimedia productions that inform customers on-line. The Enliven product suite (starter package, $695) includes Enliven Viewer, which is for playing back content that's created in the Enliven format; Enliven Producer ($249), for optimizing multimedia content and importing digital content from popular creation and authoring environments; and Enliven Server (from $5600), for managing the rapid, simultaneous delivery of large volumes of animated content.
Contact: Narrative Communications Corp., Waltham, MA, 800-978-8670 or 617-290-5300; http://www.narrative.com.
Circle 1008 on Inquiry Card.

Windows

Battery-Life Benchmark

THE SYSMARK32 FOR BATTERY LIFE ($995) benchmark uses real-world Windows 95 applications to measure battery-life performance for notebook computers. The program also reports the battery run time in minutes and seconds. A photocell sensor monitors the intensity of light on the computer's screen and detects whether a human eye will be capable of reading the display during the benchmark run time. To allow the benchmark to run unattended, an actuator device presses keys when the application script is processing commands that normally involve keyboard activity.
Contact: Business Applications Performance Corp., Santa Clara, CA, 800-321-0457 or 408-988-7654; http://www.bapco.com.
Circle 1009 on Inquiry Card.

Marc Abrahams

improbable

Advances and Retreats in Computing

Analyze a person's speech, chips as prizes, and Plug and Play as a real lifesaver.

Amazing Content Analyzer

AI is back, in the form of a remarkable machine that weighs and measures spoken words. This new device, which is called the Content Analyzer, has a simple gauge readout. It analyzes what someone is saying and then indicates whether the speech has any content whatsoever.

The technology is based on a simple adaptation of the Breathalyzer, a machine that analyzes the alcoholic content of a subject's breath. The Content Analyzer's manufacturers, who emigrated to the U.S. from Russia three years ago, claim that the device measures "the semantic content of the breath." It does so on the so-called Engels scale, which ranges from a value of zero for empty rhetoric to a value of 100 for intellectually complex discourse.

Early versions of the Content Analyzer suffered from accuracy problems. Often, they seemed to indicate that jet engines, bus exhausts, and late-night cartoons on MTV have semantic content. The current version of the machine has fixed the problem. As we understand it, some preliminary work has been done in using the Content Analyzer with animals.

Praying and Plugging for Plug and Play

Plug and Play to the rescue. Recently, a marketing manager for a company that will remain nameless heaved himself into our office. His career is intimately involved with what he and his compatriots call the "Plug and Play revolution." He revealed a new reason why everyone should adopt Plug and Play as the standard of standards for today's computing environment.

He showed us several clippings from a daily newspaper in Michigan. The first describes a new peripheral device called a Terminal Computer Terminal. It gives lethal intravenous drugs to a suffering patient who wishes to end his or her life. The patient initiates the flow of drugs by entering three computer commands.

A doctor in Michigan purchased one of these devices. He planned to hook it up for (and to) a patient who was suffering from an incurable disease. The second article, dated a week later, reports that the Terminal Computer Terminal failed to deliver the lethal dose.

A third article explains that this failure was fortunate, because the patient was not suffering from an incurable disease, but from a commonplace, easily cured disease.

What saved the patient's life was–yes–Plug and Play. How? Well, the patient had a Windows 95 machine, but Plug and Play couldn't correctly configure the PC when the Terminal Computer Terminal's hypodermic needle was stuck (plugged) into the potential suicide. Plug and Play could thus be responsible for saving thousands of lives.

The moral of this is that computer science is indisputably enriching our lives, not just the other fellows' pockets. If Plug and Play has saved your life, or the life of someone you love or despise, please send us details and, if appropriate, photographs. No biomedical samples, please.

Marc Abrahams is the editor of The Annals of Improbable Research. *You can contact him at* marca@improb.com.

