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MAY 1996

**Coming Next Year:
The 500-MHz PowerPC!
Voice-Response Programs
Microsoft, Novell Web
Servers Compared**

BYTE

THE GLOBAL AUTHORITY FOR COMPUTING TECHNOLOGY

WHICH SIDE ARE YOU ON?

UNIX VS

The Battle for Your Company's Servers

NT

**SPECIAL
REPORT**
MOBILE COMPUTING:
BETTER LIVING THROUGH
REMOTE ACCESS

MAY 1996

BYTE

UNIX VS. NT • MOBILE COMPUTING • WANS

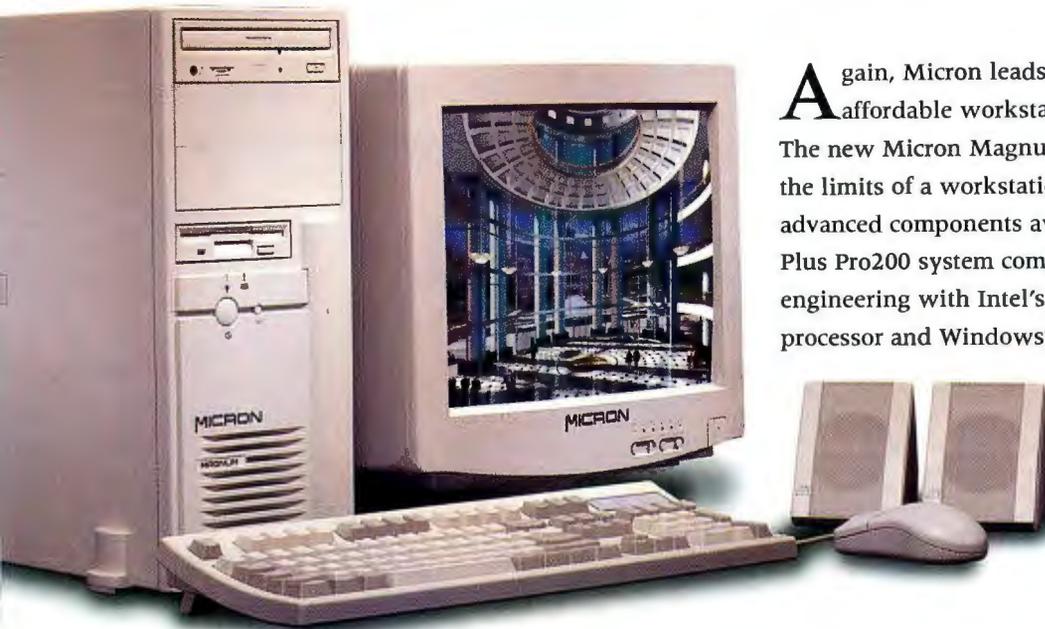
Volume 21, Number 5

♦ MULTIMEDIA DSPs
♦ INTERNET VIDEOPHONES



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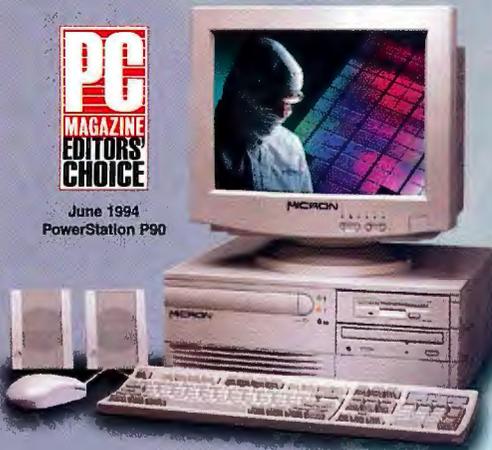
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June 1994
PowerStation P90



Designed for

Microsoft®
Windows®95

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- Microsoft® Mouse, 104-key keyboard
- Microsoft Windows® 95 CD & MS Plus! CD
- 5-year/3-year Micron Power™ warranty*



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• Microsoft Works 95 CD
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• Microsoft Office Pro 95 & Bookshelf 95 CDs
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- 8MB EDO RAM • 1.0GB EIDE hard drive
- 3.5" floppy drive, flash BIOS
- PCI 64-bit graphics accelerator (1MB)
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- Tool-free mini-tower or desktop
- Microsoft Mouse, 104-key keyboard
- Microsoft Windows 95 & MS Plus!
- Microsoft Works 95
- 5-year/3-year Micron Power warranty*



\$1,599 Business lease \$54/month

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- 6X SCSI-2 CD-ROM drive, 3.5" floppy drive
- PCI 64-bit video, MPEG, 2MB EDO
- Full-size tower with 10 drive bays
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January 9, 1996
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May 30, 1995
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December 1995
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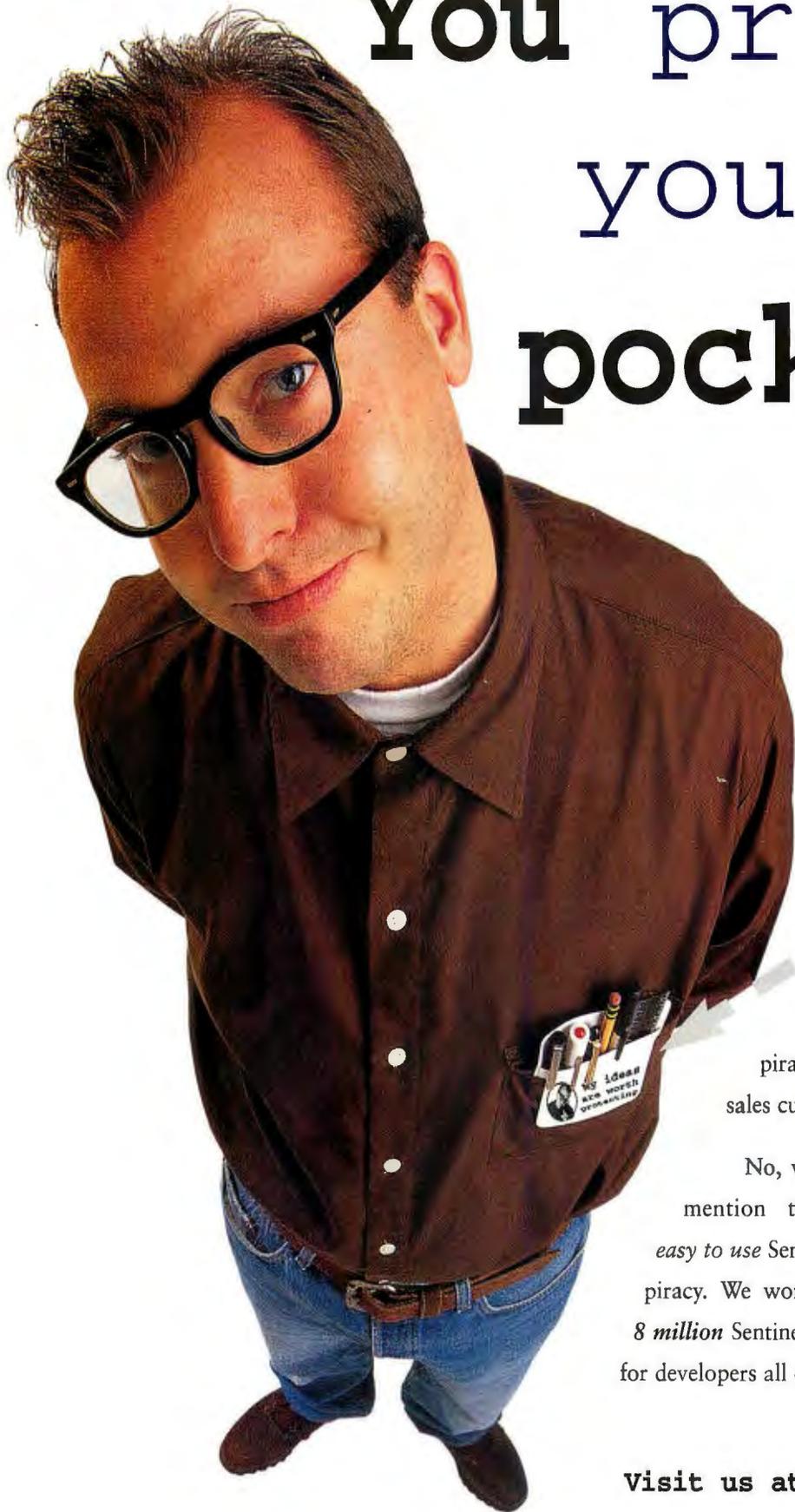
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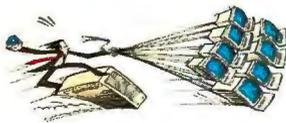
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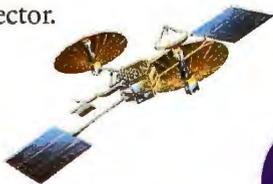
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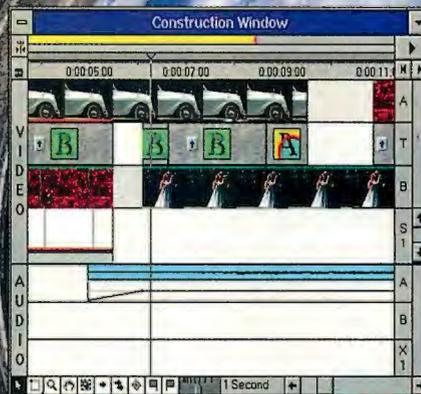
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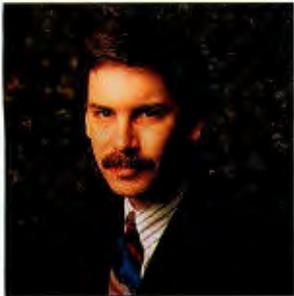


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While You're Waiting for the Web



**Everybody sing,
“We love the
Web.” Done yet?
OK, you’re cool.
Now let’s do
some real work.**

Are you worried about the Web? Do you feel the pressure to come up with an Internet strategy? OK, let's take a few facts as given: The Web is huge. The Web is important. The Web is the future. OK, fine. Now let's get on with our jobs.

While you're trying to figure out how to really take advantage of the Web, please don't forget that there are many things you can do to improve your products—be they internal corporate systems or retail software applications—that have absolutely nothing to do with Web technology.

But here's the kicker: If you do these things, you will also be preparing your systems for eventual porting to the Internet.

Make It Easier to Use

People don't compare your applications and products solely to your direct competitors' products. When you're designing an accounts-payable system, you can't judge its user interface against another accounting system. Instead, compare it to your remote control, your car, or your kid's Buzz Lightyear action figure.

People don't study products as they once did. Nobody reads manuals. Programs have to be as easy to use as *USA Today* is to read. You can complain about having to lower yourself to the standards that made *Short-Attention-Span Theater* a success—or you can quit whining and just build products that people will be able to use within 10 seconds.

Keep this in mind: If you make software, eventually it's going to get stuck on the Web. You know how distracting an environment that is, right? So make your program stand out by making it simple.

Make It Smaller

This is imperative. Hard drive technology is only barely keeping pace with software bloat. My portable has a 687-MB hard drive—and only 20 MB free.

The discipline of smallness forces you to look carefully at all new features. Does your database system really

need a singing and dancing company logo? Smallness also lowers distribution costs—especially on-line distribution. Finally, the smaller your program is, the more likely it will be installed on users' machines if they, like me, have a perennial space crunch on their systems.

My favorite example of this principle is Software Publishing's presentation graphics program, ASAP. It does about 75 percent of what Microsoft PowerPoint does. However, PowerPoint does about 300 percent more than the average presenter will ever need. And ASAP fits on two floppy disks. That's what I call progress.

Make It Faster

Yes, you can plan on Moore's law holding for the foreseeable future, but you can't plan on all your users or customers following the law. Old PCs don't die, as you know. Instead, they get put on the desks of secretaries and assistants—people who spend countless hours every day running software. If you strive to make your programs faster, you're more likely to keep these heads-down workers more productive.

As corporations (and households) begin to adopt low-cost Web terminals, the speed of your code is going to become even more important. The \$500 Web PC isn't going to have a 166-MHz Pentium in it.

Make It Cross-Platform

Windows is everywhere today, but it's not everything. Even Windows is changing—two years from now, Windows NT will be a much more common OS on business desktops (and portables). So don't limit yourself.

Fortunately, developing across platforms doesn't mean developing the same program a dozen different times. What it does mean is using the tools available to code to an intermediate standard, which can then be more quickly ported to other platforms. You must be ready to have your product run not just on a high-powered Windows PC, but possibly also on a network computer (Web PC), or perhaps on Java running on a Unix workstation.

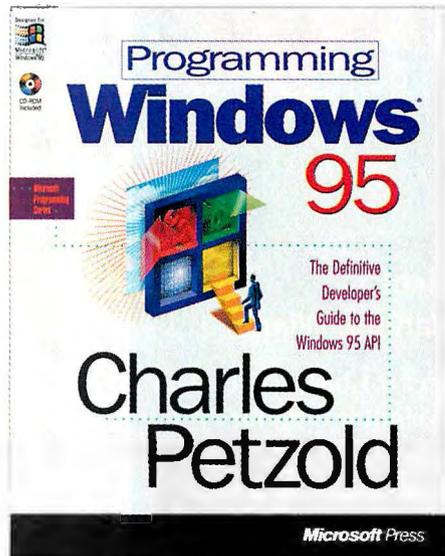
Am I asking for too much? Maybe. But if you make systems that are easier to use, smaller, faster, and multi-platform, you'll find yourself not just with better systems overall, but systems more likely to fit on the Web. That is, once you figure out your Internet strategy. ■

A handwritten signature in black ink, reading "Raf Needleman".

RAPHAEL NEEDLEMAN, EDITOR IN CHIEF
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PC Magazine, November, 1995

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MacUser, December, 1995

WordPerfect 6.1 for DOS receives Editor's Choice Award.
PC Magazine, November, 1995

COREL CORPORATION NEWS

COREL: An Award-Winning History

Corel Corporation, a world leader in the development of graphics and multimedia software, was founded in 1985 by Dr. Michael Cowland. The Company was originally engaged primarily in the systems integration business. By combining hardware and software products from various manufacturers, Corel became an important supplier of turnkey PC-based desktop publishing systems and local area networks.

As a result of its experience in developing software enhancements, Corel began to devote additional resources to creating a separately packaged graphics software program. In January 1989, the Company introduced its first version of CorelDRAW. The second version, CorelDRAW 2, was introduced in November 1990, and CorelDRAW 3 became available in May 1992, and CorelDRAW 4 and CorelDRAW 5 were released in May 1993 and May 1994 respectively, while the most

recent version of Corel Corporation's flagship product, CorelDRAW 6, was launched in August 1995.

Corel's tenth anniversary year was marked by a series of strategic new development directions for the Company. The Corel CD HOME for the rapidly expanding series, aimed at the home consumer CD-ROM market, was launched in April 1995. Featuring a wide variety of titles in the categories of education, reference, games and entertainment software, this multimedia series is distinguished by its high-quality graphics and industry-leading CD-ROM technology.

In addition, Corel set out to become a key player in the emerging desktop videoconferencing market. CorelVIDEO, announced in October, is designed to meet the changing needs of both the corporate and personal communications marketplace. Corel's solid track record in the software industry, together with its ability to supply a relatively inexpensive desktop video solution that can be implemented over existing LAN topology, make the Company's involvement in videoconferencing a natural fit.

On January 30, 1996, Corel entered into an agreement to acquire the WordPerfect family of software programs and other related technologies from Novell, Inc. of Orem, Utah. The acquisition of Novell's business applications division will make Corel the world's second largest independent vendor of personal productivity applications.



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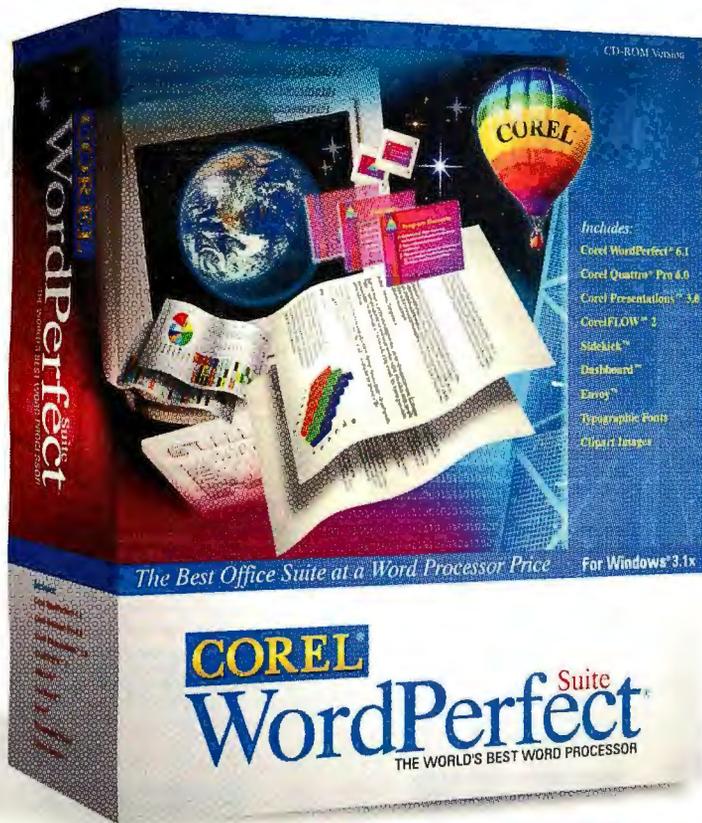
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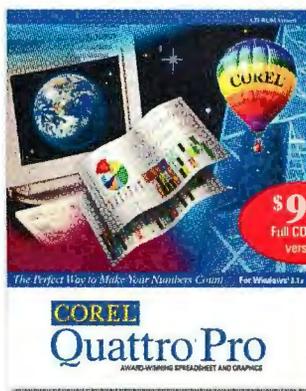
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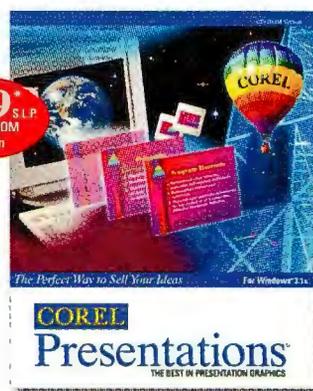


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Right now there are clever people out there making newer and smarter viruses at the rate of something like four a day. Fortunately, we've got the world's leading antivirus researchers on our side – a whole lab of men and women whose aim and pleasure in life is to explore new virus techniques and basically try to beat our IBM AntiVirus – so that we can make it even stronger for you and your company.

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“Can a customer pay by credit card without furnishing some hacker's condo in Malibu?”

COMMERCE

There are security risks in all walks of life. But there is something about cybercrime – the idea of someone pressing a few buttons and making off with one's digital belongings – that is particularly frightening. And in fact, commerce on the Net will grow only as fast as confidence in the security of the Net grows.

Fortunately, our confidence has grown pretty fast over the last couple of years. IBM SecureWay includes a variety of services and products that, over time, will make exchanges across the Internet even more secure than nonelectronic transactions – everything from credit card transactions to super-distribution of copyrighted material to the transmission of confidential corporate data.

The Secure Electronic Transactions protocol, developed using iKP multiparty payment protocol from IBM Research, allows buyers, sellers and credit card companies to be joined in a single Internet transaction that is secure, confidential and verifiable.

Our Cryptolopes™ technology promises to revolutionize online publishing by providing a mechanism for controlling distribution of copyrighted materials. This “encrypted envelope” will let the originators of the material get value for their creations and help them find a new market on the Internet.

Of course, your management needs to understand that an organization on the Internet is only as safe as its weakest link. With that in mind, we’ve developed powerful firewall, encryption and access control technology, not to mention one of the largest private secure business networks in the world – the IBM Global Network™.

So, in short, that hacker in Malibu is going to have to find a new way to make a living.

To learn more about IBM SecureWay and our secure transactions technology, visit www.ibm.com/security or call [1 800 IBM-7080](tel:1800IBM7080), ext. G122.

“Will a fancy port scanner algorithm make mincemeat of my firewall?”

DEFENSE

On the one hand, the Internet gives your company the opportunity to open its doors to millions of potential customers, partners and contributors. On the other hand, there are all sorts of very clever people out there who would love to infiltrate your system, whether for mischief, for the challenge of it, or for plain old corporate theft.

Fortunately, we’ve got some hackers of our own. We call them “ethical hackers.” These are dedicated masters of the very latest techniques of sniffing, spoofing and cracking. And, working with the IBM Global Security Analysis Lab, they put this knowledge to use to develop better and better security countermeasures.

And, for our clients, the ethical hackers will use all their tricks and techniques to try to breach your network. This is one aspect of IBM’s Security Healthcheck – a series of powerful tests and preventive measures that lets us find weak spots and strengthen defenses before a break-in occurs.

But, because the world is a rough place and the worst can sometimes come to pass, IBM’s Emergency Response Service is on call 24 hours a day, seven days a week around the globe to close any breach in your network and repair the damage. The response team makes itself intimately familiar with your network and systems ahead of time, so that, in an emergency, they already know where to go and what to do.

We believe that the networked world can be a very safe place to do business. But that doesn’t happen by mistake, it happens by planning ahead.

To learn more about IBM’s IT Security Consulting, Security Healthcheck, ethical hackers, Emergency Response Service and all the products and services in the IBM SecureWay family, visit www.ibm.com/security or call [1 800 IBM-7080](tel:1800IBM7080), ext. G121.

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Not My TV

"Toss Your TV: How the Internet Will Replace Broadcasting" (February cover story) was a well-written summary of where we are and a preview of things to come. As with a recent BYTE cover that asserted "The PC Is Dead" (October '95), I found the title premature and obviously exaggerated. The content of the article, however, is so good that I'm routing it to all my coworkers as an introduction and preview of Internet capabilities.

Christopher Hill
Huntington Beach, CA

"Toss Your TV: How the Internet Will Replace Broadcasting" was an interesting article. However, asynchronous transfer mode (ATM) is a switching, or more of a "statistical mux," technology; it does not increase the inherent information-carrying capacity of a medium. One cannot compare it with T1 or asymmetric digital subscriber line (ADSL) or symmetric digital subscriber line (SDSL), which are basically transport systems. For example, a T1 line can carry 1.544 Mbps bidirectionally, and ADSL does 6 Mbps downstream and as much as 640 Kbps bidirectionally. The same T1 or ADSL transport system can have an ATM layer embedded in it, but ATM cannot enable a 12-Mbps transmission in a system that is inherently limited to 6 Mbps.

S.K. Das
Bell Labs, Whippany, NJ
skd@harpo.wh.att.com

Thanks for pointing that out. The article did not make it clear that ATM is in fact defined as part of the Broadband ISDN (BISDN) standard.

—Edmund X. DeJesus, senior editor

Thanks a Million

Congratulations on the consistent excellence of BYTE magazine. Your feature articles have enough depth to keep me ahead of my programming competitors, and your comparative analyses often give me enough information to make a purchase decision. I also appreciate the breadth of the magazine's coverage, which enhances my ability to discuss options with customers. I once enthusiastically endorsed

BYTE to my colleagues; I now consider my subscription a competitive advantage.

Stephen Rooney
Dallas, TX

One Pippin to Go

Who needs Apple's Pippin? My school library needs it. We are looking for a browser-only machine and Pippin sounds like the answer to our prayers. I look forward to working with one.

Georgeann Kepchar
Technical coordinator, John Burroughs School,
St. Louis, MO
gkepchar@jeworld.jbs.st-louis.mo.us

The Linux Phenomenon

BYTE captured the Linux phenomenon in "Linux Matters" (February); as one of the rabid fans to whom you allude, I applaud. However, if you plan to use Linux and want to take advantage of the expensive video card you paid for when you bought your computer, you'll absolutely have to buy a commercial X server. The article also doesn't make it clear enough that there are errors in the compatibility lists. I love my Linux box, but for three weeks I

went through a hellish orgy of stack traces and expensive trips to the computer store before I could get it to work. If you want to run Linux, find someone who runs it on a platform you like and use exactly the same components they do; it will save you a lot of time and money.

Geoff Smith
gsmith@londo.caltech.edu

Last year I ordered RedHat as well as Slackware Linux. I tried for weeks to get something to work. Your statement that it is easier to change hardware than to configure the software to get "nonstandard" configurations to run does not alert potential users sufficiently.

Mel Hamilton
us067831@whtux.mmm.com

I use many OSes for different purposes. Often it's not the technical aspects but the human ones that make an OS a good choice for a particular person. On the other hand, Linux is wonderful for us geeks: While the major players preannounce

goodies to such an extent that the result is always disappointing, Linux always exceeds my technical expectations. Where else can you find an OS that comes with server software for NetWare 3.x, a Windows for Workgroups-style NetBIOS, and Network File System, that can all run concurrently, and for free?

Paul Fremantle
Reading, U.K.
paul@zsassoc.co.uk

And What About FreeBSD?

In "Not Just Another Free Unix" (December '95), you mention that motherboards with "inferior cache design or broken DMA invalidation logic do exist in... large numbers." Now you've got me worried. While I'm not yet in the market for a Unix box, I am curious how I should go about making sure the custom system my local computer shop builds for me indeed has a superior cache and robust DMA validation.

Philip Courier
100145.2002@compuserve.com

One way to attack the problem is to use only equipment that you've gotten good reports on. Another approach, given a no-name motherboard or system that you'd like to certify, is to load FreeBSD with all the sources and do a make world at the top of the source tree (/usr/src). This will recompile every component of the system, excluding the kernel, and is probably one of the most exhaustive tests of components. If your system can make it through at least two make worlds (five to 14 hours each, depending on the speed of the hardware), you probably have a winner. It's a real problem that most shops test their systems only with DOS and Windows; neither pushes hardware to the limits of its specifications. —Jordan Hubbard

Banking on ISDN

In "ISDN: Give Up and Go?" (February), you insinuate that ISDN is dead because ADSL and Digital Simultaneous Voice

We want to hear from you. Address correspondence to Letters Editor, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458; or you can send E-mail to editors@bix.com. Letters may be edited.

and Data (DSVD) are going to take its place. While ADSL works well under certain conditions, how many telephone subscribers meet these restrictions: No further than 12,000 feet from the phone company's central office; no load coils; no fiber optics? The phone companies have been trying for 10 years to get the copper out of the local loop.

Anyone who has a 28.8-Kbps modem can tell you it's very unusual to actually connect at 28.8 Kbps. DSVD works great when you can take a 9-Kb channel from 28.8 Kb, but if you take it from a 19.2-Kb channel, the system starts crawling. ADSL and DSVD may look good on paper, but they are the last vestiges of a dying technology.

Dave Breeding
bluadept@erols.com

Our point was not that we'd all be tossing ISDN in favor of ADSL or DSVD but that there are other technologies in the works that might meet some immediate needs. Obviously, ADSL will not be good for applications that require two-way traffic exchange, and DSVD is also limited. But both might appeal to niche markets: ADSL for video on demand or Web browsing, and DSVD for customer support. Given the lingering lack of ISDN service in many regions—I've been waiting for ISDN in my part of New York City for three years—these technologies may be your only choices.

—Sal Salamone, news editor

ISO 9000 for Software

In "How Software Doesn't Work" (December '95), you make it explicit, for the first time, that quality is not reached only through techniques or tools. To the two quality-management models you mention in "Make Quality Job 1" I would like to add the ISO 9001 standard, which is very important in Europe. Because it implies that a coherent company- or unit-wide organization be set up, many companies now understand that a leader can organize a project only by relating to and relying on a global organization. The standard was not written with software in mind; it is technology- and domain-independent, but it is applicable to complex software development.

Francois Tarpin
Paris, France

101472.331@compuserve.com

It's Slow in Reverse

I enjoyed "Damn Lies" (Network Project, February). It has helped me provide my boss with the server usage statistics he needs. I am running wwwstat on my server logs (output from Netscape Communications Server). I have configured the server not to convert IP addresses to Domain Naming System (DNS) names. I also have incorporated your "reverse DNS lookup" Perl script into wwwstat. I began running wwwstat almost four days ago and it has yet to complete all the reverse DNS lookups.

Scott Figgins
Webmaster, BPE, Inc.
<http://www.bpe.com>
figgins@dnai.com

Those reverse lookups do take forever. As we mentioned in the article, the plain vanilla wwwstat does not seem to cache the lookups. The modified version we use (from Process Software, www.process.com) does cache them per run of wwwstat. However, we've now had to modify that version of wwwstat.pl further in or-

der to store the lookup results across runs of wwwstat.

—Jon Udell, executive editor

FIXES

Due to an editing error in "SuperCow on the Beach" (Pournelle, February, page 190), we managed to say "Travan cartridges are physically smaller than DAT or 8-mm but have more storage...." We meant to say "Travan cartridges are larger and provide less storage than DAT or 8-mm, which is why they're cheaper...."

In our February Lab Report on graphics adapters, we reported an incorrect toll-free telephone number for Elsa, Inc. The correct number is (800) 272-3572. The company name is Elsa, Inc., not Elsa America.

The screen shot on page 86 of "Dial 1-800-Internet" (February) is incorrectly identified as Internet Telephone Co.'s WebPhone. The screen is from a Quarterdeck product that, at press time, was also known as WebPhone but has since been renamed WebTalk.

COMING UP IN JUNE

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• EVALUATIONS AND REVIEWS

NEC's MultiSync LCD 300 brings flat-panel, active-matrix display to the desktop. In the Lab Report, we rate color ink-jet printers with fast, high-resolution output. And we test Microsoft Exchange Server, the next step in Microsoft's push to standardize E-mail and workgroup applications and challenge Lotus Notes.

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Sam "Guru" Miller
Manager, New Product Development

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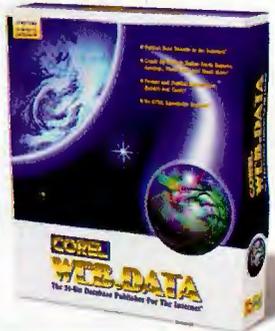
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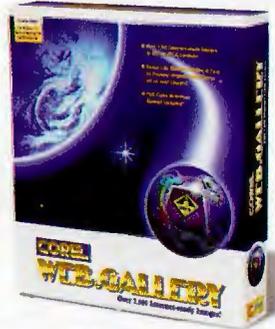
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NEWS & VIEWS

PC TRENDS

New PCs Improve Your Image

Thanks to new storage options, PCs can now satisfy the voracious memory appetites of the latest multimedia, graphics, and document-imaging applications

JON PEPPER

Prospective PC buyers can look forward to new PCs this spring and summer that offer a variety of new high-speed processors, input devices, telephony capabilities, and multimedia options. But the big news highlighting this spring's PC lineup is that new input systems and storage options make PCs better platforms for imaging applications. These new developments bolster the PC's ability to combine photos and other graphical images with standard documents and databases.

Expect the typical low-end, 75-MHz Pentium-based system with a 1-GB hard drive, a quad-speed CD-ROM drive, 8 MB of RAM, and other features to sell for less than \$1500. Higher-end systems with the latest (166-MHz) Pentium or equivalent processor, a x6 or x8 CD-ROM drive, telephony options, near-line data storage, new scanner devices, and other features will cost \$2500 or more.

One innovation from Hewlett-Packard ((800) 724-6631 or (415) 857-1501) that enhances the imaging capabilities of its new Pavilion line of consumer PCs is the PhotoDrive, a miniscanner that fits into a PC's drive bay.

• Expect PCs that support the emerging universal serial bus (USB) standard, which will gradually replace the slew of ports in the back of PCs, to start shipping in the third or fourth quarter.

• 28.8-Kbps modems with integrated telephony software will be common.

• Business computers like IBM's PC 700 ((800) 772-2227) will let network administrators turn on unattended systems over a LAN.

SVGA monitors of 15- or 17-inch-diagonal screen sizes will be standard, but some vendors such as Gateway, with its Destination PC, will offer home-entertainment PCs with 31-inch viewable displays and CATV-ready tuners.

New input options will include Compaq's scanner keyboard (about \$349), which is essentially a Visioneer PaperPort scanner built into the keyboard, and the PhotoDrive from Hewlett-Packard.

Storage options will abound. Hard drive configurations ranging from 840 MB to 2 GB will be typical. Other alternatives will include replaceable-cartridge drives like Iomega's Jaz drive, the PD-CD Drive included in new Compaq PCs, and the SyJet, a 3½-inch removable-cartridge hard drive for Macs and PCs, slated to ship this quarter. The SyJet (about \$499) from Syquest ((510) 226-4000; fax (510) 226-4100) uses cartridges that hold 650 MB or 1.3 GB (about \$65 and \$95, respectively).

Companies like Acer ((800) 733-2237; fax (408) 922-2953) and others offer PCs with x6 or x8 CD-ROM drives.

The new LS (Laser Servo) 120 internal drive packs 120 MB of storage into a 3½-inch-format medium. Get it first in the Deskpro 5133 and 5166 LS PCs or as a separate \$210 option from Compaq. Other vendors will offer LS drives this summer.

The 400-dot-per-inch PhotoDrive will accept 5- by 7-inch or smaller photos. For storing images, HP will include the Iomega Zip drive.

New systems from Compaq ((800) 345-1518; fax (713) 514-4583) also include an array of innovative storage and input options. The new LS (Laser Servo) 120 drive, which will also be available in other vendors' PCs, looks almost identical to a normal 1.44-MB disk but stores up to 120 MB. Unlike the Iomega Zip drive (100 MB) and the Syquest EZ135 drive (135 MB), the LS 120 also reads and writes 720-KB and 1.44-MB disks. The special LS 120 disks will cost about \$15 each.

Another new storage option in Compaq PCs is the PD (PowerDrive)-CD drive. (For more information on the PD-CD drive and other removable-media mass-storage options, see "16 Drives for Fast Data Backup" on page 142.)

A different take on PCs comes from Gateway ((800) 846-2000; fax (605) 232-2023). Its 120-MHz Pentium-based Destination is designed to replace your TV.

Slated to ship this spring for less than \$4000, the Gateway Destination comes with a large 31-inch monitor. The system also comes equipped with 16 MB of RAM, a x6 CD-ROM drive, a 28.8-Kbps modem, a wireless radio-frequency keyboard and pointing device, an integrated TV tuner, integrated stereo speakers, and several additional features.

The industry continues to evaluate how so-called Web PCs costing \$500 or less will fit into the overall computing scenario. However, people willing to pay a little more money will find a wealth of new options at prices similar to those of last year's models.

Inside the Ultimate Web Site

Rick Smolan's ambitious 24 Hours in Cyberspace project revealed the technical and creative difficulties of large-scale publishing on the Internet's World Wide Web

TOM R. HALFHILL

For 24 hours, it was the world's biggest Web site and the most elaborate journalistic experiment in history. It was also a revealing proving ground for new technology—the same technology that forward-looking content providers and businesses will have to master before large-scale publishing and commerce on the Internet become a reality.

The 24 Hours in Cyberspace project began as another installment in a series of photodocumentaries masterminded by Rick Smolan, a former *National Geographic* photographer. This time, Smolan tried to document how people around the world are using computer technology, especially the Internet and the Web. He also decided to publish some of the stories on the Web the same day, to be followed later by his usual coffee-table book and CD-ROM.

What began as an interesting journalistic project soon mushroomed into a massive technical challenge. Smolan had to build the biggest (in terms of installation size) Web site ever contemplated, staff it with skilled personnel, find software that could generate attractive Web pages in minutes, and keep the whole thing running for 24 hours with no downtime. To raise the stakes still further, the project itself became a media event.

Not everything went according to plan. The project was almost torpedoed by technical problems, including a mysterious memory leak that caused the database server to lose 175 MB of RAM per hour. However, Smolan's all-star team of technical wizards managed to keep the Web site alive, and it recorded more than 4 million hits that day. (Netscape's home page can record up to 10 times that number on a busy day, but the 4-million count is never-

theless impressive.) More important, Cyber24 previewed what any business will face if it tackles Web publishing on a similar scale.

The project's sponsors (nearly 50 companies, led by Adobe, Kodak, and Sun Microsystems) lent hardware and software worth more than \$5 million, plus some of their best experts. Smolan also hired a few technical gurus of his own. Last November, about three months before the February 8 event date, they started building their 6000-square-foot "mission control" in San Francisco.

From the beginning, it was an invent-as-you-go project. For instance, most Web sites follow a traditional publishing model in which someone creates Hypertext Markup Language (HTML) pages off-line and posts them on a server for browsing by users. But

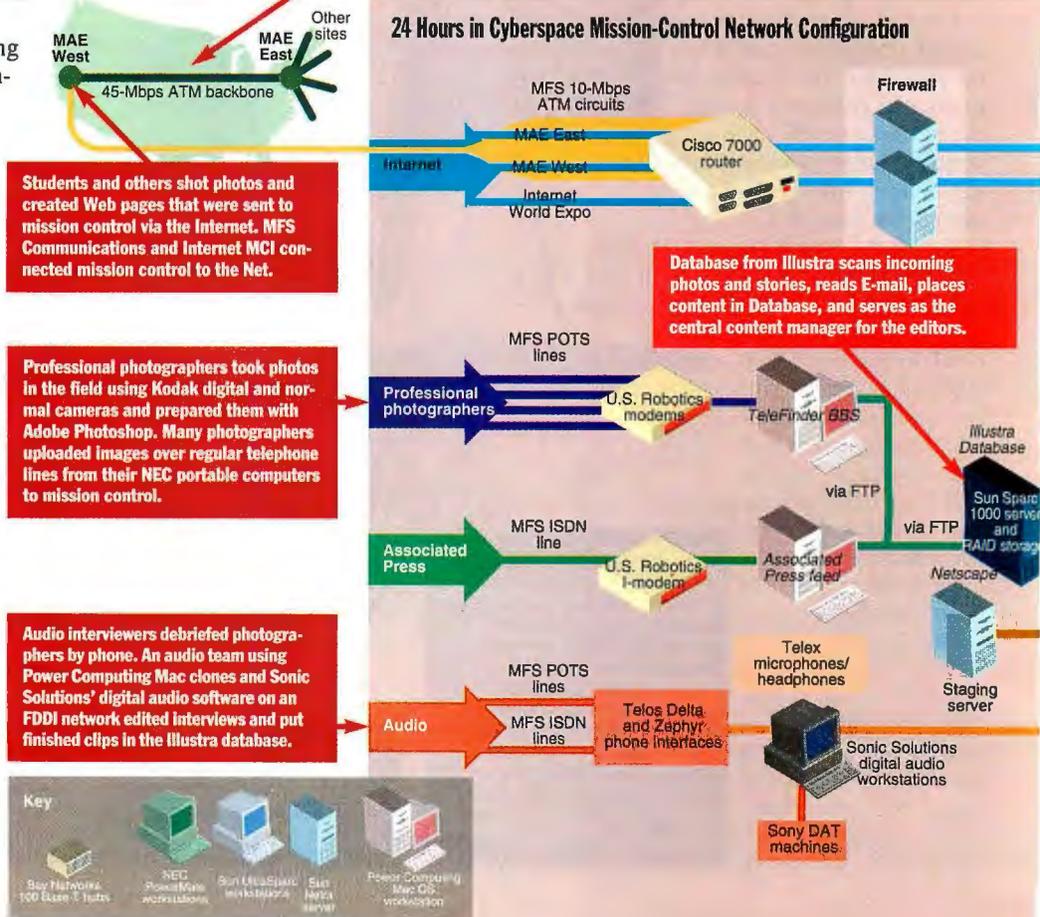
Published work is sent from the Web site to Metro Area Exchange (MAE) West, MFS Communications' hub of routers and switches running SONEt. MAE West forwards finished pages to MAE East over a 45-Mbps ATM backbone. MAE East distributes Web pages to other sites around the world. MFS Communications (Omaha, NB) supplied the local, long-distance, and international service for the project, plus the fiber-optic backbone.

Students and others shot photos and created Web pages that were sent to mission control via the Internet. MFS Communications and Internet MCI connected mission control to the Net.

Professional photographers took photos in the field using Kodak digital and normal cameras and prepared them with Adobe Photoshop. Many photographers uploaded images over regular telephone lines from their NEC portable computers to mission control.

Audio interviewers debriefed photographers by phone. An audio team using Power Computing Mac clones and Sonic Solutions' digital audio software on an FDDI network edited interviews and put finished clips in the Illustra database.

24 Hours in Cyberspace Mission-Control Network Configuration



A Mann of Vision

MIT student uses webcam to draw attention to privacy issues



"He'll no doubt remain the most-noticed guy in Massachusetts."

Wearing a pair of video cameras on his head, Massachusetts Institute of Technology graduate student Steve Mann goes about his daily business of classes and running ordinary errands. Steve's "wireless wearable webcam" acts as a visual filter, as he sees his world on a video screen shield across his eyes. Anyone can be a voyeur in Mann's world, as his cams instantly transmit images to his World Wide Web home page (<http://www-white.media.mit.edu/~steve/netcam.html>).

Cyber24's permanent Web site was scheduled to go on-line in March at <http://www.cyber24.com>.

the Cyber24 site had to do much more. It accepted raw input in the form of ASCII text, scanned photographs, and digitized audio; provided about 80 writers, photo editors, and sound technicians with the tools to rapidly shape that material into HTML pages; and staged the finished pages on a network of 14 mirrored Web servers in the U.S., bridged to five more mirrors throughout the world. (For a look at how the information flowed, visit the 24 Hours in Cyberspace site at <http://www.cyber24.com>.)

The torrent of incoming data came not only from the 150 professional photographers that Smolan deployed from the Arctic Circle to South Africa, but also from everyday users who uploaded submissions. More than 1000 photographers in 27 countries shot 6000 rolls of film and hundreds of digital images. Everything had to be archived for later use in the book and CD-ROM.

Nobody knew how much capacity or bandwidth they'd need,

so they prepared for the worst. MFS Communications hooked the Cyber24 site directly into its prime Internet hubs on the Atlantic and Pacific coasts. These hubs, known as Metro Area Exchange (MAE) East and MAE West, are the gateways to a high-speed fiber-optic backbone that uses asynchronous transfer mode (ATM) and synchronous optical network (SONET). DS-3 and T1 lines connected project servers to the hubs.

At mission control, the high-speed lines from MAE West were funneled through a NetEdge ATM bridge and a Cisco 7000 router. Sun's Firewall-1 security software guarded against intruders. Behind this wall, technicians assembled four Fast Ethernet (100Base-T) LANs, plus a MediaNet Fiber Distributed Data Interface (FDDI) ring.

Sun lent 60 of its latest UltraSparc workstations, two SS-1000 database servers (each with eight CPUs, 1 GB of RAM, and an 84-GB RAID-5 disk array), and three Netra servers for FTP and E-mail. NEC Electronics lent 25 PowerMate PCs with 100-MHz Pentiums. There were also some Mac clones from Power Computing, mostly in the audio-processing studio. The latter systems had FDDI cards from Sonic Solutions and Telos Zephyr ISDN boxes. Collectively, the Cyber24 site had 11,000 MB of RAM and 300 GB of mass storage.

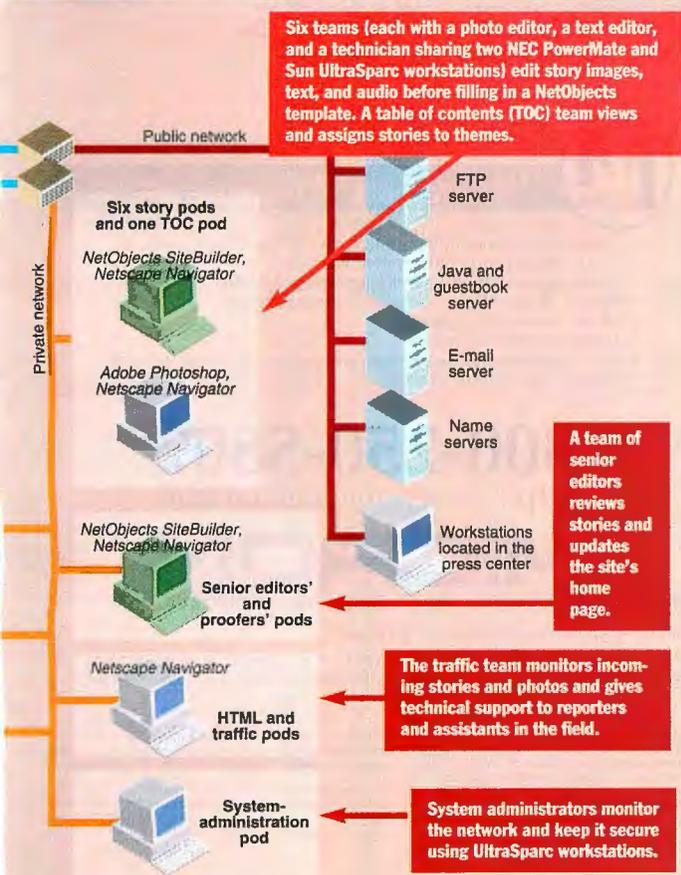
The project leaders made some surprising software choices. The story editors created all their Web pages with an automated layout tool from NetObjects (Redwood City, CA). NetObjects is a tiny start-up company, and its prototype layout tool is so new it doesn't even have a name. Yet the editors successfully created 63 multipage stories without writing any HTML code.

For their database software, the project leaders bypassed the more obvious choices in favor of Illustra, a relatively new relational DBMS from Illustra Information Technologies (Oakland, CA). Illustra is particularly good at handling multimedia data types, and the Cyber24 project generated many gigabytes of digitized photos, audio clips, and text. Adobe Photoshop was the logical choice for picture editing. The Cyber24 team sprang another surprise by tying all this software together with a custom front end that was based on templates displayed by Netscape Navigator. In other words, they pushed the underlying OSes so far into the background that they were virtually transparent to the editors.

"We have Mac bigots, Windows bigots, Sun bigots, and typewriter bigots," explained William J. Ray, Illustra's director of market development. "They don't have time to worry about what the right mouse button does on this computer or what the left button does on that computer. They can just sit and start working."

Amazingly, when the big day arrived, everything worked. Well, almost. The technicians never did trace the source of that 175-MB-per-hour memory leak. The network slowed to a crawl when the server dwindled to about 300 MB of RAM. However, they recovered the memory by rebooting the server every four hours, a solution good enough for a short-term project.

When it was over, they began tearing down what they had labored three months to build. It may be years before anyone constructs another Web site on this scale, but when they do, they'd be wise to hire some Cyber24 veterans as consultants. A century ago, the modern mass media was born when newspapers advanced from hand-set type and single-sheet platen presses to Linotype machines and high-speed rotary presses. In the near future, the on-line mass media will advance from hand-coded HTML pages and narrowband modems to automated layout software and broadband networks. Some of that new technology will trace its ancestry back to 24 Hours in Cyberspace.



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—*PC World*, March 1996

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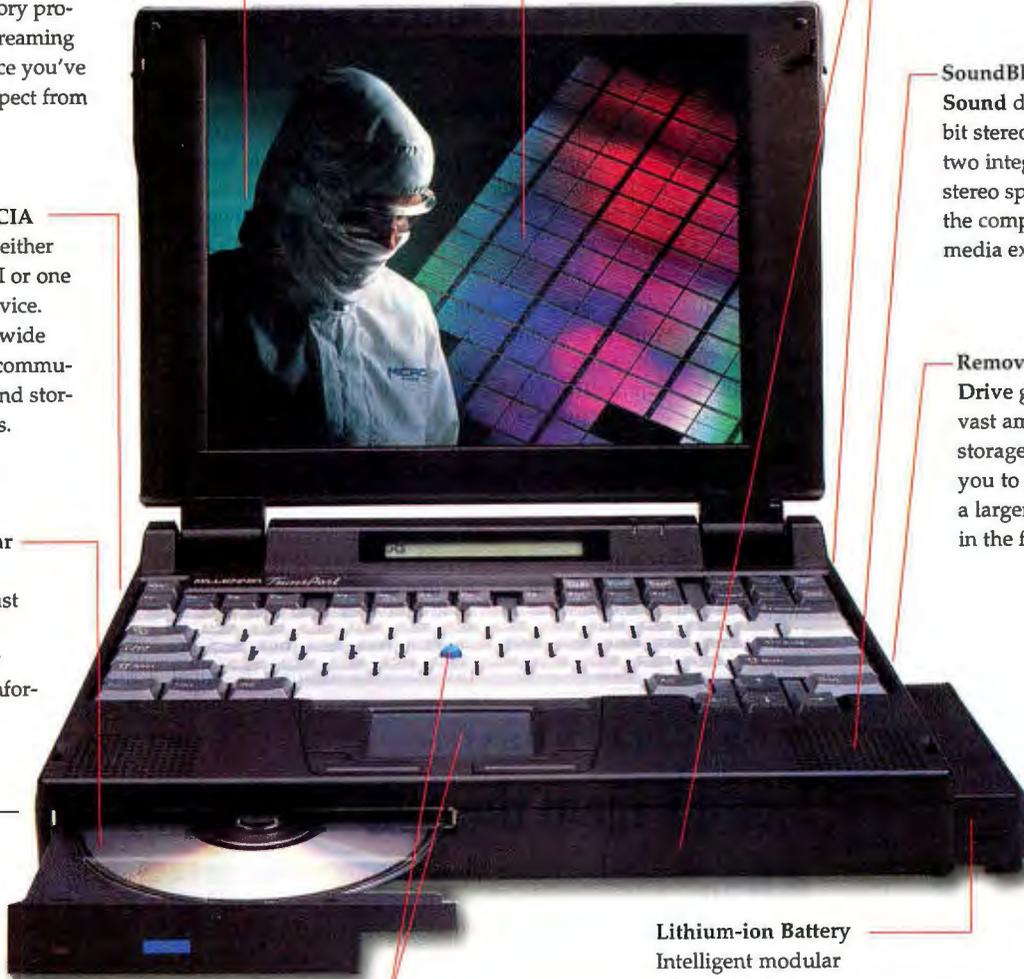
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DATA BACKUP

On-Line Information Services Deliver Disaster Recovery for Small Business

A new hands-off approach to backing up your PC promises to make it easier and less expensive to safeguard your important data, while giving new meaning to the term *on-line storage*. Traditional backup nomenclature defines on-line storage as data that's stored locally, usually on a fast hard drive. However, SureFind Information (Pittsburgh, PA, (412) 788-2511 or (800) 787-0009), in partnership with CompuServe, hopes to popularize another type of on-line backup in which users automatically back up their important data files to remote electronic "vaults" over a modem.

Ed Sarkisian, president of SureFind, stresses that the new service targets small businesses and home offices that don't regularly back up critical data and want a solution that's easy and automatic. "This is not designed to back up hundreds of megabytes and gigabytes," Sarkisian says. Similar services have been available to small- and mid-size LANs for at least three years. For example, a national service from Minneapolis-based Rimage Televaulting backs up NetWare networks via 128-Kbps ISDN lines and analog modems.

The SureFind/CompuServe service was expected to go active in March at an introductory cost of \$19.95 and a \$9.95 monthly fee. Unlike the current CompuServe service that lets you store files, the SureFind/CompuServe service includes client software to perform backups unattended. In case of interruption, you can resume backing up from the point of interruption.

ON-LINE-BACKUP PROS AND CONS

PROS

- Easy, automated backup
- Data compression speeds transmission
- Data security encrypted by user
- Reliable off-site storage on optical media
- Avoids up-front hardware costs
- Expandable storage
- Reliable data network

CONS

- Possible software bugs
- Increased monthly cost when you exceed 5-MB limit
- Limited platform support
- Possible limited bandwidth of end user
- Data over three months old stored off-line
- Limited frequency of backups with basic package

To use the service, download SureFind software from CompuServe, perform an initial system backup of up to 100 MB, and then set your software to automate weekly backups of up to 5 MB (data backups over the 5-MB minimum cost 50 cents per megabyte). Backup data is stored for three months on WORM optical media and then stored off-line, only a software-initiated request away. SureFind offers new users two recover-

ies in the first month to prove reliability. In March, SureFind was expected to provide a Windows 3.1 client. Windows 95, OS/2, Windows NT, and Unix (but not Mac) clients are slated for release later this year.

Another market entry, Xact-Labs (Seattle, WA; <http://www.xactlabs.com>), will offer full on-line storage/retrieval at geographically mirrored sites via several major communications providers by summer. Michael

Peterson, president of Strategic Research (Santa Barbara, CA), a data-storage consultancy, says that the primary benefit of services like SureFind is "hands-off automation that actually gets users to faithfully back up their data." Peterson predicts that the annual U.S. revenues for this type of on-line backup service will grow from a current \$10 million to \$200 million over the next three years. —M. G. Stevens

WEB-SITE DESIGN

Complement the Splash, Reinforce the Ad

Developers evaluating the latest tools for adding flashy advertising and multimedia capabilities to their Web sites may want to consider this sobering statistic: About 20 percent of users surf without graphics. That means you may want to complement an ad campaign that incorporates splashy banners with text that communicates your message.

A recent study made by Jumbo (<http://www.jumbo.com>), a popular Web shareware site, indicates that about 20 percent of on-line users visited [jumbo.com](http://www.jumbo.com) with the graphics capabilities of their Web-browser programs disabled. Jumbo officials reckon the 20 percent figure is conservative, because many visitors to its site are repeat customers who know that [jumbo.com](http://www.jumbo.com) typically eschews fancy graphics. However, the 20 percent figure was high enough that Jumbo, which accepts advertising, decided to start charging its advertisers half price for each ad

banner page accessed by users with their graphics turned off. The company has also made a program called GraphicTrak available at no cost. It tracks the number of no-graphics visitors to your site.

"If you look at a banner with the graphics on versus off, they just aren't the same," says Will Margiloff, national sales manager at Jumbo. Margiloff says the company decided to lower its rates for nongraphical hits because "we're already grateful to our Web advertisers, and we want them to keep advertising."

Margiloff says Web designers should be sure to remember that a fair percentage of users will visit a site with their graphics disabled, especially if they happen to have low-bandwidth connections. "Color banners are great, but if someone goes in with the graphics off, the message underneath the banner has to be just as compelling."



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Java's Busting Out All Over

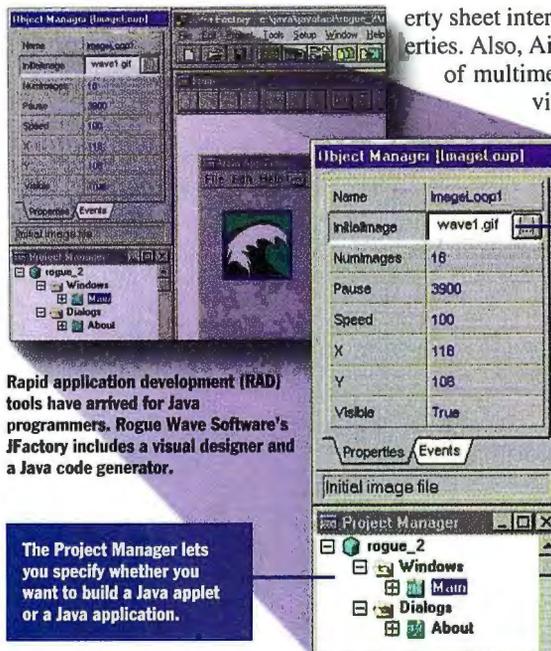
Activity surrounding Sun Microsystems' Java programming language borders on the frenetic. Java, which resembles C++ in syntax, lets a developer write programs or program applets that can execute over the Internet. New Java-related projects range from efforts to port the program to mainframe computers to new visual development tools for Java programmers. General Magic has even introduced a Web Toolkit that lets developers write active agents that surf the Web, retrieve content, and interact with Java applets.

A complete Java port requires two things: a Java integrated development environment (IDE) and run-time system for the target platform and Java-enabled Web browsers for the target platform. However, any computer for which a Java-enabled Web browser is available can interact with a Java applet.

The reference IDE for Java, Sun's Java Developer's Kit (JDK), is a command-line environment that includes a compiler, a debugger, and an applet viewer. The JDK is currently available for Solaris, Windows 95 and NT, and the Mac free from <http://www.javasoft.com/>. Another command-line development environment for Linux is available from <http://www.blackdown.org/>. However, developers desiring more than a Spartan command-line environment can also choose from a variety of graphical and rapid application development (RAD) toolkits.

Symantec (<http://cafe.symantec.com>) has updated its Java tools suite beyond the Java version of its C++ 7.2 integrated development and debugging environment for Windows, which is called Symantec Cafe, aka Espresso (for more information, see "Symantec Pours Java into Its Development Environment," March BYTE). Symantec's new development environment, called Symantec Cafe for Windows, improves upon the original Symantec Cafe by adding an integrated, graphical debugger for standalone Java applications or applets that are embedded inside an HTML Web page. Other companies planning to release graphical Java IDE/RAD environments for Windows include Borland, which will release its tools, including a graphical debugger, in stages throughout the year. Both Borland and Symantec are developing Just-In-Time compilers that turn interpreted Java programs into executables for faster performance.

Rogue Wave Software's (<http://www.roguewave.com>) JFactory brings RAD capabilities, including a visual designer and a Java code generator, to Java. Its Object Manager provides a prop-



Rapid application development (RAD) tools have arrived for Java programmers. Rogue Wave Software's JFactory includes a visual designer and a Java code generator.

The Project Manager lets you specify whether you want to build a Java applet or a Java application.

erty sheet interface to let you access your application's properties. Also, AimTech (<http://www.aimtech.com>), a publisher of multimedia authoring software, says it will release a visual authoring tool, code-named Cruiser, for

creating Java applets without the need for programming or scripting. Cruiser will be available in the first half of the year for Windows 3.1 and Windows 95.

JFactory lets you create Java animations quickly. To generate animation code, you only have to identify the first in a series of images in the Object Manager.

IDEs for Java are also available on platforms besides Windows. Natural Intelligence's (<http://www.natural.com/>) Roaster, a Java IDE for the Mac, is already available. Metrowerks (<http://www.metrowerks.com/news/press/java.html>) says it will release a version of its CodeWarrior Gold (\$399) IDE this month that will include Java and JavaScript development capabilities. Later on, Metrowerks will address Java RAD in a subsequent re-

lease of CodeWarrior. IBM says it hopes to release a Java development kit for OS/2 and AIX sometime this year. A new development environment from SunSoft (<http://www.sun.com/developer-products>), called the Java Workshop, is slated for release in the second quarter of this year. The Java Workshop is actually hosted in a Java-enabled browser. This Web-centric toolkit lets you develop and test in the same environment. The Java Workshop will first ship on Solaris for SPARC- and Intel-based systems, plus Windows 95 and NT. A version for the Mac will follow.

In the browser department, Netscape's (<http://home.netscape.com>) Navigator 2.0 is already Java-enabled for the Linux, Solaris, SunOS, Irix, HP-UX, Digital Equipment Unix, Windows NT, and Windows 95 OSes. Netscape says it will release commercial (nonbeta) versions of Navigator 2.0 for Windows 3.1, AIX, and the Mac in the second quarter. Sun is also developing a version of its Java-enabled browser, HotJava, for the Power Mac. Spyglass has licensed Java for inclusion in a future release of Spyglass Mosaic, the browser on which Microsoft's Internet Explorer is based.

The variety of hardware that supports Java will increase this year. Efforts are under way to port the Java virtual engine to the StrongARM processor for personal digital assistants (PDAs) and set-top boxes during the first half of this year. Also, get ready for Java running on mainframe computers. That's right: IBM (<http://www.hursley.ibm.com/javainfo/>) says it hopes to port Java to the MVS OS for System 390 mainframe computers and OS/400 for the AS/400 series of minicomputers. Have more questions on Java? You can check out Digital Focus's FAQ (Frequently Asked Questions) site at <http://www.digitalfocus.com>.

—Michael Shoffner

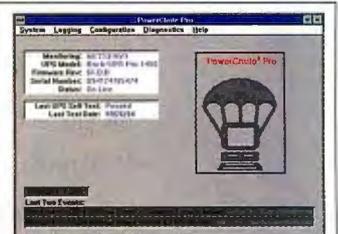
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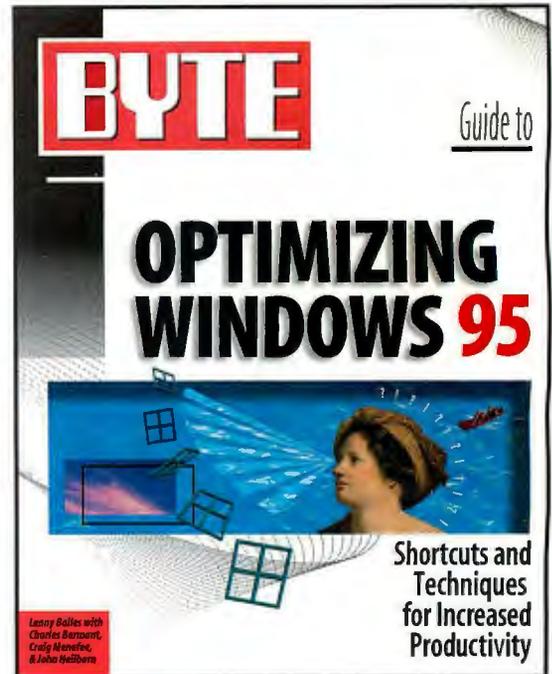
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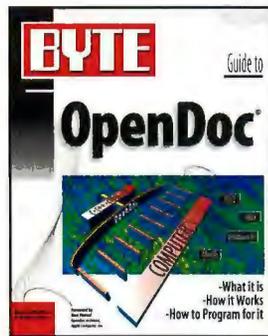
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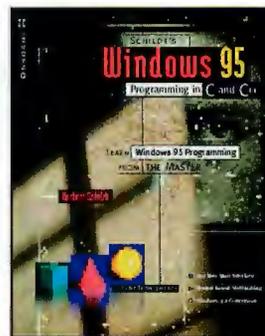
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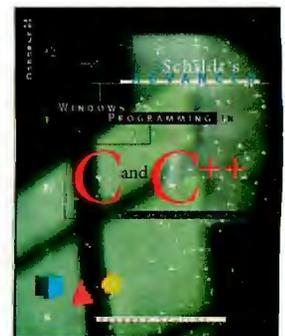
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DATABASE TRENDS

Better Replication Coming for Databases

Replication technology delivers numerous benefits, but it's not a panacea for all your distributed-data needs. By distributing data to geographically disparate offices, replication can improve application performance when a high-bandwidth communications link to a central database is unavailable or impractical. It also adds fault tolerance—users can access data locally if a central server happens to go down. However, some developers say that they want to replicate among different database vendors' databases. They also want better tools to resolve conflicts.

BYTE talked to developers, consultants, and vendors to see where the replication capabilities of Microsoft's SQL Server 6.0 and Access for Win 95, Oracle's Oracle7, and Lotus Notes release 4 need to improve.

Access for Win 95's replication abilities reflect the database's workgroup orientation. Access synchronizes data, plus forms and reports, and supports one- or two-way replication. One-way replication adds consistency by permitting changes at only one end of a pair of databases. Two-way replication is more flexible, since it lets databases propagate changes both ways during synchronization.

Developers that we interviewed were pleased to find replication in a desktop database but said that one Access limitation is in resolving conflicts when a data record has been modified in both the main and remote copies of data. If the same row has

been changed in two replicas, Access's default rule is that the database in which the row has changed most often wins. Developers say they want more sophisticated, prebuilt rules. Other drawbacks are listed in the table below.

Microsoft's SQL Server 6.0 for Win NT is designed to avoid replication conflicts altogether. Microsoft recommends that SQL Server developers use one-way replication. Larry Joseph, CEO of Strategic Database Systems, uses SQL Server's one-way replication in a traffic-law-enforcement database and decision-support system. In his application, users enter new records for traffic tickets, accident reports, and other events. At night that data is redistributed to site offices. The next day, users access the data for decision support in read-only mode.

Support for bidirectional replication is crucial to other companies' applications, however. For example, Clair Graham, system engineer for Xtra International (San Francisco), says that his Oracle7 applications, in which databases in three major business offices and numerous area offices located around the world constantly insert, update, and query records, demand two-way replication.

In Xtra's application, which is used to manage an international container-leasing operation, major offices in the U.S., Paris, and Singapore exchange data through symmetric (two-way) replication over a WAN.

Smaller offices exchange data with major offices through updatable snapshots. Graham says bidirectional replication lets branch offices update data locally while controlling when updates take place to the central databases. This helps contain communications costs by eliminating the need for an expensive, high-speed link to the central server.

Lotus Notes popularized replication as an integral element of its groupware design, and the latest version, release 4, adds numerous improvements. Developers we interviewed were generally pleased with Notes' new replication features.

But one complaint heard universally is that replicating among different vendors' databases requires additional products, such as Praxis's OmniReplicator (see December 1995 BYTE, page 36). Gary Voth, group product manager at Microsoft, says the lack of a replication-exchange standard similar to the ODBC standard for data access is partly to blame for this minimal multivendor replication support.

However, this is beginning to change in a new version of SQL Server, slated for mid-1996 release. "The first step, in version 6.5, is unidirectional replication, where changes in SQL Server get rolled into DB2, Oracle, and Access," Voth says. "We'll follow that version with an update at a later date that adds full bidirectional replication with other major systems as well." —Rick Dobson

REPLICATION SNAPSHOT, PRESENT AND FUTURE

PRODUCT	REPLICATION STRENGTHS	NEEDS IMPROVEMENT	COMMENT
Microsoft Access for Windows 95 (800) 426-9400; fax (206) 936-7329	Synchronizes forms and reports, plus data, across replicas. Permits two-way or one-way synchronization.	1.2- or 16-MB RAM requirement may require notebook upgrade. Minimal prebuilt conflict-resolution rules.	Microsoft officials say Access's replication will be improved in later versions, but declined to offer specifics.
Microsoft SQL Server	Tight integration with NT Server. GUI for enterprise database management. Replication included with base package.	Supports only one-way replication. No support for continuous replication among long text and image fields.	Version 6.5 adds continuous replication for long text and image fields, plus one-way replication with DB2, Oracle, and Access.
Lotus Notes (800) 343-5414; fax (617) 693-3512	Notes 4 introduces field-level replication. It also removes the limit of five concurrent synchronizations.	Synchronization-speed enhancement (Notes 4 delivers). Fewer replication conflicts (Notes 4 delivers).	Lotus says it's too early to comment on future replication features in Notes.
Enterprise Oracle (800) 633-0596; fax (415) 506-7200	Can replicate with other Oracle databases on multiple platforms. Permits two-way or one-way synchronization. Ten precoded conflict-resolution rules.	Oracle doesn't replicate with other vendors' databases. More graphical tools needed for conflict resolution.	A graphical module called Replication Manager will ship in the spring or early summer.

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OFFICE SUITES

WordPerfect Losing Ground to Microsoft

WordPerfect and PerfectOffice users are both relieved and apprehensive following recent changes at parent company Novell. With Novell's announcement that it sold its PerfectOffice products to Ottawa-based Corel, some users said they were confident that their favorite word processor or suite will continue to survive and compete with Microsoft and Lotus. But analysts say that Corel's new suites have an uphill battle in competing against suites from Microsoft and Lotus. Also, former WordPerfect users say the Corel announcement came too late—they've already switched.

In March, Corel announced it planned to release 16-bit Windows versions of the Corel WordPerfect suite and Corel Office Professional in April, with Windows 95 versions slated to ship in May and June, respectively. Corel WordPerfect (about \$395) will include WordPerfect 6.1, Quattro Pro 6.0, Envoy, Netscape Navigator, Presentations 3.0, CorelFlow, Starfish Software's Sidekick and Dashboard, clip art, fonts, and a screen saver.

Corel Office Professional (about \$695) will include the above programs, plus the InfoCentral information manager, the Paradox database, and a GroupWise client. The WordPerfect word processor's new features include Internet publishing tools that automatically convert documents to Hypertext Markup Language (HTML) format, a built-in address book (shared by other applications in the suite), and highlighting to support document collaboration.

Beta testers of the new suite

were encouraged. "I think that the final product is going to be extremely powerful and will lead the industry in usability," comments Bruce Norton, the owner of Norton Innovation (Lititz, PA), a VAR and consultancy. But other users who've switched say that the Windows 95 version of WordPerfect arrived way too late.

John Tredennick, a litigation partner and CIO at Holland and Hart LLP, a Denver-based law firm that employs about 600 people in 10 offices, says the company started switching to Windows 95 last year and expects to convert completely. Tredennick says a number of factors convinced the firm to switch to Microsoft Office, including lack of a Mac offering from WordPerfect or Corel and the impressive market share of Office and its prevailing use by the firm's customers. "All things being equal, we'd rather be in the mainstream than a tributary," says Tredennick.

Analyst Nicole Miller, with International Data (Framingham, MA), estimates that Microsoft now has about 86 percent of the suite market, and while Miller says Corel/WordPerfect has a good chance of gaining the number-two spot from Lotus, that is about it. Says Miller: "Lotus and WordPerfect are really quibbling over about 15 percent of the market." —J. P.

CODE TALK

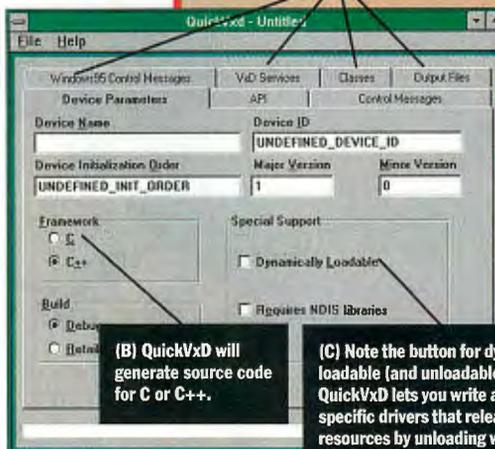
RICK GREHAN



Write Windows 95 Virtual Device Drivers on Higher Ground

If any branch of Windows programming might rightly be called rocket science, surely virtual-device-driver (VxD) programming is it. Delving into Microsoft's Windows device driver kit (DDK) in any determined fashion should qualify you for a programming Purple Heart. Moreover, building a VxD has required a serious foray into low-level assembly language programming.

(A) The tabbed window panes in VtoolsD's QuickVxD utility let you set most of your VxD's parameters in a visual fashion. Once you've set the parameters, QuickVxD produces a source code "skeleton"; you flesh out the functionality.



(B) QuickVxD will generate source code for C or C++.

(C) Note the button for dynamically loadable (and unloadable) support. QuickVxD lets you write application-specific drivers that release system resources by unloading when not needed. Dynamically loadable VxDs can also take advantage of Windows 95 capabilities, such as Plug and Play.

Notice I said "required." Thanks to the people at Vireo Software (Acton, MA), you no longer have to write your VxD in assembly language. With VtoolsD, you can use C or C++.

Vireo's version of VtoolsD for Windows 3.1 first appeared in July 1994. What's new and important, given the key role that

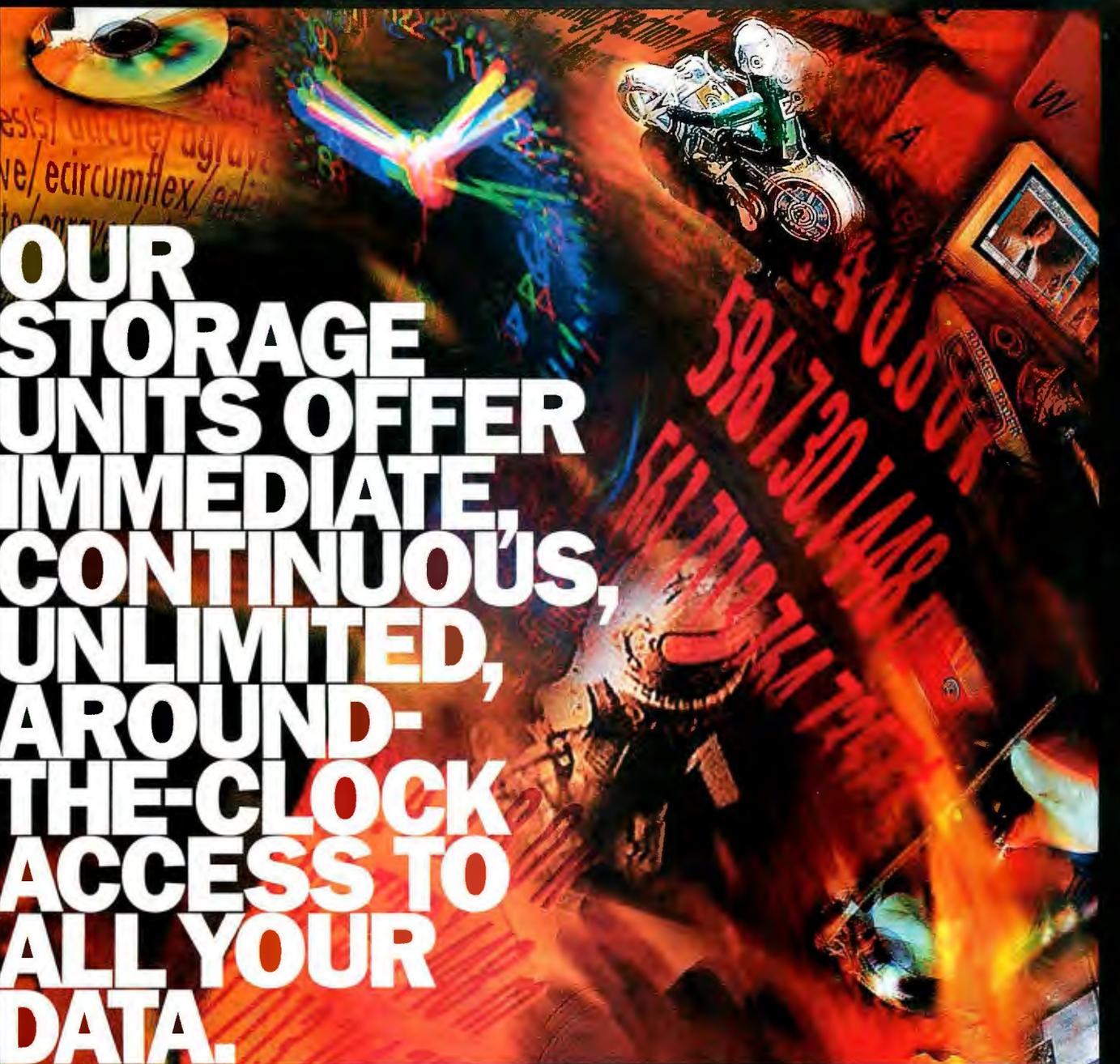
VxDs have in extending the core features of the Windows 95 kernel, is the version of VtoolsD for Windows 95.

VtoolsD for Windows 95 (\$495) requires either Windows NT or 95. If you're running NT, you can only edit and compile the VxD—you can't execute or debug it. You'll also need Microsoft Visual C/C++ 2.0 or higher, or Borland C/C++ 4.02 or higher.

The product consists of a suite of tools plus a collection of libraries. VtoolsD includes plenty of source code samples to get you started (and if you're new at VxD programming, you'll need them). It also comes with VxDView, a VxD sniffer that snoops on all the VxDs currently running on your system. (You'd be surprised at how many VxDs are active in a Windows 95 system. I counted 71 in mine.) VxDView is handy for verifying that your VxD has at least properly registered itself with the system. However, the pro of VtoolsD is the QuickVxD utility, a VxD "skeleton builder" that generates either C or C++ code (see the screen).

QuickVxD lets you select the control messages to which your VxD will respond. (Windows 95 sends control messages to VxDs on software and hardware events, such as device initialization or application execution.) For the C version, each message you select produces an entry in a `switch()` statement within a dispatcher function. In the C++ framework, QuickVxD creates methods associated with each event. In either case, you need only pour code into the empty functions (or methods) that QuickVxD constructs in the emitted source file. This source code, plus the libraries you link in, handles all the VxD initialization and VxD-to-application interface nastiness that makes this such a black art. You can concentrate on what your VxD actually does.

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BIPOLAR-PROCESSOR TECHNOLOGY

Watch Out: 500-MHz PowerPCs Planned for 1997

In a bid to create the world's fastest micro-processor, a Silicon Valley start-up company is developing a PowerPC chip that combines fast-switching bipolar transistors with conventional CMOS technology. If the hybrid CPU lives up to expectations, it could exceed 500 MHz and deliver three times the performance of today's fastest Pentiums.

The still-unnamed chip will be the first product from Exponential Technology (San Jose, CA). Founded in 1993, Exponential has a team of engineers and executives who formerly worked at Amdahl, Apple, Chips & Technologies, Intel, Mips Technologies, Motorola, National Semiconductor, and Sun Microsystems. Its initial chip design taped out in January, and first silicon samples should be available for testing this month. If the project continues on schedule, a second-pass design will tape out this summer and the chip will enter production early next year.

Exponential is keeping relatively quiet about this processor, but the available information indicates it will be a radical design. Almost all the logic—roughly 40 percent of the chip's circuitry—consists of bipolar transistors, which can switch states much faster than regular CMOS tran-

BIPOLAR PROS AND CONS	
BIPOLAR ADVANTAGES	BIPOLAR DISADVANTAGES
<ul style="list-style-type: none"> • Fast switching • High clock speeds 	<ul style="list-style-type: none"> • Hot operation • High power consumption • Lower transistor density

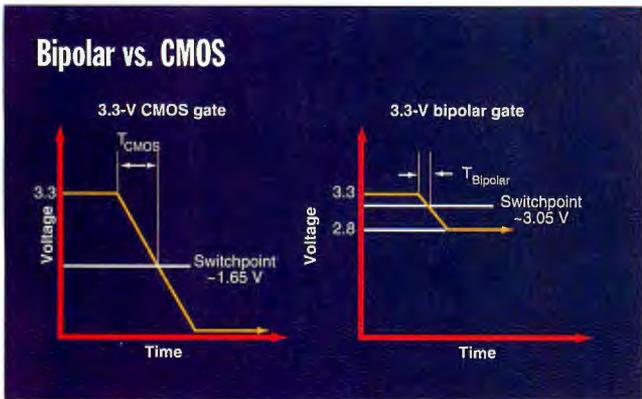
sistors (see the figure below). The remaining 60 percent of the circuitry is static RAM (SRAM) in the on-board caches. The die measures a mere 150 square millimeters.

By modern standards, the chip's primary caches are puny: only 2 KB each for instructions and data. There's also a 32-KB secondary cache on-chip. The only other processor with a similar cache arrangement is Digital Equipment's Alpha 21164, which also runs at extremely high speeds (up to 400 MHz). However, the 21164 isn't bipolar.

Intel's Pentiums use a BiCMOS process that combines bipolar and CMOS, but Intel uses the bipolar elements sparingly. Also, the Pentium's bipolar transistors don't achieve their potential speed because they're added to the primary CMOS layers. Exponential, in contrast, is starting with a bipolar process and then adding the CMOS elements. Another company that is working on this technique is MicroUnity (Sunnyvale, CA), which is developing a more specialized processor for broadband communications (see "Chip Fashion," November 1995 BYTE).

Exponential's chip will be compatible with the PowerPC 604 and is intended for high-end desktop systems and servers. The PowerPC 620 from IBM and Motorola was supposed to fill that role, but its performance has been disappointing.

—T. R. H.



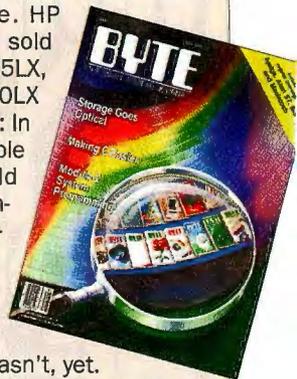
Bipolar transistors are inherently faster than CMOS transistors, partly because CMOS transistors must swing from their highest voltage to their lowest voltage to change states. Bipolar transistors swing between intermediate voltages. However, bipolar runs very hot. Exponential's chip may dissipate 40 to 60 W, compared to about 20 W for a 400-MHz Alpha 21164.

Blasts from the Past

5
Years Ago
in BYTE

The combination of PC and Lotus 1-2-3 in the palm of your hand impressed the BYTE editors who saw Hewlett Packard's 95LX. By the end of 1993, HP held a leading 39 percent market share of the standard hand-held computer segment, selling an estimated 97,000 units worldwide. HP says that it has sold over 500,000 95LX, 100LX, and 200LX hand-helds. Also: In a virtual roundtable discussion (held over the electronic BYTE Information Exchange), we wondered if telecommuting could catch on in a big way: It hasn't, yet.

A U.S. News & World Report survey in 1995 indicated that of the approximately 25 percent of those surveyed who thought they could work full- or part-time at home, only 9 percent have done so.



10
Years Ago
in BYTE

BYTE published an article with tips for programmers who thought they wanted to try an increasingly popular language called "C." An article on mass storage yielded this interesting comment: "The average [hard] disk storage capacities could soon increase to 30 megabytes or more." Today's PCs often include 2-GB hard drives; Compaq's new floppy disk holds 120 MB. We also looked at mouse substitutes that you put on the floor and operated with your foot; they had Ctrl or Alt keys assigned to them.

15
Years Ago
in BYTE

We noted that the problem of software piracy had reached near-epidemic levels in some places; this is a problem that persists today.

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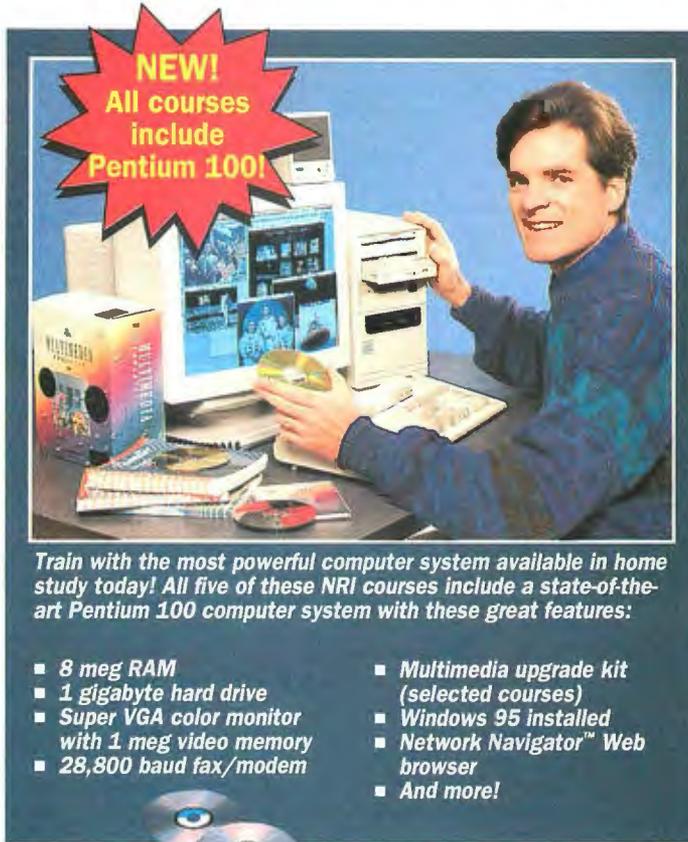
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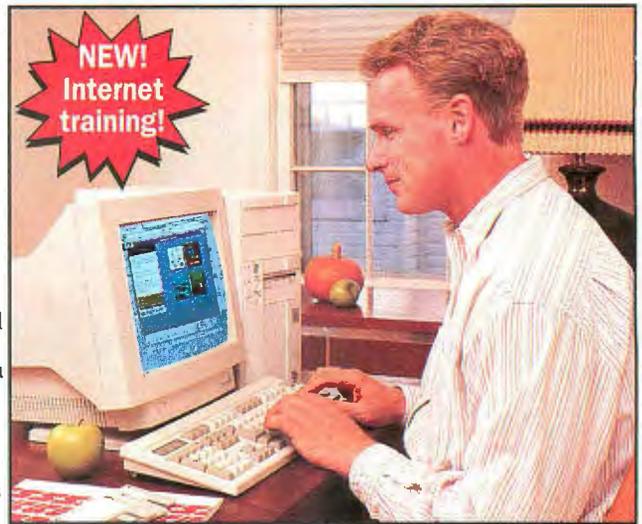
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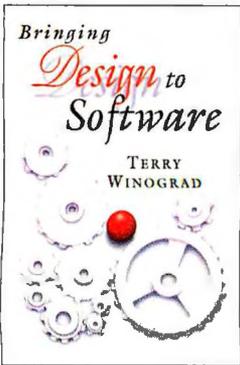
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The Art of Software Design



Steve Apiki

Software design, as editor and pioneering natural-language researcher Terry Winograd notes, is a young discipline. Its guiding principles are still a little nebulous. So, *Bringing Design to Software* is a little nebulous, too, the better to capture the freshest ideas from the software-design frontier.

This brilliant collection of essays, on topics ranging from the role of the artist in software design to redesigning the Macintosh power switch, never tells how software should be designed. Instead, it takes the designer's view of

the field itself, stepping back to find the relevant questions and resisting the temptation to grope hastily for answers. It's up to the readers to draw their own conclusions.

Mitch Kapor's "A Software Design Manifesto," delivered six years ago at Esther Dyson's PC Forum, leads with an enumeration of the difficulties that plague under-designed software and a call for the establishment of a distinct software-design profession. The remaining chapters take off from there, proposing new approaches to design, examining a few design successes, and further illuminating the context of the design problem.

"Action-Centered Design," in which former ACM president Peter Denning and developer Pamela Dargan argue that traditional business-process reengineering must be refocused on user actions and user satisfaction, is typical of the new-approach category. (It also contains a telling passage that, in summarizing the experiences of the designers of products like Quicken and the Macintosh user interface, points out that none of the designers paid much attention to standard software-engineering methodology.)

"Organizations for User-Centered Design" uses lessons learned at Intuit to suggest methods for better user contribution to design. In "The Consumer Spectrum," a chapter that helps establish the context of the design problem, Paul Safko (of the Institute for the Future) proposes a model for defining consumer concerns.

Each of the 14 chapters is followed by a lighter profile section in which the authors illustrate the subject, usually with a familiar industry example. For instance, an interview with David Liddle, a Xerox Palo Alto Research Center (PARC) alumnus, is followed up with a description of the now-historic Xerox Star; a comparison of corporate prototyping cultures is nicely reflected in its profile section, a comparison of HyperCard, Director, and Visual Basic. Although each chapter is obviously written to stand on its own, little pointers to appropriate sections in other chapters help to weave a thread throughout the book.

The topics are diverse, but three strong themes lurk behind almost every paragraph. First: Software design, like all design, is best when it's iterative. Second, the software designer must always start from the user's perspective. Last, and also least, the best analogy for the relationship of software design to the current practice of software development is that of architecture to engineering. The architecture analogy gets a little tiring, but it serves to nail down the designer's part in the software development process.

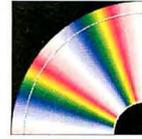
This is a book about design first, and software a distant second. For those involved in creating software, almost all of whom approach the subject of software design from the other end, this collection of new ideas provides a refreshing, and necessary, perspective. ■

Steve Apiki is a professional programmer and a BYTE consulting editor. You can contact him by sending E-mail to apiki@bix.com.

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TO SOFTWARE**

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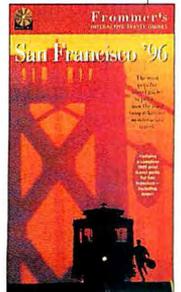
There are those who like to experience the joys of serendipitous, hit-or-miss travel, and there are those who like to plan ahead. If you fall into the latter group, *Frommer's Interactive Travel Guides* may be your ultimate security blanket to ATMs, hotels, restaurants, parking garages, hospitals, museums, walking tours, and much more in San Francisco, Boston, New Orleans, and New York.

Each CD-ROM contains information about a single city, and Macmillan Digital plans to publish CD-ROMs for several international cities late this year, a spokesperson says. This review is based on a beta version of the San Francisco disk.

It's easy to find information quickly through a series of nested topic indexes. All referenced items appear on maps of the city and surrounding areas, which you can zoom in on for more detail and print. There are short movies and plenty of high-quality still photos. Any San Franciscan will know the featured hotels, restaurants, and attractions; there aren't many off-the-beaten-track surprises. But if you have the time to follow the guide's recommendations, you won't be disappointed often or miss any must-see spots.

The guide contains sections designed for special-interest groups, such as gay/lesbian, seniors, families, students, and people with disabilities. Included are suggested itineraries—for example, for literary enthusiasts, Dashiell Hammett sites, City Lights book store, Jack London landmarks, and so on. And there's loads of San Francisco trivia. For example, how many roll calls and body searches was an Alcatraz island prisoner subjected to each day? (Answer: 13.)

—Rich Friedman



UNIX **VS** WINDOWS

Microsoft's flagship OS hasn't overthrown Unix, but savvy system

TOM R. HALFHILL

It's official: Windows NT is off probation. Nearly four years after Microsoft's all-new, industrial-strength operating system hit the market amid the usual hype and hoopla, growing numbers of managers are satisfied that it's ready for prime time.

"A couple of years ago, NT was seen as not succeeding, partly because of the unrealistic projections that were made," says Hugh Ryan, director for architectures at Andersen Consulting. "But now it's being viewed as a more viable solution, especially for what I would call departmental servers. And people are evaluating its potential for enterprise-level solutions."

In addition to MIS managers' growing comfort with NT, users and vendors say three other factors are working in Microsoft's favor:

- NT is better positioned than Unix to take advantage of cost-effective hardware and software, particularly on the Intel x86 platform.

- NT makes it easier to integrate servers and desktop PCs with Microsoft's popular Office and BackOffice suites.

- Microsoft is a reassuringly safe bet for the future because its dominance of the computer industry appears to be unshakable.

Is Unix Dead (Again)?

One vendor that has noticed the rise of NT is Platinum Software (Irvine, CA). In 1992, around the same time that Microsoft launched NT, Platinum introduced SeQueL to Platinum, a client/server accounting package for Unix/Sybase and NT/SQL Server. At first, most of Platinum's customers chose the Unix/Sybase version for their Sun Microsystems, Hewlett-Packard, and IBM servers.

"Then we started to see a shift," says Don Howren, Platinum Software's vice president of marketing. "Customers started making commitments to Windows NT and SQL Server, and

now they are looking for production-level applications."

"The Alpha processors and faster Pentium processors are making NT a high-volume transaction-processing environment," says Mike Pennell, Platinum's director of product strategy. "If you look back a year or two ago, it really wasn't. With the introduction of these new servers, you're seeing a lot more competition with the Unix servers."

Intel-based servers that deliver more bang for the buck are driving the growth of Windows NT, according to vendors and users. Although NT runs on three different RISC architectures—the Mips Rx000, the Digital Alpha, and the IBM/Motorola PowerPC—the version that runs on x86-based systems is

the most popular. Lately, Intel has greatly accelerated x86 development and is shipping faster versions of the Pentium and Pentium Pro CPUs that run neck-and-neck with the speediest RISC chips. When combined with Intel's huge manufacturing capacity and the well-known economies of the PC system architecture, the result is a price/performance value that's hard to beat. And for those who need maximum performance, NT on RISC is an option.

NT's ascendancy does not mean Unix is on the rocks, however. Other sources point out that there is still a performance gap between the midrange and the high end. Architectural limitations hobble low-priced x86-based servers when they try to tackle the really big jobs. Even the

best of them have trouble keeping up with the fastest Unix boxes, especially when managing large databases. When Unix teams up with major-league database software (from Oracle, Sybase, or Informix), Windows NT and SQL Server face some formidable competition.

IS managers are expanding their use of both platforms. They've settled on the NT/low-end symmetric multiprocessor (SMP) server (four processors or less) as the trick setup for small to medium installations. And they continue to deploy Unix servers where bigger is better.

"Microsoft has oversold the scalability of NT," says Michael

I N T E G R A T I O N		
	UNIX	WINDOWS NT
Standard application installation (network and local)	X	✓
Automatic detection of hardware	Some	✓
Multiple network protocols	Optional	✓
Windows SMB file sharing	Optional	✓
Macintosh file sharing	Optional	✓
Unix NFS file sharing	✓	Optional
Vendor device driver support (PC)	Poor	Good

Windows NT is faster to install because it's smaller than most Unices. NT's standard Macintosh file and print support is a boon for mixed-platform enterprises, and you'll generally have an easier time finding NT device drivers for new hardware.

✓ = yes X = no

DOWNS NT

managers are definitely taking Windows NT more seriously

Goulde, a consultant with the Patricia Seybold Group (Boston, MA). "NT is very cost-effective as far as it goes. But, in part because of the hardware that's available for running NT, it lacks the scalability of Unix platforms. You can't take it as far."

Beefed-Up NT Boxes

A few vendors, like Sequent Computer (Beaverton, OR), do make SMP systems for NT that have as many as 28 CPUs. Still, most Windows NT servers are less sophisticated machines with one to four CPUs—they're basically reengineered desktop PCs. Disk I/O, video, and network cards probably share the same PCI bus, and the CPUs typically have 256 KB to 1 MB of secondary cache RAM. Compare that to Sequent's WinServer 70, which has a double-sided backplane with a proprietary high-speed bus, an independent VME bus for network adapters, as many as 32 fast-and-wide SCSI channels for disk I/O, and 2 MB of secondary cache per CPU.

"If you compare some of the cheaper four-processor Intel-based machines to, say, the Alpha 2100, the difference isn't just CPU speed. It's the complete system architecture," notes Goulde. With its heavy-duty hardware, "the 2100 is designed more like a minicomputer."

Still, some users are testing the limits of NT. At Oregon State University (Corvallis), the College of Oceanic and Atmospheric Sciences handles data collected by field researchers and weather satellites. The platform? NT and SQL Server on a pair of dual-Pentium Hewlett-Packard servers to manage about 100 GB of data. The college is working on a NASA project called the Earth Observing System, which will launch several more satellites into orbit over the next few years. When that data starts pouring in, the database will expand into the terabyte range.

Mark Abbott, a professor who helps run the program, says his goal is to produce videos and animations that will let scientists more easily visualize this vast storehouse of raw data. That's why he chose NT and SQL Server to replace an Ingres database

on HP-UX (Hewlett-Packard Unix). "We wanted stronger links between data analysis and data management," says Abbott. "That's something NT is very good at. The technical strengths and directions of NT were very compelling."

The lower hardware and software costs of NT-based systems were also compelling. Some of the data-manipulation programs the college is using cost only \$60. "We wanted to get on the price/performance curve of the PC market," explains Abbott. "Ninety-five percent of our money comes from competitive federal grants, so we're more like a business than a university."

As his databases grow, however, he's aware that NT may not keep up. "Scaling and robustness are still major concerns, which is why we still have some Unix boxes."

Microsoft continues to work with Sequent and other SMP vendors to improve NT's scalability, but Unix will retain this advantage for some time to come. "NT scales pretty well with Unix up to six or eight processors, but not beyond that," acknowledges Bob Robinson, Sequent's product marketing manager. Scalability problems arise from both the hardware limitations of PC-based servers and inherent limitations of NT itself—limitations that Microsoft naturally disputes.

Windows, Meet Windows

Of course, NT isn't the only server OS that can take advantage of cost-effective x86-based hardware. So can

Novell NetWare, IBM OS/2, and SCO Unix. SCO Unix itself is running on about two million x86-based servers—more than any other version of Unix, according to SCO. Obviously, there must be additional reasons why increasing numbers of MIS managers are choosing NT.

One factor, they say, is that it's easier to integrate Windows NT with their existing hardware and software. Installations that already have Windows PCs on their desktops naturally lean toward NT when they have to choose among server options. They would rather deal with a single OS vendor, and NT has an instantly familiar look and feel. On top of that, Microsoft Office

SECURITY		
	UNIX	WINDOWS NT
User log-on required	✓	✓
File-level access permissions	✓	✓ ¹
File-access control lists	Few	✓ ²
Security auditing	Most	✓
Role-based access	Few	✓

Windows NT has excellent standard security features. Commercial Unix implementations offer varying levels of security, but none can rival NT's simple administrative interface.

¹ Windows NT and Unix both offer read, write, and execute permissions on each file. NT adds "take ownership" and "change permission" to these.

² Windows NT access control lists apply not only to files but to all objects managed by the OS.

✓ = yes

commands an overwhelming 85 to 90 percent share of the market for application suites, according to Dataquest and other market researchers. And BackOffice, particularly SQL Server with its low price, provides a powerful incentive to try NT, especially if you're charged with rolling out a departmental client/server database system on a limited budget.

"We're seeing heavy NT adoption in companies with widespread Windows on

the desktop," says Ryan of Andersen Consulting. "There is a sense that Unix is a more technically demanding environment, both in terms of productivity and connectivity issues."

These were some of the factors that convinced Penn State University (State College, PA) to switch from Banyan Vines to NT for about 1000 networked computers in classrooms and student labs. Most of Penn State's client machines are running Win-

dows for Workgroups on 75- and 100-MHz Pentium PCs; there are also some Power Macintosh 7100s. To handle these desktops (and upwards of 100,000 users, counting full- and part-time students), the network has about 25 servers, mostly 486 and Pentium systems.

Penn State evaluated NT for years before making a commitment. Finally, in March '95, the conversion began. It took about six months, and so far the school likes

Unix vs. Windows NT: The (Edited) Vendors' View

Unix (Steve MacKay, vice president, Solaris products group at SunSoft) faces off against Windows NT (Mike Nash, group product manager for Windows NT Server)

BYTE (to SunSoft): *Why do you think Solaris Unix is better than Windows NT?*

MACKAY: Scalability, reliability, and performance. Solaris has demonstrated linear scalability to 64 processors in a system, has databases larger than 5 terabytes, and lets thousands of users connect. NT does not come close. Solaris systems stay on-line for months, handling transaction after transaction. This defines mission-critical enterprise and Internet computing. And that is why the largest relational databases run on Solaris, not on NT.

In recent database performance benchmark testing (TPC-C) on a Compaq Proliant 4500, Solaris with Oracle7 outperformed NT with SQL Server by 30 percent. It takes a lot of NT marketing to overcome objective results such as this.

NASH: In the TPC-C tests, the difference is only about 5 percent. In normal operating modes, with acceptable transaction times, equal Unix and NT systems deliver roughly equal performance. Microsoft SQL Server has a limitation of 4 TB, but a 4-TB database would give you slower response time on any system.

NT has structured exception handling for capturing error conditions and responding to them uniformly. The file system is designed to recover from all types of disk errors [and is] protected by a U.S. government-certified C2 security architecture. When performance, scalability, and reliability are comparable, the important issues are service, support, and cost of administration and maintenance. NT Server provides huge savings in these areas.

NT Server is the only OS that delivers the same API set, user interface, and administration model on Intel, Mips, Alpha, and PowerPC processors. Customers [can] deploy whatever hardware is appropriate at any time. With Unix, you get locked into a particular vendor's Unix variant.

BYTE (to Microsoft): *Why do you think NT Server is better than Unix?*

NASH: NT Server is the only true multipurpose OS. It combines the performance of file and print servers and the power of Unix application servers with the ease of use of Windows.

A single cross-platform API lets developers write code once and target many platforms. Users benefit from the easy-to-use Windows environment. Administra-

tors [can] learn, use, and manage one system with powerful file and print services plus robust and reliable applications services.

NT Server is interoperable with other systems such as NetWare; it integrates with legacy systems while offering a smooth migration. And NT Server supports up to 32 processors.

MACKAY: This discussion is not about NT versus the various versions of Unix, but about Solaris and NT. If the network is the computer, then we're talking about what it will take in this new paradigm: computing on the Internet.

Microsoft's story holds together as long as the picture is monolithic: Windows dominates the desktop, NT is the application server, and everything is tied together with OLE. This isn't modular, flexible, or easily customizable. Application code to update could be on thousands of desktops, leading to high administration costs.

NT does not have the reliability and scalability required to run business-critical applications on networked servers that may have hundreds of thousands of users hitting on it every day, which is where we are with Internet-based applications.

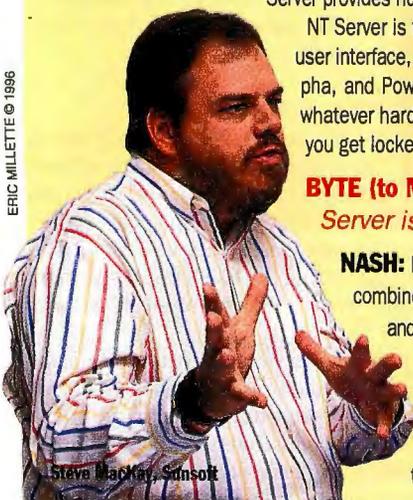
SunSoft's vision of the user world presumes a modular, distributed client/server environment, where mission-critical databases are on mainframes or large application servers, and clients can be anywhere, running on anything. In this model, the GUI interface decouples from the business logic, which in turn decouples from the database. In a traditional client/server environment, the application resides on thousands of desktops, every one of which has to be updated. Administration costs are high. But not for the SunSoft model, because the code resides in one place.

BYTE (to SunSoft): *Where do you see Unix in five years, in market presence and technology?*

MACKAY: Solaris is driving the future of Unix, including databases, Internet servers, communication servers, and how people organize and run their businesses. Microsoft has missed the Internet wave, so its growth will be limited.

The key technologies will be scalability, support for standards, object technology, and directory services. With Solaris, we already deliver on these technologies, and we will continue to invest in these areas in the future.

NASH: Microsoft has certainly not missed the Internet wave. We are likely to create the next major surge with Internet Information Server (IIS). With NT Server and IIS, we are offering a high-speed server that is simpler to own and operate than anything from Sun. By contrast, the licensing, training, maintenance, and support costs to run a Unix Internet solution are prohibitive. In a 1995 IDC article, Starwave comments that "an Internet infra-



Steve MacKay, SunSoft

the stability, security, and economy of NT.

"We wanted something robust that we could expand," says Al Williams, manager of distributed system services. "TCP/IP support, Ethernet routing support, and Mac OS support were all part of the basic package. Some of these services would have been extra on Banyan Vines, and they would have been costly." The Macintosh creates a well-known problem for network operating systems like Vines and NetWare:

It supports long filenames. In order to make Vines or NetWare support long filenames, you have to run a separate namespace—one that isn't always compatible with sharing volumes between PCs and Macs. NT provides long-filename support for Macs natively. NT also supports AppleTalk networking protocols.

Corporate and commercial software developers say NT and OLE offer more interesting possibilities for integrating their

applications with Microsoft Office and BackOffice. They can build custom solutions using OLE objects and an expanding array of rapid application development (RAD) tools, such as Microsoft's Visual Basic, PowerSoft's PowerBuilder, and Borland's Delphi. Unix does not support such a wide choice of popular RAD tools.

"OLE becomes the infrastructure with which you can customize and deploy our applications at customer sites," Pennell at

structure similar to a current Unix installation using NT servers and software could save at least \$60,000 on hardware and several thousand dollars on software licensing."

BYTE (to Microsoft): *Where do you see NT in five years, in market presence and technology?*

NASH: Today's customers are using NT Server in Unix environments. They will migrate applications to NT Server because NT will offer leading-edge technology, such as Network OLE and seamless integration with Windows. NT will evolve to support new hardware platforms. NT Server will offer more sophisticated support for building distributed applications with Network OLE.

NT Server will offer integrated namespaces to enable users to access resources regardless of the repository. As a first step, the upcoming version of NT will provide native support for DNS. A later version will include a more hierarchical, flexible directory that is upward-compatible with the current NT directory service.

Through ODSI [Open Directory Service Interface], these namespaces—including Street Talk and NetWare Directory Services—will be integrated and accessible by users as one namespace. Developers will benefit from writing to one API (ODSI) to create applications that take advantage of this multidirectory namespace.

MACKAY: Today, Solaris uptime is measured in months, not days. Today, Solaris incorporates such industry standards as CORBA, which facilitates scalable, language-independent, network computing. Today, we support XFN [X/Open Federated Naming], which facilitates universal access to various directory naming services. Today, the networked objects and management technologies of Neo and Solstice are tightly integrated with Solaris.

An Internet server OS must be able to grow. Over the next two years, Solaris will be extended to support a file system of nine million TB. It will also have a 64-bit kernel, addressing, networking, and asynchronous I/O. Yet, 64-bit Solaris will maintain compatibility with existing 32-bit applications and data sets.

BYTE (to SunSoft): *What will be the important new features of the next major Solaris release?*

MACKAY: A network-oriented object model for Solaris. Neo—SunSoft's networked object environment technology based on CORBA—is already available. Many use it as their foundation for rapidly deployed enterprise applications. When Neo is paired with Sun's Java, the result is powerful, distributed applications that can bring global resources together to create the information needed to drive critical business processes. Think of Neo plus Java as programming the network, where truly the network is the computer.