SWEET MEGABYTE SURPRISE

You thought you'd seen every conceivable kind of marketing collaboration? Not so. Sources tell us that one prominent maker of memory chips is planning to grab market share in a most appealing way. Noting that people who love computers also crave gizmos and junk food, this manufacturer will give away several thousand of its new chips as the prizes packed inside boxes of Cracker Jack and sealed into Kinder-Surprise eggs. The two confectionery makers and the chip manufacturer all stand to gain—the former from a rush of junk-food-crazy bitheads buying crates full of munchies, the latter from the anticipated rush of favorable publicity.

THAT AT THESE
O EVEN FASTER.

PS–PENTIUM® PROCESSOR WITH MMX™ TECHNOLOGY

512KB Single Bank Pipeline Burst Cache • 12X EIDE CD-ROM Drive • Matrox Millennium 4MB WRAM Video Card • AWE32 Wave **Business Edition** • Microsoft Windows 95 • MS IntelliMouse • 2 Universal Serial Bus (USB) Ports • Software Publishing l Warranty with 1 Year On-site Service

DELL DIMENSION XPS M200s
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.)
- Altec ACS-290 Speakers with Subwoofer
- 33.6 U.S. Robotics Telephony Modem
- Iomega Zip 100MB IDE Internal Drive with 3-Pak of Cartridges
- ★ *Upgrade to Altec ACS-490 Full Dolby Surround Sound Speakers with Subwoofer, add $75*

$2999

Business Lease: $111/Mo.
Order Code #500405

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-290 Speakers with Subwoofer
- ★ *Upgrade to 64MB SDRAM, add $239.*
- ★ *Upgrade to a 4.3GB Hard Drive (9.5ms), add $65.*
- ★ *Upgrade to a 1000HS Trinitron Monitor (15.9" v.i.s., .26dp, 1600 x 1200 max. res.), add $165.*

$2599

Business Lease: $96/Mo.
Order Code #500404

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 a 17LS Monitor (15.7" v.i.s.), add $175.*
- ★ *Upgrade to 3 Years On-site Service, add $99*
- ★ *Upgrade to Altec ACS-490 Full Dolby Surround Sound Speakers with Subwoofer, add $75*

$2299

Business Lease: $85/Mo.
Order Code #500403

DESKTOP UPGRADES

UPGRADES	ADD
★ *104-Key Performance Keyboard*	*$ 29*
★ *33.6 U.S. Robotics Telephony Modem*	*$109*
★ *Iomega Zip 100MB IDE Internal Drive with 3-Pak of Cartridges*	*$139*
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DELL LATITUDE™ NOTEBOOKS–PENTIUM PROCESSOR WITH MMX AND PENTIUM® PROCESSOR-BASED

Common features: • 256KB L2 Pipeline Burst Cache • Integrated 16-bit Stereo Sound • Smart Lithium Ion Battery • IrDA 1.0 Standard Compliant • Touchpad • Extendable 1 Year Warranty[1] • Under 7 pounds* • Options Bay accepts *NEW* 10X CD-ROM, 3.5" Floppy Drive (both included), or optional 2nd Li-Ion Battery

NEW DELL LATITUDE LM M166ST
166MHz PENTIUM PROCESSOR
WITH MMX TECHNOLOGY

Common features listed above plus:
- 12.1" SVGA Active Matrix Color Display
- 40MB RAM/2.1GB Hard Drive
- PCI Bus with 128-bit Graphics Accelerator with 64K Colors
- *NEW* MS Office 97, Small Business Edition
- Motorola 33.6 Fax Modem
- Leather Carrying Case
- ★ *Upgrade to 72MB RAM, add $299.*
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$4299[1]

Business Lease: $155/Mo.
Order Code #800108

NEW DELL LATITUDE LM M166ST
166MHz PENTIUM PROCESSOR
WITH MMX TECHNOLOGY

Common features listed above plus:
- 12.1" SVGA Active Matrix Color Display
- 40MB RAM/1.4GB Hard Drive
- PCI Bus with 128-bit Graphics Accelerator with 64K Colors
- *NEW* MS Office 97, Small Business Edition
- 2nd Lithium Ion Battery
- ★ *3Com LAN+ 33.6 Modem PC Card, add $349*