One major innovation for systems software will be the move to 64-bit systems. Already there are full 64-bit microprocessors entering mainstream use; for example, the UltraSparc.

These 64-bit systems will bring new scalability and performance to classes of applications that rely on large databases—for example, data warehouses or network-wide transaction-processing systems—or that incorporate real-time visual computing, such as 3-D animation applications. It is the Unix software vendors, including SunSoft, who have been working to develop a set of standard APIs for Unix on these new 64-bit systems.

NASH: How will this technology really interact with millions of desktops, many Windows-based? If Sun were embracing openness, then its server strategy would tie in with existing desktop standards seamlessly. This is a huge strength for Microsoft.

With Network OLE's strong integration between client and server, we are in the best possible position to deliver seamless client/server integration. Network OLE [in beta] works seamlessly with Windows, Windows 95, and NT Workstation clients, which together represent the majority of the desktop market.

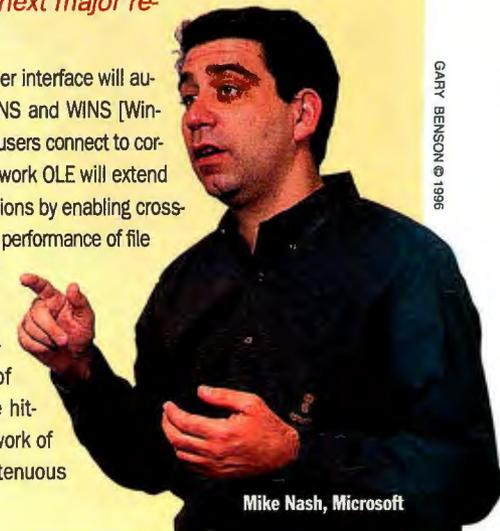
Sixty-four-bit technology is interesting, but it's not a customer requirement now. It has little meaning unless key applications exploit this architecture. NT Server will deliver 64-bit technology if this offers significant benefits beyond the current architecture.

All attempts have failed to deliver the promised Unix integration. These efforts will continue to fail. Giving customers the freedom to switch between Unix systems would eliminate the competitive edge these companies have over each other.

BYTE (to Microsoft): *What will be the most important new features of the next major release of Windows NT?*

NASH: The Windows 95-compatible user interface will automate network management tasks. DNS and WINS [Windows Internet Naming Service] will let NT users connect to corporate servers through the Internet. Network OLE will extend sharing of components between applications by enabling cross-network integration. We are improving the performance of file and print services. And we've improved the DMA path for network reads.

MACKAY: Will NT survive in a transaction environment where hundreds of thousands of simultaneous users are hitting thousands of applications in a network of servers? Market-share leadership is a tenuous thing. Just ask IBM and Novell.



Mike Nash, Microsoft

Platinum Software says. "We can not only integrate with the standard suite of Microsoft front-office products such as Word and Excel, but also with other financial-specific products, such as a tax-processing or an add-on order-entry system."

Of course, similar technology is not exactly unknown on Unix. A good example is Sun's Neo (Network Objects), a distributed object environment. Neo allows users to integrate Common Object Request Broker Architecture (CORBA) objects and even OLE objects with applications and databases across a network. Neo works with Java applets, too.

Besides, although it seems as if Windows rules the world, not everyone is primarily concerned about integrating desktop PCs into their networks. "We've had customers who looked at NT but chose Unix because they don't have Windows clients," says Jeff Ait, vice president of SCO's Internet strategy. "There are a lot of different clients out there—automatic teller

machines, cash registers, character-based terminals, telephony devices."

Still, there's no question that MIS managers want easy, seamless integration with the Windows PCs that dominate corporate desktops. Although some managers express reservations about Microsoft's industry dominance, they also crave the stability of industry standards. NT dovetails with the desktop hardware and software on which the vast majority of companies have decided to standardize.

Struggle for the Internet

Dislodging any OS from a site where it's already entrenched is difficult, even for a force as powerful as Microsoft. MIS managers tend to be fairly conservative folks who stick with things that work. That's why Microsoft and the numerous Unix vendors are hotly pursuing new installations where legacy issues—including systems, software, user training, and administrative support staff—are mostly

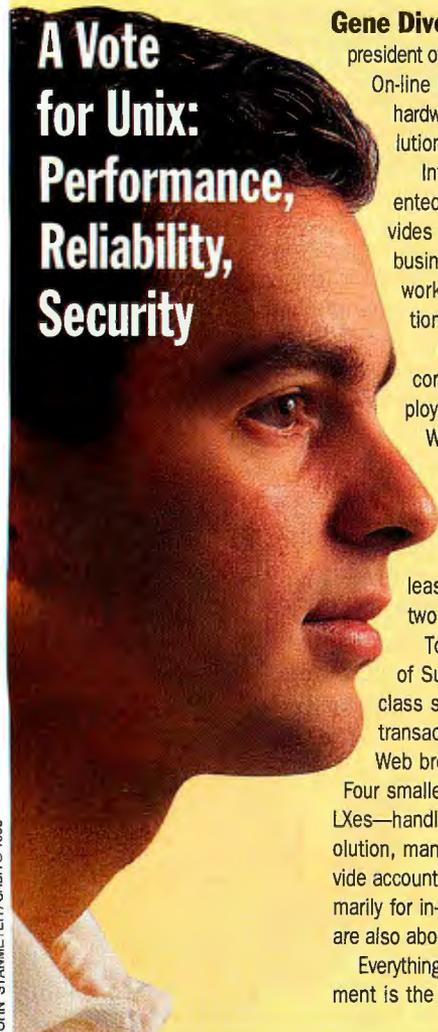
MANAGEABILITY		
	UNIX	WINDOWS NT
Text and graphical management tools	Most	X
Remote administration and diagnostics	✓	Optional
Graphical volume management	Optional	✓
DHCP	Few	✓

Unix is easier to manage from a distance than Windows NT, but a user at the console will find NT much easier to maintain. DHCP makes adding a host to a LAN as easy as plugging in a cable.

✓ = yes X = no

nonexistent and the terrain is wide open.

Examples of these potentially lucrative new markets are interactive TV networks, the World Wide Web, and the high-speed



A Vote for Unix: Performance, Reliability, Security

Gene Diveglia is a Sun worshipper. As vice president of information services for Intelligence Network On-line (Clearwater, FL), he's convinced that Sun hardware and Solaris 2.5 are the best possible solutions for his fast-growing company.

Intelligence Network On-line is a business-oriented Internet service provider (ISP). It also provides a wide array of other Internet services for businesses, such as Web pages and custom networks for companies that have remote operations and need a WAN with Internet access.

Intelligence currently has about half a dozen corporate customers whose hundreds of employees regularly use E-mail, newsgroups, and Web services. Another client is a local county government with thousands of employees. In addition, Intelligence provides Internet services to several thousand individual subscribers. The Web sites maintained or leased by Intelligence collectively receive about two million hits per month.

To support this business, Intelligence has a ton of Sun hardware. Half a dozen 490- and 690-class servers with dual CPUs handle most of the transaction-based services, such as E-mail, news, Web browsing, shell accounts, and authorization.

Four smaller servers—Sun SparcStation Classics and LXes—handle Domain Naming System (DNS) name resolution, manage the network-wide databases, and provide accounting services. Two more Sun servers are primarily for in-house development and operations. There are also about a dozen SparcStations for internal use.

Everything ties into a three-segment network. One segment is the internal network for the desktop worksta-

tions. Another segment is a local backbone that carries most of the transaction-based activity. Finally, there's an external backbone for the WANs, frame-relay networks, and connections to other service providers. Intelligence is now migrating its internal backbone onto ATM and will experiment with moving the WANs onto ATM soon.

Why is Intelligence exclusively a Sun shop? Diveglia says that Sun and Solaris offer the best combination of performance, reliability, and security. While some Internet service providers are bootstrapped startups that cater to hobbyists, Intelligence is a more established provider that specializes in corporate and governmental clients. "That makes us more conscious of security, performance, and reliability issues," he says.

"Unix has been around for so many years that it's pretty well understood," Diveglia points out. "But the PC market and Windows applications have undergone such hyper growth stages that it's difficult to believe they have the same completeness and level of understanding that exists in the Unix market."

In addition, says Diveglia, Unix systems are capable of handling more traffic than PC-based servers. "The PC architecture just doesn't support the kind of multitasking we'd like to see in a heavily transaction-based environment like the Internet," he explains. "On the Internet, you've got lots of activities happening simultaneously: news transfers, mail services, authentication, authorization processes, accounting processes. NT just didn't address that in a server environment."

Although he acknowledges that NT is an up-and-coming OS, Diveglia points out that Unix isn't exactly standing still. Unix in general, and Solaris in particular, continue to evolve and improve. "It's become more attractive over time, not less."

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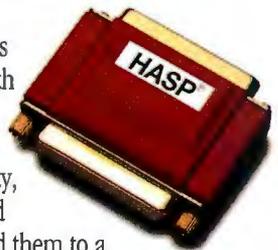
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NSTL TEST RESULTS, OCTOBER 1995*

Scoring Category	Aladdin HASP	Rainbow Sentinel	Glenco/EAST Hardlock	Software Security Activator/M
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Ease of Learning	9.1	7.1	8.8	7.7
Ease of Use	8.3	7.2	6.8	6.3
Versatility/Features	10	8.7	8.8	8.6
Compatibility/Power Consumption	6.7	6.5	6.6	7.4
Speed of API Calls	0.9	1.2	10	4.1
Final Score	8.5	6.5	7.5	6.6

*For a full copy of the NSTL report, contact your local HASP distributor.



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SCALABILITY

	UNIX	WINDOWS NT
Multiprocessor support	Some	✓
Multiprocessor support	Some	✓*
Client-only edition	Some	✓
Support for MS-DOS applications	✓	✗
Support for 16-bit Windows applications	Limited	✓
Support for 32-bit Windows applications	✗	✓
Support for Posix applications	✓	✓
Support for X Window applications	✓	✗

NT and most Unixes let you add more same-type CPUs or use a faster CPU. NT runs identical source code across CPU types. NT has a workstation and a server edition; some Unixes offer less-resource-intensive files and services. DOS and 16-bit Windows applications require an Intel CPU; some Unix systems emulate the Intel CPU in software.

✓ = yes ✗ = no * Up to 32 processors

networks required for the \$500 network computers envisioned by such companies as Oracle, Sun Microsystems, and IBM. Interactive TVs and \$500 computers are still highly speculative, but the Web is here now and growing fast.

Market research indicates Unix systems have jumped to an early lead on the Web and that Sun is doing particularly well. Some analysts think Sun is basking in the glow of Java, its multiplatform language for Web applets. "Everyone is very excited about Java," says David Flaxman, partner for advanced technology at KPMG-Peat Marwick (Radnor, PA), a systems integrator and consulting company. "People perceive that Sun is setting the standards for the Internet, so they want to buy a Sun for their Web server. That's not necessarily a rational connection, but it's there."

By contrast, Microsoft's strategy until late 1995 seemed proprietary. Microsoft originally promoted the Microsoft Network (MSN) as a self-contained alternative to the Internet and released a development tool for on-line publishing that worked only with MSN. Last December, at a press event in Seattle, Microsoft altered its course and embraced the Internet.

Among other things, Microsoft an-

nounced it would move parts of MSN onto the public Web, turn its MSN publishing tool into a standard Web tool (Internet Studio), integrate a Java run-time engine into its free Web browser (Internet Explorer), and bundle its Internet server software with future versions of NT Server.

Microsoft's turnabout is welcome news, but it came too late for early Web adopters. Two years ago, when entrepreneur Larry White was launching a new Web-based magazine for photography enthusiasts called HyperZine, he and his partner chose a Sun SparcStation 20 for their server. HyperZine (www.hyperzine.com) now runs on Solaris 2.4, Netscape's Netsite, and an Illustra database. White uses Perl scripts and Microsoft Access to link Illustra tables into Hypertext Markup Language (HTML) pages, so his on-line magazine generates many of its Web pages on the fly in response to user input.

The same SparcStation server hosts about a dozen other Web sites for White's clients. Each Web site has its own Domain Naming System (DNS) address, so they appear as independent sites to Web surfers. "That's why we felt we needed a workhorse like the Sun," White explains. "At the time, we didn't feel that confident with NT. The same

Larry Blevins believes Windows NT is good for your health. Or at least that it's good for the 261,000 people enrolled in the Harris Methodist Health System (Fort Worth, TX), the "fastest-growing health-maintenance organization in north Texas." Blevins and Harris Methodist have bet heavily on NT Advanced Server, and so far it's a bet that is paying off.

"Our entire HMO runs on the client/server Windows NT-AS platform," says Blevins. "We're getting great performance, and that's the best testimonial you can get."

Harris Methodist operates six hospitals, a hospice program, and an air ambulance, and it has 8000 employees and 3600 participating physicians. Revenues last year topped \$800 million. Yet, even though most professional health-care software runs on MS-DOS and Unix, Harris Methodist began building its client/server system with NT nearly three years ago after extensive evaluation at its own test center.

Today, Harris Methodist has 200 servers, and almost all of them are running NT. Most of the servers are Compaq Proliant 2000 and 4000 systems with 486 or Pentium CPUs. They connect to about 4000 PCs, mostly 486-based IBM and Compaq systems, with a smattering of older 386 and newer Pentium machines. Some mobile workers have IBM ThinkPads. Almost all the PCs are running Windows for Workgroups 3.11, though a few run NT. In the back office, the whole network ties into a pair of IBM 9000-series mainframes.

Employees at Harris Methodist primarily use their com-

puters to process claims, issue checks, maintain the membership database, track finances, and exchange E-mail. They use off-the-shelf software—including Microsoft Office, which Blevins calls the "corporate standard"—and custom applications written with SQL Server, Visual Basic, Microsoft Access, Borland C++, and Borland Delphi.

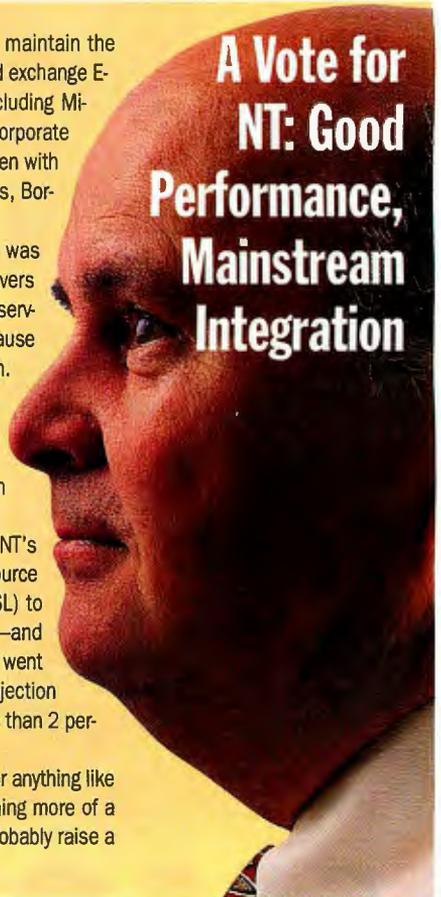
Before switching to NT, the company was much smaller and had only 10 to 15 servers running OS/2 and AIX. NT emerged as the server OS of choice, according to Blevins, because it seemed less complex and more modern.

"Unix is closer to the mainframe, as far as complexity is concerned," he says. "It has its roots in the mainframe era, whereas NT was designed from the roots up in the desktop PC era."

Blevins says he has more confidence in NT's future. He notes that AT&T sold its Unix source code and Unix Systems Laboratories (USL) to Novell, which in turn sold them to SCO—and each time they changed hands, the price went down. He also points to Dataquest's projection that Unix market share will dwindle to less than 2 percent by the end of the century.

"I'm not predicting the demise of Unix or anything like that," he says. "But I think Unix is becoming more of a niche OS than a mainstream OS. That'll probably raise a few hairs, but I think it's true."

**A Vote for
NT: Good
Performance,
Mainstream
Integration**



STEVE RAWLS © 1996

with the Macintosh server solutions."

If he were starting today, though, White says he'd consider NT. "I'll do anything it takes to get the job done. I'll use a Sun, a PC, a Mac, an Amiga. Whatever is best for that solution at that moment."

SCO foresees even greater potential for

Unix on intranets—private corporate networks assembled with the same server software, client browsers, and publishing tools developed for the public Web. An intranet could be as small as an internal LAN, or it could use the public Internet as a virtual WAN. "The intranet opportunity for Web

servers is probably 10 times as large as the Internet opportunity," says SCO's Ait.

For example, SCO currently has only two servers on its public Web site, but about 200 servers on its private intranet. When ordinary users log onto SCO's home page (www.sco.com), they can't get past

Unix vs. NT: Technical Head-to-Head

TOM YAGER

Unix and Windows NT are strikingly similar in design and capabilities, but their differences are significant. Both can deliver text and graphical applications. Both OSes give applications a protected virtual address space in which to run. Both support multiple CPUs and lightweight processes. Both run on a variety of platforms, although Unix runs on far more. Both support advanced file systems with long filenames. Both offer powerful peer file sharing and other network services.

Windows NT does have the advantages of Microsoft's hegemony, primarily strict central control of the OS and its APIs. A developer can write a Windows NT application once and retarget it to a different CPU with naught but a recompile. That is true in Unix only with the simplest of applications. NT also lets developers target 32-bit software to Windows 3.1 and Windows 95. NT's burgeoning installed base makes it easier to find device drivers and, increasingly, the vital and well-written public-domain software that has previously given Unix users cause to gloat.

Unix still has an edge in distributed resources, with the ability to share applications, files, printers, modems, and remote procedures across LAN and WAN connections. Unix E-mail is the Internet standard, and TCP/IP networking is more mature in

Unix. Still, Windows NT's native file-sharing method is generally faster and more efficient than NFS. It also serves files and printers to Windows, Windows 95, and Macintosh clients without requiring optional software.

IN THE TRENCHES

Unix currently has a market lock on serving applications. If you can get access to a Unix host through any LAN or WAN network connection, you can tap into all its services. Windows NT—not inherently a multiuser system—still lacks the native ability to share graphical applications across network connections, a failure that also makes it harder to do remote administration. This is one of NT's most serious shortcomings, although we're beginning to see third-party software that helps resolve this. It needs consistent implementation at the OS level.

At a lower level, both OSes do support remote procedure calls (RPC), and object-sharing standards are rapidly evolving for both. Nevertheless, Windows NT will have an advantage: Microsoft creates the standards, so developers will have no confusion regarding which object-sharing method to implement. Until Microsoft rounds out its network application and object services, however, Unix is the better overall application server.

In the realm of file and printer sharing, NetWare still reigns supreme, but Windows NT is coming up fast. Unix is barely on the radar, and it's fading rapidly. NT's native networking covers all the bases: PC/Windows, Macintosh, and TCP/IP (but NFS file

sharing requires third-party software). No Unix implementation can rival NT's ease of setup and management. True, Unix has more cool utilities. But Unix file and printer sharing are still dark ages compared with Windows NT. NFS is the Unix standard for file sharing, and it's recently seen enhancements. Even with those enhancements, users and administrators find NT file services faster and less problematic. And don't even get an administrator started on the setup and admin nightmares inherent in Unix printer sharing. Windows PCs require special software to work as NFS clients, and only a few Windows NFS implementations deliver the benefits of native Windows/Windows NT's effortless peer networking. NT is clearly a better choice for file and printer sharing.

Unix is a well-regarded choice for database servers. But NT has earned a reputation for easier implementation, management, and bulletproof operation. Unix still has an edge in the number of database server applications available, ground it's quickly losing to NT. In the specific case of Solaris for SPARC, every major database vendor offers a SPARC-targeted server.

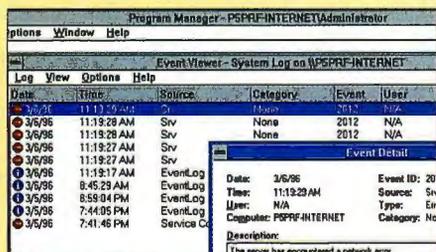
But these vendors are quickly porting to NT. The performance advantages of high-end Unix systems are no more. NT systems equipped with Alpha or Mips CPUs, or even multiple Pentiums, handily outperform SPARC systems in the same price class. NT readily finds and supports RAID disk controllers, redundant power supplies, and hot-swappable drives. Unix still has history on its side: Corporate IS managers are simply used to putting Unix to work as database servers. NT needs more time to prove itself in this role, but it has the power and vendor backing to usurp Unix's lead in database services.

NET ADVANTAGES

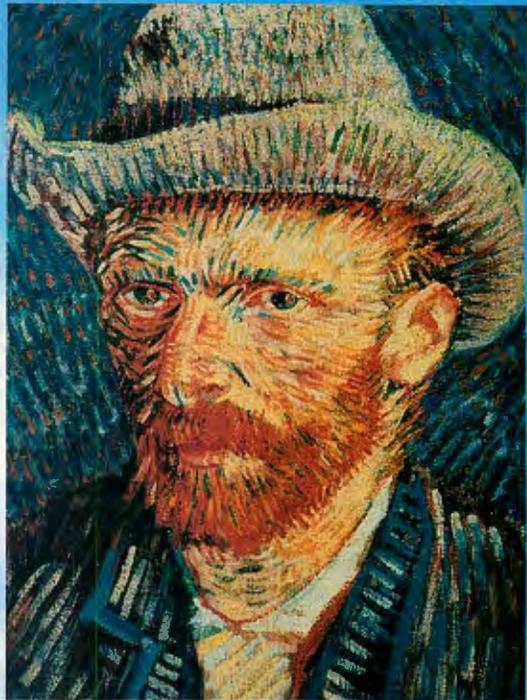
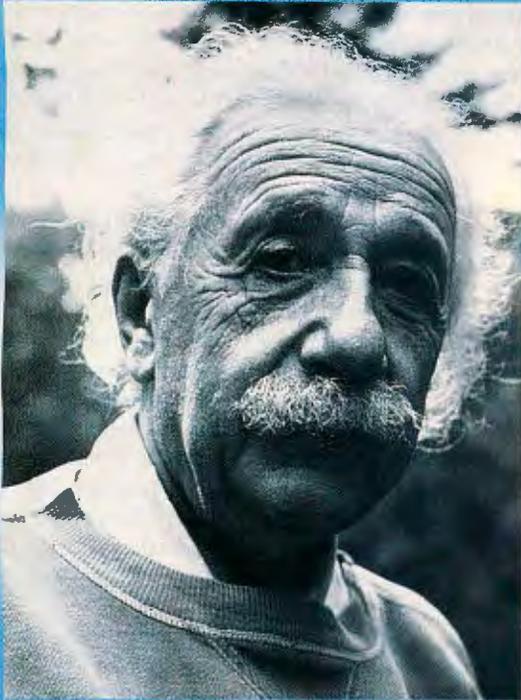
If you are putting services on the Internet, Unix is still the best way to go. You'll find yourself getting—for free—the software you must pay for under Windows NT. You can implement firewalls, proxy servers, security enhancements, and other necessities using software pulled from Internet archive sites. NT's multirouted file system (C:, D:, and so on) makes adapting services to changing storage configurations needlessly challenging. As for cost, you can deliver impressively complete Internet services through Linux or FreeBSD, OSes you can buy for less than \$50.

Windows NT is gaining ground fast, though, and the free utilities and services that Unix users enjoy will find their way to NT. Microsoft has publicly announced its intent to kick Netscape's butt in both the server and the browser markets. Microsoft is already giving away its Internet Information Server with Windows NT Server, joining its free Internet Explorer browser program. Despite the cries of "unfair," Microsoft stands poised to take over the Web.

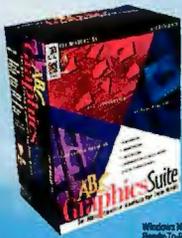
Tom Yager, a former BYTE technical editor, is a freelance writer and consultant who runs his own research lab in Texas. You can send E-mail to him at tyager@maxx.net.



Event Viewer, one of the tools integrated into NT Server 3.51, enables administrators to watch events and system behavior.



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the two public servers. Employees, however, can gain secure access to the intranet and use it like a private Web.

SCO's employees are starting to format many of their documents—such as product data sheets, press releases, white papers, and brochures—in HTML, the lingua franca of the Web. That way, coworkers in remote offices can retrieve, view, and print the documents with any Web browser. High-quality color printers generate copies of data sheets on demand, reducing the amount of out-of-date sheets headed for the trash. Plus, documents bound for public consumption are already in the proper format for the public Web servers.

None of this has escaped the attention of Microsoft. As part of its born-again Internet strategy, Microsoft is adding Internet features to all its relevant products.

By the end of this year, Microsoft promises, Office applications will let you save, open, and print HTML documents. (Word already has an add-in called Internet Assistant that provides these features.) Built-in browsers will bring the informational resources of the Web to your desktop. New OLE controls for Visual Basic will let programmers build Web connectivity into their programs. And VB Script will provide an alternative to JavaScript for applets. The Internet may have been born and nurtured on Unix, but Microsoft wants it to flower on Windows.

It's a Standoff

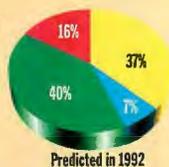
Clearly it makes little sense to declare a winner in the ongoing and evolving NT vs. Unix battle. We can draw some conclusions, however.

- Windows NT is definitely gaining ground in corporate installations, but be-

Market Forces

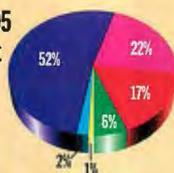
Without a doubt, at least some of NT's growth is coming at the expense of Unix. We interviewed some technically savvy users who have switched from Unix to NT, or who said they might switch if they were reengineering their installations today. Market research firms such as Dataquest predict that NT will dominate the industry by the turn of the century. Yet it's worth keeping in mind that industry analysts and journalists made similar predictions when Microsoft introduced NT in 1992, and NT's adoption rate has fallen well short of expectations.

1996 OS Market Share



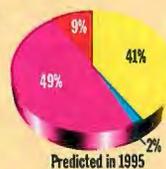
Industry sources predicted in 1992 that NT would capture 37 percent of the market for operating systems by 1996, with all Unix versions combined capturing only 7 percent.

Actual 1995 OS Market Share



Yet by 1995, NT had obtained only 1 percent of the OS market, even less than Unix's 2-percent share.

1999 OS Market Share



That doesn't stop predictions that by 1999 Windows NT will have 41 percent of the market, while Unix is projected to have 2 percent.

KEY
 Others
 DOS
 Windows 95
 Windows 3.1
 Unix
 Windows NT
 Source: Dataquest

NT's slow start is not surprising. Despite the computer industry's reputation for fast-paced change, fundamental shifts often happen at a glacial rate. It has been 11 years since Intel introduced the first 32-bit x86 processor (the 386), yet the vast majority of x86 users are just beginning to enter the 32-bit world of Windows 95 and Windows NT.

Those inertial forces are even stronger at corporate sites where Unix and NT are battling head-to-head for the loyalty of MIS managers. You don't migrate an enterprise or even a departmental network onto a new OS overnight. That's probably why NT appears to be doing best at new sites that don't have to deal with major legacy issues. Meanwhile, Unix is hanging tight at larger companies that have already invested heavily in information technology.

"While NT has slowed the growth of Unix—and has dampened it most at the uni- and quad-processor levels—Unix is still holding its own," says Pauline Mist, VP of Digital's Alpha server business. "We still see our Unix numbers going up quarter after quarter. Our midrange Unix boxes with Oracle have continued to set quarter-to-quarter sales records."

Based on its own research and data from analysts, Digital forecasts that server business by revenue in the year 2000 will be 40 percent Unix, 40 percent NT, and 20 percent legacy systems (including MVS, OS/400, and OpenVMS). "But NT will by far dominate in unit numbers because it will come up from the desktop," says Mist.

cause the global computer market continues to expand at a prodigious rate, NT is not killing off Unix. On the contrary, Unix is likely to thrive into the next century.

- Unix is still the best solution for large databases and other enterprise-scale jobs. That won't change until Microsoft radically improves the scalability of NT and SQL Server on SMP machines with six or more processors. Also, NT has no time server, which may rule it out for large on-line transaction processing (OLTP) systems.

- NT is winning more mind share among users. It's new, it's hot, it's from Microsoft, and it has "Windows" in its name. Unix suffers from discrimination against old age and from disunity among vendors. People who cut their teeth on Windows are moving into authority and will increasingly look toward Microsoft for solutions.

- Microsoft's slow embrace of the Internet has worked to the advantage of Unix. But by bundling Internet software

with NT Server and making its leading applications Internet-aware, Microsoft can establish NT as the no-brainer choice for companies that are setting up new Web sites and intranets.

- Microsoft has a strong tools strategy with Visual Basic, VB for Applications, VB Script, Visual C++, and OLE. However, as users become more Internet-savvy and multiplatform-minded, that strategy must become less proprietary and Windows-based. Sun has blazed a path with Java that Microsoft needs to follow.

In the end, there is no one-size-fits-all answer to which OS is better. Experts who want to craft the best possible solution for a given business problem must be knowledgeable enough and open-minded enough to adopt either OS—or both. ■

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

RELIABILITY		
	UNIX	WINDOWS NT
Per-process memory protection	✓	✓
Recoverable file system	Few	✓
Remote diagnostics	✓	Optional
Storage volume management	Optional	✓
Disk mirroring and striping	Optional	✓

Both Unix and Windows NT benefit from mature designs, and most regard them as stable. Unix systems must improve to rise to NT's excellent standard disk fault-tolerance.

✓ = yes

Make Voice Response Sing

DAVID S. LINTHICUM

Press a few buttons on your phone, and an interactive-voice-response (IVR) system will report your checking-account balance, deliver the closing prices of your stocks, or confirm that Visa received your latest payment. If you're like most callers, you're happy to communicate with a computer instead of a human as long as you get accurate information quickly and you don't have to tax your brain to use the system.

These are all worthy goals, but speed and ease of use on the user side usually mean headaches and complexity behind the scenes, where programmers work. IVR systems are no exception. They test your programming mettle for pulling together multitasking operations, shared resources, and myriad hardware components. If you do it right, you will keep your customers happy and loyal. But if you trip up, a crippled IVR system frustrates customers and loses sales.

Fortunately, help is available. IVR development has moved forward from its pioneering days, and the trend today is for smaller and less expensive IVR applications that leverage affordable PC technology. The programming tools available to build these systems offer rapid application development (RAD) capabilities riding on top of popular development tools, such as Microsoft's Visual Basic. These tools can turn IVR into a "bolt-on technology" so that developers can make just about any application answer the phone and speak with callers.

Multitasking Muscle

IVR builds on audiotex technology, the venerable method of using telephony and audio menus. However, IVR goes beyond simple menu trees by helping callers to perform calculations online or talk directly to an application using enhanced speech-recognition technology. When it's time for the system to respond to caller inquiries, recorded messages are just one option. IVR systems can send faxes or E-mail and even talk to you using text-to-speech and simultaneous voice/data technologies.



VICTOR GAD © 1996

A new generation of programming tools helps IVR programmers avoid the panic button

In the corporate world, IVR systems typically use distributed databases on servers that are linked via client/server middleware, such as Open Database Connectivity (ODBC), Ethernet, or TCP/IP networks (see the text box "Hardware Building Blocks" on page 54). By nature,

IVR applications support multiple operations. If you're building an application for an OS that isn't multitasking—for example, DOS and Windows 3.1—you have your work cut out for you.

But don't gloat, even if you develop for Windows NT and 95, Unix, or OS/2. Within these multitasking Oses, it's difficult to do the real-time parallel programming necessary for IVR because you have to allocate resources among so many ports. You must launch many processes that run in parallel and share resources in real time. Each process must compete with other processes for processor time, memory, and IVR devices. If you don't handle this well, callers will experience delays, and in the IVR world, every delay is a threat that callers will hang up.

continued

MAKE VOICE RESPONSE SING

To deal with the trickiness of real-time multitasking and interprocess communications (IPC) with a single-tasking OS, you must learn how to make up for the OS's deficiencies. If you're using DOS, the IVR system must be able to shut down single-tasking OS services to run tasks in parallel. For example, the product might boot DOS and then shut the OS down while the IVR server becomes the OS.

In multitasking environments, a device-manager process can ensure that the IVR system allocates ports evenly among tasks. You might also consider using multiprocessing computers that have the ability to assign tasks to specific processors to reduce the risk of processes getting in each other's way.

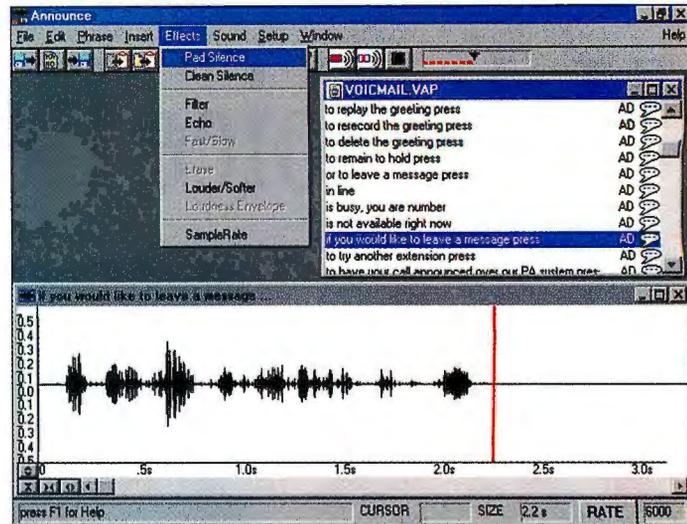
High-Level Programming

Fortunately, a number of IVR development tools exist that can help you sort out the complexities of building an IVR system. There are three basic types of IVR

Pronexus uses a PC-based development environment that allows developers to roll their own IVR applications. Microsoft's Visual Basic is the development platform of choice for Pronexus.

development environments: applications generators, third-generation languages (3GLs) using IVR APIs, and fourth-generation language (4GL) development environments with value-added IVR capabilities.

Applications generators can speed development time by freeing you from the low-level details of programming. What does programming freedom mean for



IVR? For one thing, applications generators directly address the problems of multitasking. Even if you're building a system for DOS or Windows, a generator can provide an executable that makes the ap-

Hardware Building Blocks

PC-based interactive-voice-response (IVR) systems are agnostic: You can run them under Windows, OS/2, Unix, or DOS. The problem is that your IVR server might have to hold enough different kinds of cards to make a Las Vegas dealer dizzy.

For example, you need line-interface cards to hook up your PC to analog or digital telephone lines. Voice cards record and play back audio, as well as interpret DTMF touch tones and network tones. Fax modems send out requests for information. Asynchronous modems provide callback remote data transfer. Network interface cards (NICs) connect an IVR system to voice-response units (VRUs) or remote database servers and applications. Depending on your application, you might also require text-to-speech, speech-recognition, and switch-matrix cards.

If this sounds like an integration nightmare, you're right. IVR pioneers had to stitch together multiple PCs because single servers didn't have enough slots and interrupts to handle all those boards. Fortunately, now there's relief available. New multifunction cards employ digital signal processors (DSPs) to consolidate IVR technologies onto a single card and a single PC. This setup can support hun-

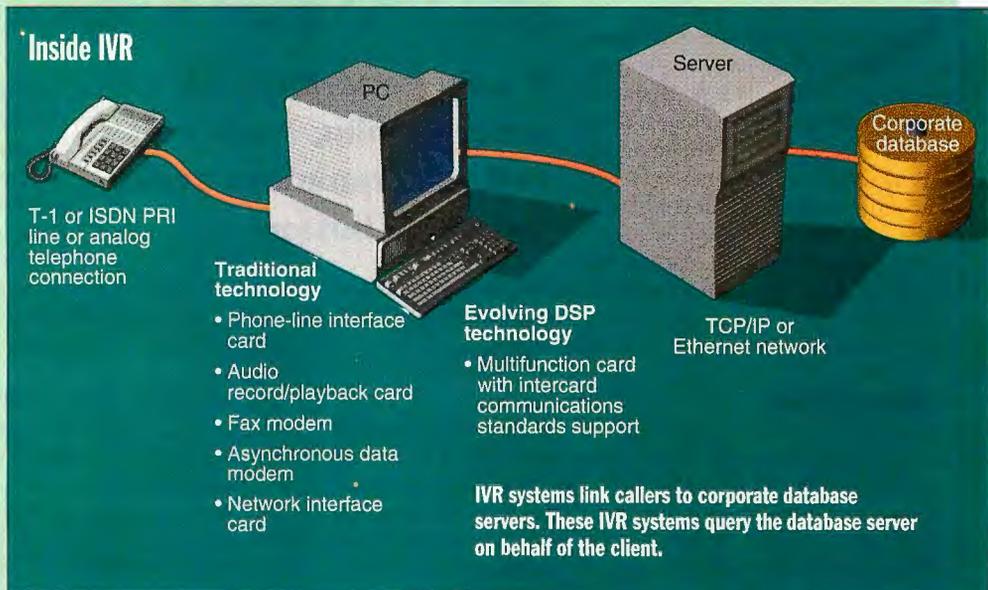
dreds of ports at the same time. The trick is to find cards that adhere to resource-sharing and intercard-communications standards, such as Signal Computing System Architecture (SCSA) and Multi-Vendor Integration Protocol (MVIP).

These two standards allow you to dynamically allocate telephony subsystems (e.g., text-to-speech) as required, rather than tying them to a

single piece of hardware. You can link together MVIP or SCSA systems to scale to changing requirements. For example, Dialogic (Parsippany, NJ) sells a high-density single-slot card with 24 voice-processing channels using a relatively inexpensive ISDN interface to the outside world. Dialogic's card can serve as many as 800 customer-support lines with a single PC.

To connect their IVR systems to

the outside world, companies typically use T-1 or ISDN Primary Rate Interface (PRI) for high-bandwidth, single-wire telephone services. These digital services are not cheap: They can cost thousands of dollars per month, depending on the configuration and local lease rates (see "You Can Take It with You," September 1995 BYTE, and "How To Implement ISDN," April 1995 BYTE).



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MAKE VOICE RESPONSE SING

plication run like a multitasking OS. The applications generator moves the underlying OS out of the way to perform these complex operations. You simply write a single-tasking application description and then scale to the requirements of your IVR system.

Applications generators also have built-in mechanisms to communicate with IVR hardware, and there's no need to write to hardware-specific APIs or to various proprietary phone systems. In addition, applications generators provide debugging tools, voice-prompt recording software, and other toolkits to help you build IVR applications.

Choices include Info Systems' Talkie, International Voice Systems' IVS Builder, and Lucent's (formerly AT&T's) Intuity Conversant. These products offer graphical point-and-click interfaces with script- and forms-based IVR development systems. They also include IVR-oriented libraries and components for use with C and C++ or with client/server development environments, such as Visual Basic, PowerBuilder, and Delphi.

Just keep in mind that IVR applications generators are task specific. Don't expect them to perform other applications development chores for you.

Higher-End Tools

Turnkey IVR systems with 4GL environments generally fall into the high-end and midrange categories. High-end products cost as much as \$100,000 and can serve hundreds or even thousands of callers simultaneously.

For example, Invesco Funds, a mutual-fund brokerage in Denver, Colorado, uses five Intuity Conversant systems. Each system has two T-1 trunks (equivalent to 48 lines), which lets Invesco handle a total of 240 lines distributed across all its systems. Invesco can process as many as 40,000 calls per day. Using Ethernet, the IVR systems link to remote databases running on several NCR 3600 minicomputers that act as database servers for account

information.

Like a lot of high-end IVR products, Conversant sits at the end of a toll-free phone number. Callers using Conversant can call this number to find out the value of a fund, or, when they supply a personal identification number, receive account balances and private information.

You can tell midrange IVR systems from high-end systems largely by caller capacity: midrange systems allow fewer simultaneous callers. Typically, high-end systems can handle hundreds of callers simultaneously, while midrange systems top out at less than 100 callers. Midrange systems, however, are more affordable; they cost tens of thousands—rather than hundreds of thousands—of dollars. Both classes of systems usually work with standard 4GL development environments for DOS or Windows, which means you can customize an IVR system to meet your individual needs.

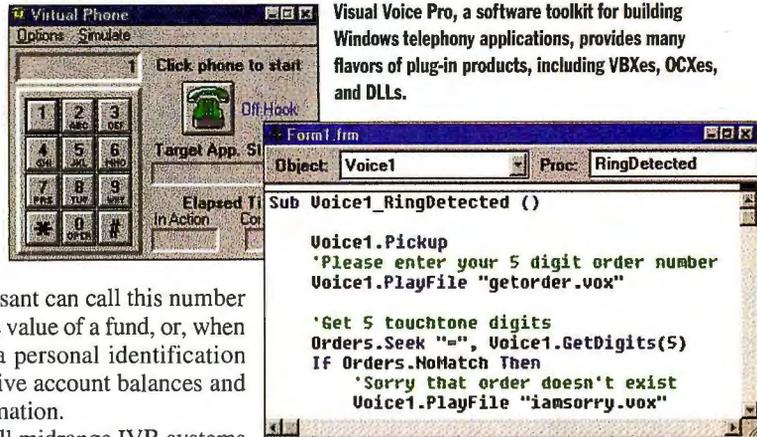
For example, Voysys sells boards and software that ride on top of ISA-bus computers. With the company's VoysAccess, you can build IVR applications using FoxPro or Visual Basic. FoxPro provides the programming language as well as the database. If FoxPro isn't your favorite environment, then consider VoysAccess for Visual Basic or Pronexus's VBVoice, which comes in 16- and 32-bit versions. Like VoysAccess, VBVoice is a PC-based development environment for rolling your own IVR applications.

Visual Voice Pro, from Stylus Innovation, employs custom controls, such as VBXes and OCXes, as well as DLLs that you can access from most applications development environments. Visual Voice Pro handles up to 24 calls simultaneously and supports Telephony API (TAPI)-compliant hardware, multiline voice-response boards, and most fax modems.

Press for Success

Even with the best tools available, you still need careful planning and solid programming techniques to launch a successful IVR installation (for more information, see the text box "IVR Tips" above). Like any complex application, IVR systems require

Visual Voice Pro, a software toolkit for building Windows telephony applications, provides many flavors of plug-in products, including VBXes, OCXes, and DLLs.



IVR Tips

Successful interactive-voice-response (IVR) systems are a mix of science and art. Development tools can help with the science part; the art has to come from you. Here are some key points to keep in mind.

As in any development project, the first step is to understand the business problem you need to solve. Next, don't try to please everyone: Some callers hate IVR no matter how easy it is to use the system. Always give callers an option to speak with a human. If you use speech recognition, callers should be able to speak over voice prompts to move through the system. When you're specifying an IVR system, make sure the final product can handle your current and future call volume: Your IVR system needs to be expandable so you can add telephone interfaces and voice-storage capacity as the system grows.

If you want to use your IVR system in a client/server environment, make sure your system can handle the network connection without straining the IVR software. IVR systems should be able to multitask and provide multiple data-file access. If the host OS does not support this, the IVR software should. Finally, when considering IVR, plan to do a significant amount of research. Speak with developers as well as vendors, and examine each IRV candidate closely before buying.

testing, debugging, and a sound design.

But with careful planning and the right programming tools, the telephone keypad can act as an aid to unlock corporate information rather than acting as the panic buttons for an IS staff. ■

David S. Linthicum is a technical manager with EDS in Falls Church, Virginia. You can reach him by sending E-mail to 70742.3165@compuserve.com.

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A DSP SAMPLER

ANDREW W. DAVIS

It wasn't so long ago that multimedia was an intriguing—and expensive—option on desktop computers. Nowadays, you can't buy a PC without it. What changed?

First, the computer's processor got a lot faster. Second, low-cost digital signal processors (DSPs) became common. DSPs are dedicated coprocessors that adroitly manage real-time data streams, such as audio, video, and telephony functions. When you put them into a computer, they relieve the processor of these compute-intensive jobs.

So, what's a DSP? How does it work? What's it good for? The answer to all three questions is, "It depends on who you ask." Just as there are many definitions of *multimedia*, the definition of *DSP* is blurred. Processor vendors would have you believe that a CPU is a DSP. Purists argue that only a dedicated piece of silicon is equal to the task.

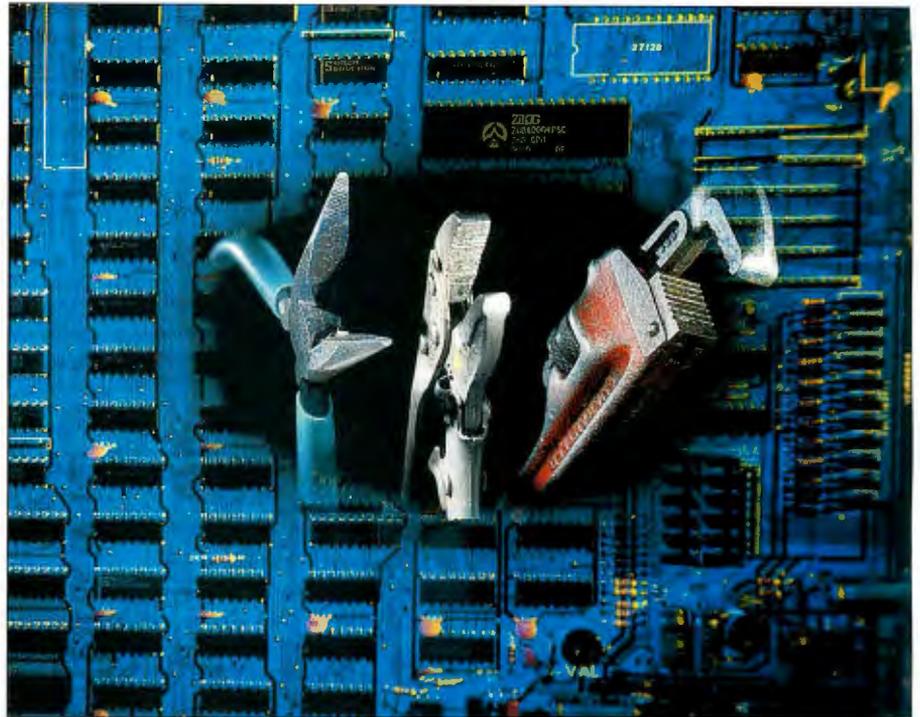
The truth, as with most truths in engineering, lies somewhere between the extremes. A CPU is indeed capable of tackling some DSP chores (e.g., wave-table synthesis), but there are others that a DSP really is better at (e.g., being a modem data pump). Let's take a look at different approaches to tackling digital signal processing, from the traditional to the avant-garde.

Fuzzbusters

In the 1960s, mathematicians at AT&T Bell Labs were trying to recover something from nothing. Specifically, they worked on the problem of recovering information from signals that were distorted, noisy, or incomplete. Out of this research came a set of DSP algorithms. Today, the descendants of AT&T's DSP algorithms compress and decompress audio and video signals, enhance music, perform speech recognition and synthesis, and drive modems—the stuff of multimedia peripherals.

The initial implementation of DSP technology was software running on a mainframe. But the high cost of CPU cycles spurred engineers to inexpensive alternatives. They developed specialized, high-performance coprocessor chips optimized for the real-time signal-processing requirements of audio, video, and telephony. Currently, DSP multimedia solutions come in a spectrum of packages, ranging from function- and algorithm-specific ICs (FASICs), such as modem chips, to programmable DSP engines to software-only solutions.

DSPs typically execute most instructions in one clock cycle and



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Exploring the pros and cons of dedicated multimedia DSPs

often execute multiple instructions per cycle. For example, today's multimedia DSP can execute a multiply-accumulate (MAC) instruction—the fundamental operation for all audio and video processing—in a single clock cycle.

An algorithm implementing a similar instruction on a Pentium requires 11 clock cycles. Hence, a \$30 66-MHz DSP can run multimedia circles around a 133-MHz Pentium. But the pendulum may be swinging signal processing back to the general-purpose processor as engineers add DSP functions to the CPU. (See the text box "Native Signal Processing" on page 56NA 2 for details.)

The Programmable DSP

Until recently, multimedia on the desktop was really *single-media*. Audio, video, and communications each relied on separate, dedicated hardware. Today's trend is to replace multiple single-function devices with one multifunction device. Sitting at the center of this trend is the programmable DSP chip.

The concept is simple. Just as your PC takes on different personalities depending on whether you've loaded a word processor, spreadsheet, or database, a programmable multimedia engine takes on different personalities by loading different DSP programs for speech recognition, audio/video playback, sending a fax, and so on. A multitasking DSP OS manages the different tasks, arbitrates resources, and handles communications with the PC processor. While a multifunction device can cost more than any single device it replaces, it's less expensive than all the devices combined. It also saves board space and eliminates hardware

A DSP SAMPLER

conflicts and software incompatibilities. The downside is that it can be tricky communicating to the separate OS that the DSP hosts. (See the text box "Types of DSP Implementations" on page 56NA 6.)

IBM's Mwave is an example of a programmable DSP. It's the embedded multimedia engine in IBM's ThinkPad and Aptiva systems and also is used in board-level products from other vendors. With glueless (i.e., no support chips are required) interfaces to stereo audio codecs and ISDN chip sets, the MDSP2780 (as it's officially known) powers a variety of audio, video, and communications tasks.

To write software for it, you write to IBM's Mwave OS and Mwave libraries. These libraries support Sound Blaster emulation, wave-table synthesis, MIDI, voice, and modem functions up to and including V.34 modulation on the chip. Note that these are APIs and libraries: IBM doesn't expect its customers to directly program the chip. IBM demonstrated the advantages of programmability when it announced a software upgrade that allowed the installed MDSP2780 base to obtain V.34 modem capability and enhanced telephony functions without a change to the hardware.

Horsepower and Multiprocessors

While IBM's Mwave represents the "traditional" programmable DSP technology, Texas Instruments' TMS320C80 family is more like a DSP on steroids. Recogniz-

NATIVE SIGNAL PROCESSING

Intel and other processor vendors have championed native signal processing (NSP). The concept is simple: Given ever-more-powerful processors, the host should be able to take on a longer list of multimedia chores. The first NSP implementation appeared on the PowerPC-based Macintosh from Apple Computer in March 1994. The host PowerPC 601 has signal-processing support for speech, telephony, and many audio/video functions as well.

How much can the CPU do? To implement NSP, Intel recommends a baseline target platform that includes an audio codec and an accelerated graphics chip, thereby leaving the Pentium free to perform DSP functions. Without the graphics-acceleration chip, the decode and playback of an Indeo video clip consumes 100 percent of a

90-MHz Pentium's bandwidth. By off-loading BITBLT and color-conversion operations to the graphics chip, 60 percent of the Pentium processor becomes available.

Perhaps the most dramatic example of NSP is Vivo Software's (Waltham, MA) H.320-compliant codec package, in which a Pentium host does all the compression/decompression, multiplexing, and control functions for a video-conference. Other NSP demonstrations include wave-table synthesis, digital mixing, sample rate conversion, MIDI synthesis, and A/D pulse-code modulation compression/decompression.

In general, compute-intensive tasks and heavily interrupt-driven applications for audio, video, and telephony (e.g., MPEG-2, G.728, and V.34 modulation) benefit from DSP hardware in the NSP en-

vironment. Hence, under the hood, most NSP-labeled Pentium platforms will include several DSP engines dubbed smart codecs, modem data pumps, and graphics accelerator chips.