$3999[1]

Business Lease: $144/Mo.
Order Code #800109

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
- PCI Bus with 128-bit Graphics Accelerator with 64K Colors
- *NEW* MS Office 97, Small Business Edition
- ★ *Upgrade to 40MB RAM, add $299.*
- ★ *Upgrade to a 2.1GB Hard Drive, add $200*

$3499[1]

Business Lease: $129/Mo.
Order Code #800101

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 40MB RAM, add $299.*
- ★ *Motorola 33.6 Fax Modem, add $169*
- ★ *Upgrade to a 2.1GB Hard Drive, add $200.*
- ★ *2nd Lithium Ion Battery, add $199.*

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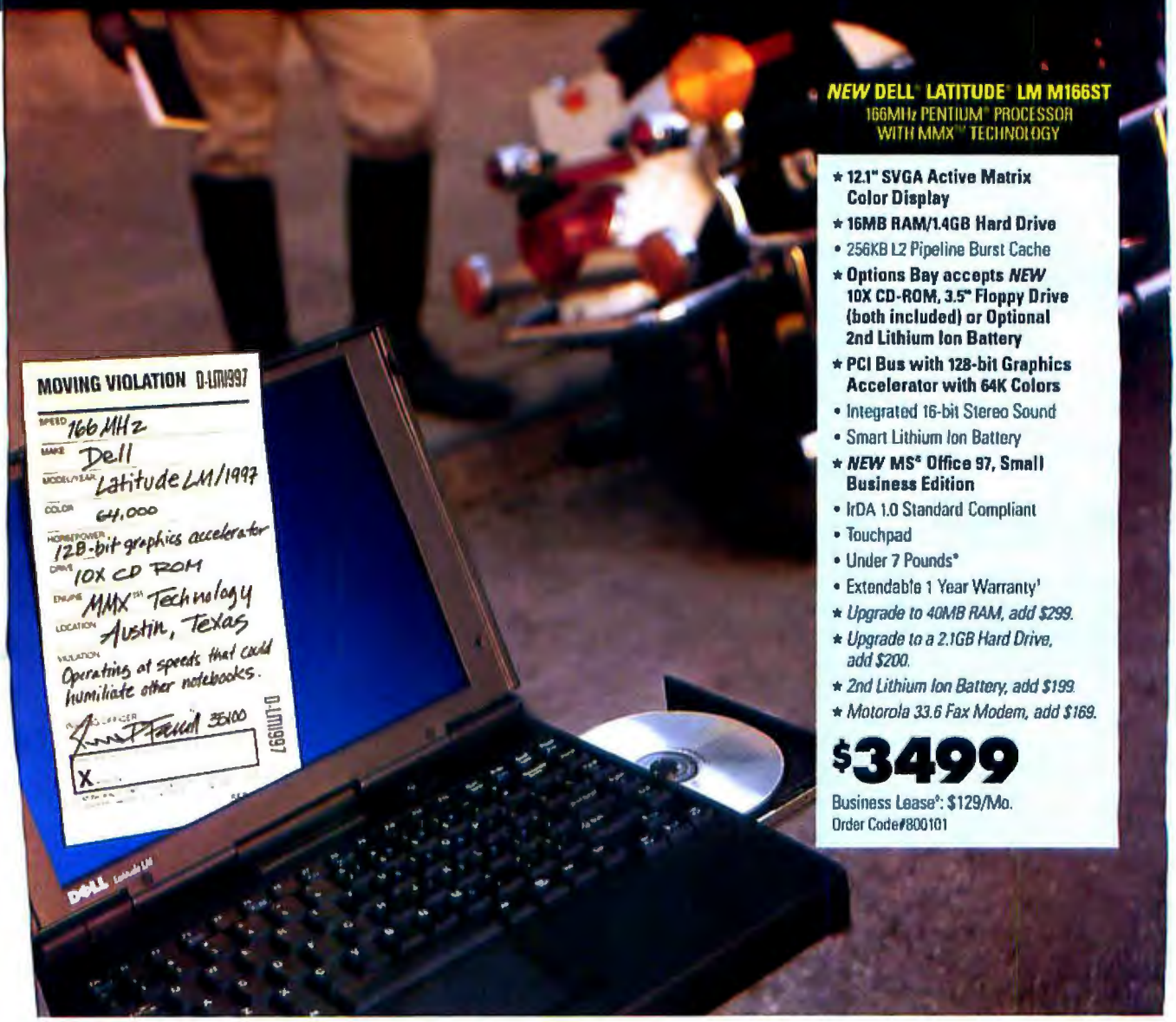