Intel is not standing still, however. The upcoming P55C chip is a Pentium with greatly enhanced integer performance and will be better suited for multimedia algorithms. Intel also is reworking its NSP plans to function within Microsoft's approach to NSP, which is based on DirectX. As host platforms migrate from Pentium to Pentium Pro to P7 technology, the ability to perform more real-time signal-processing and multimedia functions increases. This assumes, of course, that the OSes and user-friendly applications of the future do not expand to consume all available processing power.

ing that multimedia applications have a nearly limitless thirst for processing power, TI has combined multiple computational units on a single, monolithic die. The 2-billion-operation-per-second TI TMS320C80 has four 32-bit DSPs, a 32-bit RISC coprocessor with an FPU, a video controller with dual frame timers, a trans-

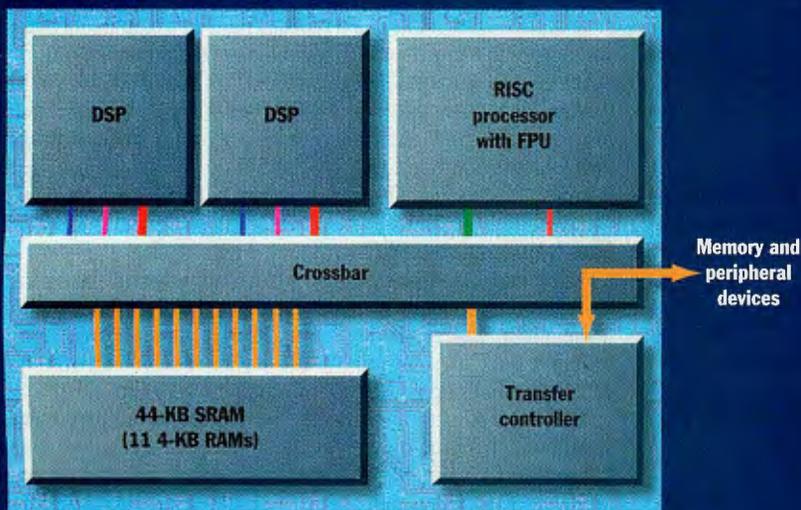
fer controller, and 50 KB of memory. Each DSP has 4 KB of instruction cache and has the ability to access 12 KB of on-chip shared memory via the crossbar.

A sister chip, called the TMS320C82, weighs in at 1.5 BOPS with two DSPs, the RISC master processor, and 44 KB of on-chip memory. It has an enhanced, simplified system interface, but no video controller (see the figure "The TMS320C82 Architecture" at left). To attract the attention of desktop designers, TI has announced that the chip will be available for \$82 in OEM quantities, 90 percent less than the original TI TMS320C80's price.

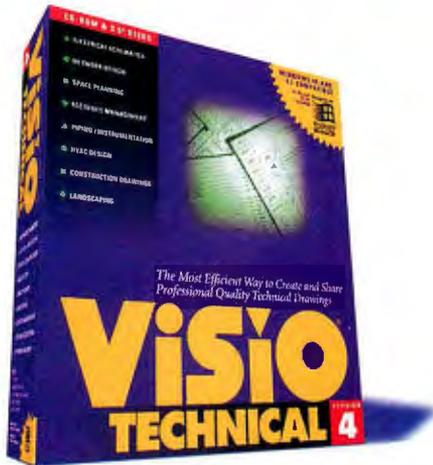
While multiple DSPs provide the TMS320C8X with raw multimedia processing horsepower, its embedded RISC machine orchestrates the parallel DSP processing and manages the I/O. For example, the C82's three on-chip processors can execute instructions independently of each other. A crossbar switch matrix supports the sharing of memory among all the processors, providing the capability to support many different parallel-processing programming models.

Having a multimedia engine with distinct processing components can be an advantage. For example, H.320 videoconferencing involves H.261 video coding and G.728 audio coding, two processes that can be cleanly separated. H.324 videoconferencing is based on V.34 modem technology, and TI claims that the C82 is

The TMS320C82 Architecture



The TMS320C82 represents a general-purpose DSP. It's optimized for high-performance work using multiple internal processors; a high-speed crossbar supports the sharing of on-chip memory with the various internal processors.



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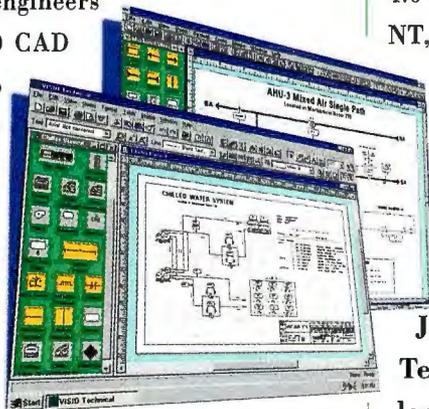
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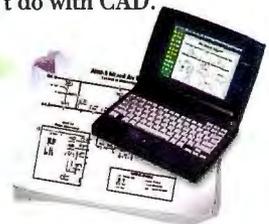


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powerful enough to run the modem modulations on one DSP and the G.723 audio/H.263 video-compression engine on the other. This eliminates the cost of a separate modem data pump.

Programming for this architecture isn't always so easy, however. These models aren't simple, and while the C82 is powerful, it's complex to program and presents a difficult optimization challenge.

TI, which has staked out a leading position in DSP largely on the basis of its C30, C40, and C50 product lines, makes available C80/C82 assemblers, compilers, linkers, and debuggers. For traditional, single DSP chips, TI relies on third-party software developers and OEMs to provide higher-level code that implements JPEG, MPEG, speech coding, and telephony. For the C80, TI is making available software libraries that handle videoconferencing, image processing, and MPEG.

FASIC the Music

Another class of DSP is the FASIC. No one markets FASICs as the DSP devices they are. Rather, their names identify them by their main function, like modem chip set, MPEG-1 video decoder, or H.320 codec.

One example of a multimedia FASIC is Lucent Technologies' (formerly AT&T Microelectronics) AVP video/audio processor (commonly referred to as a codec chip). This third-generation codec is half the price of the second-generation chip and will go into dedicated-videoconferencing and other PC multimedia communications products. The AV4400A supports H.320, H.324, MPEG-1 encoding and playback, JPEG, and motion JPEG.

H.320 is an International Telecommunications Union (ITU) standard for video telephony over switched digital lines. The AVP can perform simultaneous H.261 video encoding/decoding at CIF resolution (352 by 288 pixels) up to 15 frames per second and Quarter CIF (QCIF) resolution (176 by 144 pixels) up to 30 fps. A separate DSP handles audio. H.324 is the new ITU recommendation for videoconferencing over plain old telephone lines. Lucent has squeezed both H.263 video and G.723 audio coding onto the chip (QCIF resolution up to 15 fps), eliminating the need for a separate audio processor.

According to Mort Herman, AVP program manager at Lucent, "the new chip was designed to work gluelessly with new video controllers to provide multimedia and videoconferencing features on a VGA card." Lucent has announced a collaborative effort with Diamond Multimedia to incorporate the AVP within Diamond's

The AVP represents the function- and algorithm-specific IC (FASIC). This DSP supports simultaneous video and audio signal processing for videoconferencing applications. Data multiplexing/demultiplexing and system control are left up to the host processor.

next-generation video and graphics accelerator board. The expansion of graphics and video peripherals into the communications and audio realms is another trend that desktop design-

TYPES OF DSP IMPLEMENTATIONS

General-purpose DSP

Pros:

- ◆ Parallel processing offers high throughput.
- ◆ Programmability allows chip to support different functions at different times.
- ◆ Can do field software upgrade to fix bugs, enhance features, or add new functions.

Cons:

- ◆ Expensive.
- ◆ May require work to integrate the DSP OS with that of the host processor.
- ◆ Hard to program multiprocessor chips to perform optimal parallel operations.

Function- and algorithm-specific IC (FASIC)

Pros:

- ◆ Less expensive than general-purpose DSP.
- ◆ Design optimized for specific purpose, so it's very efficient.

Cons:

- ◆ Can only handle the function for which it was designed.
- ◆ No ability to upgrade.
- ◆ Limited or no programmability.
- ◆ Often requires host processor support.

Native signal processing (NSP)

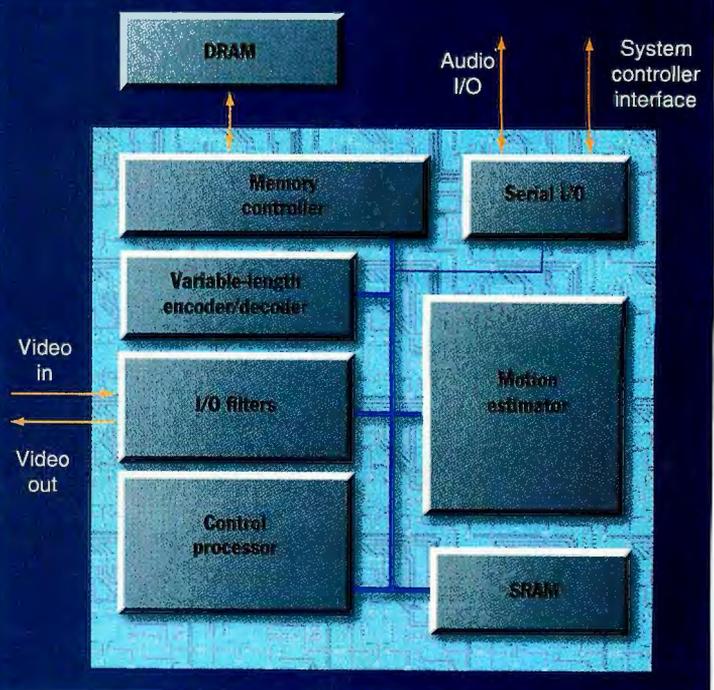
Pros:

- ◆ Signal-processing software uses host processor's instruction set.
- ◆ Fixes, upgrades, and new features added via software.
- ◆ Some instructions are optimized to signal processing.

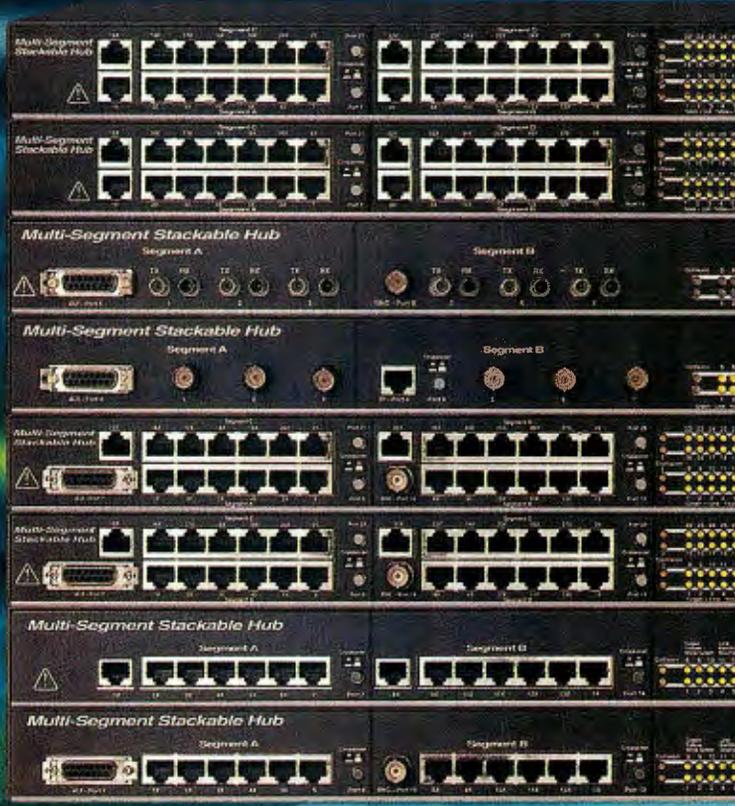
Cons:

- ◆ The most powerful versions of the processor are the most expensive.
- ◆ Host processor's throughput is limited. It can support only a few real-time operations, which consume a significant portion of the processor's bandwidth.
- ◆ Vendor often recommends other FASICs to support DSP operations, so there's no benefit of reducing the parts count.

The Lucent AVP Architecture



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A DSP SAMPLER

ers will be certain to follow carefully.

In what may first appear to be a paradox, new audio and video chips are taking advantage of the increasing power of today's host processors. Lucent's designers have focused this 2.3-million-transistor device on simultaneous audio and video signal processing, leaving the multiplexing, demultiplexing, and system-control functions to host-based software. For high-performance videoconferencing products (e.g., 384-Kbps systems) where the system-control functions would drown a host processor, the AV4400A has a glueless interface to its AV4125 dedicated system controller.

The AVP chip includes advanced motion-estimation circuitry, which provides a higher frame rate and smoother video, as well as hardware for video scaling at input and output, on-chip temporal and spatial noise-reduction filters, and circuits for forward error correction, as shown in the figure "The Lucent AVP Architecture" on page 56NA 6. These function blocks represent areas of dedicated silicon. The motion-estimation engine is programmable—by Lucent, that is. But the on-chip real estate is not available to other algorithms if motion estimation is not required. The advantage is higher performance, optimized silicon and software, and a product that presents itself to Lucent's customers as a well-defined solution. The disadvantage, others argue, is a lack of flexibility. Lucent does not expect its customers to program the chip, thereby limiting Lucent's software and support requirements.

Long Instructions

Two companies, Philips Semiconductors and Chromatic Research, are taking a different approach to PC multimedia engines and expect to be sampling product this year. Rather than using fixed functionality, or multiple processors on a single die, their engines use very-long-instruction-word

(VLIW) processors. These words specify multiple operations for a processor that has multiple functional units.

Philips is taking this approach with its TriMedia VLIW and DSP architecture, designed from the ground up to be a multimedia processor. TriMedia uses instructions composed of as many as five independent operations. These operations can target any five of the 27 functional units in the DSP, including integer and floating-point arithmetic units and parallel DSP-like units. Each operation in turn can execute multiple RISC instructions.

For example, the me8 operation, which is aimed at MPEG "pixel-banging," executes four subtracts, four absolute values, and three adds in one cycle (11 RISC instructions). Hence, with a 100-MHz clock rate, five operations per VLIW instruction, and multiple RISC instructions per operation, the TriMedia chip has a theoretical limit of 2.5 BOPS. For additional information on the characteristics of VLIW, see "The Word on VLIW," April BYTE.

According to Derek Meyer, marketing manager for the Philips TriMedia Group, customers can program and optimize TriMedia at the C language level—no assembly or machine language is needed—which is a key advantage for independent developers. Besides the TriMedia chip itself, Philips will be providing a robust software development environment, including a C compiler, an emulator, a debugger, and a software simulator, as well as the embedded real-time OS and multimedia application libraries, such as MPEG, V.34, and H.320/H.324.

VLIW is also the basis of the Mpack multimedia DSP from Chromatic Research. The core of the chip includes five groups of parallel-processing units surrounded by interface controllers for five high-speed external I/O buses. Each Mpack instruction word contains two op codes, or instructions. Each op code can operate on two to 16 integers simultaneously, enabling as many as 32 integer operations (common in imaging and video) to occur in parallel for each clock cycle. The Mpack media engine is exclusively for multimedia operations; Chromatic's designers assume that the PC's processor will be available to handle floating-point calculations and other control functions.

Unlike the Philips approach, however, the Chromatic chip doesn't have a public interface. But that's OK—it fits neatly into a novel business model that Chromatic is pioneering.

While the world has grown accustomed to "fabless" semiconductor companies,

Chromatic may be the first chipless chip company. Instead of worrying about building and selling chips, Chromatic licensed the design to two large semiconductor companies (Toshiba and LG Semicon) that will sell the chip. Chromatic will focus on developing and selling "mediaware" for the Mpack to enable video, sound, 2-D and 3-D graphics, and fax/modem/telephony/videoconferencing capabilities. Mediaware is a set of libraries and high-level APIs that let applications programmers readily access the Mpack's functions.

Whether customers will perceive a gap between independent chip vendors and software vendors remains to be seen. Says Julie Gallagher, marketing manager at TI for the C80 product line, "most chip buyers are used to paying for silicon and having the software ride along nearly for free. Whether Chromatic can reset customer expectations is another business risk."

Striking the Balance

There are clearly many different ways of tackling signal processing, ranging from software running on a general-purpose CPU to hardware that's good for only one specific function. Which is going to win? The answer is probably all of them. Host processors will continue to evolve and take on more of the common DSP functions, while dedicated DSPs will evolve to higher performance levels and lower costs. DSPs are expanding their capabilities beyond traditional modem and audio processing to include video, voice recognition, and graphics acceleration. From another viewpoint, graphics accelerators are taking on DSP capabilities and are evolving to include video and audio.

So which kind of signal processing is best for what? In general, a dedicated DSP will enable you to deliver a system that handles multimedia faster than a system that relies entirely on the CPU. But you'll be paying for the extra silicon.

If you go the dedicated DSP route, you must make decisions based on software issues. For those who want to minimize software costs, consider DSPs with ready-made APIs and libraries that offer easy, high-level access to their functions. If you're working on an application that requires unique or custom signal-processing algorithms, then you'll definitely go the programmable route. ■

Andrew W. Davis is president of the Wainhouse Consulting Group (Southborough, MA), which specializes in marketing services and business planning. He can be reached at andrewwd@wainhouse.ultranet.com.

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THE LINES UNLEASHED

The Telecommunications Act changes all the rules when it comes to providing WAN services

Once upon a time, there were WANs connecting mainframe computers. Then there were LANs connecting PCs and servers. Then LANs began to talk over WANs.

In the following pages, we show how even these distinctions are becoming meaningless. The new WAN is a flexible animal that carries client and server traffic at many rates and in many forms. With that flexibility will come a much more complicated, but ultimately more efficient, cost picture.

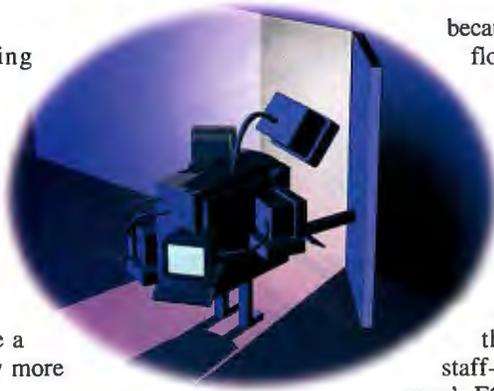
But all this technological change is matched by a regulatory sea change of tsunami proportions. You'll be buying new services for new purposes not only at new price levels but potentially from a very different mix of vendors.

An Act of Congress

If you simply went by the general press coverage, you'd think that the 280-page Telecommunications Act that Congress passed earlier this year was aimed at keeping obscene material out of the hands of children. But there's more to the story. The Telecommunications Act rewrites laws that have been in place for nearly 62 years. Most pointedly, the act removes some of the major restrictions placed on AT&T and the regional Bell companies in 1984 under the orders of Judge Harold Greene (who presided over the U.S. government's antitrust action against AT&T).

The act frees long-distance carriers to offer local service. In addition, the act allows regional Bells to offer long-distance service outside of their territories. And others, such as cable-TV operators, are now free to offer telecommunications services.

Theoretically, the competition from all this activity should drive down prices. But nothing will happen immediately. That's



because the bill doesn't simply say, "Open the floodgates." Instead, the bill orders the Federal Communications Commission to write regulations (using a formal process called *rulemaking*) that allow this competition to happen. All told, the bill calls for 58 different rulemakings.

Typically, the rulemaking process takes about a year, but it might take longer if the carriers file appeals. Also, the FCC has already said it doesn't have the staff—or the money to hire more staff—to handle such a process (the current year's FCC budget is \$175 million; the minimum budget required to handle the process would be \$185 million, according to FCC Chairman Reed Hundt).

What does it all mean to you? For now, business as usual. But by the end of the year, you may have many more options when selecting a WAN service to connect your sites and your users. ■

—Salvatore Salamone, News Editor

The New WAN

Public switched networks redefine corporate networks.....**59**



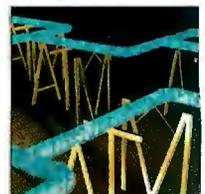
The Price of WAN Connectivity

New services and more competition could mean savings.....**65**



Playing the ATM Card

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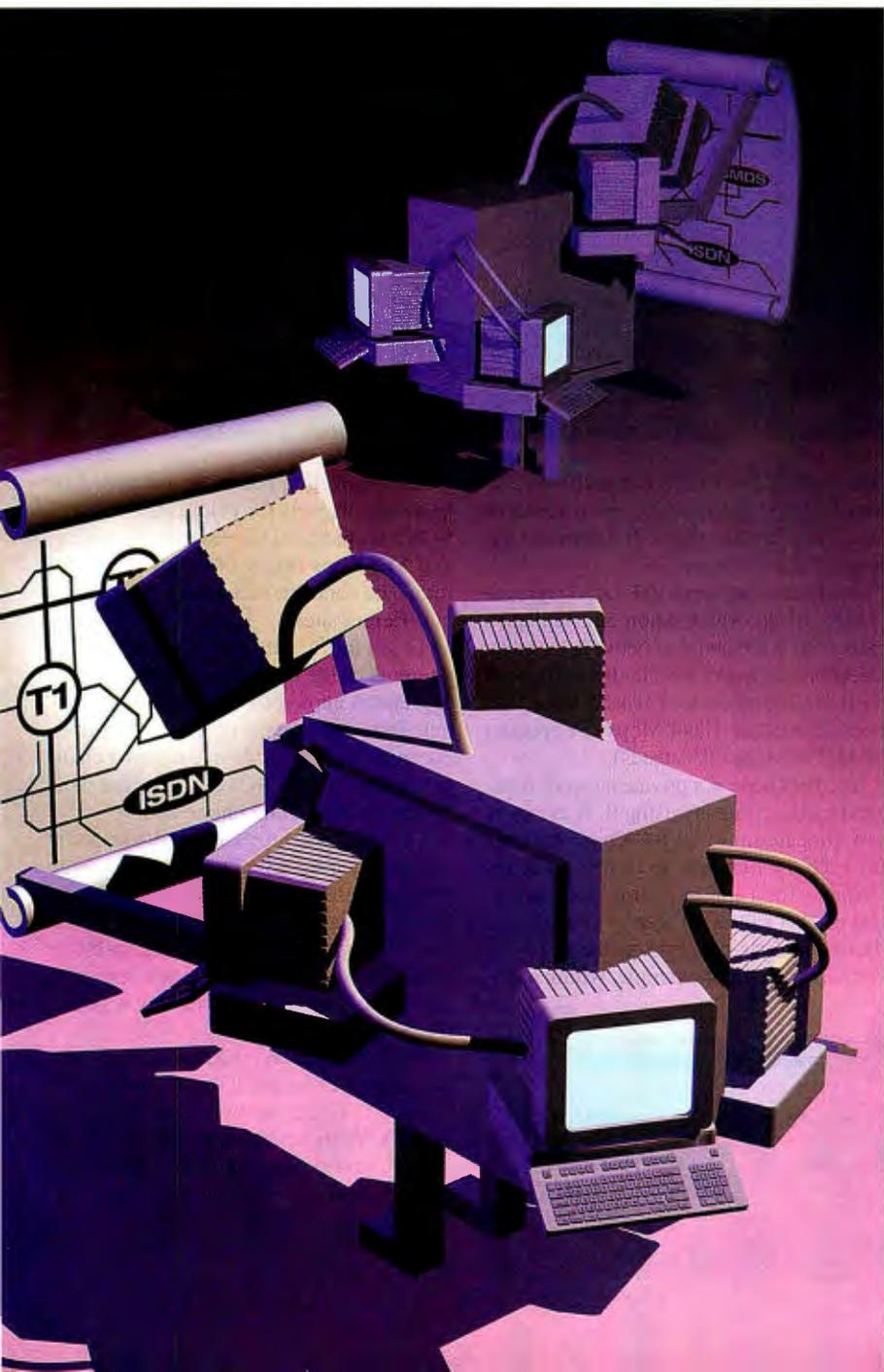
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THE NEW WAN

New services make it easier to shift corporate traffic from private nets to public switched networks

SALVATORE SALAMONE



If you've ever been through an earthquake, you know how things can shake up when two plates of the Earth's crust abruptly shift. That's what happens when you build upon a foundation that's moving.

Corporations are riding out a shake-up of another type. The foundation upon which all corporate networks reside—the connectivity services offered by telecom carriers—is undergoing a radical change.

For years, most corporate networks ran on a telecommunications infrastructure that was fairly stable. But in the last four years that all changed: The widespread deployment and acceptance of ISDN, and the growing acceptance of other switched services, including frame relay, Switched Multimegabit Data Service (SMDS), and even asynchronous transfer mode (ATM), are turning corporate WANs into a kind of telecommunications Loma Prieta.

All this at a time when the organizational structure of corporations is shifting from a setting where most employees work in large central offices to one where employees increasingly work in many smaller, geographically dispersed offices.

The result is a radical shift in the architecture of corporate networks. Four years ago, you'd likely see a private backbone network of dedicated, leased T1 or T3 lines carrying voice and data traffic between, at most, a handful of large regional offices. And you'd see low-speed (9.6- or 19.2-Kbps) dedicated leased lines carrying transaction-oriented data between dumb terminals in smaller offices (a bank branch office, for example) and mainframes in large data centers.

Today it's more likely that this backbone architecture is supplemented with higher-speed links carrying LAN traffic from branch offices, dial-up and switched-circuit connections between the various branch offices, and dial-up access to the backbone for telecommuters and employees on the road.

continued

The shift is dramatic. It signals a change from the use of private corporate networks where most, if not all, of the traffic ran over leased lines managed by the corporation to a system where most traffic runs over the public switched telecommunications infrastructure.

The Perfect Match

The challenge most organizations face today is choosing the right service for their connectivity needs. Determining what exactly is the most appropriate service is often a juggling act. First, you have to consider performance issues. Does the service provide enough bandwidth for my applications? Does the service let me set priority levels so that my most time-sensitive traffic gets through even when the network bogs down?

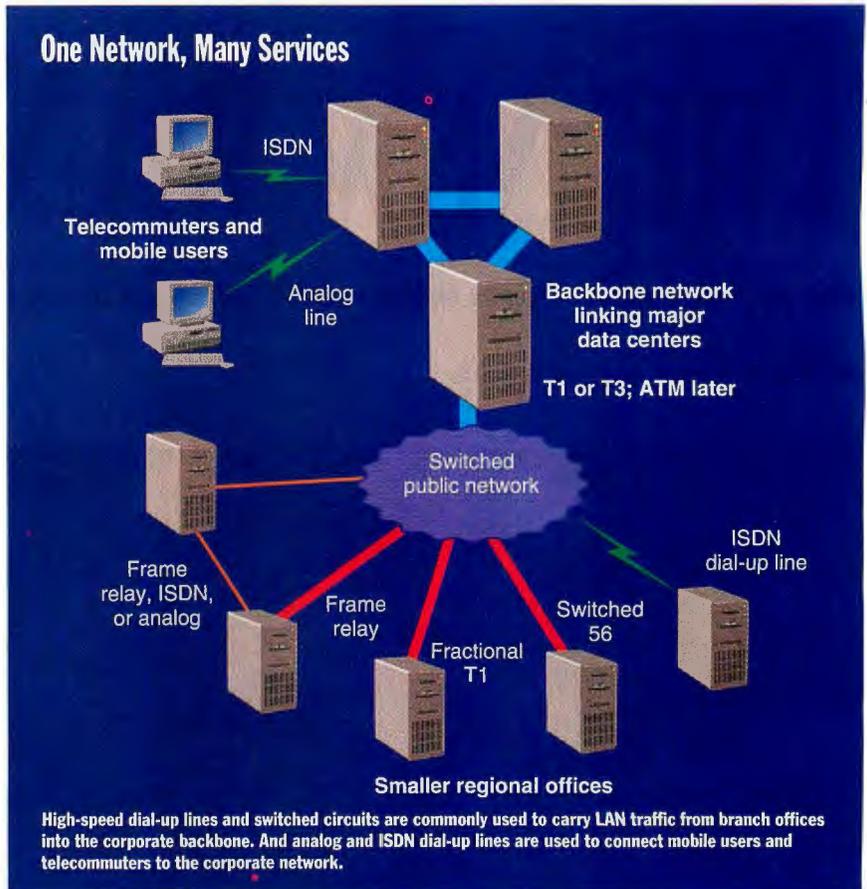
Second, you have to consider financial aspects. Pricing for the same service can vary greatly between regional Bell companies. ISDN is the perfect example of this. Users in Southern California have seen fairly low monthly fees and usage charges because of Pacific Bell's aggressive ISDN campaign. Whereas users in the New York/New England region pay a much higher rate for the same service. (For a more detailed breakdown of WAN service costs, see "The Price of WAN Connectivity" on page 65.)

Third, there's the issue of availability. Sure, ISDN might offer the best performance characteristics and be reasonably priced, but if it isn't available in the town your accounting department's located in, you need to reevaluate your choice.

Finally, to select a WAN service you must have an understanding of the traffic that will be running over a link. Basically, you need to predict the traffic volume for each link, the mix of protocols that will run over the link, and whether any of the traffic is time-sensitive.

The Backbone

There are basically four connectivity scenarios you will need to analyze: the backbone network, LAN-to-backbone con-



nectivity, LAN-to-LAN connectivity, and user-to-LAN connectivity. Each scenario has characteristics that will determine the best service to choose.

Backbone networks link large regional centers of an organization and typically carry both voice and data between the sites. Backbone networks have traditionally been built around dedicated leased lines that operate at either 1.544 Mbps (T1 speeds) or 44.736 Mbps (T3 speeds).

The backbone is a private network managed by the company using it. A manager can allocate up to 24 64-Kbps channels for each T1 line and up to 673 64-Kbps channels for a single T3 line (the equivalent of 28 T1 links). The way you allocate these channels depends on the needs of your company. For example, within a sin-

gle T1 connection you might set aside four 64-Kbps channels for voice, 768 Kbps (12 64-Kbps channels) for videoconferencing, and 512 Kbps (eight 64-Kbps channels) for a data connection between mainframes in different sites.

To get traffic onto the network, you use a time-division multiplexer in each site. It aggregates numerous voice and data channels into one stream of traffic that goes out over the link. A device called a channel service unit (CSU) connects the multiplexer to the actual phone line.

T1 and T3 circuits are still the most commonly used circuits connecting large regional centers to form a core backbone network. But there are alternatives to consider. Some companies use frame relay or SMDS to meet their backbone connectivity needs. Currently, frame relay is one of the hotter technologies.

With frame relay, data travels between two sites over a logical link called a virtual circuit. There are two types of virtual circuits. With a permanent virtual circuit (PVC), you define the path and the end points of a link once and they always remain the same. With a switched virtual circuit (SVC), as the name implies, the frame-relay hardware assembles and tears

BACKBONE GUIDE

TRAFFIC VOLUME	TYPE OF TRAFFIC	PROTOCOL MIX	RECOMMENDED SERVICE
Heavy	Voice, data, and time-sensitive data, such as SNA and transaction processing	Multiple protocols such as TCP/IP, IPX, NetBIOS, SNA	Dedicated T1 or T3 leased lines (ATM in the near future)

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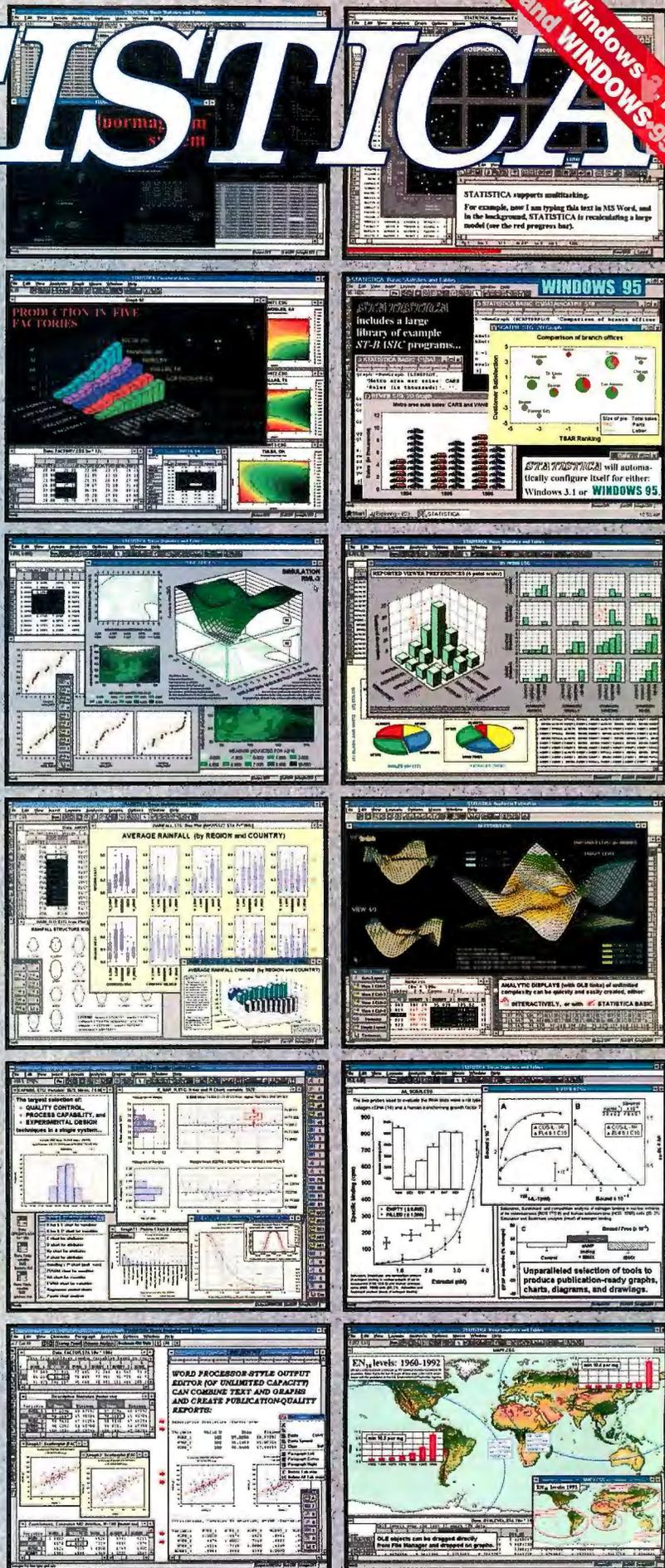
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down the logical link between two points for each transmission.

You can use public or private frame-relay circuits to build your backbone network. You order service by specifying the minimum guaranteed throughput you would like over a particular PVC. This minimum figure is called the *committed information rate (CIR)*.

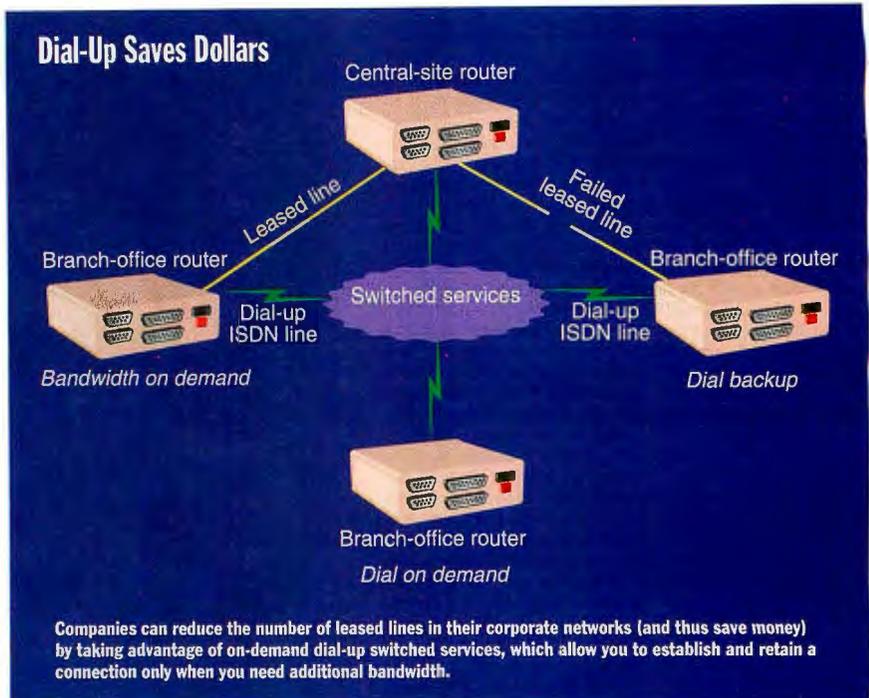
One of the appealing factors of using frame relay is its flexibility when it comes to designing a network. You can select a CIR ranging from 64 Kbps up to T1 rates; this range of speeds makes sure you have some room to maneuver when trying to match the actual performance needs of a connection with a telco service offering.

Another appealing thing about frame relay is that it accommodates bursty traffic, such as the traffic generated by your typical LAN applications. Even though you order frame-relay service based on the CIR, traffic loads above this amount can be accommodated (at no extra charge) if the telco's network has the capacity to handle the traffic. (How often and how long you can exceed the CIR is something that must be negotiated with the carrier before the service is installed.)

For the most part, frame-relay networks support data only. However, a number of companies run their voice traffic over their private frame-relay networks. And it is even possible to carry voice traffic over a public frame-relay network (see "Voice Gets Framed," February BYTE).

Similarly, companies have traditionally used SMDS for data. It's a public high-speed packet-switched service aimed at interconnecting LANs at T3 rates. But it, too, can carry voice if you have the proper equipment. For example, some multiplexers allow you to combine voice, data, and video traffic so that it can be carried over a single SMDS link.

One of the great attractions of SMDS is that it's the only high-bandwidth public net available today (at least until ATM becomes more widespread). That makes it attractive for companies that have to send large files (for example, an automaker



zapping CAD files to a parts manufacturer). If both companies use SMDS, they can always communicate through the public network without the hassle of setting up private lines.

ATM is another possible service to consider for a backbone technology. But today, it's availability is fairly limited. That could change in the next few years.

Branching Out

Often the choice of a backbone WAN service dictates the service choices for connecting branch offices. For instance, if you're using frame relay for the core network, you'll likely use frame relay to bring in the traffic from your branch offices. But there is a degree of flexibility.

In a typical LAN-to-backbone scenario, you will have to support multiple networking protocols, handle time-sensitive traffic to and from legacy systems, such as IBM hosts, and support a high volume of LAN traffic.

Many private networks use fractional

T1 service between sites. As the name implies, this service is offered in fractional units of a T1's link—usually in increments of 64, 128, 512, or 768 Kbps. Typically, you would select the bandwidth based on your peak traffic loads between sites. That's the safe way to do it. But it can also be uneconomical. You might exceed the peak traffic only once a week (when everyone logs into the system at the same time Monday morning, for example).

The ideal solution would be to select your service based on average loads and somehow get some extra bandwidth when it's needed. Frame relay does that to some extent, allowing you to exceed your CIR when you have a burst in traffic load.

But if you are using leased lines between sites, there's another way to design your networks to save money: Use switched services to supplement leased lines. Suppose your average traffic loads are below a T1 line's capacity and your peak loads are somewhat above that. Using traditional communications options, you might opt for a second line just to be safe.

A better choice would be to use a T1 link that satisfies your average traffic loads and then simply add bandwidth on an as-needed basis using dial-up ISDN lines. It's simple: Once it determines that a leased line link is saturated, a router in a branch office simply brings up an ISDN connection to the main office. This process is commonly called bandwidth on demand. (Most major router vendors have built

LAN-TO-BACKBONE GUIDE

TRAFFIC VOLUME	TYPE OF TRAFFIC	PROTOCOL MIX	RECOMMENDED SERVICE
Moderate	LAN data traffic and some time-sensitive traffic, such as SNA session traffic	IP, IPX, some AppleTalk, and possibly a small amount of SNA	Frame relay, fractional T1, ISDN, Switched 56

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Using ISDN like this gives a link some elasticity to accommodate peak traffic. Most routers can add a single 64-Kbps B channel. To add more bandwidth requires an inverse multiplexer, which allows you to aggregate the bandwidth of additional B channels into a single higher-bandwidth link. For example, with an inverse multiplexer you could easily merge the two B channels of a Basic Rate Interface (BRI) ISDN connection to form what appears to be a single 128-Kbps pipe to carry videoconferencing traffic between two sites.

Another way you can use ISDN connections with existing leased lines is as a backup link in case the main link fails—a feature commonly called *dial backup*. This, too, can save money on WAN service charges. For example, many companies install redundant leased lines between sites in case the primary one fails. Typically, the secondary, or backup, line remains idle unless there's a failure. All the while, you're paying monthly charges for this additional line. The way dial backup works is that once a branch-office router detects a failed link, it brings up an ISDN connection to the main office to carry traffic.

Additionally, you can use ISDN in LAN-to-backbone connectivity as the sole connection. Basically, an ISDN router attached to a LAN in a remote site dials up a connection when it receives traffic destined for a LAN in another location.

If you want to connect a number of smaller offices to a regional office using ISDN, you can equip the regional office in one of two ways. You can have multiple ISDN BRI lines coming into the facility. Or you can choose Primary Rate Interface (PRI) service for the central site. This way the carrier multiplexes the signals coming from the various sites onto a single access line into your facility.

Keep in Touch

Connectivity needs are different when linking branch offices to each other. They're so different that you should pay special attention when selecting the service you'll

LAN-TO-LAN GUIDE



TRAFFIC VOLUME	TYPE OF TRAFFIC	PROTOCOL MIX	RECOMMENDED SERVICE
Moderate to Low	LAN data from E-mail exchanges and occasional file transfers	IP, IPX, possibly some AppleTalk	Frame relay, ISDN, analog

use. For example, it is usually impractical to have dedicated links from each office to all other offices. Such meshed networks were common when you needed to link only a handful of large offices. But today it's quite common for a large organization to have hundreds of smaller offices. Instead, the more typical pattern now is a star structure where smaller offices feed into larger data centers. In this scenario, a person in Boston might send a file to a coworker in Pittsburgh by way of the company's headquarters in New York. But there are often times where it makes sense to let two branch sites connect directly.

Determining whether the link between two smaller offices should be dial-up or dedicated is not a simple matter. You pay a fixed monthly rate for a leased line. You can fill the link to capacity for every second of the month or not send a single byte of data over it and still pay the same amount. With dial-up ISDN, you typically have a small set monthly fee and a usage fee based on the time the connection is up.

There are no hard and fast rules of when to use a dedicated line versus when to use an on-demand dial-up connection—it largely depends on the pricing of the service. A general rule of thumb is that if you need more than three to four hours of connectivity per business day, you should use a dedicated line. Anything below that and you can get by with a dial-up line. Most routers support a function called dial-on-demand for this type of LAN-to-LAN connectivity between smaller offices.

For many years Switched 56 service was a big hit. It's a dial-up service that lets two sites exchange data at 56 Kbps, but it uses a channel service unit/data service unit (CSU/DSU) instead of a modem

to place the call. With Switched 56, you pay a monthly fee plus a usage fee that is based on the time the circuit is up. That makes it economically practical for casual connectivity, where one site simply needs to open a link to another site for a short period each day. Switched 56 is well-suited to applications such as videoconferencing and telemedicine where large image files must be transferred.

But the use of Switched 56 is likely to drop off as ISDN becomes more available. ISDN offers more bandwidth (two 64-Kbps channels in a PRI circuit vs. 56 Kbps for a Switched 56 link). And many carriers are pricing ISDN so that it makes better economical sense to use it rather than Switched 56 services.

ISDN is also starting to gain ground in the single user-to-LAN connectivity area. Today most telecommuters and mobile workers still rely on modems and analog phone lines. However, as ISDN BRI service becomes easier to get, and the price for ISDN terminal adapters drops, more telecommuters will switch to ISDN because of its higher speeds.

Get with the Program

The nature of connectivity has changed dramatically in the past year. Corporations are much more decentralized now, and that makes the old paradigm of private networks obsolete. Everyone wants more bandwidth, more performance, and more sites connected, all while paying less for the telecom services.

To accommodate such connectivity needs is no mean feat. Many businesses are using a mix of public telecom services that best meets their performance and economical needs.

The good news is that there are many services to choose from. The bad news is that some of the services are not ubiquitous, or their pricing structure makes them too expensive. ■

Salvatore Salamone is a BYTE news editor and author of Reducing the Cost of LAN Ownership (Van Nostrand Reinhold, 1995). You can reach him at ssalamone@bix.com.

SINGLE USER-TO-LAN GUIDE



TRAFFIC VOLUME	TYPE OF TRAFFIC	PROTOCOL MIX	RECOMMENDED SERVICE
Low to Moderate	Access to server and host applications, E-mail, file transfers	IP, IPX (usually only one)	ISDN or analog

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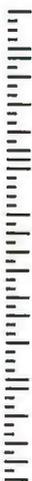
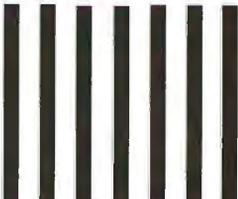
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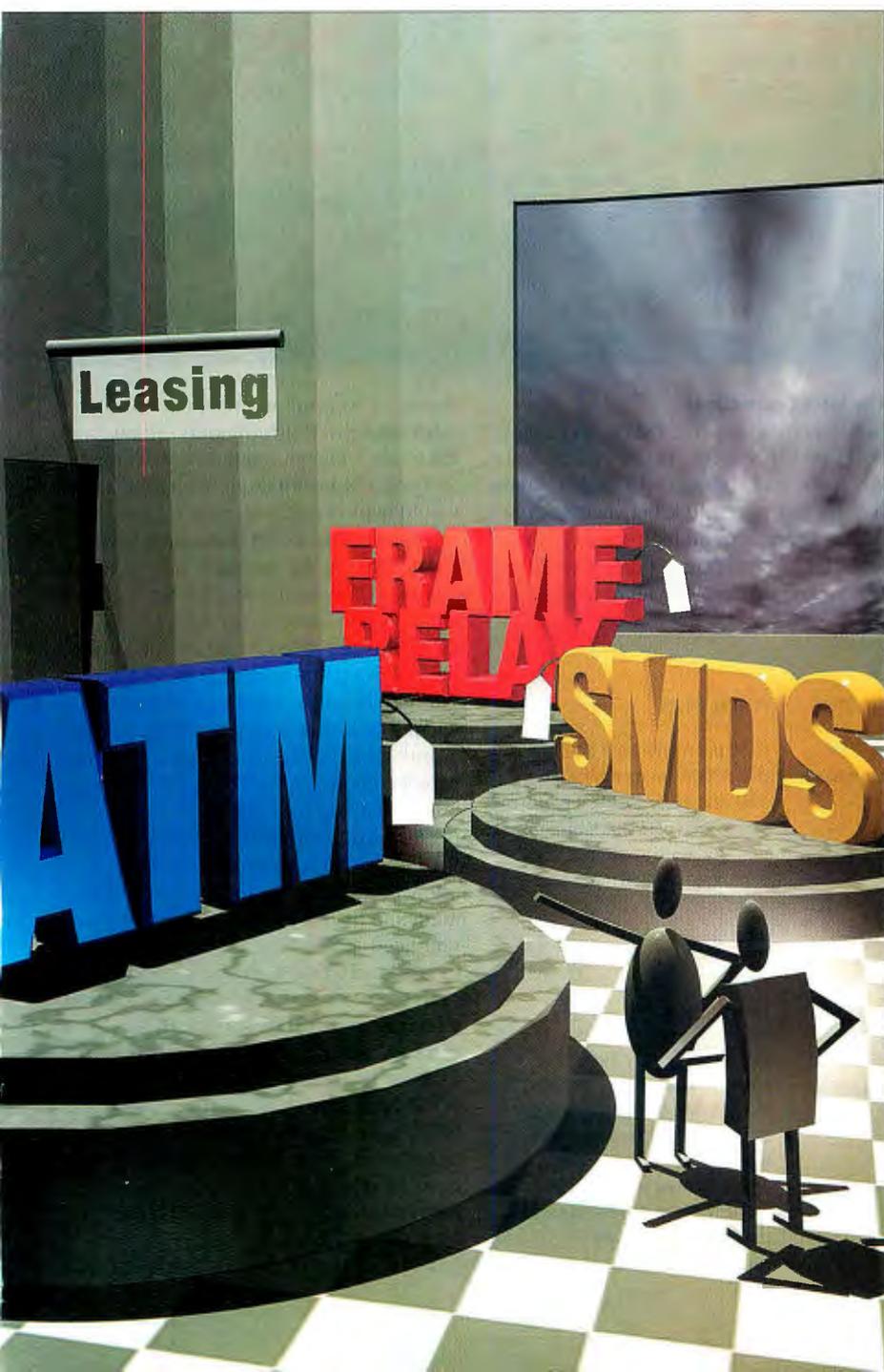
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THE PRICE OF WAN CONNECTIVITY

Choosing the right WAN service for your business typically comes down to pricing

LIZA HENDERSON



If you grew up in the Eastern bloc, you probably got used to having one or two choices of consumer goods. If you then moved to the United States, walking through a grocery store or a mall probably wouldn't be fun—it'd be stressful. The number of choices is overwhelming.

Wide-area networking services are starting to offer the same wealth of riches. It can be stressful picking one of the many alternatives; that the differences between the solutions are not always readily apparent only adds to the difficulty.

To choose, you not only have to know what your business and network goals are, you need to know how much these things cost. And that isn't always easy to figure out. Service providers can charge on the basis of distance, type of service, bandwidth, and usage. To make it more complicated, they can also strike deals. Here's what you need to know about the cost of the most popular WAN services.

A Cornucopia of Choices

There are five main WAN services for high-speed data networking used in the U.S. today. These types of service are: private lines, X.25, frame relay, Switched Multimegabit Data Service (SMDS), and asynchronous transfer mode (ATM). These services are used to build core networks; many companies extend the boundaries of their core nets by using other services, such as ISDN and analog phone lines, to give users in smaller offices, telecommuters, and mobile workers access to this core backbone network.

Private lines and X.25 have been around for a couple of decades. The other three broadband services are relatively new.

Private lines (also known as leased lines or dedicated circuits) are best suited for point-to-point connections. Nearly all the large corporate networks built during the 1980s used private lines. You lease a private line on a monthly basis from a local or

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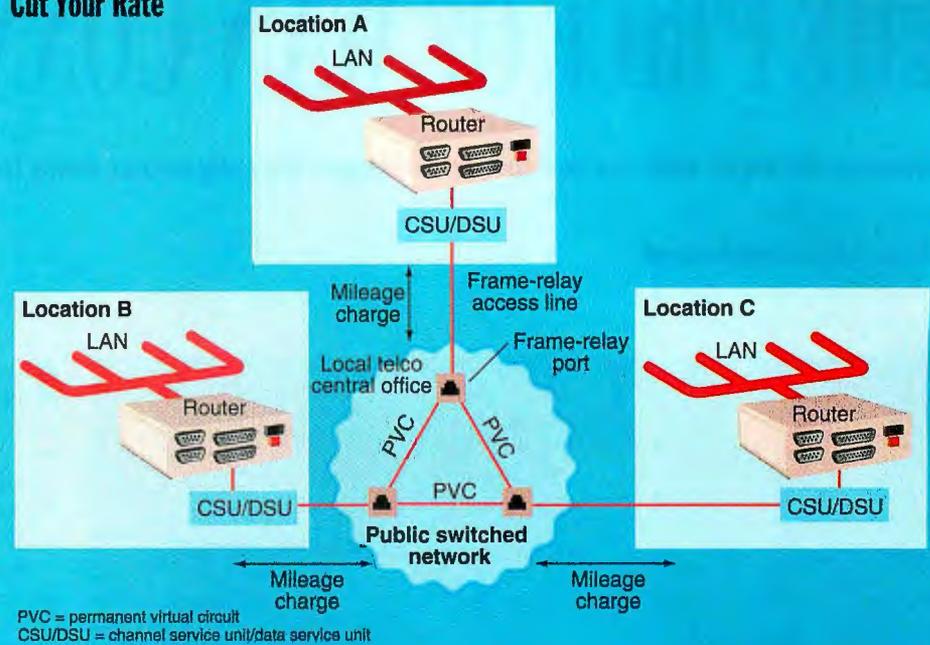
STATE OF THE ART The Price of WAN Connectivity

long-distance service provider, or from a carrier. This type of line offers a direct path between two corporate locations for sending voice, fax, data, and video.

You can define private lines in terms of bandwidth. Private lines come in three main flavors: DS-0, DS-1, and DS-3. All other private line services are some variation of these basic building blocks (built in 64-Kbps increments). A DS-0 runs at 64 Kbps, a DS-1 at 1.5 Mbps, and a DS-3 at 45 Mbps. A DS-1 is made up of 24 DS-0 circuits; a DS-3 is made up of 28 DS-1s or 672 DS-0s.

Service providers typically price private lines on the basis of bandwidth, with fixed and mileage-based monthly recurring charges. The mileage portion of the pricing typically breaks down into mileage zones, such as 0-100 miles, 101-500 miles, and over 500 miles. For example, a DS-3 circuit between Los Angeles and San Francisco (approximately 350 miles) would typically cost about \$350 per month for a DS-0, \$3300 per month for a DS-1, and \$32,000 per month for a DS-3. There are no additional fees for usage. So basically you try to fill the pipe with as much traffic as possible and try to keep it busy for as many hours as you can.