***NEW* DELL® LATITUDE® LM M166ST**
166MHz PENTIUM® PROCESSOR WITH MMX™ TECHNOLOGY

- ★ **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**
- ★ **PCI Bus with 128-bit Graphics Accelerator with 64K Colors**
- • Integrated 16-bit Stereo Sound
- • Smart Lithium Ion Battery
- ★ ***NEW* MS® Office 97, Small Business Edition**
- • 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.*

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Business Lease‡: $129/Mo.
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DELL DIMENSION™ XPS DESKTOPS–PENTIUM® PRO PROCESSOR-BASED

Common features: • Mini Tower Model • Matrox Millennium 4MB WRAM Video Card • AWE32 Wave Table Sound Card • 256KB Internal L2 Cache • **MS® Office 97 Small Business Edition** • MS IntelliMouse • 3 Year Limited Warranty† with 1 Year On-site‡ Service

DELL DIMENSION XPS Pro200n
200MHz PENTIUM® PRO PROCESSOR

Common features listed above plus:
- 64MB EDO Memory with ECC
- *NEW* 6.4GB Hard Drive with 512KB Cache (9.5ms)
- 20TD Trinitron® Monitor (19.0" v.i.s.)
- *NEW* 16X Variable EIDE CD-ROM Drive
- Altec ACS-90 Speakers
- Iomega Zip 100MB IDE Internal Drive with 3-Pak of Cartridges
- Microsoft® Windows® 95
- ★ *Upgrade to 128MB EDO Memory with ECC, add $599*
- ★ *4/8GB EIDE TR4 Tape Backup, add $299.*

$3999

Business Lease*: $144/Mo.
Order Code #500409

DELL DIMENSION XPS Pro200n
200MHz PENTIUM PRO PROCESSOR

Common features listed above plus:
- 32MB EDO Memory
- 2GB SCSI UW Hard Drive (7200RPM, 8ms)
- Adaptec 2940UW Controller Card
- 17LS Monitor (15.7" v.i.s.)
- *NEW* 8X SCSI CD-ROM Drive
- Altec ACS-90 Speakers
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Business Lease: $111/Mo.
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DELL DIMENSION XPS Pro200n
200MHz PENTIUM PRO PROCESSOR

Common features listed above plus:
- 32MB EDO Memory
- 3.2GB Hard Drive (11ms)
- 17LS Monitor (15.7" v.i.s.)
- *NEW* 16X Variable EIDE CD-ROM Drive
- Altec ACS-90 Speakers
- Microsoft Windows 95
- ★ *Upgrade to a 4.3GB Hard Drive (9.5 ms), add $65.*
- ★ *Upgrade to a 1000HS Trinitron Monitor (15.9" v.i.s, .26dp, 1600 x 1200 max. res.), add $165*
- ★ *Upgrade to Altec ACS-290 Speakers with Subwoofer, add $75.*

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Common features: • Mini Tower Model • Table Upgrade Card • **MS Office 97 Sma** Association MPC-3 Certified • 3 Year Limite