Cut Your Rate



PVC = permanent virtual circuit
CSU/DSU = channel service unit/data service unit

There's been a major shift in the way companies construct corporate networks. Today, many organizations build their backbones using public switched services instead of private leased lines.

The ISDN Connection

Some companies use ISDN services to build their networks. ISDN makes sense when you have branch offices that do not require a constant link between sites but do, however, require high-speed connections for several hours a day. For example, you might have a chain of retail stores

that need to send and retrieve inventory, sales, and price information to and from the chain's headquarters every evening.

Typically in situations such as this, you would deploy a dial-up router within each store and use an ISDN Basic Rate Interface (BRI) link as the primary link to headquarters. This would provide an economical solution since usage charges for the ISDN link are based on the amount of time the line is up and running.

There is no hard and fast way to figure when it becomes more economical to use a dial-up line versus a leased line, but here's a good rule of thumb: For anything less than about four hours of connectivity per day, a dial-up line is more economical. So dial-up might be a good bet if you simply need to back up a local database to a main site once a night, for example, or if you need to send the day's sales figures to headquarters at the close of business.

In the central site, you need to choose which type of ISDN service to use. You can have either a number of incoming BRI lines or a single Primary Rate Interface (PRI) line. The choice between multiple BRI lines and a PRI line is strictly an economic one. There's typically a cutover point at which it becomes more cost-effective to use a single PRI line rather than multiple BRI lines.

Here's how to estimate this cutover

LEASED LINE SHOPPER'S GUIDE

Bandwidth range	USAGE RATE	MILEAGE RATE	TYPICAL COSTS
T3+	Pay fixed price for a specific amount of bandwidth (e.g., T1 or T3) and no additional fee for usage.	Pay more for greater distance.	\$350 per month for a 64-Kbps link; \$3300 per month for a 1.54-Mbps link; \$32,000 per month for a 45-Mbps link (all rates for a line to connect sites approximately 350 miles apart).
T1-T3			
T1			
sub-T1			

ISDN SHOPPER'S GUIDE

Bandwidth range	USAGE RATE	MILEAGE RATE	TYPICAL COSTS
T3+	Pay fixed price per month for service plus a usage charge based on the amount of connect time.	Long-distance charges apply.	Costs vary greatly throughout country. Typically the recurring monthly line charge that covers basic BRI service ranges from \$20 to \$35 per month. The usage charges vary and are typically competitive with analog phone usage charges.
T1-T3			
T1			
sub-T1			

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STATE OF THE ART The Price of WAN Connectivity

point: Take the monthly cost per PRI line and divide it by the cost for a single BRI link. Depending on the rates your ISDN service provider charges, the cutover point between multiple BRI links and a single PRI link may be around eight or 10 lines.

There's another factor you should take into account: Consider the cost of managing the ISDN equipment in headquarters. It is typically less expensive to manage a single device to which a PRI line is connected than to manage multiple routers to which each BRI line is connected.

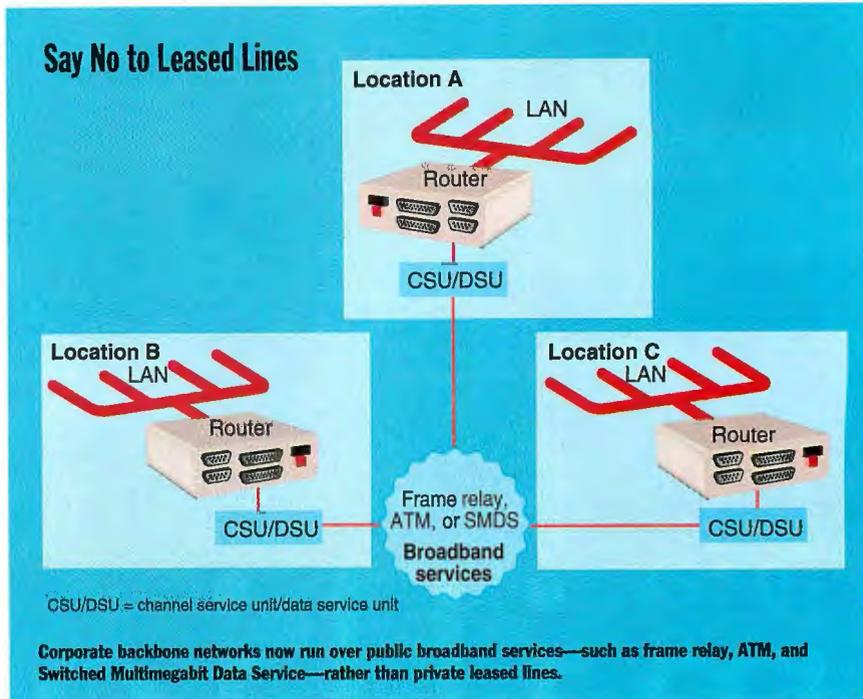
Meshing with Success

Frame relay becomes economical when four or more locations require interconnectivity. It's the '90s version of X.25. (For many users in Europe, X.25 is still quite popular. It's priced attractively compared to other services and its availability is quite extensive.)

With a frame-relay service, each network location gets a connection into the frame-relay public network service and a port connection. The port connection is the location's gateway into the public frame-relay service.

Permanent virtual circuits (PVCs) exist between these port connections. The main advantage of frame relay over a leased line is that one connection into the network can support many PVCs to many other locations. (That is, one physical connection into the frame-relay "cloud" creates many logical connections to many sites.) Compared with using private lines, the PVC architecture often offers savings on wide-area equipment ports, network access, and operational costs. The alternative is to have dedicated connections to every location from every site, requiring much more hardware at each site, such as termination equipment for each connection.

Frame-relay pricing is generally not sensitive to mileage. A connection from Chicago to St. Louis costs the same as a cross-country connection from Seattle to Tampa. The most common pricing struc-



ture includes a flat-rate monthly charge for the port connection and a flat-rate monthly charge for the PVC based on bandwidth. Port connections and PVCs are typically available in 64-Kbps increments, up to 1.5 Mbps. The amount of bandwidth assigned to each PVC is called the *committed information rate*, or CIR. The CIR often affects the price of the PVC, but a PVC is able to "burst" above this CIR all the way up to the port connection speed. A 64-Kbps port from a long-distance carrier like AT&T or MCI would cost you approximately \$200 to \$300 per month before discounts, and a two-way 32-Kbps PVC is about \$60, for a total of \$260 to \$360 per month.

Some service providers, like MCI, also offer usage-based PVCs. With usage pricing you can pay a monthly minimum and then pay for the number of packets successfully sent over the network. MCI even offers a price cap with this option, so you don't risk paying more for the usage-based

service than what you would pay for a regular PVC.

Some providers also offer a zero-CIR PVC. This is where the carrier doesn't assign the PVC any bandwidth. Instead, the network attempts to deliver packets but can discard them if the network is too busy. Zero-CIR PVCs can cost less than nonzero PVCs—typically about \$120 per month.

Some local exchange carriers that offer frame-relay services charge by the number of PVCs, not by the PVC bandwidth. Four 32-Kbps PVCs cost the same as four 64-Kbps PVCs. But the service provider gets you in another way: by imposing "subscription" limits. The subscription of a port is the ratio of the total assigned PVC bandwidth for all the assigned PVCs to the port's bandwidth.

The frame-relay market has been growing, spurred in large part by the rapid adoption of this new service by small and medium-size companies. The applications that frame relay can support have increased as well, with voice and packetized video now being relatively common.

Aiming High with ATM

ATM is another new public data service that supports very high-speed connectivity—from 1.5 to 622 Mbps. The excitement surrounding ATM stems from its capability to support a wide variety of applications, including voice, data, imaging, and video on one network. But with this consolidation comes an added layer

FRAME RELAY SHOPPER'S GUIDE

Bandwidth range	USAGE RATE	MILEAGE RATE	TYPICAL COSTS
T3+	Pay fixed price per month for a port connection and a flat rate for a PVC based on the bandwidth of the link.	Not mileage sensitive.	\$200-\$300 per month for a 64-Kbps port; \$120 for a zero-CIR PVC, \$270 per month for a 64-Kbps CIR PVC.
T1-T3			
T1			
sub-T1			

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of complexity: ATM handles each application according to its unique needs, but fine-tuning the network to achieve this goal of carrying multiple data types is complicated. ATM is also still expensive, as is often the case with new technologies.

Frame relay and ATM work together to address the low- and high-speed connectivity needs within an enterprise network, respectively. They talk to each other through a process called *service interworking*, which lets a frame-relay site directly communicate with an ATM site. Interworking is useful when many small remote locations need to communicate with headquarters. For example, it's common to see the remote sites use 56-Kbps frame relay and the headquarters use 45-Mbps ATM in order to aggregate the traffic coming in from all the outlying locations.

Most service providers have not published their ATM pricing. Instead, they normally quote ATM rates on a case-by-case basis. Because ATM is still in the early stages of development and acceptance, end users sometimes have the opportunity to conduct "free" network trials for a month or so before committing to buying the service.

You can expect to pay about \$3000 to \$5000 for a DS-1-speed ATM port and about \$15,000 to \$20,000 for a DS-3 port. ATM offers four different classes of service today, each designed with different characteristics to support the needs of voice, data, and video applications. Like frame relay, the connections between ATM port connections are virtual. The class of service you assign to a virtual circuit can affect the price. Typically, a virtual circuit with a class of service that supports voice or video has a higher price compared to a virtual circuit with a class of service that supports data. Why? Because the voice and video applications are more sensitive to delay than data and require a higher quality of service. When we're talking on the phone, we would rather hear "good morning" as opposed to "good," a two-second silence, then "morning." Prices for ATM virtual circuits vary greatly between carriers. And for the most part, these prices are negotiable.

Getting Connected by SMDS

SMDS is yet another public data service, but unlike frame relay and ATM, which are connection-oriented services, SMDS operates like a very large LAN. Its connectionless environment is ideal for data networks that require any-to-any connec-

SWITCHED BROADBAND SHOPPER'S GUIDE



SMDS

USAGE RATE	MILEAGE RATE	TYPICAL COSTS
Pay a monthly port connection charge based on the bandwidth of the connection. Also pay a monthly usage charge based on megabytes of traffic that pass over the link.	Not mileage sensitive.	\$50 per month for a 64-Kbps port up to \$3000 for a 34-Mbps port. Usage charges range from \$0.04 to \$0.18 per MB.



ATM

USAGE RATE	MILEAGE RATE	TYPICAL COSTS
Pricing normally quoted on a case-by-case basis.	Not mileage sensitive.	\$3000 to \$5000 per month for a 1.54-Mbps link; \$15,000 to \$20,000 per month for a 45-Mbps link.

tivity between four or more locations.

"Any-to-any connectivity" is like making a phone call: You can call anyone with a phone from any other phone. Any location that has an SMDS-compatible device can communicate with other locations that have SMDS-compatible devices. (Instead of using a telephone number to call a location, SMDS uses an assigned address.) The service providers offer the capability to screen unwanted or unauthorized "calls" through a filter. They also allow you to create closed user groups so that a company or a community can create its own virtual network among its constituents.

SMDS runs from 56 Kbps up to 34 Mbps, although some SMDS service providers do not offer connections below 1.5 Mbps. Similar to the situation with frame relay and ATM, each location needs its own port connection to access the SMDS network. But unlike frame relay and ATM, SMDS doesn't need predefined virtual circuits between ports.

There is a charge for an SMDS port connection based on the assigned bandwidth. It can range from approximately \$50 for a 64-Kbps (DS-0) port up to \$3000 to \$4000 for a 34-Mbps port. In addition to the port charges, service providers assess usage charges based on the number of megabytes that pass over the connection. Some service providers have usage charges, which can range from 4 to 18 cents per megabyte.

Down to Brass Tacks

Most long-distance and local-area providers offer frame-relay services today. Many offer ATM services, but only

half the local carriers offer SMDS, and only one interexchange carrier, MCI, does so. Deciding between using a local-service provider and a long distance provider depends on the relative proximity of the locations you're connecting. If most or all of the network locations are in the same city or metropolitan area, then you're probably better off using your local carrier. If most of your locations are scattered over the state, the region, the country, or the world, then you will need to talk to an interexchange carrier.

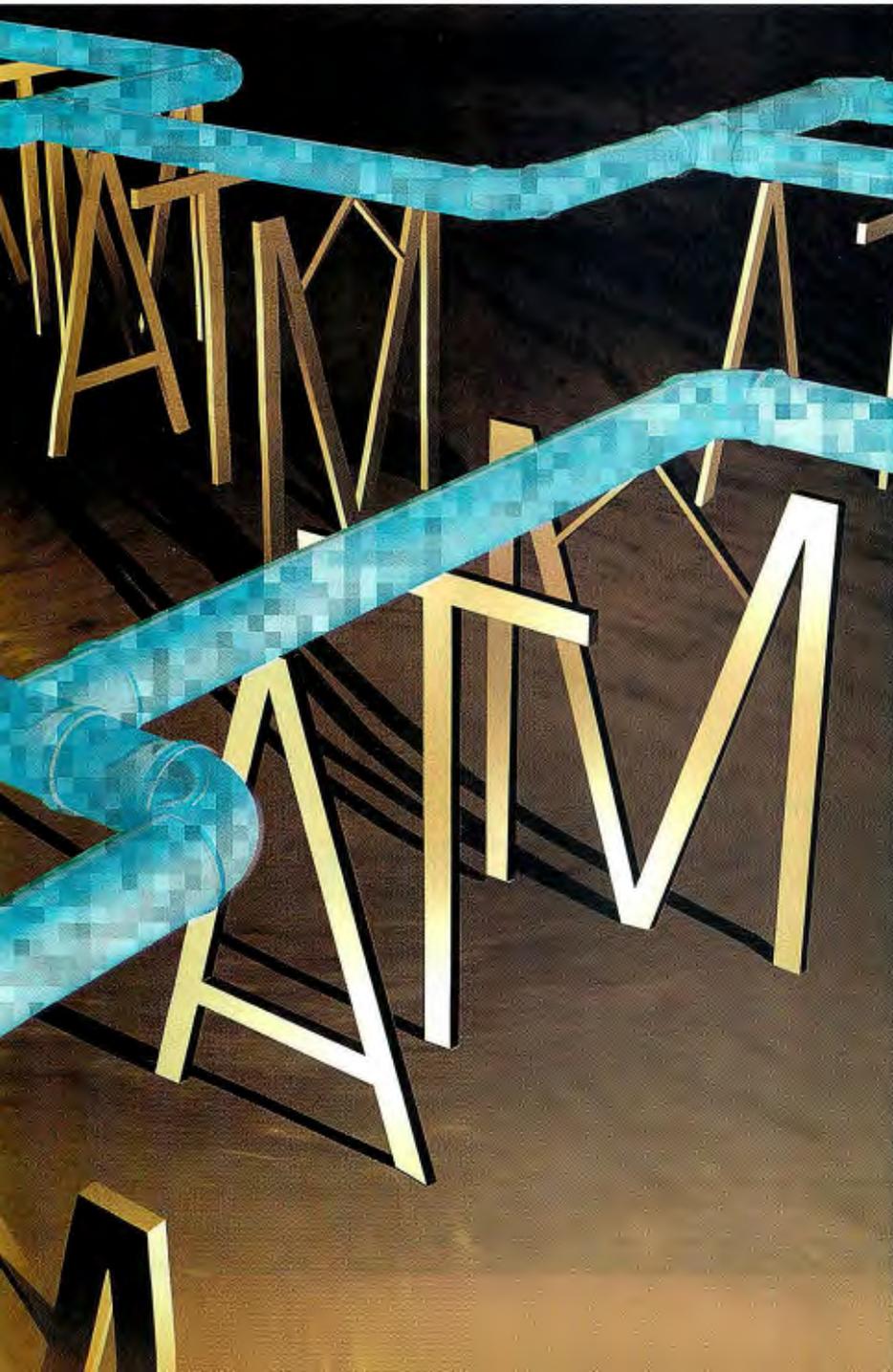
The carriers will help you match your applications with the service that will provide the best overall price/performance. They can also help you design the network, install the equipment and the network, and even operate the network if you do not have the resources or expertise. With managed network services, the service can provide you with an end-to-end solution that includes equipment at your location, transport facilities, installation, maintenance, monitoring, network management, and even ongoing network optimization and design. The carrier becomes an extension of your business organization that will take care of your telecommunications internetworking needs. This gives you more time to concentrate on your core business. ■

Liza Henderson is a consultant in the broadband group of TeleChoice (Verona, NJ), a telecommunications consultancy. You can reach her at TeleChoice's Midwest office at (918) 343-0201, or you can send E-mail to editors@bix.com.

PLAYING THE ATM CARD

Companies are already using this broadband networking technology to speed up communications

LANE F. COOPER



Anyone who has tried to access a graphically rich Web site, even on a shared Switched 56 link, will tell you that the going can still be pretty tough on the so-called information superhighway. Long journeys through virtual labyrinths end in frustration as data stored on powerful Web servers gets bottled up on the public telecommunications networks.

The problem is even more acute in the corporate world of interconnected LANs. Decentralized information has improved local productivity and competitiveness but made it difficult to share information. Initially, companies were limited to dedicated high-capacity leased lines. In the past 10 years, more cost-effective switched data technologies (e.g., X.25, frame relay, and Switched Multimegabit Data Service, or SMDS) have emerged.

But as we launch into the second half of the decade, the progress of a group of international users, vendors, and telcos promises to pave a raceway with the broadband networking standard called asynchronous transfer mode (ATM).

Building a Universal Backbone

ATM, originally a telecommunications industry switching initiative for delivering broadband services, has rapidly caught on in the data communications community. ATM owes its origins to the AT&Ts of the world and the International Telecommunications Union, through which ATM standards were first developed. Other organizations—the ATM Forum in particular—have come along to move ATM into the data communications world.

The ATM standard describes a universal networking architecture that will enable all kinds of traffic—voice, data, and video—to flow over midspeed (56-Kbps to 1.54-Mbps) to high-speed (multigigabit rates) data pipes in a manner compatible with current and planned electrical and optical cables. The idea is to achieve an

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STATE OF THE ART Playing the ATM Card

industry-wide consensus on how to build a globally internetworked broadband infrastructure that will support multiple vendors' products and existing services.

Without the standard, telcos and users have had to rely on dedicated frame relay, Fiber Distributed Data Interface (FDDI), X.25, and Systems Network Architecture (SNA) networks to connect their LANs and have high-speed access to the Internet. Yet, despite the fact that these technologies remain viable today—indeed, given the investments that have gone into their creation, these technologies have their loyal supporters—bandwidth demands that exceed their design parameters are inevitable. This is especially true as multimedia applications that integrate voice, data, and video leave the drawing board and head for the market.

Running the Numbers

The imminent convergence of media, applications, and technologies has many experts predicting that this will be the year ATM achieves solid commercial significance. Indeed, demand for ATM products and services is accelerating toward a critical mass, according to Vertical Systems

Group (VSG; Dedham, MA), a consulting firm that tracks the growth of broadband technologies. The global ATM market was pegged at \$134 million in 1994, with VSG analysts predicting it will top the \$2 billion mark by the end of 1998.

Most of this activity, says VSG principal Rosemary Cochran, is occurring in equipment sales as broadband network implementors, led by telcos, buy WAN and LAN switches along with other access devices to build an ATM infrastructure. Cochran believes deploying infrastructure will account for 85 percent of the cumulative investment in ATM through 1998. Then, services delivered over the new standard will begin to ring the high-speed-communication cash registers.

But even then, it is not at all certain that the traffic coursing through these networks will be native ATM. The short- to mid-term service revenue, says Cochran, will come from using the multigigabit ATM service as the transport mechanism for kilobit and megabit technologies. In other words, the early service money will come from offering things like frame relay over ATM, or Ethernet over ATM, even voice over ATM.

WHY YOU'LL NEED ATM

1 **ISDN does the trick** for browsing vanilla Web pages, but videoconferencing and other bandwidth-intensive Internet activities will need low- to midspeed ATM.

2 **Cost-efficient integration** of voice, data, and bandwidth-hungry applications like imaging over the wide area will require ATM's bandwidth.

3 **Ensuring proper quality of service** for all the different types of traffic that your net will eventually carry requires a network that inherently understands quality of service. ATM was designed to do just that.

4 **The public network** will become an ATM network, so in the long run, carriers will offer companies financial incentives to switch to ATM.

The implications are quite dramatic, particularly for telecommunications companies entering the market with a relatively clean technological slate. For these players, a bulk investment in ATM networking technologies, supplemented by smaller investments in conversion technologies that

A Hierarchy of Switches

1 High-performance ATM backbone switches

Used by carriers in their local offices or by large corporations to form the core of the backbone network.

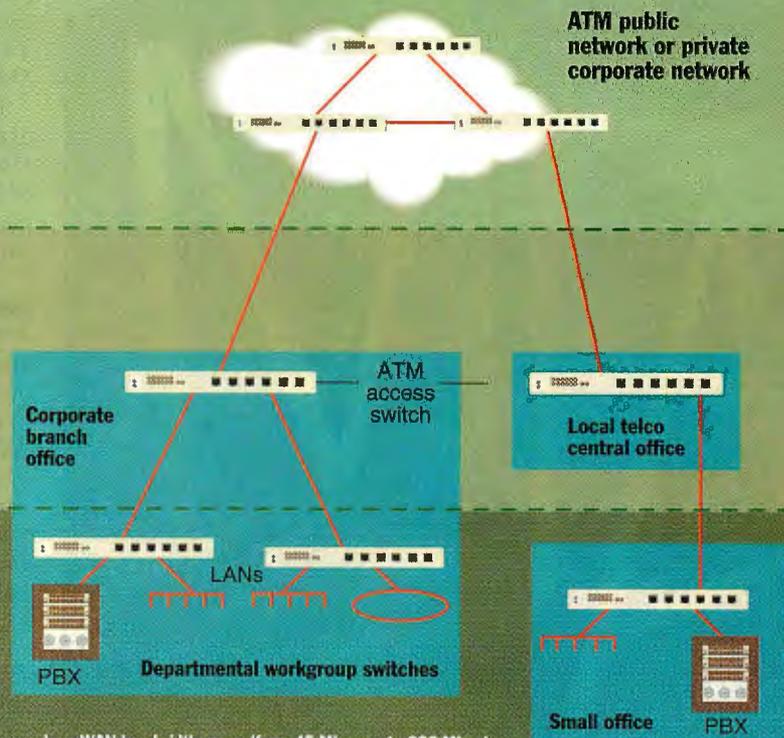
2 ATM access switches

Used as an interface to the carrier's network or the corporate ATM backbone.

3 ATM concentrators or multiplexers

Used in small offices to concentrate traffic to make more efficient use of ATM links.

Used in corporate sites to combine multiple voice, data, and video channels onto a single ATM access line.



ATM's tremendous WAN bandwidth range (from 45 Mbps up to 622 Mbps) means it can find its home nearly anywhere, while its high price means that, for now at least, it will stop short of the desktop. Telcos and large corporations have been the largest ATM adopters to date.

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STATE OF THE ART Playing the ATM Card

hang on the edge of the network, will allow for the "virtual" provision of multiple services on a single network.

For example, you might see a provider with an ATM backbone offering frame-relay service over ATM. If that's the case, the provider would supply you with an edge device that converts frame-relay frames to ATM cells (and the opposite at the destination end of a link). You might also see a provider use an edge device that simply carries your traffic (in its native frame-relay format) to a central office switch, which would handle the conversion to ATM cells.

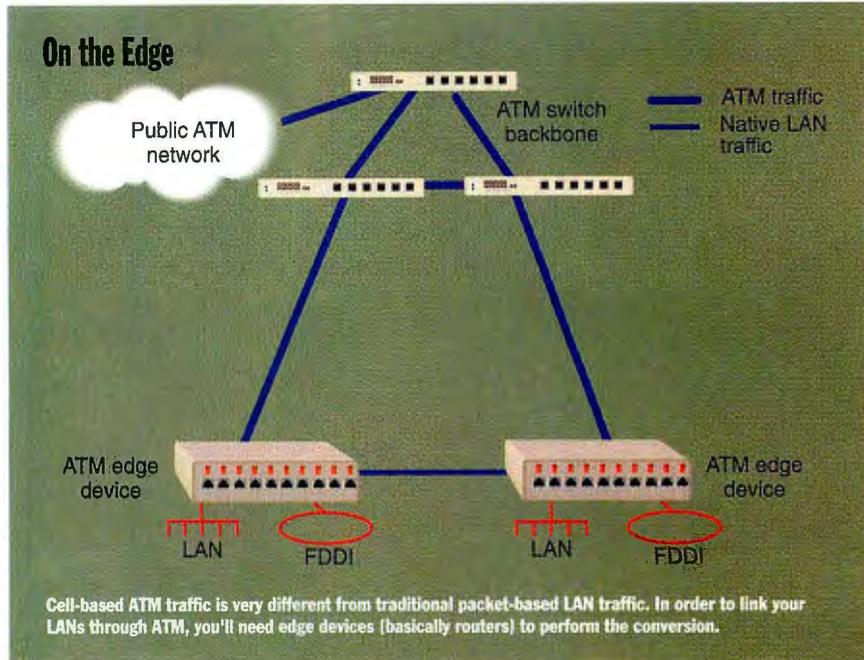
As the ATM standard grows more robust and spreads, it will be increasingly easy for network managers to connect LANs scattered across the world using the technologies of their choice with the telcos of their choice. "Service providers will be able to offer Ethernet access on one side and Ethernet delivery on the other side, and what happens in between on their ATM backbone over the WAN will be transparent to the user," says Doug Green, a product line manager with NetEdge (Research Triangle Park, NC).

Getting over ATM

Currently there are a number of efforts under way to carry traditional LAN traffic over ATM networks without the user having to worry about it. Basically, you'd like some type of edge device, such as a router or multiplexer, that has an ATM port on one side that connects to your wide-area service link and a LAN port on the other side that connects to your hubs or routers. The desktop environment would remain unchanged. So a user on an Ethernet LAN in one site who sends large files to a user on an Ethernet LAN in another site wouldn't know the file is being carried over an ATM link.

Today this transparency might mean using LAN emulation (commonly called Ethernet over ATM). This effort involves mapping Ethernet MAC addresses to ATM node addresses (see "ATM with a Twist of LAN," November 1995 BYTE). There's also an effort to carry IP over ATM. The Internet Engineering Task Force's RFC 1577 Address Resolution Protocol specifies how to carry IP traffic over an ATM network. A number of vendors already support this protocol in their products.

Then there's the effort by the Frame Relay Forum to carry frame-relay traffic over ATM permanent virtual circuits (PVCs). The Forum has come up with an Internet-



working Implementors Agreement that specifies how this can be done. Additionally, a number of vendors, including Motorola, ACT, Stratacom, and Micom, have developed switch technology to carry voice over ATM (see "Voice Gets Framed," February BYTE).

IBM, through a developers' group, has proposed a specification to carry Advanced Peer-to-Peer Networking (APPN) traffic over ATM. What's interesting here is that IBM maps APPN class-of-service properties to ATM's quality-of-service features—a company sets traffic priority levels using its existing APPN network management tools. So, for example, you could give transaction-oriented traffic a higher priority than, say, file transfers. With these APPN levels of service defined, you could then run the traffic over an ATM network and tap the service's built-in quality-of-service features that also allow you to prioritize traffic.

The upshot of all these efforts is that ATM might change how you choose WAN services. In the past, companies usually settled on one networking technology for their backbone (e.g., T-1 or frame relay) and that choice dictated all connectivity choices after that. ATM changes the scenario by allowing you to use pretty much any access technology to feed into it.

ATM could become a universal transport conduit that will enable companies to run anything over it. At the same time, they'll be able to use any type of WAN service as access into an ATM backbone.

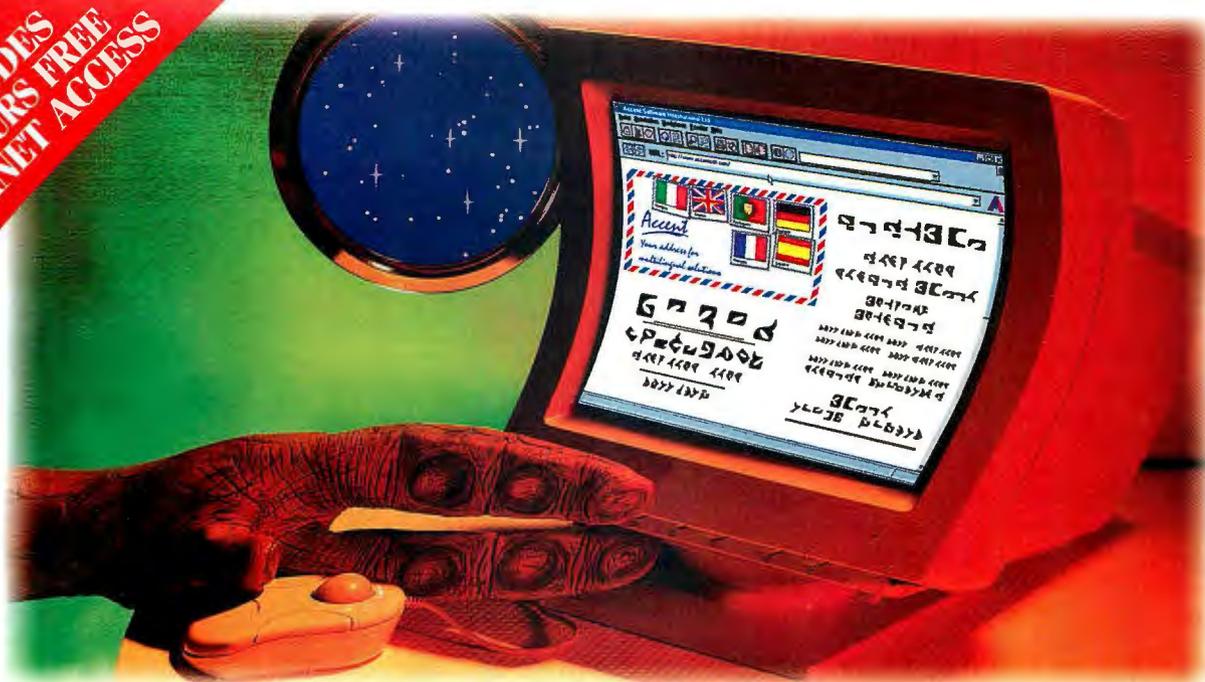
Thus, the ATM network's ability to support multiple services not only forms the technological backbone for the next generation of telcos, it also underpins a new business development strategy.

Take the case of MFS Data Services. MFS is a competitive access provider that started out offering fiber-based network services in metropolitan areas but has used ATM over the last three years to develop a national and international data service. "MFS is an example of a telco that has been able to start with a clean slate by building an ATM backbone," says VSG's Cochran. "It has allowed them to provide services quickly and have competitive advantage." And as the ATM standard develops further to accommodate existing and emerging access technologies, it will allow them to provide a greater variety of services without the costs that come with building dedicated network services.

The company rolled out one of the nation's first commercially available ATM networks in August of 1993. It deployed ATM switches, manufactured by Newbridge, and leased 45-Mbps DS-3 lines from long-distance carriers to link eight cities across the country. In February of 1994, MFS stretched its network to Europe. It now has 26 ATM switches throughout the world.

"We would not be in the data business without ATM," confirms Bob Barbour, MFS' director of marketing services. "We couldn't do the depth and breadth of products that we do right now on a national

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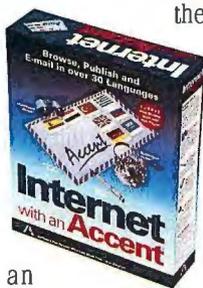
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STATE OF THE ART **Playing the ATM Card**

and international basis. Every bit of our traffic that runs on a national basis runs over ATM, even if it comes in as Ethernet, frame relay, Token Ring, video, or wide-area voice exchange," says Barbour.

Reaping the rewards of ATM will probably be more difficult and complicated for older, larger players that have made core investments in discrete data networks. Most of the RBOCs will have to upgrade their infrastructures to ATM while continuing to support existing networks.

But that is not stopping them from moving forward with strategic ATM agendas. All the major telcos we talked to have plans for ATM at the core. The race is on among the carriers to get commercial traffic on ATM platforms that have been rolled out for tests. "Most if not all of the national carriers now have generalized ATM service offerings," says Newbridge's John Shaw.

About half the local carriers, including the RBOCs, GTE, and the competitive access providers, have plans for ATM, according to Shaw. Over half of them have ATM services in at least their major metropolitan markets. "I think you will see close to 100-percent participation in ATM by the end of 1996 from all the major local carriers," says Shaw. And many of those carriers will attempt to have widely dispersed service coverage.

Bringing It All Back Home

The pressure has built up to a point where we are seeing a flurry of activity in the user community. In January, for instance, Educational Testing Services (Princeton, NJ), the venerable institution that administers the SAT exams, tapped Bell Atlantic Network Integration to deploy and manage a \$1 million ATM backbone network that will support voice, data, and eventually video traffic.

The ATM network replaces an aging multiplexer-based network that provided connectivity for voice and the wide-area connections that used Cisco routers and SNA controllers. The move to ATM will increase bandwidth at least tenfold.

In Colorado, University Hospital in Denver redesigned its entire 3000-user network and hooked up 52 ATM switches from 3Com. The network will consist of a 155-Mbps ATM backbone to which are attached Ethernet switches that deliver 10 Mbps to each desktop.

Connecting the hospital's eight-building campus, the ATM network will support existing applications, plus lay the ground-

work for rolling out new ones. For example, the hospital is interested in creating a "filmless" environment in its radiology department so that all image modalities can be accessed through the network. In addition, advanced medical imaging functions, such as real-time ultrasound and cardiology video examinations, will be networked for physician access.

ATM is also figuring prominently in the Dow Jones Investor Network/On-Demand, a financial news service that uses full-motion video. MFS' ATM and SONET-based network will be used to deliver on-line access to a digital video library of over 250 hours of recorded news events, interviews, corporate presentations, and market analysis.

Users can access recorded video events on the service via a database search, or by choosing from a daily schedule stored on Dow Jones' server. The video is then delivered through the ATM network to corporate LANs that subscribe to the service.

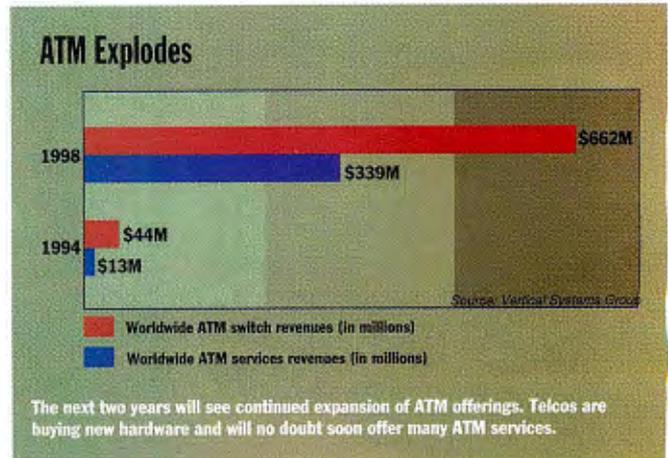
Of course, there's one other area where ATM has the potential to alter commonly accepted approaches to networking. That's when you use ATM in both the LAN and the WAN. Basically, you'd carry all traffic—LAN and WAN—over a single network. Such an approach turns the traditional view of networking on its head.

Traditionally, the low bandwidth of wide-area networks limited the performance of many applications. And your conventional Ethernet LANs, while offering 10 Mbps, simply bogged down under the strain of too many users or bandwidth-hungry applications, such as imaging or videoconferencing.

Many companies have opted to give their LAN users more bandwidth either by segmenting the LANS (less users per segment means more bandwidth per user) or by moving to higher-speed LAN technologies, such as FDDI. A move to ATM could eliminate both the wide-area and the LAN bottlenecks at the same time.

Barriers to Confront

Notwithstanding the pioneer work being done by the companies we've mentioned,



the ATM champions still have some work cut out for them if they are to fulfill the expectations already being formed by the corporate networking community.

The cost of ATM equipment still carries its own version of sticker shock. Making a desktop unit ATM-capable costs a minimum of \$1000, and keeping a WAN connected via ATM can average \$100,000 per month when traffic exceeds 1.54 Mbps.

As a matter of fact, the high cost of ATM is contributing to the continued attraction of frame relay. Frame-relay technology was supposed to be a stopgap measure until ATM was ready for commercial release. But with frame relay capable of supporting up to 2 Mbps of throughput, it is proving to be a very viable LAN interconnection solution at a fraction of the cost of ATM. Moreover, a broader cross section of the corporate marketplace will have to roll out applications similar to those of Dow Jones or University Hospital in order for a critical mass of native ATM end users to develop.

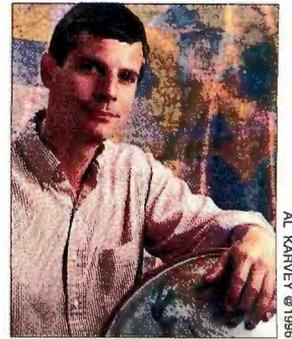
That said, however, the increase in performance that ATM brings to both private and public backbone infrastructures is exciting. ATM's expanding ability to absorb existing solutions and offer a more cost-effective delivery mechanism through a single integrated pipeline are proven. This will undoubtedly solve a lot of connectivity problems for end users and make telcos a bundle of money.

And with cable modems, who knows? Maybe even consumers will one day get to tear through cyberspace over an ATM-paved fast lane. ■

Lane F. Cooper covers broadband networking on a regular basis. You can reach him by sending E-mail to lcooper404@aol.com or to editors@bix.com.

JON UDELL

LET'S TALK



We add conferencing to The BYTE Site, and explore the merits of NNTP, the Usenet's protocol

If you visited The BYTE Site earlier this year, you might have read—and even contributed to—the first draft of this column. How? By joining our “conference on conferencing,” an open test of several ways to host threaded discussions on a Web site. Manifestations of electronic conferencing include Notes discussion databases, CompuServe forums, BIX conferences, and Usenet newsgroups. Because my working life has for a decade revolved around a conferencing system—first Notes, then BIX—I find it difficult to imagine a workplace that isn't conference-enabled. Nevertheless, many are not, so I'll spell out what I mean by the term (see “What Conferencing Is and Isn't” on page 78).

There are two ways to support this kind of conferencing on your Internet or intranet site. You can do it with a Net News Transfer Protocol (NNTP) server of the same sort your company, university, or Internet service provider may already use to connect to the Usenet. That's our focus this month. Or you can do it with a Web server that runs one of a rapidly growing number of purely Web-based conferencing systems. That's next month's topic. A third option will soon emerge as commercial conferencing systems such as Notes and SoftArc's FirstClass develop interfaces to standard Web browsers.

Usenet-Style Conferencing

For our first experiment I downloaded version 1.4 of the Internet news server (INN) from ftp.bsdi.com, compiled it, and installed it on our BSDI 2.0 server. If that sounds scary, it should. The Internet news server is a big, complicated beast. War stories fill the newsgroups that discuss how to master it (e.g., news.nntp.software). But if your goal is to set up your own conferences, you can skip most of the hard

stuff. Maintaining a full inbound Usenet newsfeed is a fairly hard problem. Your server has to suck in up to 10,000 newsgroups' updates every day and delete enough messages to make room for the next batch. So why bother? Newsgroup data has become a commodity nowadays. If you don't supply it locally, your users can always get it from remote sites.

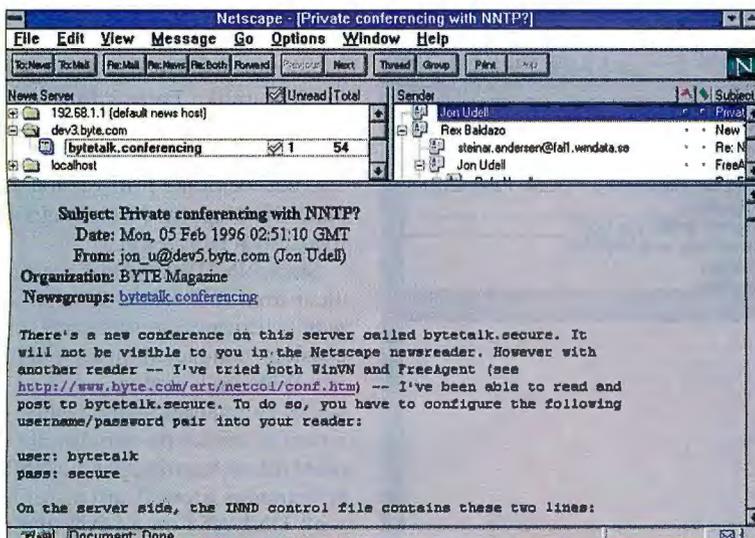
Focus on INN as a stand-alone conferencing system and things get much simpler. Once I got it running, it took just one command to open our first global conference:

```
ctlinn d newgroup
bytetalk.conferencing
```

Two related trends make this venerable Unix command more powerful than it was five or 10 years ago. Thanks to the growth of Internet connectivity, a site-specific conference such as this one can now play to a potential audience of millions. Thanks to the parallel growth of the Usenet, today's newsreaders are more powerful and flexible, so participants in NNTP-based conferences enjoy a richer experience. The Netscape reader, for example, activates URLs found in message texts to create a hyperlinked environment that feels like a Web browser.

How did people discover and join bytetalk.conferencing? I advertised it on our Web site. Netscape users had only to click on the URL news://dev3.byte.com/bytetalk.conferencing. That link invokes either Navigator 1.x's browser-based newsreader or version 2.0's much snazzier stand-alone reader. Users of other browsers relied on their built-in readers (if available). Or else they used stand-alone readers such as WinVN (<http://www.ksc.nasa.gov/software/winvn/winvn.html>) and Free Agent (<http://www.forteinc.com/forte/agent/index.html>) for Windows, or Nuntius (<http://www.inch.com/~aaron/nuntius/nuntius.html>) for the Macintosh. None of these was as seamless as Navigator 2.0, however.

Microsoft's Internet Explorer doesn't yet honor the news://dev3.byte.com syntax; it requires you to configure dev3.byte.com as your default news server. Likewise Free Agent and WinVN. If you're already using these with your



Netscape 2.0's newsreader flexibly accommodates multiple news servers and activates URLs in message texts. Unfortunately, it doesn't do authentication or off-line replication.

WHAT CONFERENCING IS AND ISN'T

WHAT CONFERENCING IS

- ✓ **It's both public and private.** BYTE staffers use BIX to participate in public discussions on BIX and the Usenet. These discussions are an invaluable source of the information and the personal contacts we use to research, write, and edit this magazine. At the same time, in a private conference on BIX, we conduct an ongoing virtual staff meeting in which we exchange information and shape the editorial product.
- ✓ **It's global.** Global public conferencing means we can find people all over the world who bring information and ideas to the magazine. Global private conferencing means that BYTE staffers everywhere—in Peterborough, New Hampshire; New York, New York; San Mateo, California; Frankfurt, Germany; and elsewhere—are equal participants in the virtual staff meeting.
- ✓ **It's threaded.** A threaded discussion organizes messages as a set of topics, each of which can grow a subtree of responses.
- ✓ **It's platform-neutral.** Even in private space, it's hard to settle on a single client OS or application. BYTE editors are a stubborn bunch with eclectic tastes in software. In public space, a homogenous software substrate would be impossible to achieve.
- ✓ **It's capable of replication.** Two forms of replication matter. Server-to-server replication can move conference data to places where it's in high demand and ensure availability by eliminating dependence on a single host. (BIX doesn't do this today; it's a single-host system.) Server-to-client replication enables mobile participants to read and post even while off-line. Many of us at BYTE use Galahad, an off-line reader for BIX, to replicate conference data to laptops.

WHAT CONFERENCING ISN'T

- ✓ **It's not E-mail.** E-mail and conferencing are so closely related that it's tempting to use them interchangeably. DON'T! E-mail is best for one-to-one or one-to-many communication; senders push messages to recipients. Conferencing is best for many-to-many communication; receivers pull the messages. These are fundamentally different modes. Sure, you can use cc:Mail's "Reply to all addresses" option to emulate conferencing, but the ensuing mailbox overload will drive everyone crazy.
- ✓ **It's not list-server-based discussion.** List servers such as majordomo and listserv create the Internet version of cc:Mail's "Reply to all addresses" mode. I don't dispute that many useful list-based discussions thrive on the Internet today. One key benefit is privacy. You can make a list that users must ask to join. Another is archival storage. Mail-to-Web converters such as hypermail can turn list-based discussions into navigable Web collections. Add search capability and the discussion can become a high-quality information resource.
- Despite these advantages, list-based discussion is awkward. A site-specific newsgroup, by contrast, supports richer and more interactive discourse. And it retains the list's advantages. It can be made private. And since its messages use the same RFC 822 format as do regular mail messages, it can also be made into an archive (see <http://www.byte.com/art/netcol/conf.htm>).
- ✓ **It's not chat.** Interactive chat—a teletype party line—can be entertaining, but it's not a very useful tool for goal-directed collaboration. The best group thinking emerges when there is time to absorb what's been said and compose a thoughtful response.

regular news server, you have to reconfigure them to point at a different one.

Netscape's promiscuity encourages users to hop among news servers just as they hop among Web servers. This unconventional way to exploit NNTP could

Free Agent lacks Navigator's promiscuity and hypertextual richness. However, it does authenticate against private news servers, and it can replicate conference data to your laptop for off-line reading and posting.

augur a profound change in the relationship between the Usenet and the Web.

Public and Private NNTP Servers

I've tried both INN 1.4 and a Windows NT version called DNEWS (<http://www.net-shopper.co.uk/software/dnews/index.htm>). INN runs on an Internet server and hosts both public and private conferences. Here's how to set up one of each:

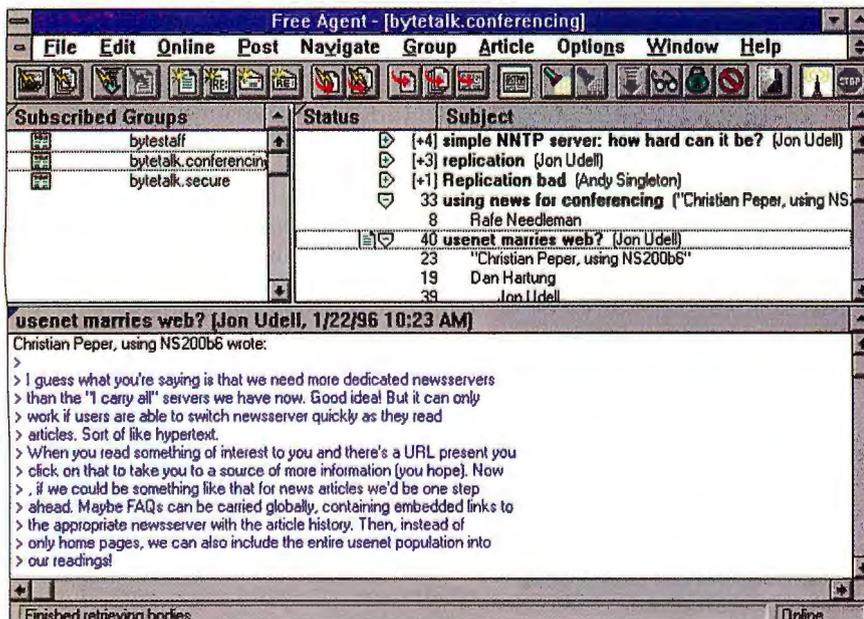
```
*:Read,Post:bytetalk:secure:
bytetalk.secure
*:Read,Post:::bytetalk.confer-
encing
```

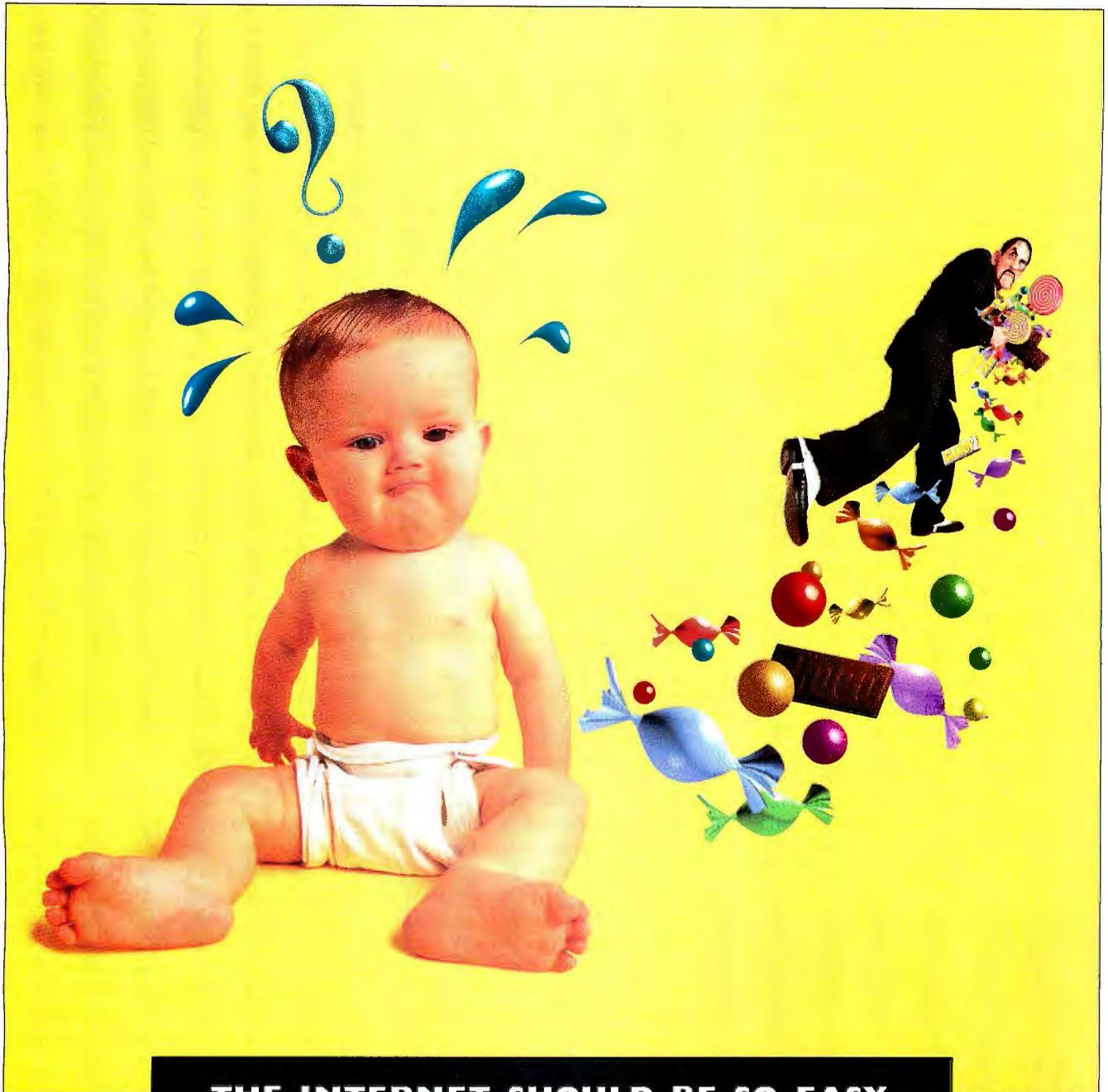
These lines, which I placed in the file `nntp.access`, say: "Allow users from any IP domain (*) who authenticate themselves (user: bytetalk, password: secure) to read and post in bytetalk.secure. And let the whole world use bytetalk.conferencing."

Most visitors to our test conference weren't able to join bytetalk.secure because most were using Netscape Navigator 2.0; unlike Forte's Free Agent and WinVN, it does not support authentication. "Authentication worked in Netscape 1.x, but we broke it in version 2.0," explains Netscape product manager J.F. Sullivan. "It'll be fixed in 2.1."

Since NNTP exchanges credentials as clear text, this casual form of security won't adequately protect confidential discussions conducted on the public Internet. Why use it at all, then? It's a tool for social engineering—the NNTP equivalent of an invitation-only list. If you need more robust security, put the NNTP server behind a firewall or (as we're doing with DNEWS) on a LAN that doesn't connect to the Internet.