DELL DIMENSION XPS M200s
200MHz PENTIUM® PROCESSOR
WITH MMX™ TECHNOLOGY

Common features listed above plus:
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- *NEW* 4.3GB Hard Drive (9.5ms)
- 1000HS Trinitron Monitor (15.9" v.i.s., .26dp, 1600 x 1200 max. res.)
- Altec ACS-490 Full Dolby Surround Sound Speakers with Subwoofer
- Iomega Zip 100MB IDE Internal Drive with 3-Pak of Cartridges
- ★ *Upgrade to a 20TD Trinitron Monitor (19.0" v.i.s.), add $599*

$3249

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NEW DELL DIMENSION DESKTOPS–PENTIUM PROCESSOR WITH MMX

Common features: • Mini Tower Model • 256KB 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 USB Ports • 3 Year Limited Warranty with 1 Year On-site Service

NEW DELL DIMENSION M200a
200MHz PENTIUM PROCESSOR
WITH MMX TECHNOLOGY

Common features listed above plus:
- 16MB SDRAM Memory
- 2.1GB Hard Drive (12ms)
- 800HS Trinitron Monitor (13.7" v.i.s.)
- ★ *Upgrade to 32MB SDRAM, add $119*
- ★ *Upgrade to a 3.2GB Hard Drive (12ms), add $60.*
- ★ *Upgrade to a 17LS Monitor (15.7" v.i.s.), add $175*

$1999

Business Lease: $74/Mo
Order Code #500402

NEW DELL DIMENSION M166a
166MHz PENTIUM PROCESSOR
WITH MMX TECHNOLOGY

Common features listed above plus
- 16MB SDRAM Memory
- 2.1GB Hard Drive (12ms)
- 15LS Monitor (13.7" v.i.s.)
- ★ *Upgrade to an 800HS Trinitron Monitor (13.7" v.i.s.), add $49*
- ★ *3Com 3C905 Fast EtherLink XL 10/100 PCI Card, add $139.*
- ★ *Sound Blaster 16 PnP Sound Card and Altec ACS-90 Speakers, add $89*

$1799

Business Lease: $67/Mo.
Order Code #500401

DELL® POWEREDGE™ SERVERS–PENTIUM PRO PROCESSOR-BASED

Common features: • 256KB Integrated L2 Cache • Integrated PCI Ultra-Wide SCSI-3 Controller • 8X SCSI CD-ROM Drive • 3Com 10/100 PCI 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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200MHz PENTIUM PRO PROCESSOR
Common features listed above plus:
- 64MB ECC EDO Memory (512MB Max.)
- *NEW* 4GB Ultra-Wide SCSI-3 Hard Drive (7200RPM, 8ms) (27GB Max.)
- MS Windows NT Server 4.0 (10 Client Access Licenses)
- ★ *Upgrade to a 9GB Ultra Wide SCSI-3 Hard Drive, add $850*
- ★ *800HS Trinitron Monitor (13.7" v.i.s.), add $399*
- ★ *3Com OfficeConnect Hub 8/TPC, add $149*

$3999

Business Lease: $144/Mo.
Order Code #250056

DELL POWEREDGE 2100 SERVER
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 OfficeConnect Hub 8/TPC
- ★ *Upgrade to 4GB Ultra Wide SCSI-3 Hard Drive, add $320*
- ★ *MS Windows NT Server 4.0 (with 10 Client Access Licences), add $799*
- ★ *Upgrade to 3 Years On-site Service, add $99.*

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Business Lease: $111/Mo.
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***NEW* DELL DIMENSION™ XPS M200s**
200MHz PENTIUM® PROCESSOR WITH MMX™ TECHNOLOGY

- Mini Tower Model
- ★ **32MB SDRAM Memory**
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- ★ **4.3GB Hard Drive (9.5ms)**
- 800HS Trinitron® Monitor (13.7" v.i.s.)
- Matrox Millennium 4MB WRAM Video Card
- 12X EIDE CD-ROM Drive
- AWE32 Wave Table Upgrade Card
- Altec ACS-90 Speakers
- ★ **MS® Office 97 Small Business Edition**
- Microsoft® Windows® 95/30 Days Free Support/MS IntelliMouse
- 3 Year Limited Warranty[1] with 1 Year On-site[4] Service
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