Alternatively, you can use the Netscape News Server; it wraps Secure Sockets





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Layer (SSL) security, as well as simplified setup and administration, around the core INN. The URL for our conference would then become:

snews://dev3.byte.com/bytetalk.conferencing

You'd need a Netscape browser in order to join this kind of conference. Navigator 2.0's broken authentication wouldn't matter much in this case because you'd be communicating with the news server on a secure port.

Two Forms of Replication

NNTP technology can handle both necessary forms of replication: server-to-server and server-to-client. You can use server-to-server replication to move data nearer to its users. We probably wouldn't because none of our satellite offices has more than a handful of employees. But if your company has several large divisions, you'd probably want to set up local pools of conference data on a server at each division.

Server-to-client replication matters more to us because BYTE editors often need to work on airplanes or in other places that lack network connections. Forte's excellent Free Agent handles off-line reading and posting nicely. Mark the

A Modest Proposal

Why don't Usenet conversations live as long as Web documents? It's an accident of history. But the Internet's evolution could create a new role for tried-and-true NNTP technologies.

Bookmark a Web document and, most likely, it will still be there a month later. Bookmark a Usenet article, though, and most likely it will have expired in a month. Why this asymmetry? NNTP's roots go deeper than HTTP's—back to when newsgroup replication was the only way to ensure reliable access to conversational data from all points on the Internet, including intermittently connected nodes.

Times change. Now Web sites routinely offer unique collections of documents, perhaps mirrored to a few other sites, but more often not because a single site can be available to nearly the whole Internet. So the question arises:

Why flood the Internet with redundant Usenet data? Like many other Internet service providers, both of the local New Hampshire outfits I use carry relatively full newsgroups. How many of these ISPs' customers are really active in the likes of, say, comp.theory.cell-automata? Few or none. But the newsgroups these folks do join churn so quickly—to make room for the next batch of mostly unread data—that members who don't tune in almost daily miss much of the action. The Usenet is a swiftly flowing river and, as Heraclites observed, you can't step into the same river twice.

Or can you? Imagine another Internet where collections of related documentary and conversational data live side by side, each collection on its site (or small group of mirror sites). The cell automata theorists, for example, run one site in Europe (mirrored to the U.S. and Asia), which hosts both the documents and the discussions these researchers cre-

ate. Likewise the snowboarders, the knitters, and the foot fetishists. Members of these groups can refer to other groups' sites where, as on their own sites, documents and discussions are carefully preserved and interwoven.

Who will decide which of several rival snowboarding organizations gets to be the official site? There doesn't have to be one official site. If snowboarding discussions concentrate on several, or even several dozen, sites, then tens of thousands of sites don't have to carry this material. Multiplying this effect by the 10,000+ newsgroups extant on the Usenet today yields a massive reduction of network traffic. The quality of discourse within each group can improve. Today there's little incentive for participants to weave a rich fabric of discussion because the medium is too ephemeral. But if discussions live for months rather than days, they can grow and deepen in ways that aren't possible now.

messages you want to save and it'll stash them on your local disk. Read and reply off-line, then resynchronize the next time you connect.

Neither of these forms of replication challenges the sophistication of Lotus Notes. But as with Web technology, the great strength of Usenet technology is its universality. NNTP-based tools are inexpensive or freely available, they're lightweight, and they run on a global network in both public and private modes. Unlike HTTP, NNTP hasn't yet grown modern extensions. But that could change dramatically this year.

The Future of NNTP

I can't say that bytetalk.conferencing was an unqualified success. Usenet technologies are still diamonds in the rough. NNTP isn't stateless like HTTP, and communication suffers when connections are poor. It doesn't cross firewalls as easily as HTTP. No one newsreader has all the desirable features—rich hypertextual presentation, off-line replication, easy access to multiple servers, authentication. Servers lack tools for pruning and reorganizing discussions.

Despite all these disadvantages,

though, bytetalk.conferencing became a useful and widely read ad hoc discussion involving participants all over the world. Note that this conference relied on no commercial software. Many businesses refuse, for valid reasons, to base infrastructure on crusty old Unix shareware. But let's separate implementations from protocols. It's the protocols that really matter. HTTP, SMTP, and NNTP all evolved on a global network and are therefore proven scalable.

Consider mail. Does the notoriously complex sendmail utility scare you? It should. But for \$495 you can buy Software.com's outstanding SMTP/POP3 server. It runs on Unix and on Windows NT; it's as easy to use as any LAN-based E-mail package; it's a supported product; and it connects you to a planetary communication system.

In the same vein, I expect we'll soon see commercial reimplementations of NNTP servers and clients. Will these usher in a new era of Usenet-style conferencing and spur NNTP innovation? It could happen. Alternatively, Web-based conferencing systems could prevail. We'll explore some of these next month. ■

Jon Udell (judell@bix.com) is BYTE's executive editor for new media.

BOOKNOTE

IPv6: The New Internet Protocol (\$38)

by Christian Huitema

Prentice-Hall

<http://www.prenhall.com>

Figured out how to write 32-bit IP addresses such as 199.125.99.2? Good, now get ready for 128-bit addresses like 0:0:0:0:0:0:192.125.99.2 (or ::192.125.99.2 for short). Huitema, former chair of the Internet Architecture Board, has written a definitive guide to IPv6 addressing, routing, autoconfiguration, and authentication.

TOOLWATCH

Epsilon Programmer's Editor v.8 (\$250)

Lugaru Software

Pittsburgh, PA

<http://lugaru.com>

A superb adaptation of a character-mode application to Windows. Everything my fingers have done automatically for a decade still works the same way. The Windows benefits, which include native Win32 execution, clipboard support, and font control, play a supporting role but, thankfully don't try to steal the show.

MOBILE COMPUTING

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Perfect-Fit Portables 83

Different notebooks address different needs. We test the top nine portables for three key business applications.

Reach Beyond Win 95 91

Windows 95's remote access is strong. We evaluate seven packages that can make it even stronger.

Stay Connected 95

No one communications tool is right everywhere, every time. We test seven PC Card modems and update the latest trends in cellular modems, two-way paging, and packet-radio networks.

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PERFECT-FIT PORTABLES

MARTY JEROME

Bid good-bye—and good riddance—to all-in-one, general-purpose notebooks. Better yet, paint them red and see if the Swiss Army will take them. For real work, your portable computer must have nothing more and nothing less than what you need to do your job.

The good news is that notebook makers are diversifying their product lines rather than searching for magic combinations of features that will please everyone. The result? You can choose from among various form factors, displays, storage components, and graphics systems to get a portable that doesn't weigh you down unnecessarily or leave you feeling compromised.

With this in mind, we tested the latest crop of notebooks and ultraportables for their suitability in three important areas: word processing/E-mail, presentations, and as an all-in-one computer for the road and office. Our ratings identify the top picks as well as significant runners-up in each category.

Our evaluations revealed that design diversification is a thriving concept, even given the constraints of a portable's tiny form factor. Consider CPUs, for instance. Only two years ago, processors for portables differed primarily in clock speed. Today they differ by whole generations of CPUs.

For Windows portables, 75- and 100-MHz DX4 CPUs define the low end of the market. But with Cyrix nipping at its heels, Intel is in a mad rush to move the portable market to low-voltage 75- and 90-MHz Pentiums. Faster 120- and 133-MHz versions are already showing up (and appear in some of the models we tested). These multi-multimegahertz portables use Intel's 32-bit Peripheral Component Interconnect (PCI) chip set, which supports advanced memory technologies, such as extended data out (EDO) RAM and synchronous DRAM (SDRAM). The chip set also provides crafty power management to keep in check the confounding thermal problems caused by faster clock speeds.

Intel nemesis Cyrix now offers its 100-MHz 5x86 as a lower-cost alternative to the 90-MHz Pentium. Based on a 32-bit architecture, the chip includes a 64-bit internal core and on-board power management that reduces charge consumption to 2.9 W to abate heat problems. Epson is already using the CPU in its new



We choose the best notebooks and ultraportables for three important business applications

line of notebooks, and several other vendors—including IBM and Compaq—are eyeing it.

Meanwhile, Apple has migrated its entire Power-

Book family to the PowerPC processor to harness the speed of RISC computing. Windows users can run their applications (albeit slowly) via Insignia Solutions' SoftWindows. IBM has also embraced RISC for the road with a family of PowerPC-based ThinkPads.

CPUs aside, full multimedia capability is today's key distinguishing feature among portables within a family. Sound Blaster-compatible, 16-bit audio circuitry has been standard equipment on notebooks for three years. Bigger—and heavier—notebooks often feature dual stereo speakers built into the case. But on the whole, reproduction quality remains dreadful, especially if you plan to use voice-overs or sophisticated soundtracks. Traveling presentations still demand a pair of external speakers. *continued*

Vendors are stampeding to integrate CD-ROM drives into their machines. The most popular implementation is a removable drive that attaches to the notebook through an Enhanced IDE (EIDE) connector. You can swap out the CD-ROM drive with a floppy drive, a second hard drive, or a second battery in more-advanced portables.

CD-ROM drives are big, and their piggy power demands mean that notebook batteries have grown in size and heft. So grows the notebook itself. Many portables that spent the early 1990s trimming down to under 6 pounds are now bloating back up to the size and weight of older laptops.

LCD panels share in the blame. The 10.4-inch screen was last year's standard; this year's benchmark is the 11.3-inch panel. Even bigger screens are coming; witness the 12.1-inch display sported by the IBM ThinkPad 760CD we chose as the top notebook for multimedia presentations.

Does burgeoning size mean you'll be back to lugging an 11-pound turkey as you race between concourses at O'Hare? Not at all. High portability is still in great demand. Many of us are happy to forgo big screens and multimedia capability for slim form factors and light weight. In fact, when choosing which compromises you are—and are not—willing to live with in a portable, throbbing shoulders should enter into your considerations early on.

We considered portability, analyzed CPU choices, and threw multimedia capabilities and displays into the mix as we chose the best systems for our three key business applications. Here's a closer look at the portables that rose to the top.

Word Processing/E-Mail

While high-end multimedia notebooks garner the most attention these days, many of us use a portable primarily as a travel tool for light word processing, E-mail, faxes, and scheduling. Unobtrusiveness, long battery life, and usability take precedence over power and sophisticated features. The machine should claim only a *part* of your briefcase. Ideally, it should be configured with 8 MB of RAM (unless you're running Windows 95, in which case you'll need 16 MB), a 500-MB hard drive, and a dual-scan color display, which costs and weighs less than a thin-film transistor (TFT) panel and thwarts the prying eyes of nosy fellow passengers and colleagues.

Despite several fine attempts at an under-5-pound portable, subnotebooks—or ultraportables—stalled as a category. Users became leery of their compromises. But Toshiba's Portégé changed all that. Slight-

Word Processing/ E-Mail

What You'll Need:

DX4 or low-voltage Pentium

8 MB of RAM

500-MB hard drive

Dual-scan
color display

14.4- or 28.8-Kbps
data/fax modem

Top Choice:

Toshiba Portégé 610CT
(shown)



ly larger and heavier than other subnotebooks (see the table "Features for the Fast Lane" on page 85), it brought together a perfect alchemy of size trade-offs and features when introduced three years ago.

The new Portégé 610CT packs a 90-MHz Pentium, 8 MB of EDO RAM (expandable to 40 MB), a 685-MB hard drive, and a serviceable, if small, 9½-inch color display (either TFT or double supertwist nematic [DSTN]). No, the machine is not made for running Photoshop or CAD applications, but for work on the road, you won't experience any power shortages or feel cramped for expansion space: The 610CT includes two PC Card slots (two Type II or one Type III) plus serial, parallel, and VGA connectors. It also has audio-in and audio-out jacks and 16-bit sound.

The Portégé's success really derives from its keyboard, which is 90 percent the size of traditional notebook keyboards. This keyboard proves that less is more, because it's exceedingly well designed. Toshiba packed the QWERTY keys densely but comfortably for typing. Half-size function keys line up in a row along the top; tiny PgUp, PgDown, Home, and End keys gather in a column on the right.

However, the design has one irksome flaw: The Home key elbows into the Backspace key. Tight quarters? Yes, but kudos to the expansive wrist rest and large concave mouse buttons, which allow your palms to relax while you work.

Not everyone will agree that Toshiba's frugal use of space is comfortable. Fortunately, there are alternative designs. For a similar configuration, IBM's ThinkPad 701C (aka Butterfly) takes a fresh ap-

proach to keyboard comfort. If your fingers simply can't adapt to the Portégé's under-size keyboard, the Butterfly is a godsend. When you open the lid, the keyboard expands to reveal a full-size notebook keyboard (an inch overhangs each side of the machine, but the keyboard feels solid and responsive). There's no wrist rest.

The keyboard isn't the Butterfly's only asset. The system is smaller than the Portégé and about a half pound lighter. The Butterfly's 10.4-inch TFT or DSTN display is nearly a diagonal inch larger than the Portégé's. The 540-MB hard drive is removable. There's a digital signal processor (DSP) that doubles as a built-in 14.4-Kbps fax modem and telephone (like the Portégé, the Butterfly has an integrated microphone). The Butterfly has two PC Card slots (for two Type II or one Type III card). There's even an Infrared Device Association (IRDA)—compatible infrared port.

So what's not to like about the Butterfly? First of all, its CPU is a modest 75-MHz DX4, and IBM has no current plans to upgrade it. Its floating-point and integer performance numbers (see the figure "By the Numbers" on page 90) are disappointing compared to the Portégé's—but remember that we're considering the systems primarily as word processing and E-mail tools.

Another disappointment is the small nicad battery; its real-world charge life is well under 3 hours. For an additional \$150, you can buy a lithium-ion battery, which should boost the charge by about 20 percent (we highly recommend this option). The Butterfly is a solid alternative to the Portégé, especially if you place your high-

FEATURES FOR THE FAST LANE

Vendor	Model	Price*	CPU	Display	Size (inches)	Weight (pounds)	Key Features
Apple	Macintosh PowerBook 5300ce	\$5999	117-MHz PowerPC 603e	10.4-inch active-matrix	11.5 × 8.5 × 2.2	6.4	Fast performance
Apple	Macintosh PowerBook Duo 2300c	\$3958	100-MHz PowerPC 603e	9.5-inch active-matrix or dual-scan	10.9 × 8.5 × 1.5	4.8	Fast performance
Compaq	LTE 5100	\$6428	90-MHz Pentium	10.4-inch active-matrix; 11.3-inch dual-scan	12 × 9 × 2	7.5	Fast PCI-bus graphics
Gateway	Solo	\$4599	120-MHz Pentium	10.4-inch active-matrix	11.8 × 8.8 × 2.0	6.4	Fast performance
IBM	ThinkPad 760CD	\$7584	90- or 120-MHz Pentium	12.1-inch active-matrix	11.7 × 8.3 × 2.1	7.4	Large display
IBM	ThinkPad 701C	\$3798	75-MHz DX4	10.4-inch active-matrix or dual-scan	9.7 × 7.9 × 1.7	4.5	Full-size keyboard
NEC	Versa 4050C	\$4971	90-MHz Pentium	10.4-inch active-matrix	11.7 × 9.5 × 2.1	6.6	Impressive modularity
Toshiba	Tecra 700CT	\$5999	120-MHz Pentium	11.3-inch active-matrix or dual-scan	11.6 × 8.81 × 2.06	7.5	Fast performance; PCI bus
Toshiba	Portégé 610CT	\$4678	90-MHz Pentium	9.5-inch active-matrix or dual-scan	9.9 × 7.9 × 2.0	4.8	Balance of features and portability

*As configured for testing.

est priorities on screen and keyboard size.

But not so fast, counter Macintosh users. The PowerBooks have been leaders in

portable ergonomics for years. Even if your usual applications run under Windows, OS/2, or Unix, Apple's new Power-

Book Duo 2300c certainly makes a good case for joining the Macintosh fold.

The 2300c's PowerPC 603e delivers far better performance than the Butterfly's DX4 and the Portégé's Pentium in the integer tests: 1.65 for the 2300c versus 0.88 for the Portégé. PowerBook usability is just as significant. Apple's keyboard makes no compromises. There's a new trackpad pointer, which lets you double-click by tapping the pad itself—no need to use mouse buttons. It lacks the precision of the pointing stick used on both the Butterfly and the Portégé, but we found it easy to adapt to the trackpad. Finally, the wrist rests on other portables, like the Portégé's, are yeoman attempts to emulate the design pioneered by the PowerBook: The 2300c's wrist rests won't disappoint.

The charge life from the 2300c's nickel-metal-hydride (NiMH) battery is better than what you get from either of the portables with lithium-ion batteries. The 2300c features a 750-MB hard drive (or an optional 1-GB drive). Apple finally bumped up the display from just 8.4 inches to a usable (but still small) 9½ inches. It's avail-

Presentations

What You'll Need:

90-MHz (or faster) Pentium or 100-MHz 603e

Accelerated video

10.4-inch TFT display (preferably larger)

1 GB or more of hard disk space

16 to 32 MB of memory

16-bit audio

External speakers

Integrated CD-ROM drive

Top Choice:

IBM ThinkPad 760CD (shown)



12.1" DISPLAY, 1024 x 768 RESOLUTION

Watch brilliant colors spring to life on a display so large, it rivals desktop monitors. 1024 x 768 resolution provides the sharpest images ever found in a portable and 64% more workspace than 800 x 600 resolution.

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NEW TECHNOLOGY

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NEW TECHNOLOGY

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NEW TECHNOLOGY

DESK STATION V PLUS

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SPECIAL REPORT PERFECT-FIT PORTABLES

able as a TFT, DSTN, or gray-scale panel.

What's the downside to the 2300c? It's slightly bigger than the other machines, and it weighs as much as the Portégé. Expansion is limited. You get just a slot and an RJ-11 connector for an internal modem. There's a small serial port that can function as a LocalTalk network port, a printer port, or a modem port.

The 2300c can plug into a docking station (yes, the new Duo 2300c is backward compatible with old Duo docking stations). But there are no PC Card slots and no infrared port. Another disappointing note: The machine is wired only for 8-bit sound.

In the end, the 2300c is competitive with the Windows subnotebooks, but it's not superior to them. Its main advantages are performance, ease of use, and the convenience of taking the Mac OS on the road.

Presentations

Praise multimedia. It might not make us more productive, but it's helping to kill off the flip chart, that staple of presentations that glazes the eyes and numbs the mind. Color, animation, 24-bit images, and movement all breathe life into ideas. Used judiciously, a presentation notebook might pay for itself in cinched sales.

Just beware that good presentation notebooks are expensive and heavy, and their battery life is woefully short. None of this is surprising considering what it takes to bring multimedia on the road. First off, you need a speedy CPU: At a minimum, choose a 90-MHz Pentium or a 100-MHz 603e with accelerated video and a 10.4-inch TFT display. You also need 16 to 32

MB of memory, 16-bit audio (with external speakers), and an integrated dual- or quad-speed CD-ROM drive. Finally, you need as much hard disk capacity as you can afford—1 GB is a good starting place.

The IBM ThinkPad 760CD is a good ending place. It combines innovative technology and a shrewd design. Powered by a 90- or 120-MHz Pentium processor with a 256-KB L2 cache, the 760CD brings to the party the first 12.1-inch TFT display—suitable for audiences of four without making you resort to an external monitor.

The 760CD offers MPEG-1 and MPEG-2 compression, as well as NTSC and PAL video support. It also features a 28.8-Kbps fax modem with telephony (a microphone is integrated into the display case), leaving the PC Card slots (two Type II or one Type III) free. Infrared is standard.

Pop up the keyboard, and you can swap the quad-speed CD-ROM drive for a second 1.2-GB hard drive or a second lithium-ion battery. With 2.4 GB of total hard disk space, why shackle your presentations to the slow access times of a CD? The audio supports MIDI and WAV files, and there are two integrated speakers. Too bad the sound reproduction is terrible.

The 760CD is big and heavy enough to give Schwarzenegger aching muscles—especially when you pack along an extra battery and external speakers. And the machine's \$7584 price tag may rock your purchasing manager back on his or her heels. But as a strategic sales tool, the system can pay back its price quickly.

Is the 760CD's size and price too much to handle? Don't worry; this part of the

market is robust enough to offer choices rather than compromises. Gateway's Solo delivers nearly 25 percent faster performance than the 760CD using the same 120-MHz Pentium. And like the 760CD, the Solo can render 800- by 600-pixel resolution, albeit on a smaller 10.4-inch TFT display. Best of all, the notebook weighs a pound less than the ThinkPad 760CD.

There's no MPEG support, and the dual-speed CD-ROM drive swaps out only with a floppy drive. But the 1.2-GB hard drive is removable, which lets you put multiple presentations on separate drives. The machine comes with an infrared port, 16 MB of RAM (the 760CD comes standard with only 8 MB), and an extra lithium-ion battery. If that's not compelling enough, look at the Solo's price tag: \$4599.

NEC's Versa 4050C also offers an 800- by 600-pixel, 10.4-inch TFT display. But it's a modest machine in terms of performance and capabilities. The CPU is only a 90-MHz Pentium, although it comes with a 256-KB L2 cache. The dual-speed CD-ROM drive is not as fast as the ThinkPad 760CD's quad-speed drive, but it swaps out with a floppy, a second hard drive, or a second lithium-ion battery. An 810-MB hard drive is standard (you can buy a 1-GB drive as an option).

The Versa is heavier than the Solo, but smaller. Like the Solo, it comes with infrared capabilities, dual speakers, and an expansive wrist rest. In other words, the Versa offers greater modularity, which expands your range of options for taking a show on the road. But the machine isn't as powerful as the Solo.

All-in-One Computer

Increasingly, the corporate rule runs thus: "Only one PC per employee; choose any PC you like, but choose it carefully."

But what exactly makes a notebook a desktop replacement? First of all, you don't want to compromise even 1 MHz of power. A 90-MHz Pentium or 100-MHz PowerPC 603e should be the minimum CPU you accept. Accelerated graphics are requisite. Bonus points go to machines with a local bus. And you'll want at least 16 MB of RAM (EDO or SDRAM, if possible) and a 750-MB hard drive—preferably larger and removable. The machine should feature full multimedia capability, including 16-bit sound with a standard complement of audio jacks, and a dual- or quad-speed CD-ROM drive—through a docking station, if not in the machine itself.

Even if you use an external monitor at the office, the TFT LCD panel should measure at least 10.4 inches. You'll want

All-in-One Computer

What You'll Need:

90-MHz (or faster)
Pentium or 100-MHz
PowerPC 603e

Accelerated graphics

16 MB of RAM
(EDO or SDRAM)
750-MB hard drive
(preferably removable)
CD-ROM drive
10.4-inch TFT LCD
Port replicator
or docking station

Top Choice:

Compaq LTE 5100
(shown)



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lithium-ion batteries for all these charge-draining technologies. Two PC Card slots are mandatory; an IRDA-2 infrared port can be useful. You'll also want a port replicator, if not an actual docking station. The best replicators include not only serial, parallel, keyboard, and VGA attachments but also a network connection.

Where do you find such a machine? Look no further than Compaq's LTE 5100. Its 90-MHz Pentium is augmented by a 256-KB L2 cache. Its performance is formidable: You'll hardly believe that you're working on a portable PC, especially when the video is running on an external monitor. A speedy graphics accelerator runs on the PCI local bus and renders a resolution of 800 by 600 pixels on the LCD.

You can expand the machine's standard 8 MB of RAM to a whopping 72 MB. Drive options range up to 1.2 GB. Better still, you can put a second hard drive into a bay on the machine that alternately holds a floppy drive, a dual-speed CD-ROM drive, or a second lithium-ion battery. With two hard drives, total storage can reach 2.7 GB. You can swap any of these components on the fly; the lock mechanisms and component bays are well designed.

The 5100 comes loaded with as much multimedia capability as you'd want from a general-purpose system. MPEG-2 playback data compression is standard. There's also video-capture circuitry that supports NTSC and PAL formats. The 5100 has its own built-in speakers, but you'll want to buy your own external speakers for when you're not traveling. Infrared is standard equipment.

The TFT display measures 10.4 inches, although you can get an optional 11.3-inch DSTN screen (stick to the smaller TFT display if you plan to use an external monitor). And, of course, there are the design details we all expect from Compaq: an easy-to-read LED panel for system status, an AC adapter no bigger than

a pack of cigarettes, and a total traveling weight of under 7½ pounds.

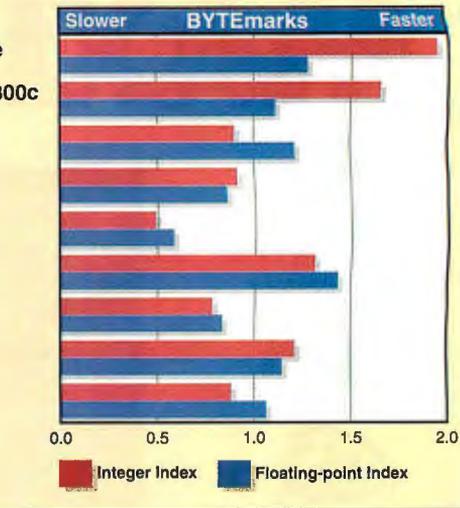
If you would rather trade a portion of the 5100's modularity and some of its advanced features for a larger TFT display, then the Toshiba Tecra 700CT is your ticket. Powered by a 120-MHz Pentium processor, the Tecra comes with 16 MB of SDRAM and a removable quad-speed CD-ROM drive. It also features an internal and external PCI bus (which makes it incompatible with Toshiba's old line of docking stations). Its performance is on a par with that of the Compaq LTE 5100—and slightly better in the integer benchmarks (1.21 versus 0.90).

Unlike the 5100, the Tecra lacks MPEG support and video-capture circuitry. Also, the CD-ROM drive swaps out only with a floppy drive—not a second battery or a second hard drive. On the other hand, you can order the system's 11.3-inch display in either TFT or DSTN panels. But make no mistake: Performance is its forte, not desktop refinement. For about the same dollar investment, the 5100 is a better buy.

Unless, of course, your shop happens to be Mac-based. Apple's new PowerBook 5300ce features a 117-MHz PowerPC 603e, 32 MB of RAM, a 1.1-GB hard drive, and a removable SuperDrive, which can be swapped out with a second hard drive or a magneto-optical drive.

Like the Compaq LTE 5100, the PowerBook 5300ce's 10.4-inch TFT display supports 800-

by 600-pixel resolutions. The 5300ce also offers plenty of room for expansion, including two PC Card slots, a serial port, a SCSI port, audio and video jacks, an infrared adapter, and a connector for the machine's docking station. Like the Tecra, the Mac PowerBook 5300ce costs just un-



Apple's RISC-based PowerBook 5300ce and PowerBook Duo 2300c outran all the CISC-based machines in our integer tests.

der \$6000; the LTE 5100 is slightly more.

The docking station is necessary if you need a CD-ROM drive, which is one disappointing omission in the 5300ce. Curiously, the machine also uses NiMH batteries, rather than long-lasting lithium-ion batteries. Nevertheless, seasoned Mac users will be pleased with the 5300ce's power and expandability. Besides, as desktop replacements for the Macintosh go, it's the only game in town.

The Right Size

No one's computing needs fit congenially into these three categories. To choose the right portable for yourself, you need to take a hard look at how you'll use the computer. The small size and light weight of ultraportables can certainly unburden you in your travels, but these systems turn into expensive paperweights if you need multimedia capability or high-end computing power.

Likewise, all the presentation notebooks reviewed here make fine desktop replacements, but the opposite isn't true. If you need a good desktop replacement, you can save thousands of dollars by outfitting a traditional docking station with multimedia capabilities rather than by buying a \$7000 presentation notebook.

In the end, choosing the right portable is a lot like passing through customs. Once you answer the fundamental questions, the rest is smooth sailing. ■

Marty Jerome is a columnist for the Boston Globe. His latest book is Screamer: The Ultimate PC Performance Book (Random House, 1994). You can reach him by sending E-mail to editors@bix.com.

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REACH BEYOND WIN 95

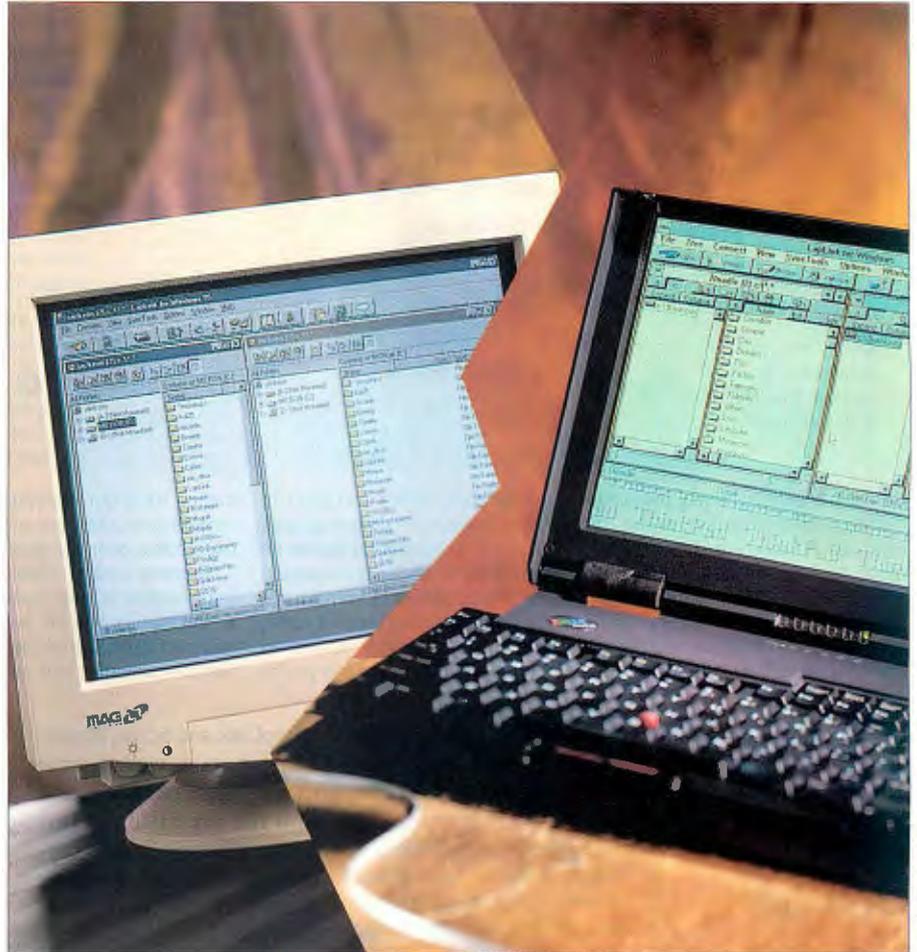
NICHOLAS BARAN

If you don't travel a lot, you might believe all the hoopla about Windows 95's remote-access capabilities. After all, Windows 95 ships with a Dial-Up Networking server that can connect to Windows NT Remote Access Server (RAS), Novell NetWare Connect, and Shiva's LanRover and NetModem through TCP/IP, IPX, NetBEUI, and SLIP/PPP remote-access protocols. You can even map drives from one node on the network to another for transparent file access from a remote site. Add to that Windows 95's Direct Cable Connection utility, which lets you transfer files between two PCs via serial or parallel cables. DCC even includes file synchronization to automatically update the files of one PC if they are out of sync with those files on the connected PC.

But before you decide that third-party remote-access software is about as valuable as a free trip to Ho-Ho-Kus, consider the advantages of stand-alone packages. For example, if you've used the Windows 95 Briefcase, you know about easy file synchronization. But what happens when you have an 8-MB presentation with only one slide that changed? The Briefcase will copy the whole thing. Intelligent synchronization built into such products as pcAnywhere32 enables you to synchronize only the part that changed.

As we were preparing this article, only a handful of remote-access products were available in 32-bit versions. These packages include LapLink for Windows 95 from Traveling Software, Norton pcAnywhere32 from Symantec, and Remotely Possible/32 from Avalan Technology. Other products, such as NetRemote from McAfee, Carbon Copy from Microcom, ReachOut from Stac Electronics, and CoSession from Artisoft (formerly from Triton Technologies), continue to ship in 16-bit versions, although Artisoft has updated CoSession to include some Windows 95 support (see "Remote Update" on page 92).

Should you spend \$100 or \$200 for one of these packages? In some cases, the answer is no. For example, if you work only in a homogeneous Windows 95 environment and never connect with a machine running any other OS, the native remote-access capabilities in Win 95 may be all you need. Or if you typically



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Despite solid features, Windows 95 needs help when it's time to run remote communications

transfer only small files that don't go through a complex revision process, you should just bank the hundred bucks or more you'd spend on remote-access products. Remote-access programs shine, however, when you need more sophisticated remote communications capabilities that don't fall within the vanilla offerings in Windows 95.

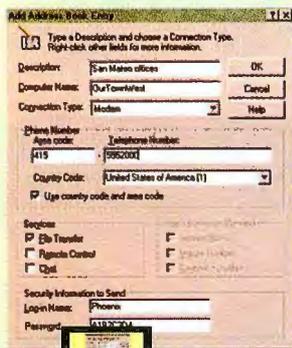
Top Three Reasons to Buy

There are three main reasons to buy a third-party remote-control program: synchronization, security, and programmability.

If your communications with coworkers and customers involve updating and revising files, one of the most important functions of remote-access programs is their capability to copy only the modified portions of files. Sending only the changed portions of files over the communications link speeds file transfers and cuts down on phone charges. The Briefcase utility in Windows 95 lets you synchronize files by using date stamps and file

CHOOSE THE RIGHT REMOTE OPTION

Remote Access



1 A notebook connects via modem to a PC at a distant location.

2 The notebook can download files and execute applications stored on the PC.

3 Any network files accessible to the PC are also available to the notebook computer.

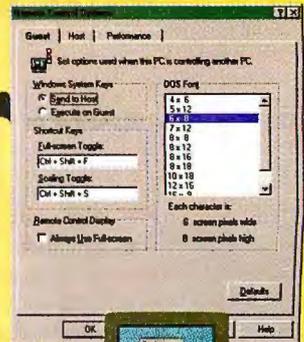


LAN



A The notebook controls the remote PC via keyboard commands and mouse clicks that travel over the phone lines.

Remote Control



B The notebook computer can initiate processing tasks on the PC. The notebook's screen displays the same image as the PC screen.

Remote access typically involves dialing into a connection point (e.g., an NT system running Remote Access Services); from that point you'll have the same capabilities as you would if your computer were directly connected to the LAN. You can, for example,

map network drives and print to network printers. In remote-access situations, applications reside on the remote computer and execute there. This is different from what's sometimes called a remote node, where the application resides on the host computer (the one you're

dialing into) but executes on the remote computer, transferring the executable over the phone line.

Remote control enables you to take control of a remote computer's screen, keyboard, and mouse. You can launch applications on a remote computer and use its stor-

age devices and peripherals as if you were sitting in front of that computer. Your keystrokes or mouse movements appear both on the screens of the host PC and your remote PC (unless you choose to blank the remote screen for security purposes).

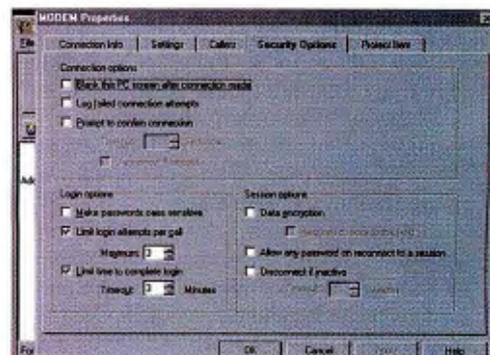
sizes to manage multiple copies of files on different systems. But the Briefcase can deal only with entire files—not parts of

files. Currently, LapLink and pcAnywhere, among the 32-bit products, as well as some 16-bit programs, can figure out what parts

of a file are different (no matter what application created the file) and synchronize only the parts that changed.

Security is another reason to think remote-access software. Windows 95's remote-access features typically rely on the LAN server to provide a secure path into the network back home. With remote-control software, you can require passwords and restrict user access to as many or as few activities as necessary. You can blank the screen on the host PC during a remote-control session so that unauthorized eyes can't see what's going on. You can control the number of log-in attempts and

Norton pcAnywhere32 offers data encryption for added security while transferring files.



REMOTE UPDATE

If you're running Windows 3.1 or DOS, 16-bit remote-access software will make far-flung communications easier. Here's a report on some leading programs for those two OSes.

CoSession Remote 7.0 is the upgraded version of CoSession for Windows 6.0, which itself was released only last December. In the meantime, Artisoft, best known for LANtastic, acquired Triton Technologies, the developer of CoSession. Like version 6.0, the latest iteration is a 16-bit program that supports long filenames when you transfer data within the Windows 95 environment. Version 6.0 marked the first time CoSession could transfer only the modified data in files. Artisoft says version 7.0 offers

incremental speed improvements for screen updates and when running scripts, thanks to improvements in caching and compression.

Microcom has no immediate plans to upgrade Carbon Copy 3.0, which remains a solid product for Windows 3.1. The current version is simple to use and costs only \$99.

ReachOut 5.0 from Stac Electronics comes with a scripting language and terminal emulation for a competitive price of \$100.

NetRemote 6.0, from McAfee, licenses Artisoft's (formerly Triton's) technology to offer remote access with features like file synchronization and file-update transfers. Retail price is only \$65.

Norton-Lambert's Close-Up 6.0 is undergoing a rewrite from a 16- to a 32-bit program. The company declined to announce a release date.



TRY pcANYWHERE32 FOR FREE

Introducing the first remote control solution that takes full advantage of the 32-bit power of Windows 95 and Windows NT.



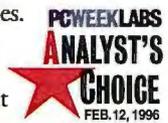
pcANYWHERE32™ gives you remote control, file transfer and communications in a single package so you get the fastest

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access to your remote PC, network servers, printers, applications and files.

That's 25% faster access to Word, Excel and PowerPoint



files than with any other remote access product. Which means you'll spend less time staring at that hourglass and spend less money on your phone bills.



pcANYWHERE32 even lets you increase the speed of remote control sessions by reducing the graphics load. With ColorScale™, you can limit the total number of colors transmitted—all the way down to black and white for optimal performance. And you can automatically disable host wallpaper and screen savers. Our Quick Start Wizards simplify set-up and configuration so you can connect and remotely access applications and data quickly and easily.

To get your free 30-day trial disks, just call 1-800-240-2279 ext. 9AP16. Or for more information, visit us on the Web at www.symantec.com. So wherever you go, the office can follow.

SYMANTEC.

Trial disks available in Windows 95 version only. Offer valid in USA only, while supplies last. Symantec is a registered trademark and pcANYWHERE32 and ColorScale are trademarks of Symantec Corporation. Microsoft, Windows, the Windows logo and PowerPoint are registered trademarks of Microsoft Corporation. All other brand names or trademarks are the property of their respective owners. ©1996 Symantec Corporation. All rights reserved. In Canada, call 1-800-365-8641. In Australia, call 2-879-6577. In Europe, call 31-71-353111.

Circle 155 on Inquiry Card.

```
WAIT STRING "login:"
SEND LINE "BIX^M"
WAIT STRING "Name?"
SEND LINE "nickbaran^M"
```

Core Capabilities

The current 32-bit packages offer a core set of other features for remote access and remote control (see the table at right). LapLink, pcAnywhere32, and Remotely Possible take advantage of Windows 95's capabilities for automatic modem configuration and dial-up connections. Other standard offerings are support for remote printing and copying of clipboards between connected PCs. Each program can cache files to speed screen refresh rates. LapLink and pcAnywhere support drive mapping, which allows you to view a disk drive on a remote PC as if it were another drive on your system.

LapLink and pcAnywhere also offer an automatic "callback" feature that tells the host computer to automatically call the remote PC back. This is handy not only for security but also if you're a telecommuter and want the home office to pick up the phone charges, for example.

LapLink is unique because it lets you define either one of the connected PCs as "host" or "guest." This is useful if two people are communicating and want to alternate control of the remote PC. Other products in this review require that you define the host and the guest before making the connection.

Remotely Possible lets you simultane-

ously perform remote-control, file transfer, and chat functions, which means you can transfer a file in the background while performing other remote tasks.

You can use these three programs to connect a remote PC to a LAN as an independent node (sometimes also called a remote node). In this case, the applications execute on the remote PC and files and applications travel across the telephone lines. If the files and the applications are large, this can severely degrade performance.

So what's not to like about these packages? While remote-access programs are fairly straightforward to use, the process of connecting remotely between PCs is still surprisingly quirky. It's not unusual for one of the two computers to lock up and require a reboot. This makes unattended, automated remote control and remote access shaky propositions. If your business depends on PC-to-PC remote access, we suggest having a back-up system in place.

Also, LapLink and Remotely Possible don't include a terminal emulation utility. You won't miss this capability if you have a direct Internet connection: Both programs support connection via TCP/IP to the Internet. However, many of us need to connect to the Internet via an on-line service and cannot use these two programs to do so. Norton pcAnywhere, however, does include terminal-emulation software.

WHAT'S INSIDE THE 32-BIT PROGRAMS

Product	LapLink for Windows 95	pcAnywhere32	Remotely Possible/32
Price	\$149	\$149	\$169
Full Windows 95 support	Y	Y	Y
Terminal emulation	N	Y	N
Cables included	P/S ¹	P	N
Network protocol support	Y	Y	Y
Speed file copy ²	Y	Y	N
Cache ³	Y	Y	Y
Require passwords	Y	Y	Y
Restrict activities ⁴	Y	Y	Y
Blank screen ⁵	Y	Y	Y
Data encryption	N	Y	Y
Drive mapping	Y	Y	N
Chat function	Y	Y	Y
Remote clipboard copy/print	Y	Y	Y
Automatic callback	Y	Y	Y
Virus check	N	Y	N
Scripting language	N	Y	N
Macro keys	N	Y	N

Y = yes N = no

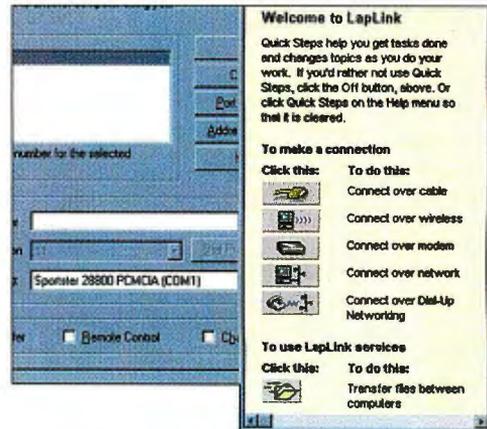
¹ P = parallel, S = serial

² Ability to copy only modified portions of a file (includes file synchronization)

³ To speed up screen refreshes

⁴ For example, some users may be allowed to chat but not permitted to transfer files.

⁵ On the host PC during a remote-control session



The setup screen in LapLink for Windows 95 helps you quickly establish a remote-access session no matter what type of connection you're using.

Life on the Road

So Windows 95 goes 80 percent of the way, delivering basic remote communications. If working on the road is a change of pace for you rather than being your everyday business life, the capabilities in Win 95 may be all you need. But if the title on your business card says "Road Warrior," consider Symantec's pcAnywhere32 and Traveling Software's LapLink, both of which we found to be good remote-access, remote-control solutions. ■

Nicholas Baran is a BYTE consulting editor who lives in Sandpoint, Idaho. His E-mail address is nickbaran@bix.com.

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Norwood, MA
(800) 822-8224
(617) 551-1000
<http://www.microcom.com>
Circle 1102 on Inquiry Card.

Close-Up 6.0...\$199
Norton-Lambert
Santa Barbara, CA
(805) 964-6767
Circle 1144 on Inquiry Card.

CoSession Remote 7.0...\$79
Artisoft
Iselin, NJ
(800) 322-9440
(908) 855-9440
<http://www.artisoft.com>
Circle 1106 on Inquiry Card.

Laplink for Windows 95...\$149
Traveling Software
Bothell, WA
(800) 343-8080
(206) 483-8088
<http://www.travsoft.com>
Circle 1105 on Inquiry Card.

NetRemote 6.0...\$65
McAfee
Santa Clara, CA
(408) 988-3832
<http://www.mcafee.com>
Circle 1101 on Inquiry Card.

Norton pcAnywhere32...\$149
Symantec Corp.
Cupertino, CA
(800) 441-7234
(541) 334-6054
<http://www.symantec.com>
Circle 1104 on Inquiry Card.

Reachout 5.0...\$100
Stac Electronics
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Circle 1103 on Inquiry Card.

Remotely Possible/32...\$169
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Holliston, MA
(508) 429-6882
<http://www.avalan.com>
Circle 1100 on Inquiry Card.

STAY CONNECTED

Rather than a single solution, you may need a mix of wire-line and wireless options for on-the-road communications. Here are four essential tools.

The world moves too fast for you to be incommunicado for even a single day. The trouble is, you'd fill a suitcase full of gadgets, cables, and software to meet every communications contingency. Because you clearly don't want to do this, you'll need to pick the best tools for you. Your final mix may include products for wired communications (or wire-line communications, as it's sometimes called) as well as wireless devices.

In the following stories, we offer some hands-on tests and technology updates on four different technologies that have the ability to give you flexible, fast, and economical data communications when you travel: PC Card modems, cellular modems, two-way pagers, and private packet radio.

Mobile doesn't mean mute when it comes to sending and retrieving data. One or more of these technologies can make sure mum's not the word you hear on the street.

POCKET-SIZE MODEMS SQUARE OFF

We speed-test seven PC Card modems to pick the best ones for real-world telephone-line conditions

PC Card modems have a checkered past plagued by compatibility hassles and high prices. Today, installation glitches should be rare if you run Windows 95. If that's not your platform of choice, you'll still need to load Card and Socket services and individual modem-installation software on your portable. As for prices, you'll still pay a premium compared to desktop modems for shirt-pocket portability. The good news is that portable-modem prices are dropping. The cards in this roundup cost from \$50 to \$100 less than equivalent V.34 modems from a year ago.

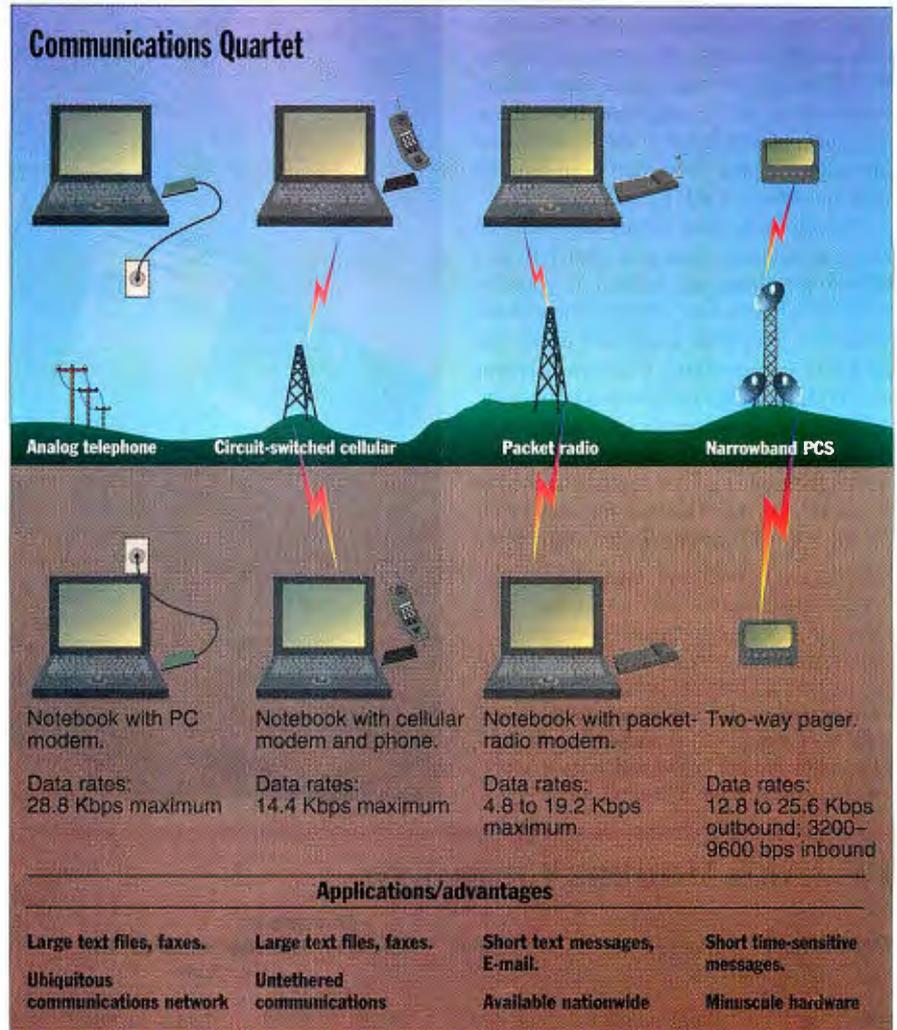
The real news is performance. The svelte PC Card form factor makes no compromises in terms of speed and connection reliability. The PC Card modems we tested punch data through both

clean and noisy telephone lines as fast as full-size modems with 28.8-Kbps data transfer rates and 14.4-Kbps fax capabilities.

Built for Speed

For this roundup, six V.34, land-line modems ran a suite of performance tests developed by NSTL, an independent testing lab and sister organization to BYTE (see the table on page 96). In these tests, modems must send five sizes and types of files under seven line conditions. While performance varied among the cards, all the devices fell within the range we saw in previous tests of full-size V.34 modems. That said, this is not a roundup of clones. Most of the products offer something unique in hardware design or software to grab your attention.

For example, TDK and Microcom both emulate the parallel port on a portable computer. This allows for raw computer-to-modem bandwidth of up to 300,000 bps. This is also known as data terminal equipment (DTE) speed. However, if you're running under Windows 95, DTE speed tops out at 115,000 bps; the lim-



JOSEPH A. GALLAGHER © 1996

it under Windows 3.1 is just 19,200 bps without special drivers. Parallel-port connections take advantage of the fastest processors that are in today's portables. In theory, the faster the computer can deliver data to the modem, the faster the modem can compress and send the data.

Two of the modems we looked at in this review—the Megahertz 28.8 PC Card Modem and the Practical Peripherals ProClass PCMCIA 28.8—come with a pop-out connector for attaching telephone-line cables. You just push the edge of the modem, and out pops the jack. You then plug into the jack any standard RJ-11 line cord.

The relatively short cables supplied with all these modems often don't reach from a table to the phone jack hidden on your hotel room's baseboard, so don't leave home without a telephone extension cable and an RJ-11 cable-joining connector. Hayes and TDK modems include this connector.

A unique connector comes with the U.S. Robotics Sportster. It uses a pigtail cable with a locking edge connector attached to a dual RJ-11 jack. The jack features LEDs on the top to indicate Power On, Send

The throughput scores indicate performance in one- and two-way transmissions over line conditions typically found in the U.S. Impairment tests increase the amount of noise, delay, and phase roll to simulate the stress placed on modems making calls over satellites or overseas. Higher numbers indicate faster transmission speeds. NSTL simulated telephone-line conditions using a TAS Series II modem tester from Telecom Analysis Systems (Eatontown, NJ).

The Practical Peripherals ProClass offers the best in price and performance. The U.S. Robotics Sportster 28.8 and the Hayes Optima 288 V.34 also posted fast throughput scores.



PC CARD MODEMS COMPARED

Manufacturer	Product	Price	Throughput ¹				Maximum Speed DTE	Error Control	Compression	Connector
			One-Way	Two-Way	Impaired Line	TIA ²				
ActionTec	DataLink 28.8	\$319	5526	3731	3081	5813	115 Kbps	V.42	V.42bis	Proprietary RJ-11
Hayes	Optima 288 V.34 +Fax	\$319	6963	5634	4303	7744	230 Kbps	V.42	V.42bis	Proprietary RJ-11
Megahertz	28.8 PC Card Modem	\$369	4295	3301	2012	4006	115 Kbps	V.42	V.42bis	XJack
Microcom	TravelCard 28.8P	\$299	6648	4526	3276	7198	115–300 Kbps	V.42	V.42bis	Proprietary RJ-11
Practical Peripherals	ProClass PCMCIA 288 V.34	\$299	6955	5625	7030	7755	115 Kbps	V.42	V.42bis	EZ-Port
TDK	TDKModem DF2814	\$599	6638	4605	2718	7195	115–300 Kbps	V.42	V.42bis	Proprietary RJ-11
U.S. Robotics	Sportster 28.8 PC Card Faxmodem	\$329	6507	4752	6505	7438	115 Kbps	V.42	V.42bis	Proprietary Dual RJ-11

¹ Bytes per second; higher numbers indicate faster performance.

² Tests run under the guidelines specified in table 6 of the Telecommunications Industry Association's bulletin TSB-38.

Data, Receive Data, and On-Line. These LEDs may offer clues to solve tricky connection problems. For most users, though, they simply reinforce the obvious.

Each vendor ships basic communications software for both fax and data transfers. Hayes provides a Lite version of its SmartCom program. TDK supplies Del-

rina's WinFax and WinCom Lite versions. Microcom and Megahertz both furnish copies of FaxWorks from Global Village Communications. U.S. Robotics gives you a copy of Smith Micro's QuickLink II, while Practical Peripherals packages both QuickLink II and WinFax Lite.

The prize for the most extensive list of bundled software goes to ActionTec. Its modems ship with Cheyenne Software's BitWare communications and fax programs, Traveling Software's LapLink for Windows, Sidekick 2.0, McAfee's Virus Scan, and Spry's Mosaic.

pay anywhere from \$50 to \$100 for the connector. Everything is fine as long as you don't upgrade your phone. If you do, there's no guarantee that your cable will work with the new phone.

If you've grappled with this problem, you'll understand part of the justification for a new class of cell phones that severs the tether by integrating a data/fax modem into the cell-phone handset. These new phones should begin shipping around the time you read this.

If you're wondering why no one has thought of modem-equipped cell phones before, you probably own BellSouth or IBM stock and have blotted the Simon out of your memory. That design also combined cell phone, modem, and LCD in the same unit. However, the Simon, which is heavier and uses a slower modem than the new phones, failed to attract a large market when it began shipping in 1994. BellSouth says it no longer promotes the product.

The Products

Air Communications, AirGo Communications, and Pacific Communications Sciences have announced modem-equipped cell phones. Motorola, the leading supplier of cell phones, declines to comment on its plans. A spokesman for Nokia, the number two cell-phone provider, won't discuss plans either, but says that every phone manufacturer that "has its head screwed on straight" is looking at this market.

The phones will sell for eye-popping prices—from \$600 to \$1000 through computer channels (cellular service providers may significantly discount the hardware to attract new subscribers). What do these high prices get you? Convenience, most of all. You won't have to worry about cable compatibility, and there won't be the setup hassles that sometimes arise when a cell phone and modem don't initially talk to each other. Some modem-phone companies also claim they can optimize performance so transmission rates will be faster than in cell phones that use cable-attached modems. Because none of the products was shipping in time for this story, we are unable to verify these claims.

Besides voice capabilities over standard analog cellular networks, common characteristics of these devices are 14.4-Kbps cellular modems; backlit LCDs and keypads; nicad, nickel-metal-hydride (NiMH), or lithium-ion batteries; and storage for voice messages and incoming faxes. You can receive cellular faxes directly with these units, but to send and retrieve files, you need to connect the devices to a computer via the serial port (cables typically

MULTICULTURAL MODEMS

Is your modem up to the task if your business travels take you outside North America? That question is best answered on a country-by-country basis. In Germany, you'll find a basic incompatibility between the native phone system and your "alien" modem. In other countries, your modem may work, but you might be breaking the law by using an unauthorized device. You'll also face the never-ending search for the proper adapter to connect your telephone cable.

One of the products in our tests, the TDK DF2814, provides solutions to all these problems. TDK's software lets you configure the product for use in 17 European and Asian countries. You can download from a TDK BBS additional country configurations as they become available. TDK also includes cable adapters for France, Italy, and the U.K., along with information for ordering other specialized phone gear for international travel.

Top Data Gun

Which modem offers the best in terms of price and performance? For our money, it's the Practical Peripherals ProClass PCMCIA 28.8. It posted the fastest overall scores when we consider both clean- and impaired-line tests. Its price was among the lowest in this group. The U.S. Robotics Sportster came in a close second, with throughput scores that ranked near the top for clean and noisy lines.

Note that the Hayes Optima 28.8 outpaced the ProClass and Sportster in the one- and two-way throughput tests. Unfortunately, the Optima suffers from lackluster performance in the impaired-line tests. You won't typically face such tough line conditions, but it's nice to know your modem can handle noise and delays in an emergency. When we're on the road, we'll take peace of mind every time.

—Andrew Froning

Andrew Froning is managing editor at NSTL. You can contact him at editors@NSTL.com or editors@bix.com.

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(617) 551-1000	(800) 822-8224
(770) 840-9966	(800) 225-4774 (fax)
(916) 478-8421	(800) 999-4835
(708) 676-7010	(800) 342-5877

CELL MODEMS FIND A PHONE HOME

A new generation of cell phones with built-in modems ignore what Simon says

The cellular PC Card modem may be the biggest irony in mobile communications. This symbol of *untethered* communications suffers from a lack of standardization for—you guessed it—the cable that tethers the modem to your cell phone. You specify the proper cable to fit your cell phone when you buy the modem and

come standard with the phone package).

The AirCommunicator, from Air Communications, will expand on the basic design by offering a small docking station with additional storage, land-line communications, and battery-recharging capabilities. Air Communications also diverges from the pack with its proprietary error-correction protocol called AirTrue, which the company says works even if only one end of the communications link uses it (standard cellular protocols, such as MNP level 10, require the error-correction scheme on modems at both the sending and receiving ends). The company expects to list its base-model phone for \$695.

The PAL phone, from Pacific Communications Sciences, supports the traditional circuit-switched cellular networks and the Cellular Digital Packet Data (CDPD) system. The latter sends packetized data over idle capacity on cellular voice networks at a relatively fast 19.2 Kbps. You can encrypt CDPD transmissions for greater security than standard cellular communications. However, CDPD's coverage remains far from universal. The company expects to reach full production in the second quarter and estimates prices will range from \$600 to \$800.

AirGo Communications will offer the most flexible design of all. Its Phone System consists of a Type III PC Card that

Where to Find

Air Communications
Santa Clara, CA
(408) 567-8000
fax: (408) 567-9090

AirGo Communications
Salt Lake City, UT
(801) 269-7200
fax: (801) 269-7363
<http://www.dayna.com>

Pacific Communications Sciences, Inc.
San Diego, CA
(619) 535-9500
fax: (619) 535-9235
<http://www.pcsi.com>

houses cell-phone and modem circuitry. You can slip the card into an AirGo handset for the same form factor and capabilities as the other phones. To send or receive large files, you slide the card into your portable's Type III slot rather than connecting via a serial connector, as in the competing designs. The Phone Card also has a mini-stereo plug that accepts the Jabra EarPhone, an earpiece with a built-in microphone for "hands-free" communications. The package will sell for \$900 to \$1000 through computer channels. The card alone will sell for about \$600.

The new cell phones promise speed improvements over the Simon and more convenience than external PC Card modems. High prices may still dampen demand. Also, some people question how useful a cell phone is as a fax, file transfer, and E-mail device. Most mobile workers may opt instead for the fuller storage and input capabilities of a notebook or ultraportable. However, if land-line connections are inconvenient or you need to capture a file on the run, these phones could give you the freedom of cellular communications without tying you up in knots.

—Alan Joch

Alan Joch is a senior editor at BYTE. You can contact him on the Internet at ajoch@bix.com.

TWO-WAY PAGING'S SECOND ACT

New services will soon make narrowband PCS networks sing

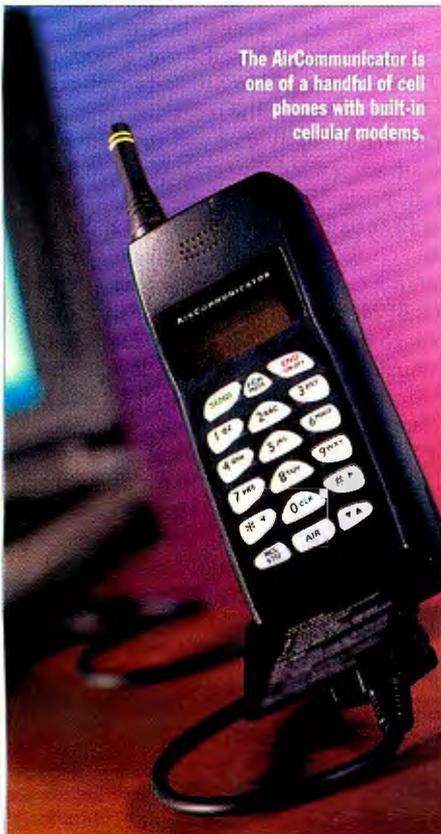
More of us are benefiting from two-way paging now that narrowband Personal Communications Services (NPCS) is

starting to spread across the country. For example, the SkyTel NPCS network and Motorola's Tango paging device give us guaranteed message delivery and the ability to respond to pages with either a set of canned replies or a phone call to a central voice-mail center.

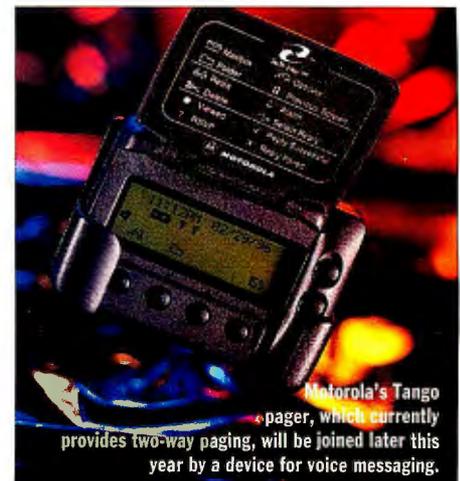
That's nice, but two-way paging still feels like a work-in-progress. The Tango's multibutton interface and manuals for both you *and* the people who need to page you can be daunting. SkyTel boasts about its 1300-city coverage area, but that still does not serve those on far-flung business trips or those whose headquarters, like BYTE, are in areas such as Peterborough, New Hampshire.

NPCS providers and pager-equipment makers say the second act for two-way paging will address these issues and more. By the second half of the year, you will be able to use the NPCS network for both data and voice messaging. No, you won't use your Tango like a cellular phone. Instead, for a much lower cost than a direct voice linkup, your pager will act as a sort of answering machine on your belt. Someone can send you a message, and you'll actually be able to hear, rather than read, the page.

To offer this capability, service providers use the two-way system to find the transmitter/receiver closest to you. The



The AirCommunicator is one of a handful of cell phones with built-in cellular modems.



Motorola's Tango

pager, which currently provides two-way paging, will be joined later this year by a device for voice messaging.

one-way paging system, by contrast, blasts the message to every transmitter/receiver in the country.

By honing in on your location and finding you before the actual message is sent, service providers use the system more efficiently. This means you can send larger messages packed with more information—like voice messages—than you could with older paging networks.

During voice-paging's initial rollout, look for Motorola to have the lion's share

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TWO-WAY PAGING PLANS

Company	Service Name	Type of Service	Availability	Coverage Area	Cost	Pager	Pager Price*	Service's Phone	Service's 800 Number	Service's E-Mail or URL
Airtouch Communications	TBD	Data	Late 1996	California, Dallas	TBD	Motorola Tango	TBD	(214) 458-5200	(214) 458-5219	None
American Paging Co.	American Paging	Data	Q1 1997	Midwest, Florida, Washington D.C., Salt Lake City	\$20 per month	Motorola Tango; AccessLink device	\$260 for purchase	(612) 623-3100	(612) 379-7562	djonesapi@aol.com
AT&T Wireless	TBD	Data	Date TBD	Nationwide	TBD	TBD	TBD	(206) 827-4500	None	None
Pagemart, Inc.	Voice Mart	Voice	Q4 1996	Major metropolitan areas	TBD	Motorola's Tenor	TBD	(214) 706-3306	(800) 593-4953	Info@pagemart.com
Pagemart, Inc.	PageMe USA	Data	Q4 1996	Urban and suburban markets	TBD	Motorola Tango; testing others	TBD	(214) 706-3306	(800) 593-4953	Info@pagemart.com
Paging Network, Inc.	Voice Now	Voice	Q3 1996	Dallas, New York, San Francisco	\$12 per month	Motorola's Tenor	\$8 per month	(214) 985-4100	(800) 724-3638	http://www.pagenet.com
SkyTel	SkyTel 2-Way	Data	Operational	1300 cities in North America	Local: \$24.95; nationwide: \$74.95 per month	Motorola Tango	\$15 per month lease or \$399 for purchase	None	(800) 643-0323	http://www.skytel.com

*Estimated TBD = to be determined

of the paging hardware market with its Tenor device. The pager will be able to store 4 minutes of voice messages. However, some service providers, off the record, say a handful of other hardware

vendors are shopping around voice-paging devices. Thus, the competition in that area will heat up about the time services come on-line, which will be good news for price-conscious mobile workers.

The table above gives a snapshot of the plans of the major paging services for both data-only and the upcoming voice capabilities this year.

—Alan Joch
continued

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RADIO DIALS NEW LISTENERS

Underlying software fine-tunes the problems of radio communications

Private packet radio from RAM Mobile Data and Ardis, among others, is great for mobile workers who send short, bursty messages and need two-way communica-

tions. However, acceptance in horizontal markets has been slow. Now, some of the stumbling blocks to wider acceptance of packet radio may soon fall.

Until recently, you couldn't plug a radio modem into a COM port of your laptop and enjoy the features of a wired connection. Many software packages aren't ready for the long latency times and slow throughput of packet-radio networks. These delays can cause software to simply time out and assume that you lost the connection.

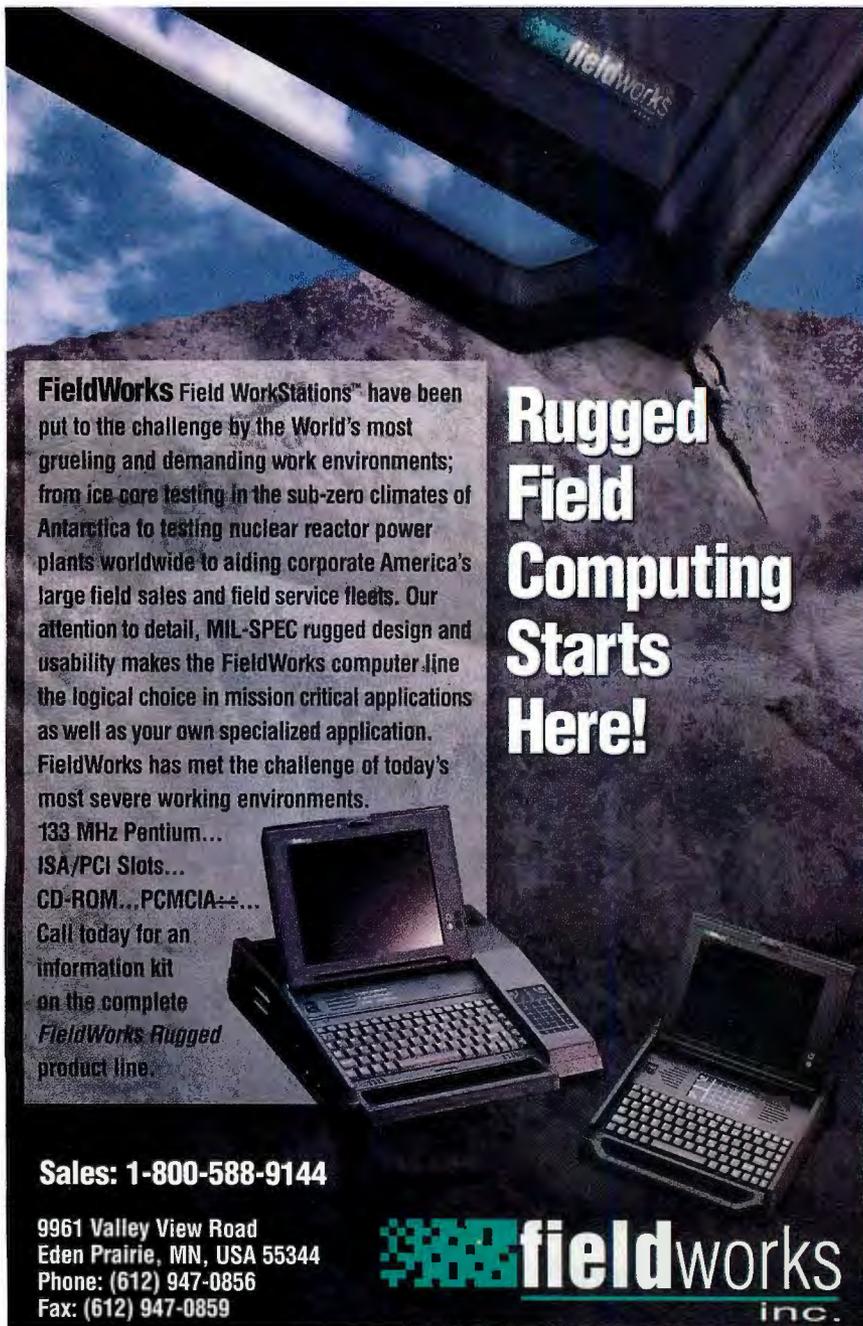
Many radio-modem manufacturers are enhancing the software glue that binds their products with communications software. One example is Megahertz's RADsock software layer, which is interchangeable with Winsock, the Windows interface to the Internet. To use it, developers substitute calls to the RADsock DLL for calls to Winsock and recompile their communications program.

RADsock extends time-outs to keep connections in place even when no data is flowing. Megahertz is now shipping RADsock with its AllPoints radio-modem card, which connects to portables via a Type II PC Card interface and works primarily over the RAM network.

IBM's ARTour communications software takes a different approach: It sits beneath the TCP/IP stack, so there is no need for developers to recompile programs. The programs call TCP/IP as they would have before.

The ARTour client runs on the laptop and the ARTour server takes the data from the RAM Mobile or Ardis network. The ARTour client can compress the standard 40-byte TCP/IP-packet header to 3 to 7 bytes because the data is flowing to only one place. The ARTour server adds the rest of the packet information and sends the data on its way. For end users, this approach can boost response times.

Caching is an important part of the equation. If you run a 3270 terminal package over the ARTour link, the server and client coordinate their caches. These coordinated caches can save plenty of bandwidth.



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Packet radio won't replace traditional modems because of radio's speed (4.8 to 19.2 Kbps) and price (about 15 to 25 cents per KB). However, for E-mail, database queries, and other bursty traffic, private radio networks may soon become easier to use than ever. —Peter Wayner

Peter Wayner's latest book is Disappearing Cryptography: Being and Nothingness on the Net (Academic Press, 1996). You can reach him at <http://access.digex.net/~pcw/pcwpage.html>.

WELL-CONNECTED PDAS

THOMAS MARSHALL

Just down flashes of inspiration at your beachside cabana. Record the uniform resource locator (URL) of a new contact before you hit the next trade-show booth. Update your schedule as the taxi driver makes an end run to La Guardia via Central Park. Such are the freedoms promised by personal digital assistants (PDAs).

But what if you can't easily get that information from your PDA to the master databases and schedulers on your desktop system? Suddenly, a PDA seems less like a door to freedom and more the key to your own private data prison. The value of a PDA isn't only in how easily it helps you capture information but also in how efficiently you can share that data with other systems.

We evaluated five midrange PDAs to see how well the current generation of diminutive travel computers collects data and connects with other systems. Our criteria eliminated those high-end PDAs designed as personal communicators with integrated wireless modems and prices above the threshold for wide acceptance. We also excluded all low-end—and low-performance—electronic organizers from this roundup. (Note: Palm Computing's Pilot, a new 5½-ounce PDA, wasn't shipping in time for inclusion in this review.)

We found that midrange PDAs have matured quietly in recent months. All the models we looked at can communicate with PC and/or Macintosh desktop systems, although this usually requires an optional cable. Most PDA vendors now offer a kit with a serial cable and software for data backups and basic file management between the unit and a desktop system. A few PDA connectivity tools even allow *data synchronization*—the reconciliation of multiple versions of a file. Some vendors also provide desktop versions of PDA applications, which makes data management more convenient.

What about technical enhancements in other areas? Make no mistake, design improvements in PDAs remain incremental, and most models still haven't gone far enough for mass adoption. However, improvements have come in PDA OSes, which can now handle more tasks, and in programming tools, which keep evolving. PDA maturation gets a boost from the PC Card, which brings to some PDAs networking and two-way paging, plus land-line and wireless-modem connections.

For this review, we ran each unit through a suite of tests de-



Need to capture information? Buy a 75-cent notepad. Need to integrate that data with other systems? Think PDA.

signed to simulate such real-world tasks as making and retrieving appointments, sending and receiving E-mail and faxes, and writing notes and memos. For units with handwriting recognition, we paid special attention

during the appointment and notes steps to the maximum allowable rate of input and accuracy of recognition. Equally important was the ease of correcting misrecognized text.

To test data transfer capabilities, we used built-in or bundled tools to move data from a desktop computer to the PDA and then back again. We repeated the tasks using optional connectivity kits sold by the PDA vendor. Here we looked for added value in merge or synchronization, import/export, file-format conversion, and other utilities. We also tested the units using IntelliLink for Windows 3.4 connectivity software from IntelliLink Corp. (see the text box "Lingua Franca for PDAs" on page 106). What follows is a look at how the PDAs measure up against each other.

Apple Newton MessagePad 120

Don't judge the latest MessagePad by its cover. Apple bulked up the PDA's internals with more RAM (2 MB, up from 1 MB) and the snappier Newton 2.0 OS, both of which play up this pioneer's traditional strengths in capturing information on the fly.

The enhanced Newton OS makes both connectivity and file management easier. Just tap the Routing button, and up pops a

POCKET-SIZE FEATURES

Model	List price	Dimensions (inches) ¹	Weight (ounces)	Batteries	OS	CPU/MHz	PC Card	Display resolution (pixels)
Apple Newton MessagePad 120	\$699/2MB	4 × 8 × 1.2	16.2	4 AA	Newton OS 2.0	ARM 610 RISC/20	Type II	320 × 240
HP OmniGo 100	\$349/1MB	6 × 3.75 × 1	11.6	2 AA	GEOS 2.0	80186 compatible/16	Type II (no flash RAM)	240 × 240
HP 200LX	\$699/2MB	6.3 × 3.4 × 1.1	11	2 AA	MS-DOS 5.0	80186 compatible/7.8	Type II	640 × 200/80 × 25
Psion Series 3a	\$695/2MB \$595/1MB	6.5 × 3.3 × 0.9	10	2 AA	Proprietary; DOS format	NEC V30H (80186 compatible)/7.68	(Flash SSD: 2); SRAM	480 × 160/80 × 25
Sharp Zaurus ZR-5000FX	\$549	6.7 × 3.9 × 1	14.9	2 AA	Proprietary	Proprietary/16	Type II	320 × 240

¹Width, depth, and thickness (with device closed). ● = yes; ○ = no; NCU = Newton Connection Utility.

menu with options for printing a file, beaming it via infrared to another Newton device, or sending the data via fax or E-mail. When you route a note before making a connection to another device, the MessagePad stores the file in a universal Out Box and holds it there. Make a connection, and the MessagePad automatically transmits the note.

Our MessagePad came with the Newton Backup Utility (NBU) for backing up data and applications to a desktop system. With NBU and a standard Apple serial cable, we installed applications from a Macintosh to the MessagePad's internal memory or to PC Card RAM.

Unfortunately, the NBU won't transfer data. For that, you need the new Newton Connection Utilities (\$69) or a third-party package. Unfortunately, a version of Connection Utilities that's compatible with the new OS wasn't released in time for our evaluation. The utilities will add import/export conversions and data synchronization with personal information managers (PIMs) and schedulers. The package allows MessagePad data entry via your desktop keyboard and supports remote access to desktops via modem.

We easily printed files on Mac-compatible printers using a standard Apple cable. Apple also sells a \$69 kit for printing on DOS/Windows parallel-port printers. Apple ships the MessagePad with software for faxing and accessing eWorld, but you'll need client applications for other communications services. Support for many PC Card wireless and land-line modems is standard.

Handwriting-recognition capabilities

The revamped MessagePad offers a snappier OS.

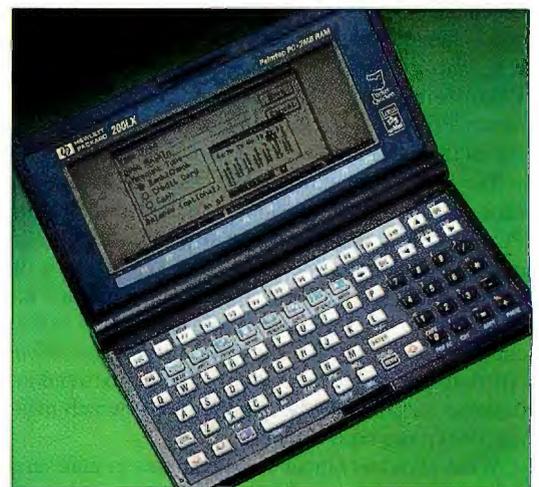
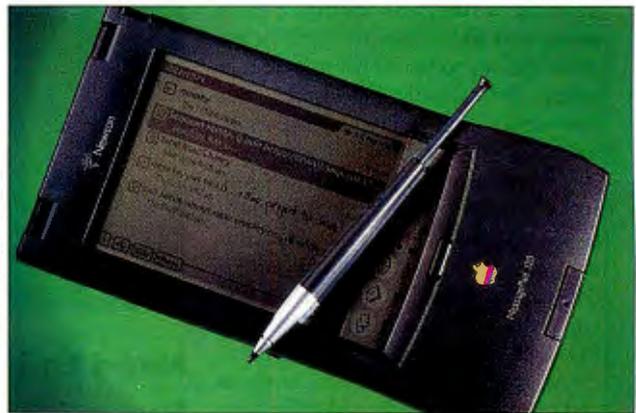
generally perform well from the start, and the machine learns your handwriting better over time. But recognition is still not all it should be. Misinterpretations may be fewer, but editing misrecognized text by hand remains extremely frustrating; we found it much faster to call up the virtual keyboard for making corrections. These problems aside, the MessagePad's pen-input system remains easier to use than the tiny keyboards on other PDAs.

Hewlett-Packard 200LX

The 200LX is the roving number-cruncher's dream. HP squeezed the QWERTY keyboard into a length of only 4 inches—the tiniest of the lot, which makes text input a chore, but it accommodates a numeric keypad that's handy for entering figures.

A further nod to the math-minded is the bundled combination of Lotus 1-2-3, Pocket Quicken, and emulations of HP's programmable calculators. But the 200LX isn't just for a niche market; rounding out its capabilities are applications that include a phone book, a scheduler, a notepad, cc:Mail Mobile client, and LapLink Remote Access.

LapLink Remote Access allows drives

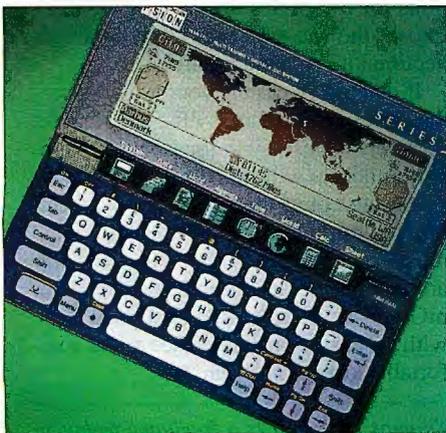
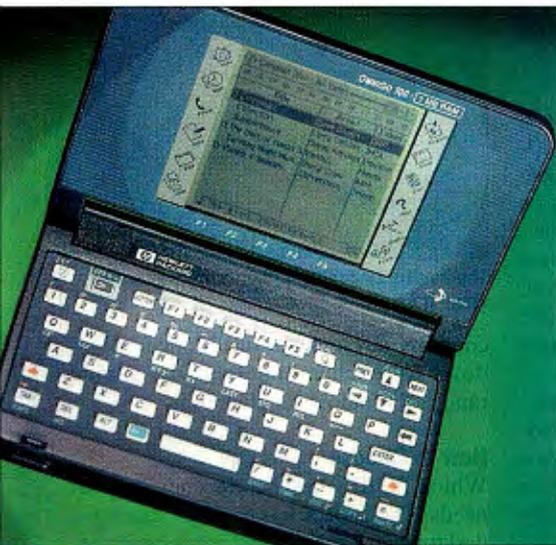


HP's 200LX has a keypad designed for number crunchers on the move.

on the remote system to be mapped as extra drives on the local unit and vice versa. LapLink works with the built-in infrared port or over serial connections, but it requires a proprietary cable (\$25). HP's Con-

						DESKTOP CONNECTIVITY	
Fax	E-mail	Modem	Serial port	Infrared port	PC connect	Data synchronization	File transfer
●	●	●	●	●	●	NCU	NCU
○	○	○	●	○	●	HP Connectivity Pack	HPCP
●	●	●	●	○	LapLink (need cable)	HP Connectivity Pack	LapLink; HPCP; IntelliLink
○	○	○	●	○	●	○	PsiWin; IntelliLink
●	●	●	●	●	●	○	PC Link; IntelliLink

The HP OmniGo's low price doesn't come at the expense of poor design.



Psion's Series 3a shines with its Windows applications.

nectivity Pack (\$120) includes the serial cable and software to connect to desktop PCs via LapLink and to do file conversion and data synchronization.

But data synchronization via the Connectivity Pack was more complex than we anticipated, mainly because we had to make sure that the files we wanted to synchronize already existed on the PC. (Alternatively, we could have used LapLink Remote Access.) Synchronization then went smoothly. Windows users, especially those who rely on mouse-clicks to perform tasks, will long for a Windows version of the synchronization software. The current edition doesn't support mouse input.

HP provides adapters to connect the 200LX to serial printers and modems. The Connectivity Pack link allows you to connect via modems as well as via infrared links.

The 200LX offers one PC Card Type II slot for flash RAM cards in 5-, 10-, and 20-MB capacities. The slot also supports a wide range of wireless and land-line fax/data modem, pager, and LAN cards.

The MS-DOS-based 200LX has an 80-column by 25-row screen. The unit is 6 1/4 inches wide and weighs under a pound. Small in size and packed with time-proven applications, the 200LX is irresistible for those who live life by the numbers.

Hewlett-Packard OmniGo 100

One of the continuing raps against PDAs is their high cost. HP takes the price/performance issue head on with the \$349 OmniGo 100, which proves low prices don't

have to mean clumsy designs or data transfer compromises.

The OmniGo 100 is HP's first foray into the world of pen computing, although the PDA packs a keyboard as well. Ironically, the keyboard is larger than the one on the 200LX, while the 2 1/2-inch-square screen is much smaller. But the OmniGo's clamshell design incorporates a double hinge that allows the lid-mounted display to fold all the way back over the keypad for convenient hand-held pen input. One of the 12 permanent icons toggles the display's orientation to accommodate keyboard or pen-only input.

The OmniGo runs Geoworks' GEOS 2.0 graphical OS and incorporates Palm Computing's Graffiti handwriting-recognition technology. The Graffiti alphabet is relatively easy to learn, but we found it easy to forget how to produce punctuation. You also have a couple of programming options with the OmniGo. Geoworks sells a software development kit for \$89 for use with Borland C++, while Feras Information Technologies makes a programming language and environment for GEOS named IZL. (It costs \$56.)

What trade-offs did HP make to keep the OmniGo's price low? First, the PDA isn't as well connected as its LX relatives. There's no infrared port, and the Type II PC Card slot accommodates only static RAM (SRAM) memory cards.

The \$120 Connectivity Pack provides automated file management plus data backup and synchronization between the OmniGo and Windows systems. (A less extensive connection option is HP's \$70 Clip & Go, which allows serial data transfer via your Windows Clipboard.)

We found it extremely easy to synchronize data using the Connectivity Pack. We simply clicked on two buttons—first HotSync, and then Auto—to get two systems in sync. The first time we synchronized, the software automatically backed up the data on the OmniGo to our PC.

Windows versions of the OmniGo's telephone book, appointment book, and notepad applications make it easy to manage data between the PDA and our desktop system. We just entered or edited items on our PC and then pressed HotSync to carry the changes over to the OmniGo.

Psion Series 3a

If you consider seamless Windows support a necessary lifeline linking a PDA to your desktop, you should take a look at Psion's Series 3a. Its Windows connection kit, known as PsiWin (\$120), is a set of Windows utilities for cross-platform

file management, conversion, and compression. Included in the suite are Psi Print, for TrueType printing via Windows, and Psi Database, a Windows version of the database application that's built into the Series 3a. Macintosh connections are possible with an optional (\$120) kit, but it only allows you to transfer files.

PsiWin's File Manager-style interface provides effective drag-and-drop file exchange and conversion between the Series 3a and several popular Windows applications. It correctly recognized our incoming DOC file as belonging to Word for Windows 6.0 and automatically converted it to Psion Word. When we imported a contact database, the program popped up a dialog box for field mapping when it encountered our CSV export file. We were then able to map and name data fields for the Psion database.

The PDA comes with Psion's proprietary and fully preemptive multitasking OS, Epoc. OPL, a compact programming environment, is among the applications built into the Series 3a's 2 MB of ROM.

The proprietary OS means you won't have the range of shrink-wrapped DOS applications that are available for a device like the 200LX. However, Epoc offers fully preemptive multitasking, a compact development environment, and a raft of third-party programs.

The Series 3a comes with two PC Card slots; unfortunately, the slots accept only flash solid-state disk (flash SSD) or SRAM cards. An optional portable modem offers slow (2400-bps) data connections, but high-quality faxing, for \$295.

The Series 3a packs an 8-MHz 80186-equivalent CPU into a clamshell case with about the same dimensions as the 200LX. However, the Series 3a's stylishly rounded edges make it seem smaller when you slide it in and out of your pockets. Its larger and simpler QWERTY keypad makes for more accurate hunt-and-peck typing.

Sharp Zaurus ZR-5000FX

Sharp's Wizard is a leader among electronic organizers, and the Zaurus looks

LINGUA FRANCA FOR PDAS

IntelliLink for Windows 3.4 does for personal digital assistants (PDAs) and desktop applications what graphics converters like Hi-Jaak have been doing for graphical images for years: It changes files into a form you can use, thereby ironing out many of the kinks associated with transferring information.

Given the right cable, IntelliLink provides intelligent data transfer among many applications, ranging from Act 2.0 for Windows and Ecco to dBase IV, Paradox, Excel 7.0, Word 7.0, and WordPerfect for Windows. Supported PDAs include most of the devices from Casio, Hewlett-Packard, Psion, and Sharp.

The intelligence comes in when your job is more than just copying a file from one system to another. The program recognizes the source type, and, depending on the application, can even handle such special items as recurring appointments.

In addition to format conversion, IntelliLink allows you to reconcile the data in a target file

with that in a source—for example, when two records share the same personal name but are otherwise at odds. You can filter data when you don't want to transfer an entire file. IntelliLink's ability to map fields in a source file to those in a target is crucial, as anyone who has dropped one PIM for another knows well.

Occasionally we encountered difficulties in mapping fields for data transfer. When we attempted card-file transfers from Sidekick 2.0 for Windows to the Sharp Zaurus, we got a "Fields in data file have not been mapped" error message without further explanation. The message appeared even when the map showed all fields in the source were mapped. The documentation didn't explain the problem, nor did IntelliLink's technical-support staff, which kept us on hold at length.

Minor drawbacks aside, however, IntelliLink's file-conversion capabilities make this a dandy little application for people who demand an honest day's work from their PDA.

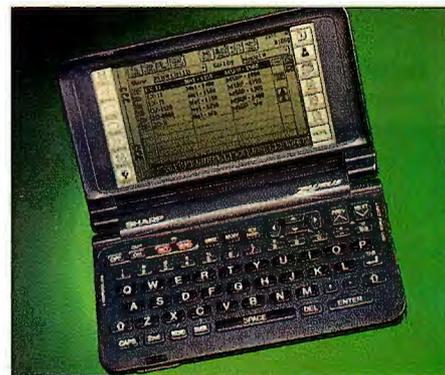
like a Wizard grown up. The Zaurus offers a plethora of convenient applications and a graphical OS. Because it doesn't attempt to perform handwriting recognition, the Zaurus's OS is not as ambitious as the Newton's or even the OmniGo's GEOS. However, everything that the Zaurus does, it does well.

Like the OmniGo, Zaurus is a pen-and-keypad system. Otherwise, its 320- by 240-pixel, 80-column by 25-row screen makes it look more like the Psion Series 3a or HP's 200LX. Zaurus's large, well-spaced keypad was the easiest to use of this bunch (the Psion Series 3a's was a close second). The Zaurus's pen and touchscreen made getting around the interface easy compared to using key-only PDAs.

The applications are among the most sophisticated of the PDAs we reviewed. For example, we easily linked a letter created in the Documents application with a contact or data file entry to jump directly between the files.

The Zaurus includes a lightweight fax modem that plugs into the serial port on the unit's side to provide two-way data and send-only fax capabilities. There's also an infrared port for communications with other Zauruses and some Wizards. Peripheral infrared ports are available for wireless desktop connections to either DOS or Macintosh systems, as well as to some printers.

Built-in communications applications include clients for terminal emulation and serial links, an E-mail interface, and a fax log. A proprietary cable (needed for serial connections) is available in a PC Link connectivity kit with backup and limited import/export software for DOS or the Mac (\$6.95). The



The Zaurus ZR-5000FX's pen and touchscreen make it easy to use.

company recommends IntelliLink for Windows for exchanging data with a wide range of Windows applications.

How to Choose

Which PDA is best? It depends on your needs. The 200LX has the most extensive desktop compatibility and connectivity options for PC environments. For the Macintosh, the MessagePad 120 with a connection kit is a natural partner.

If data-entry ease is your top criterion, the Series 3a and Zaurus ZR-5000FX sport relatively large, easy-to-use keypads. Number crunchers will find the 200LX handiest because of its numeric keypad and embedded applications. If what you want most is simply a PDA that's easy to carry around and works without fuss, the OmniGo takes the cake: It's small and light, with an easy-to-use interface and a comfortable keypad and pen. ■

Thomas Marshall is a freelance technical writer based in Seattle. You can contact him by sending E-mail to editors@bix.com.

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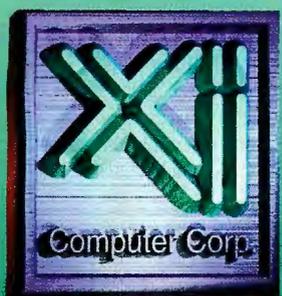
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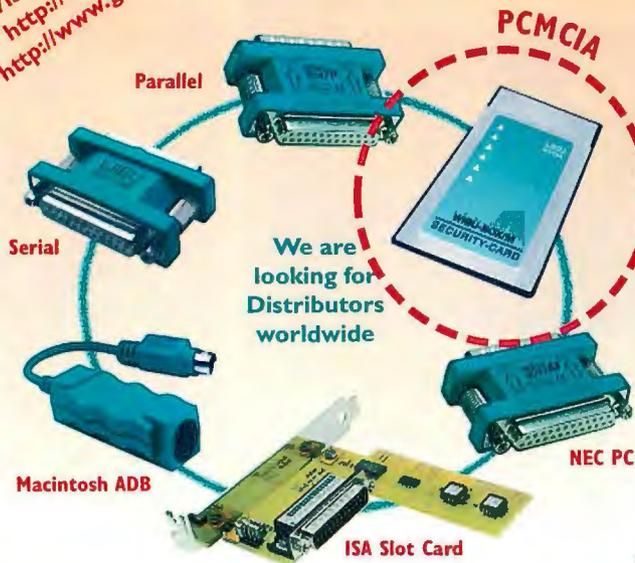
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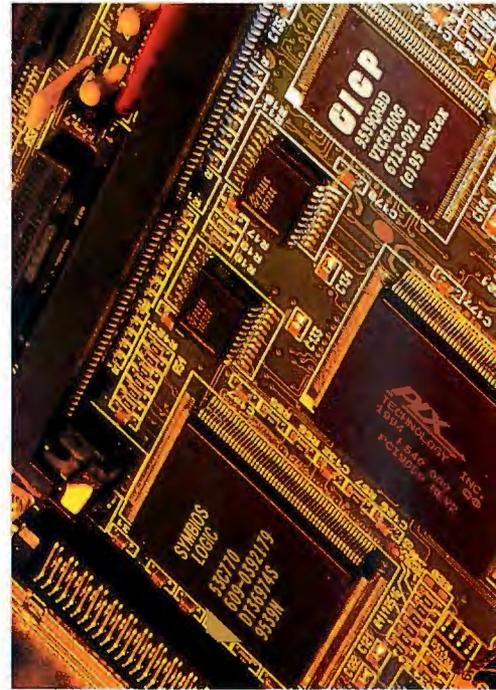
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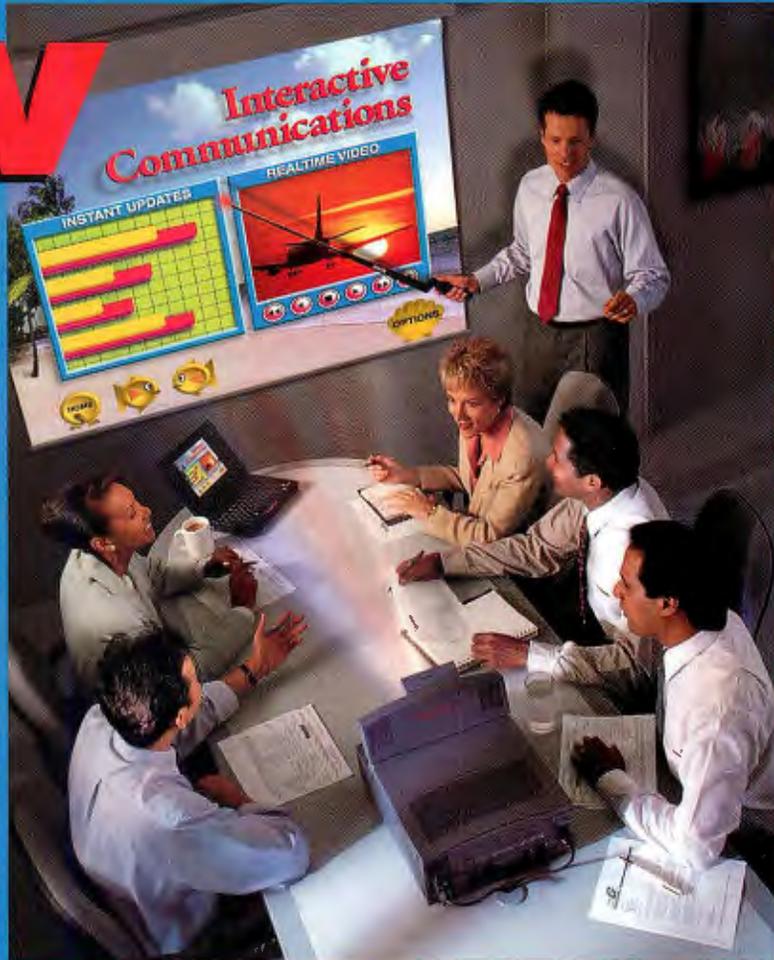
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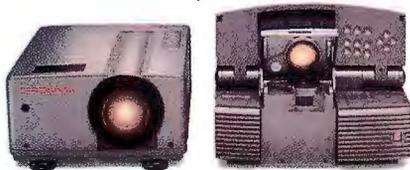


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Spinning the Corporate Web

Microsoft's Windows NT-based Web-server software beats Novell's NetWare entry in both versatility and capacity

STEVEN J. VAUGHAN-NICHOLS

Novell's NetWare reigns supreme as the network OS (NOS) of choice, but Microsoft's Windows NT has been snapping at its heels. Now, both companies are releasing Web servers to broaden the reach of their respective systems both within and outside the confines of their customers' offices.

Though they join an already crowded field, NetWare's Web Server (NWS) and Microsoft's Internet Information Server (IIS) are likely to figure prominently in the plans of corporations looking to add a Web server to their existing networks.

Of Markets and Technology

While the technology behind the programs takes two very different paths, the markets that Novell and Microsoft are trying to reach are the same. Each server essentially requires its company's top-of-the-line NOS—NetWare 4.1 and NT 3.51, respectively. If you're running any other NOS, you can forget about running these servers.

This means that only big companies with large user bases will find these servers useful. For a small enterprise, either NOS would be an unnecessary luxury. Smaller scale servers like O'Reilly & Associates' WebSite or Quarterdeck's WebServer would be more appropriate.

However, for companies with multiple WAN-connected sites or hundreds of users, NetWare and NT both make perfect sense, and so do their respective servers. Both Web servers play up this theme. You can use either one as easily for intranet communications and data sharing as you can for Internet services.

NetWare, Meet the Web

NWS is a complete Web publication kit. Besides the server, the package includes a licensed, single-user copy of Netscape Navigator and the WordPerfect Internet Publisher, a Hypertext Markup Language (HTML) editor that works with WordPerfect for Windows. However, NWS isn't picky about what flavor of HTML it serves out: You can choose to have your Web weavers use other HTML editors instead.

Although you can run NWS on earlier

Microsoft's Internet Information Server relies heavily on the setup procedures of Windows NT, including this screen for setting up a maintenance log.

Novell NWS can create NCSA standard logs, but it can't export them to ODBC databases like Microsoft IIS can.

The ability to feed report data to any ODBC database is a unique feature of IIS.

Like the Microsoft product, Novell's NetWare Web Server uses a succession of modular setup screens rather than a single front end.

versions of NetWare, you need NetWare 4.1 to get NetWare Directory Services (NDS) security. You also need the TCP/IP NetWare loadable module (NLM) and NDS up and configured. The server hardware itself requires only 2 MB of disk space to accommodate NWS, but Web pages require additional space of their own. Network administrators with an eye to security should create a NetWare volume specifically for HTML documents. Since NWS uses NDS for security, this makes it easier to keep unwanted visitors off the server.

Novell will say that NetWare 4.1, and hence NWS, needs only a 386 to run. In fact, you need at least a 486DX/25. More than anything else, you'll need RAM. Our test system, a 33-/66-MHz 486DX2 with 32 MB of RAM, made mincemeat of a

100-MHz Pentium system trying to run NDS with only 8 MB of RAM.

For practical purposes, you'll want to run NWS on a 486DX or higher system with as much memory as possible. Except for RAM, it requires little in the way of system resources, so you can run it in conjunction with your usual business NLMs. Your throughput may vary, but NWS plays well with other applications.

If you expect to run NWS on a server that's doing double duty as a heavily used database server, you may want to move up to a multiprocessor system, since NWS can take advantage of NetWare's symmetric multiprocessing (SMP) abilities. NWS will work on systems using System Fault Tolerance (SFT) Level III, Novell's ultimate defense against system failure.

NWS takes little time to install and configure. Novell claims it takes 10 minutes, and—if you're an experienced NetWare administrator installing NWS onto a pre-existing NetWare 4.1 server—that's right. But if you're also installing the bundled two-user-license copy of NetWare 4.1 onto a new machine, set aside several hours for

your jaunt into LAN management.

Next comes the security setup. Besides using NDS to provide basic access and log-in control, NWS comes with its own security tools. Alternatively, you can set security based on IP addresses, user name, host name, directory, document, users, or group, for fine-tuned security.

The GUI makes most administration tasks simple. For programming, you'll need to use the Remote-Common Gateway Interface (R-CGI), BASIC, and Perl to produce sophisticated Web applications.

Sophisticated is as sophisticated does, as Web administrator Forrest Gump might say, and here NWS seems clueless compared to the security-rich Microsoft offering. NWS supports neither of the two major on-line transaction security protocols, Secure Sockets Layer (SSL) or S-HTTP.

NWS also lacks certain reporting capacities. While it will generate National Center for Supercomputing Applications (NCSA) standard logs, it won't automatically log comments. If you want to keep close tabs on what's going on in your server, you'll need to add third-party tools.

Performance is one area where NWS isn't lacking in the least. On our test system, which included an NE2000 Ethernet card hooking the system into a 10-Mbps LAN, we were never able to make NWS break a sweat. The lesson is clear: With ample RAM, NWS is as fast as a fox with a pack of hounds on its trail.

Microsoft Joins the Web Revolution

Microsoft didn't really want to be on the Internet. When it introduced the Microsoft Network (MSN) along with Windows 95 last summer, the company was all set to offer a proprietary way for Microsoft product users to connect with each other and with Microsoft. Then, the Internet revolution happened, followed by the Web revolution; on-line services like MSN became old news. Worse still, Microsoft saw Netscape riding the wave toward Web domination. Suddenly, the Web wasn't a small ripple anymore: It was emerging as the tide of computing. So, for once, instead of hurrying a product to market before it was ready, Microsoft took its time in bringing out IIS.

IIS has fewer frills than NWS has. The package doesn't include an HTML editor, but you do get versions of Microsoft's Web browser, Internet Explorer, for all four main Windows versions. (Since Microsoft's Internet Assistant for Word is free for the downloading, it's not as if you're missing anything.) You also get

Microsoft IIS and Novell NWS Go Head to Head

	Microsoft Internet Information Server	NetWare Web Server
Features		
Access to variables from CGI scripting	✓	✓
Ability to send dynamic documents or images (aka server push)	✓	✗
Automatic directory tree	✓	✓
User directories	✓	✓
Search engine	✗	✗
Includes custom interaction (chat rooms, BBS-like systems)	✗	✗
Also acts as an HTTP proxy server	✗	✗
Logging		
CERN/NCSA common log format	✓	✓
Normal (hit) log entries can be customized	✓	✗
Can write to multiple logs	✓	✓
Server can generate nonhit log entries (e.g., comments)	✓	✗
CGI scripts can create their own log entries	✓	✓
Performance measurement logs	✓	✗
Security		
Supports SSL/S-HTTP	SSL only	✗
Prohibit by domain name	✗	✓
Prohibit by IP address	✓	✓
Access to data hierarchies based on IP address	✓	✓
Configurable user groups	✓	✓
Change user access without restarting server	✓	✓
GUI-based setup	✓	✓
GUI-based maintenance	✓	✓
Remote maintenance	✓	✓

✓ = yes; ✗ = no.

some old-fashioned Internet basics with IIS. For instance, IIS supports both FTP and gopher with their own servers.

As with NWS, you must have Microsoft's latest and greatest NOS, Windows NT 3.51, for its server to run. And, like Novell, Microsoft claims that NT will run on as slight a machine as a 386DX/25. Maybe it can if you don't mind taking coffee breaks—long coffee breaks—between file requests.

While a 486DX/25 is a more realistic minimum system to run IIS on, the key to performance is memory. Practically speaking, 32 MB of RAM is the least you'll want on your server.

IIS is not just for x86-compatible processors. The program will run on any platform supported by NT 3.51. This means that you can also put your DEC Alpha AXP, MIPS, or PowerPC NT servers to work as Web servers.

Installation is as easy—and as difficult—as installing NWS. If you already

have a working NT 3.51 server, it will take only a few minutes to set the server up. If you don't, however, that's another story.

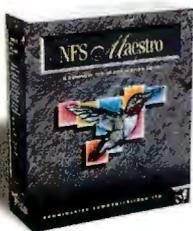
IIS begins to veer away from NWS, and from competitors like Netscape's Netsite Commerce 1.1, in its integration with the NOS. The Internet Service Manager, for example, uses NT's own administration tools for both users and file access. This has two benefits. The first is that if you know how to run NT, you know the basics of administering the server. The second is that it should run faster than other NT Web servers because it's so tightly tied to the OS.

On our test-bed network—which consisted of another 486DX/33/66 with 32 MB of RAM, with an NE2000 network interface card (NIC) and 10-Mbps Ethernet—we never seriously challenged the server's ability to dish out files. As with NWS, we ran out of bandwidth long before we ran out of server capability. That said, IIS's use of NT's own tools and its Mi-

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- SOCKS V4 Support
- IRC Client
- Archie

Microsoft code written to work hand in glove with the server's code clearly indicates that IIS should be hard to beat in performance, no matter whose server it's matched against.

Another place where IIS outdoes NWS is reporting. Besides just pouring out its information in standard ASCII Common Log File format, you can set it to feed information to any Open Database Connectivity (ODBC)-compliant database. What IIS can report on, though, is little more than what NWS can. For overall performance, IIS can call upon NT's own Performance Monitor.

Netscape's Commerce Server, the dominant NT server on the market, goes one better than both servers due to its log-analysis tool. One plus for IIS over Commerce Server, though, is its support of SSL. Unlike Netscape's server family, all versions of IIS support SSL. Since Mi-

crosoft plans to give IIS away, this clearly is a strike at Netscape's server business.

IIS shines brightest with its ODBC database integration. By using an ODBC-compliant engine, like Microsoft's own SQL Server, Web weavers can make truly complex, interactive intranet and Internet applications. They'll have to write them in Perl and use CGI for their interface, but with capacity like ODBC to draw upon, developers will have far more reason to pick up Perl.

Microsoft wants more than that level of interactivity. IIS is meant to integrate the Internet with the Microsoft Back Office. Therefore, IIS includes the Internet Server API, a Microsoft API that relies on DLLs for applications that should prove speedy, have a small RAM footprint, and will eventually enable developers to directly connect applications like Excel to network resources.

Product Information

Internet Information Server 1.0free
(downloadable from Web site; requires Windows NT Server 3.51)

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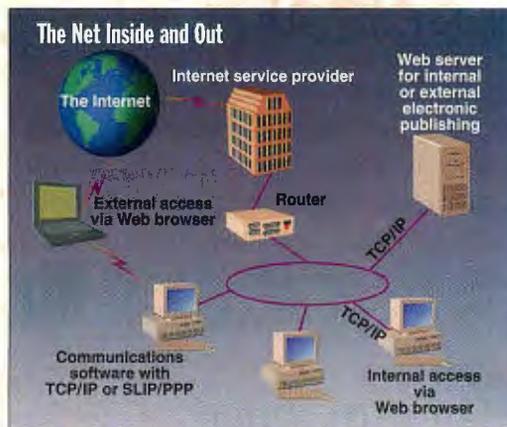
While Novell's NetWare Web Server and Microsoft's Internet Information Server do similar jobs—providing HTTP for TCP/IP transfer of Hypertext Markup Language (HTML) documents—they go about it in very different ways.

NWS is a NetWare loadable module (NLM) that stands apart from the network OS (NOS) and requires other NLMs. If you don't have the TCP/IP NLM installed, for example, NWS itself won't run. IIS, on the other hand, is an integral part of Windows NT Server 3.51. Instead of adding new layers of commands and menus, most IIS functions are performed with existing NT administration tools. Microsoft is currently offering IIS free of charge as part of its standard NT Server Value Pack.

For local users, NWS requires only that clients have a Web browser and are running TCP/IP.

While IIS also requires TCP/IP connectivity, this, along with IPX connectivity, is already provided in the base NT Server package. In our real-world tests, IIS was able to supply pages to workstations running Trumpet Winsock 1.1b, Windows 95's TCP/IP stack, and Frontier Technology's SuperTCP along with LAN WorkPlace. NWS, alas, worked only with LAN WorkPlace.

IIS also comes ready to hook into the other Microsoft Back Office applications with OLE 2.0 connectivity. With NWS, however, to achieve interoperability with other applications, you'll need to work hard customizing NLMs or writing Perl or BASIC programs. In the former case, to get the full advantage of IIS, you must also make the commitment to running Microsoft's Back Office products.



The Web server and LAN clients can access the Internet using a TCP/IP connection to a router linked to an Internet service provider. Clients can also use software (such as NetWare Connect) that provides an external TCP/IP or SLIP/PPP connection. Without TCP/IP, clients can still use their standard network protocol to access HTML pages on the Web server.

Closing the Connection

Which Web server is right for your enterprise? Well, if you don't already have a commitment to one NOS, IIS is the server for you. It just works better, and you can't beat the cost.

In terms of performance, there's little to separate the two. Both are faster than blazes. The difference lies in features, where Microsoft holds the advantage.

But is it enough of a difference to switch if you're already using NetWare? That depends on what kind of work you want to do. For basic Web publishing, NWS provides all you need. If you need to do bigger and better publishing on the Web, then you might want to consider adding an NT server to your NetWare system. The NT server, as odd as it may sound, now proudly wears the "Yes, it runs with NetWare" logo, and Microsoft offers utilities that make NT blend into any NetWare LAN.

The real question for NT users, who have no reason to switch to NWS, is whether they should go with Commerce Server or IIS. At this point, the decision is too close to call. Both offer great performance, good features, and tools for expansion. If price is important, IIS wins hands down. However, if you're running NT 3.51 and Web publishing is important to your enterprise, cost shouldn't be your chief concern anyway. ■

Steven J. Vaughan-Nichols is a freelance writer and consultant in Lanham, Maryland. You can reach him at sjvn@bix.com.



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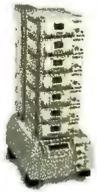
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Circle 106 on Inquiry Card.

Browse This Color Laser

The Phaser 550 brings 1200-dpi resolution to color laser printing, with a Web-based management interface

ROBERT L. HUMMEL

With its latest color laser printer, Tektronix has abandoned continuous-tone color for dithering. Eschewing variable-size pixels at 600 dots per inch, Tektronix has bet that the Phaser 550's 1200- by 1200-dpi native resolution will be the new standard for quality and consistency in color laser output. Tektronix is also placing heavy emphasis on the printer's monochrome output speed of 14 pages per minute (ppm) and on the ease of use that stems from its PhaserLink Web-based management interface.

With a full configuration costing nearly \$10,000, Tektronix is aiming the Phaser 550 at corporate workgroups. By also offering the Phaser 550 in a stripped-down version for \$6995, Tektronix hopes to lower the color laser price barrier. We found that this printer's color output is indeed excellent for a color laser, that its text quality matches that of a good 600-dpi monochrome laser, and that the Web interface has advantages but is not yet a complete print-management solution.

So Long, Con-Tone

The current crop of so-called continuous-tone color laser printers, including Tektronix's Phaser 540 and 540 Plus, use vari-

able-size dots to fine-tune their color output. But variations in physical factors, such as voltage, drum speed, or toner particle size, make the exact dimensions of the printed dots hard to reproduce consistently from job to job and printer to printer.

Tektronix has addressed the problem of dot inconsistency by avoiding it entirely and going with higher resolution (see the Technology Focus on page 122). The Phaser 550's Matsushita color laser engine produces a true 1200- by 1200-dpi resolution. With dithering, it generates at least the same apparent resolution as that produced by pulse-width-modulated lasers at 600 by 600 dpi. Dithering patterns are visible with close scrutiny, but color quality is the same as that of a good 600-dpi continuous-tone color laser.

The entry-level version of the Phaser 550 ships with 8 MB of installed memory—enough to support three- and four-color printing at only 600 by 600 dpi. To take advantage of the printer's 1200- by 600- and 1200- by 1200-dpi modes, you'll have to purchase a minimum of 16 MB of additional RAM in proprietary SIMMs (\$1195) as well as Tektronix's Extended Features Option (\$795, firmware on a SIMM).

The Phaser 550 uses a 32-MHz AMD 29040 RISC processor with a compression coprocessor to accelerate throughput and reduce physical memory requirements. Tektronix claims the Phaser 550 is the fastest desktop color laser on the market, citing a print-engine speed of 4.7 ppm in three-color mode (cyan, magenta, and yellow toners only) and with resolution at 600 by 600 dpi. Print speed drops when you switch to higher-quality output modes, but monochrome print speed is competitive with that of many monochrome lasers at 14 ppm for 600 by 600 dpi and 7 ppm for 1200 by 1200 dpi.

The Phaser 550 supports Pantone-



DAVID SHOPPER © 1996

Tektronix's Phaser 550 color laser can print at 1200- by 1200-dpi resolution. You can monitor and configure the printer itself with a Web browser (see the screen at lower left), but you still need standard tools to administer the network aspects of printing.

approved solid color simulations, ICM and ColorSync 2.0 color profiles, and TekColor dynamic correction. A 250-sheet feeder tray is standard, and you can add two more 250-sheet trays.

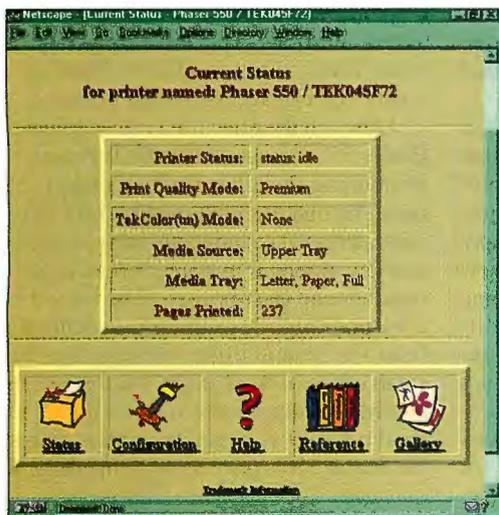
Even in its minimal configuration, the printer provides Adobe PostScript Level 2 and HPGL support. However, PCL 5 emulation (monochrome only) is optional and must be enabled specifically for each printer with a 28-digit authorization code you request from Tektronix.

Tektronix ships only 17 Type 1 outline fonts with the printer. Installing the Extended Features Option provides an additional 22 fonts. The printer accepts Adobe Type 1, Type 3, and TrueType downloadable fonts as well as a variety of user-defined fonts. Attaching an external hard drive adds font storage.

Interfaces and Drivers

You can install one of three optional PhaserShare network cards (one at a time). The Ethernet card (\$595) supports EtherTalk, and the Token Ring card supports TokenTalk. Both cards provide TCP/IP support as well as Novell NetWare support (including Novell Embedded Systems Technology (NEST) and NetWare Directory Service). A LocalTalk/serial card is also available.

The Phaser 550 comes with support software for a wide range of platforms; this software comes on CD-ROM and floppy disks. Drivers and installation utilities are provided for Macintosh, Windows 3.1,



The Phaser 550 provides this HTML page of printer-status information to any Web browser. You can also set up a site-specific help page.

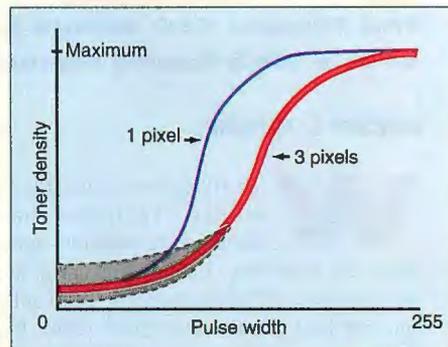
The Fine Art of Toner Control

Laser printers lay down discrete dots of toner onto paper in a grid pattern. If the dots are uniformly spaced and sized, fine lines and edges may look jagged, and the dithering patterns used to produce shades of color or gray may appear discontinuous. Many printers use techniques that adjust dot size and position to smooth lines and fine-tune dithering patterns. The size and even vertical position of a dot can be manipulated by adjusting the timing of the light source striking the printer's imaging drum. Varying the dot size is also how color laser printers create continuous-tone printing.

The relationship between the energy delivered by a printer's laser beam (controlled by pulse width) and the toner density of the dot it produces is anything but linear (see the figure). The sigmoid curve characterizing this relationship means that only a small range of the possible pulse-width values actually effect changes in toner density.

Laying down coarser three-dot pixels increases the range of control by decreasing the curve slope, but at the expense of resolution. Tektronix took this typical approach with the Phaser 540 and 540 Plus. However, minute changes in the printer's environment—including nonuniform toner particles, jitter, and variations in temperature, voltage, and humidity—still create uncontrollable variation at low toner densities (between the dotted lines in the figure).

With the Phaser 550, Tektronix avoided the problem of inconsistent dot size by eliminating laser modulation altogether and returning to pure dithering, but at higher resolution. Instead of varying the size of dots, the 1200- by 1200-dpi Phaser 550 can produce 16 different patterns of four discrete dots in the same space taken up by a single dot from a 600- by 600-dpi laser.



The relationship between toner density and laser pulse width doesn't allow for fine-tuning with single-pixel color dots. Using three-pixel color dots provides more range for control but suffers from noise variation at the low end.

Windows 95, as well as Windows NT.

To print from Unix and VMS workstations, you simply treat the Phaser 550 as a standard PostScript printer. You can print from any application that generates PostScript Level 1 or Level 2 output. To communicate directly with the printer to use the TekColor color corrections and other configuration features, however, you'll need the optional PhaserPrint software for Unix or PhaserSym software and Easy-Copy/X for VMS. You can also send downloadable utility files to the printer to set the various options.

While reviewing the Phaser 550, we did discover one catch-22. While you can enter nearly all printer settings from the front panel, there is no documented procedure for entering the IP address. So even if you plan to use the printer exclusively on a TCP/IP network, you have to configure it using one of the other interfaces, such as through Novell NetWare or a direct physical connection to the parallel port interface. There is an undocumented procedure to set the IP address directly, but as we

learned when setting up our unit, you have to talk to Tektronix tech support to get it.

Tech Support and the Web

As a networked printer, the Phaser 550 presents a classic technical-support problem. Deployed in a shared environment, the printer may serve users in different workgroups, on different floors, or even in different buildings. And although hundreds of users may ultimately use the printer, it still ships with only one set of printed manuals. Tektronix has taken several steps to ease the support burden.

In addition to hard-copy manuals, Tektronix provides a complete set of documentation on a CD-ROM in Adobe Acrobat PDF format. Copies of the Adobe Acrobat Reader for the Macintosh and Windows are included as well.

Tektronix also provides PhaserLink, a printer administration and support tool that uses World Wide Web (HTTP) technology. With PhaserLink, you can view printer status over a TCP/IP network using any standard Web browser. Although PhaserLink is an interesting feature, it's not going to replace traditional printer-control software in its current form. PhaserLink reports the status of the printer itself, but not the printer as part of the network environment. So it can't report how many jobs are in the print queue ahead of yours, for example, or whose job is currently printing.

Linking to the printer's Web page gives you only a static snapshot of printer status. For real-time status, you must remember to

refresh the Web page manually. Several times we caught ourselves waiting for a print job that had already finished while we monitored an out-of-date status page.

The true value of the Web interface is twofold. First, tech-support personnel, away from their workstations, need not worry about having proprietary software to check or configure the printer. Instead, they can do it on the nearest available machine using a standard Web browser. The second advantage is to facilitate in-house technical support. PhaserLink allows you to define a link from the printer's Web pages to a local Web server. You can use this link to supply your own site-specific help information or answers to frequently asked questions. The software also provides links to the Tektronix Web site, where you can access on-line manuals.

Although the price for a fully equipped Phaser 550 is around \$10,000, Tektronix is positioning the device as two printers in one. The first is a high-quality color laser with increased resolution to solve the consistency problems that are inherent in continuous-tone laser printers. The second is a 14-ppm high-resolution monochrome laser for general office printing. For the small office or workgroup, totaling up the purchase and support costs you'd have to shell out for two separate printers makes the Phaser 550's price more competitive. ■

Robert L. Hummel is an electrical engineer, programmer, and consultant. You can reach him at rhummel@monad.net.

Product Information

Phaser 550 \$9580
 (Includes 24 MB of RAM, Ethernet PhaserShare card, Extended Features Option)
 Tektronix
 Wilsonville, OR
 (800) 835-6100
 (503) 682-7377
 fax: (503) 682-7450
 http://www.tek.com/color_printers/
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Circle 228 on Inquiry Card.

Newton Reborn

A major revision of the Newton OS offers vastly improved handwriting recognition

TOM THOMPSON

The Newton OS, Apple's OS for hand-held computers, took a beating when it was introduced in 1993. But give Apple credit for taking the long view: While other companies went bankrupt or got out of the hand-held computer market, Apple kept plugging away, refining and improving the Newton OS.

Version 2.0 fixes a number of problems and offers better connectivity to networks. The handwriting recognition is vastly improved, the OS's improved heap management now provides faster response to object searches, and performance has been beefed up so that it can support PC Card modems at rates up to 28.8 Kbps.

By midyear, a TCP/IP stack with PPP support will let you use the MessagePad with a text-only World Wide Web browser, such as NetHopper from AllPen Software (Los Gatos, CA). This will enable personal digital assistants (PDAs) running the Newton OS to be low-cost Internet terminals. A \$109 ROM swap lets you upgrade a MessagePad 120 with an earlier OS version to version 2.0.

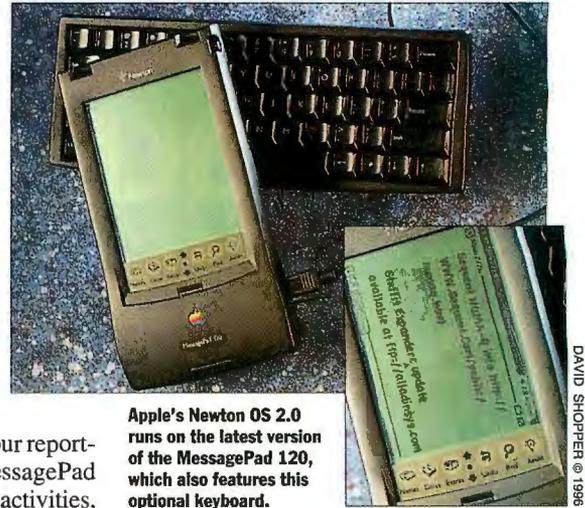
The most maligned part of the Newton OS, the handwriting-recognition engine, shows the most noticeable improvement. The brand-new recognition engine is optimized for printed, unconnected text. Having seen earlier versions of the Newton OS, we were curious to see if the recognizer was accurate enough to be really useful.

For this review, we put aside our reporter's notebooks and used the MessagePad to jot down technical notes, work activities, phone numbers, Internet addresses, and conversations with vendors and researchers. If you write separate printed or cursive characters, the new recognizer is a vast improvement. Because it interprets your writing character by character, when it stumbles you simply get a misspelled word. The frequency of these errors was small, and on many occasions the recognizer scored perfectly on eclectic sentences such as "Talked to Jon about an HQX file for the PowerPC BYTEmark archive." We could also jot down Internet uniform resource locators (URLs) without problems.

An input caret helps you direct where text should go on-screen, and a pop-up menu with Delete, Space, Return, and punctuation keys lets you quickly fix most typos. Apple also offers a small \$89 keyboard that's only slightly longer than the MessagePad itself. Just plug it into the serial port, turn on the MessagePad, and start typing.

Other Improvements

Digital ink (the pixel patterns that appear on-screen



Apple's Newton OS 2.0 runs on the latest version of the MessagePad 120, which also features this optional keyboard.

as you write) is now a data type that you can manipulate. Rather than having the OS treat the entire screen as a static blob of pixels, you select sections of it for deferred text conversion. Or you can copy and paste chunks of textual ink, such as a signature, into other Newton applications.

The new Newton OS also makes better use of the screen. You can rotate what's on-screen by 90 degrees so that the layout is in landscape, rather than portrait, mode. Old Newton applications will have a problem with this if they hard-wire the screen coordinates into a vertical layout. Applications that use relative coordinates within a graphical object (such as a dialog box) work without problems.

Overall, the Newton OS 2.0 is a significant improvement. If you print using separate letters, your handwriting troubles are over. The overall response of Newton applications is snappier, thanks to improved memory management. Finally, during all our work with the Newton, we never had to poke the Reset button, a common occurrence with the earlier Newton OS.

We'd be tempted to trade in our reporter's notebooks, but the several-second lag between writing and recognition interrupts our note-taking. We might switch when Apple comes out with a MessagePad with a StrongARM processor, which is expected later this year. ■

Tom Thompson is a BYTE senior technical editor at large with a B.S.E.E. degree from the University of Memphis. You can reach him by sending E-mail to tom_thompson@bix.com.

Building the Better Recognizer

The original Newton's handwriting-recognition engine was written by ParaGraph International (Sunnyvale, CA). It matched scrawls of ink against a 10,000-word dictionary. When it had to make a guess—a frequent occurrence—you got whimsical results.

With the Newton OS 2.0, the handwriting mechanism is split into two separate engines. An enhanced ParaGraph engine (called the cursive recognizer) translates connected, cursive text using a 30,000-word dictionary and improved recognition algorithms.

A brand-new engine converts unconnected, printed text. Written in-house by Apple, this engine tracks the sequence of strokes used to write an isolated character. An artificial neural network (ANN) uses this stroke information to classify a character. The ANN can deal with variations in the stroke size and geometry of handwritten characters that occur among different people, and also for changes in an individual writer's style over time.

Product Information

Newton OS 2.0
 ROM swap\$109
 MessagePad 120 with
 version 2.0\$699
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 Cupertino, CA
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New Videophones Starved for Bandwidth

How to make your own dancing postage stamps

PETER WAYNER

Videoconferencing systems are pricey, and the oft-promised telco videophone remains a promise of the future. So, to videoconference inexpensively, try your Internet connection: It's got worldwide reach and low hourly rates. All you need is an inexpensive video camera and one of the videophone programs reviewed here. The videoconferencing quality is disappointing at typical Internet bandwidths, but the price is right (less than \$200).

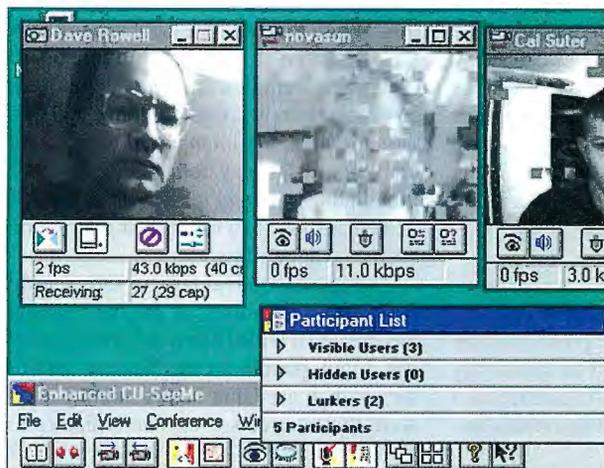
Low-cost Internet videophone technology comes from three major sources. Cornell University distributes free, over the Internet, the CU-SeeMe application. Cornell is also working with White Pine Software to develop a \$99 commercial version with more features, called Enhanced CU-SeeMe. The free version runs on the Macintosh and Windows and successfully links users of both types of machines. When this was written, White Pine was just releasing the Windows version of Enhanced CU-SeeMe, with the Mac version promised shortly thereafter. We tested White Pine's Windows software.

Source two is Apple. Its QuickTime Conferencing is a set of extensions to the Mac OS that allows videoconferencing over networks, including the Internet. Apple bundles these extensions with its own camera (\$289), but it also allows Connectix to bundle a version of the software with QuickCam, an inexpensive, squash-ball-size video camera (see the text box "Starter Camera" on page 128). We tested the Connectix version of Apple's software.

As the third source, Connectix sells its software/camera package for \$249 (\$149 estimated street price) under the name VideoPhone. For the same price, Connectix also sells a Windows version of VideoPhone that's based on the InVision software package. (InVision Systems is now a Connectix subsidiary.)

We tested late-beta versions of the Mac and Windows versions of VideoPhone 1.1. Although they bear the same name, the Mac and the Windows products emerged from completely different sources. However, their logos and manuals look similar.

Unfortunately, the Mac and Windows



Connectix VideoPhone (Windows version at left) doesn't yet work across platforms but provides better imaging and more professional features than does Enhanced CU-SeeMe (below). Only the Mac version of VideoPhone supports multiperson conferencing. It uses multicasting, while CU-SeeMe requires reflector sites. All these programs require significant network bandwidth for any quality at all. With a 28.8-Kbps modem hookup, the frame rate often falls below one per second.

versions of VideoPhone can't yet connect with each other. Connectix says it plans by this summer to blend features and make the products work together.

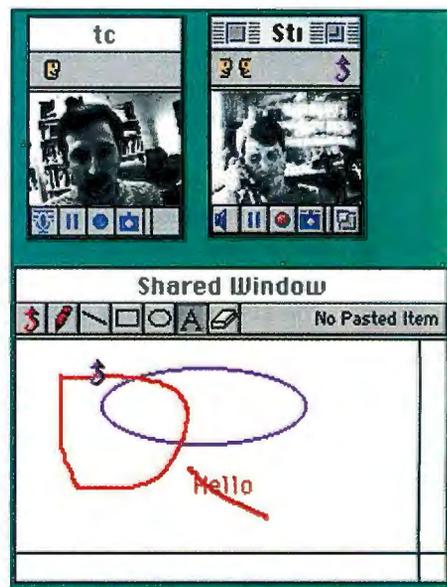
The Basic Idea

The basic idea behind all three packages is to provide a mechanism for several people to discuss topics remotely. Each person's image is broadcast from his or her camera to appear in a window on everyone else's display.

A five-person conference requires five windows on everyone's screen and a mixed audio feed. All this video requires plenty of bandwidth: A simple, 8-bit, black-and-white, 160- by 120-pixel image digitized at 15 frames per second takes up about 2.5 Mbps. Compression can lower this to well below 1 Mbps—but still too much data to ship down a 28.8-Kbps modem line. The audio channel adds even more to the data load.

Such numbers make it easy to see why using these systems over the Internet is often disappointing. When the pipes aren't fat enough, the software reduces the number of frames per second. Rates of between 1 to 5 fps are typical of a good connection, but rates below 1 fps are all too common on slower links.

The systems send their images as compressed blocks of pixels. With CU-SeeMe, if a block doesn't show up, the phone never puts it on the screen. This can lead to a crazy-quilt effect when the network is heavily loaded, because some blocks in the displayed image are from the current



frame and some are from a previous frame. This becomes quite apparent when the video feed abruptly segues to another view, as it often does in broadcast video. VideoPhone doesn't have this problem with either its Mac (QuickTime Conferencing) or its Windows version.

We tested the products over a variety of configurations. We used Connectix QuickCams on Apple Power Macs, as well as on a 90-MHz Hewlett-Packard Vectra and a 150-MHz Dell Dimension XPS Pro150, both running Windows 95. The Internet connections were created through a 28.8-Kbps modem connected to an Internet service provider (ISP) running PPP. This level of performance is far from ade-

REVIEWS New Videophones Starved for Bandwidth

quate, but it's typical of many Internet connections.

In addition to testing over a 28.8-Kbps Internet connection, we tested some of these products on an Ethernet LAN and found the performance to be quite reasonable when the software could use the full speed of a dedicated LAN connection. The images were not full screen size or anywhere near broadcast quality, but these problems weren't caused by any network bottlenecks; rather, low-cost cameras and slower video boards got in the way. In the LAN environment, the products delivered much of what we expected.

Enhanced CU-SeeMe

Cornell University's CU-SeeMe technology started as an academic project to link people over the Internet. The university will continue to support CU-SeeMe as a free product while White Pine creates and

markets the more feature-rich commercial product, Enhanced CU-SeeMe.

White Pine has added a number of features to the commercial version of CU-SeeMe. We tested a late-beta copy of the Windows version; the Macintosh version should be available by the time you read this. White Pine's biggest enhancement is the addition of a shared WhitePineboard drawing system that conference members can use to jointly create diagrams and discuss pictures. It's intended to work like a chalkboard. The system works fine, although the drawing tools aren't as sophisticated as those of a full drawing program, such as Adobe Illustrator.

The greatest advantage to CU-SeeMe is that the availability of the free version has created a wide following on the Internet. Many people on the Net run *reflectors*, which are Unix boxes running software that redirects everyone's picture to

everyone else in a conference. NASA, for instance, broadcasts pictures from its space shuttles across the Net using a CU-SeeMe reflector. Other people have set up reflectors that act as after-hours gathering places.

Among the reflector technology's limitations is that the software runs only on Unix machines. If you want to have a multiperson videoconference, you need to either set up your own reflector on such a system or borrow someone's Unix box on the Net. Many people are generous with their reflectors, but like all other free resources, they get bogged down. In addition, traffic increases quadratically with the number of users (see the Technology Focus box below).

When you first sign on to a conference, the White Pine version of CU-SeeMe displays all the subconferences and the number of members. The plain Cornell version (0.84) won't do this. In addition, the program's basic appearance is greatly improved; it now approximates the Cornell Macintosh version (0.83) in look and feel.

VideoPhone Mac

The Macintosh version of Connectix VideoPhone is the same software as Apple's QuickTime Conferencing. The main difference is that Connectix bundles its QuickCam camera with VideoPhone.

The well-designed program integrates well with Apple's QuickTime system extension, which already provides a wide selection of image-compression algorithms. The system hides low-level networking details from the user and is optimized to provide good service over high-speed links. The software also integrates well with other Macintosh system enhancements, including PowerTalk and the built-in Catalogs.

You can display images of all the other people involved in a conference, each in a separate window. A shared whiteboard is also integrated with the software, and any conference member can add his or her photo to the whiteboard by pressing a button. In practice, you might point your camera at a document, photo, or object and then send a picture to all members. The drawing tools are somewhat rudimentary.

The major difference between VideoPhone (and QuickTime Conferencing) and CU-SeeMe lies below the surface. VideoPhone supports multiperson conferencing without using a reflector. The underlying technology supports network multicasts, which saves bandwidth by cutting down on multiple rebroadcasts. If two of the participants are on the same branch of a net-

TECHNOLOGY FOCUS

Reflectors or Multicasting?

The fact that the Internet was originally designed for point-to-point communications does not stop people from attempting multiperson conferencing and broadcasting of video signals. One challenge is in passing time-sensitive audio and video data over a network designed for passing data in irregular bursts, often with significant delays. Another challenge is in the sheer volume of data involved in a videoconference. If there are 12 people conferencing with pure point-to-point communications, then each participant must simultaneously send and receive 11 signals. This takes an awful lot of bandwidth.

The CU-SeeMe system, built at Cornell University, solves half the bandwidth problem by creating reflecting software that runs on a central machine with high-speed access to the network. A reflector takes one incoming signal from each participant and sends it out to the others. This saves each participant the bandwidth of shipping $n-1$ copies of an image at the same time (where n is the number of participants) and gives people with 28.8-Kbps modem connections a shot at multiconferencing.

But this solves only half the problem. A central reflector still overloads easily. It must ship out $n-1$ image streams to each of n participants. That's n^2-n image streams—a number that grows quadratically as more people join. Even

T-1 lines can become saturated very quickly. Clearly, reflectors are not a large- or even medium-scale solution.

A better long-term solution comes from IP multicasting (supported by Apple QuickTime Conferencing), which allows one node to send out a single video feed to several other nodes. Each member of the conference broadcasts his or her feed over the multicasting backbone, and each other member taps into this feed. Only n copies travel over the backbone, and each recipient picks up only n copies. It's still a lot of data, but multicasting caps the quadratic explosion.



A reflector cuts the data each conferee must transmit on a point-to-point network.

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REVIEWS New Videophones Starved for Bandwidth

work, only one copy of each image travels to them, and both receive it. This can be a significant advantage.

We also liked the ability to create a compressed QuickTime movie of a conference. Moreover, the software requires all members of a conference to consent before starting a movie. This is a nice way of acknowledging people's desire for privacy.

The QuickTime Conferencing sessions ran quite well over an Ethernet line, but they crashed frequently when connected to the greater Internet with a minimal 28.8-Kbps line. We're not sure why this failure occurred, because the software simply announced that the other side was ending the conversation. The symptoms seem to suggest that one side reached a time-out and decided that the other side had quit.

VideoPhone Windows

It's not interoperable with the Mac version, but the Windows version of VideoPhone is similar in features, although the two interfaces are somewhat different (e.g., the whiteboard is a different program). In spite of the differences, there are few enough controls that a user familiar with one version should be able to use the other without encountering problems.

The biggest differ-

ence between the two is that the Windows version cannot create a multiperson conference. It has the ability to send one video signal to several recipients in a broadcast, but it can't arrange for all to talk simultaneously; only two people can interact. This is largely because of the differences in the network software layer. The Apple version is optimized around AppleTalk and the latest IP multicasting standards, while the Windows version is optimized for Novell IPX networks.

The Windows version of Connectix VideoPhone works fairly well and delivers an acceptably stable connection over a slow line. The compression software does not fragment the screen or clutter up the current frame with artifacts from previous frames. The picture, though small, is of decent quality.

Connectix says that it's committed to making the Macintosh and Windows versions interoperable, and with identical options. This means that the Windows version will pick up multiperson conferencing and some advanced video-compression routines, such as H.261, while the Mac version will emerge with the ability to use modems to initiate calls without using a network. Currently only the Windows version can do this.



Connectix's QuickCam camera is a low-cost route to black-and-white videoconferencing.

Starter Camera

People who would never consider hooking video feeds into their computer because of the expense are experimenting with the low-cost QuickCam from Connectix. You can often buy the black-and-white camera for less than \$100, and a package that includes videoconferencing software doesn't cost much more.

The big reason for the small price is that QuickCam uses a more direct host interface than other video cameras do. Most video cameras turn the raw analog data from their imaging hardware into a standardized, compressed NTSC or PAL signal, also analog. That signal must then be converted to digital data in the host system by a special video-processing card that can cost several hundred dollars.

QuickCam uses a low-cost charge coupled device (CCD) that generates a digital image in the camera and sends that digital data to the host system's parallel port (on a PC) or serial port (on a Mac), where it can be read directly by software. The camera is less expensive because it doesn't need as much signal-processing electronics, and you also avoid the cost of a video card.

On the downside, completely digital video signals can overload a computer's parallel port. A 320- by 160-pixel frame with 256 gray levels takes up 50 KB. At 20 frames per second, a megabyte must flow over a parallel port every second. Newer parallel ports can handle just about that much data, but many older ports can't. In addition, QuickCam's proprietary interface prevents you from using it with standard video equipment. While QuickCam's direct design makes these compromises, it delivers video at a significantly lower cost than other approaches.

Product Information

Connectix VideoPhone 1.1 . . . \$249
(\$149 estimated street price)
(Macintosh or Windows version; QuickCam camera included)
Connectix Corp.
San Mateo, CA
(800) 950-5880
(415) 571-5100
fax: (415) 571-5195
<http://www.connectix.com>
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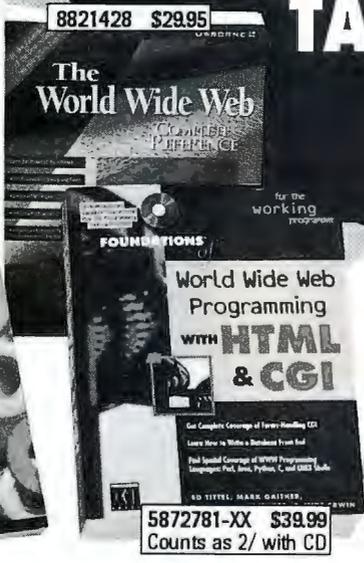
Picking a best product depends on what you want to do with it. The CU-SeeMe software is the only cross-platform solution available at this writing. Whether you get the free or the commercial version, it also provides the worst performance, and you need to set up a reflector if you want multiperson communications.

The Mac version of VideoPhone and Apple's QuickTime Conferencing technology are better business tools. The software doesn't require a separate reflector to handle multiperson conferencing and integrates well with the Mac OS. The Apple platform's video support provides users with many options for getting their video feed. The QuickCam camera bundled with VideoPhone is a good option.

The Windows version of VideoPhone comes in a close second, and the product should benefit as it incorporates many of the features of its Apple cousin. When this happens, VideoPhone should turn out to be the best cross-platform system of the three.

None of these programs can deal very well with the fundamental lack of bandwidth available on the Internet. To their credit, all of them advertise themselves as useful for ISDN or networks and conveniently forget to mention the Internet. They all work reasonably well on fast branches of the Internet, but if you've got a 28.8-Kbps hookup, consider it an experiment and jump in with both feet. ■

Peter Wayner is a BYTE consulting editor living in Baltimore, Maryland. You can reach him on the Internet at pcw@access.digex.net, on BIX at pwayner@bix.com, or on the World Wide Web at <http://access.digex.net/~pcw/pcwpage.html>.



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Reinventing SmartSuite

Lotus bolsters its struggling application suite with workgroup features and connections to both Notes 4 and the Web

STEVE GILLMOR

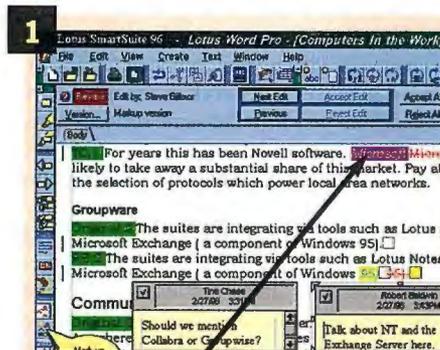
Lotus has coordinated the new SmartSuite 96 release with the Notes 4.0 rollout to bring a common look and feel to many of the SmartSuite applications. Add to that SmartSuite's unique team-computing features and Notes 4.0's user friendliness and Web capabilities, and the benefits deserve a closer look.

SmartSuite 96 includes 32-bit versions of the Word Pro (formerly Ami Pro) word processor, the Freelance Graphics presentation tool, and the Approach database manager. The 1-2-3 Release 5 spreadsheet, the Organizer 2.1 personal and group scheduler, and the innovative ScreenCam multimedia recorder/player remain 16-bit applications with minor revisions to accommodate Windows 95 compatibility.

Both 1-2-3 and Organizer already had team features before SmartSuite 96 came out. You can share Organizer files on a network for simultaneous read and write access, with LAN-based group scheduling delivered via cc:Mail and Notes networks. Lotus 1-2-3 Release 5 added the Version Manager technology for creating and viewing different sets of data within the same named range. You can share the resulting data with a workgroup via a network or through Notes, and you can merge versions and scenarios into a master file. Range routing employs E-mail to send data to a workgroup either simultaneously or sequentially for updates and comments.

Lotus has integrated these group-enabling tools into the new SmartSuite, employing a revamped user interface and Windows 95 capabilities. The 32-bit SmartCenter application is automatically installed in the Start menu; it uses a file cabinet metaphor to store and launch applications and documents. You can double-click to launch Notes databases, or you can directly access Organizer calendar and address data without running the PIM.

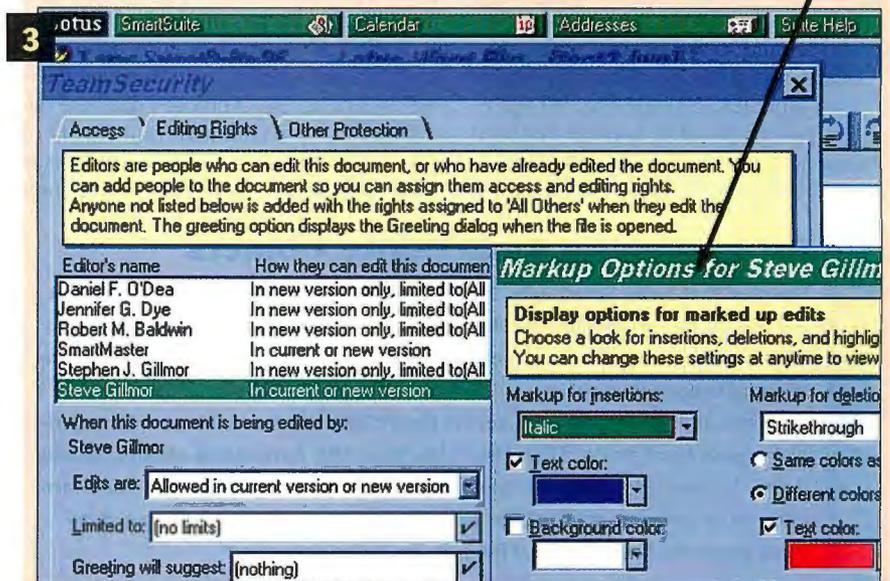
The 32-bit applications share many of Lotus' new context-sensitive tools, including the floating InfoBox, the interactive status bar, programmable SmartIcons, tabs, and a common menu structure. Lotus' SmartMaster templates have been enhanced



The user's unique highlighting marks, as set up in TeamReview Assistant



User privileges are set up in TeamSecurity and TeamReview Assistant to control changes in the consolidated document.



SmartSuite's groupware features require you to define members of the workgroup and their privileges. For example, Word Pro's TeamReview Assistant (1) walks you through a series of tabbed dialog boxes to assign reviewers, determine their editing rights, and select a distribution method. TeamConsolidate (2) displays edited paragraphs below the originals. Tags with the reviewer's initials indicate who made the first editorial changes in a section. You use the review bar to accept or reject marked edits individually or all at once. The TeamSecurity dialog box (3) lets you specify the location and types of changes allowed by editors.

with "Click Here" blocks you can contour to specific clients and business goals.

Working in Teams

While SmartSuite's team-computing features share some names, implementation of these tools varies. Word Pro sports the widest range of options, including versioning, TeamReview, TeamSecurity, TeamMail, and TeamConsolidate.

Versioning exploits Word Pro's new

document file structure, letting you maintain multiple versions in a single file. Only the changes are stored in the document. You can use versioning to track a document's history, viewing the names of the people who edited each version as well as the dates and times the versions were created and last edited.

TeamReview provides an Assistant dialog box with three tabs labeled Who, What, and How. The first lets you add or

remove the names of people who will review or edit the current document. Next you determine each reviewer's editing rights. Then you can save the document to a file, route it to your E-mail system, or open the Save to Internet dialog box to send the file to a reviewer via FTP.

TeamSecurity provides another layer of security for shared documents. An author can assign access rights not only to a document but to the TeamSecurity dialog box itself. You can specify the types of changes an editor can make, set markup options to color-code changes, and create private sections of documents that you can hide or protect from alteration.

TeamMail stitches the workgroup together, letting you broadcast documents or route them from one team member to the next from within Word Pro. You can track the progress of your documents or have your mail system notify another team member. You can also let recipients add, delete, or modify names on the list to reroute documents around an absent team member.

TeamConsolidate combines the results of team input into a single file. Word Pro copies paragraphs that contain editorial changes and displays them in a markup file below the original. You use the review bar

to accept or reject edits, then save your consolidated document to a new file or over the original document.

Freelance Graphics 96 supports TeamReview, TeamMail, and the unique TeamShow, which lets you run a screen show from your computer while others watch over a network or via a modem. TeamMail performs the same services here, but TeamReview reviewers cannot change or edit the original presentation or the comments of other participants.

Comments take the form of yellow sticky notes; you can mark up sections of the presentation with lines, circles, arrows, and freehand drawings. The package includes a new Win 95 run-time player that you can freely distribute with your presentations, or you can let Freelance convert your pages into Hypertext Markup Language (HTML) and GIF files for posting on the Web.

Approach's team-computing options include TeamSecurity, TeamMail, and PowerKey data access. Approach database designers can provide different levels of password-protected access for a workgroup, allowing some to access all views, enter

Product Information

SmartSuite 96 Edition for Windows 95\$399
(estimated retail price)
Lotus Development Corp.
Cambridge, MA
(800) 343-5414
(617) 577-8500
<http://www.lotus.com>
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new records, and modify existing ones. Others might have read-only access. You can use TeamMail to send an entire database application, or you can send the current

view, a Windows metafile snapshot of the current view, or a blank form. You can also use Notes PowerKey to generate reports, mailing labels, crosstabs, and data-entry forms from Notes data without opening Notes itself.

The World Beyond

SmartSuite 96 supports the enhanced Notes/FX technology, which lets you exchange data between fields in a Notes document and fields in SmartSuite application files. The new NotesFlow extension allows customization of both Notes 4.0 and SmartSuite application menus to create an integrated workflow interface.

The addition of LotusScript to Notes 4.0, Word Pro, Freelance, and Approach extends team computing to incorporate Notes strengths such as replication, security, and Web site management. You can embed a Word Pro document in a rich text field in a Notes document, then use Notes mail routing, dial-up remote access, category viewing, and sorting to extend your workgroup's functionality.

You can use other new SmartSuite tools to interact with the Internet environment. Word Pro can use its built-in FTP support and TeamReview to publish Web pages from within the word processor. Approach ships with the Webster OCX browser tool, which allows embedding of Web capabilities in your own database applications.

Forced Integration

Overall, SmartSuite 96 is vastly improved in its user interface design, with SmartMasters, tabbed dialogs, and particularly the InfoBox properties tool providing a common thread throughout the system. But the LotusScript development environment can be somewhat difficult to navigate, partly because it lacks a facility like the one in Visual Basic to jump with a function key to a referenced subroutine.

With Notes 4.0's recent surge in sales and a timely foray into Web publishing, SmartSuite 96's tool set becomes a valuable addition for corporations already committed to the Lotus environment. ■

Steve Gillmor is director of Southern Digital (Charleston, South Carolina). You can reach him at sgillmor@aol.com.

TECHNOLOGY FOCUS

Programming SmartSuite Objects

The glue that holds SmartSuite 96 and Lotus Notes 4.0 together is LotusScript 3.0 and its object-oriented development environment. Besides making SmartSuite programmable to users, LotusScript works behind the scenes to integrate the applications themselves.

LotusScript's ability to work across SmartSuite and Notes lets you, for example, expose Word Pro's "Click Here" blocks as OLE Automation objects, making it easy to search for a specific block and fill it with Notes-aware text. For a form letter to an investment client, for example, you might use the following statement to get the first of several fields in the Notes document:

```
PortValue = doc.GetFirstItem("PortValue")
```

Next (and still inside Notes), you might calculate investment results and use the following **If...Else** statement to choose and print a brief report:

```
If SPAnGain > CustAnGain Then  
    Closing = "We're doing fine and will contact you about  
    some changes to your investment mix."  
Else  
    Closing = "We're beating the S & P 500 - Aren't you  
    glad you invested with us!"
```

Notes then calls Word Pro, starting with the statement:

```
Set WP = GetWordPro()
```

and Word Pro loads a template containing several Click Here blocks. These, when activated, start the Notes routines, including the one containing the boilerplate report:

```
Call EnterClickHere( "Closing", Closing, WP )
```

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CDBY096

Workgroups Dock at IR Port

Hewlett-Packard's new infrared device provides a quick connection between notebook and network

BARRY NANCE

Tired of plugging your laptop into the LAN? Hewlett-Packard's answer is NetBeamIR, a small infrared (IR) device that gives automatic network access to IR-capable systems.

As a simple, plugless replacement for a PC Card Ethernet adapter, the \$289 NetBeamIR is too expensive for most users. It's better employed in a shop or sales-floor environment where information is collected on many laptops and central network files are updated frequently. But here NetBeamIR could become more useful with improved distance and direction—now a limited 1 meter and 30 degrees.

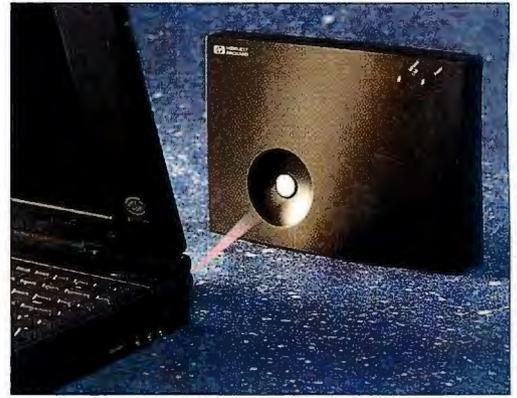
Through an RJ-45 (10Base-T) or BNC (10Base-2) connector, NetBeamIR attaches to your Ethernet LAN. A notebook computer with an infrared port running Windows 95 or OS/2 (drivers are scheduled to ship soon) can treat NetBeamIR like a regular LAN connection point.

Most PC infrared ports currently offer only 115-Kbps operation, but HP expects notebook makers to build PCs with faster IR ports later this year. NetBeamIR works with 115-Kbps ports and, HP claims, with the future crop of 1-Mbps and 4-Mbps ports. The ports themselves are standardized, thanks to the Infrared Device Association (IRDA; <http://www.irda.org>).

NetBeamIR works with most network

OSes (NOSes) that support Ethernet, including Novell NetWare, Microsoft NT Server, and IBM LAN Server. We tested NetBeamIR on both NetWare and LAN Server, using an HP Omnibook 5000 PC with a 115-Kbps infrared port. With NetBeamIR, the PC worked just as if it were directly connected to the network. Once we got beyond 4 feet or 30 degrees, connection was intermittent but still possible—up to about 6 feet. In these ranges, even the presence of dust in the air could disrupt the connection.

But what's nice about NetBeamIR is the way it reestablishes a temporarily lost connection. If the PC moves out of range or an obstruction blocks the infrared signal, NetBeamIR automatically tries for 16 seconds to reconnect. During this period, NetBeamIR handles intermittent signal losses reliably: It quickly reconnects and doesn't drop or damage LAN packets (e.g., during file transfers). After 16 seconds, NetBeamIR breaks the connection, and



With its subtle curves and cyclops-eye infrared window, HP's NetBeamIR offers painless connectivity between laptop and LAN.

DAVID SHOPPER © 1996

you have to log in to the file server again.

NetBeamIR does not yet work with IR-equipped personal digital assistants (PDAs), such as the Apple Newton. HP says it will support token ring in the future if there's sufficient demand.

NetBeamIR makes a costly but nice desktop LAN connection. Once HP improves the distance and direction limitations, we think NetBeamIR will easily find its way onto sales floors and into warehouses and corporate conference rooms. ■

Product Information

NetBeamIR Infrared LAN

Access Point\$289

Hewlett-Packard Co.

Santa Clara, CA

(800) 533-1333

fax: (800) 333-1917; (208) 344-4809

http://www.hp.com/go/network_city

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Barry Nance is a BYTE contributing editor and the author of Using OS/2 Warp (Que, 1994), Introduction to Networking (Que, 1994), and Client/Server LAN Programming (Que, 1994). You can reach him by sending E-mail to barryn@bix.com.

TECHNOLOGY FOCUS

Hot New Standards from IRDA

The Infrared Device Association (IRDA), a group of about 120 companies, supports infrared connectivity among computers and other devices. Until recently, IRDA's standards characterized infrared ports as serial links operating at speeds up to 115 Kbps. IRDA's latest standards allow transmission rates as high as 4 Mbps and provide for LAN access via a new IRLAN protocol.

The 4-Mbps mode uses pulse-position-modulation data encoding with four possible chip or time-slice positions per data symbol. The system can recognize and prevent interference with UART-based systems by including a Serial Infrared physical-layer-link Interaction Pulse (SIP) at least every 500 milliseconds.

IRDA has developed two APIs for accessing the infrared port. The first, IRCOMM, emulates existing communications

device drivers to handle legacy serial and parallel-port connectivity. There's also a native API that infrared-aware programs can use to locate and communicate with each other.

IRDA defines a link protocol for serial infrared links, called Infrared Link Access Protocol (IRLAP). IRLAP explains how link initialization, device address discovery, connection start-up (including link data rate negotiation), information exchange, disconnection, link shutdown, and device address conflict resolution occur on an IR connection. IRLAP implements the high-level data-link control (HDLC) communications protocol for infrared environments and adds procedures for infrared-based link initialization and shutdown plus connection start-up, disconnection, and information transfer. The rules for discovery and address-conflict resolution are IRLAP's most significant departure from HDLC.

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Don't Lose Your Crypto Keys

Entrust's simple yet effective key management offers a solution for encrypting E-mail throughout your enterprise

PETER WAYNER

There's an old saying in the cryptography business: "Encryption is easy, but key management is hard." Entrust, an enterprise-wide encryption and digital-signature package from Nortel, offers encryption and key management to small and large companies alike.

Key management is a potential nightmare because any system must guarantee a secure channel that will not reveal the secret key to eavesdroppers. The problem is severe in corporate WANs, where a central administrator must install individual keys on every computer.

Public and Private Keys

Entrust comes in two pieces: Entrust Manager and Entrust Client. The former maintains an easy-to-administer list of users' private and public key pairs. With the Entrust Manager software, you create a public and private key pair for each new user. Your organization publishes the public key in a central directory; you give the encrypted pri-

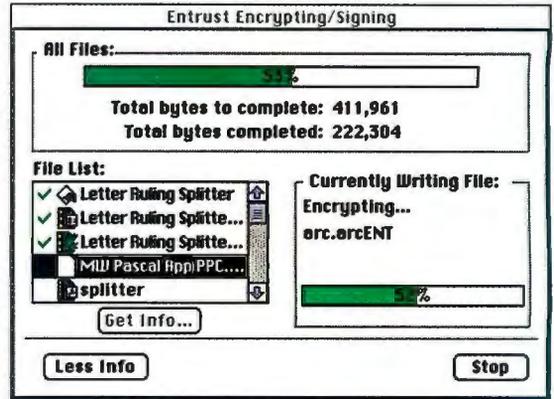
vate key to the user in a separate file along with installation instructions. The Manager manual even includes a sample letter that gives a new user all the necessary local information.

The administrator also retains an encrypted copy of the private key in a special file that he or she must keep secret. If someone leaves the company, forgets a password, or calls in sick, the manager can reconstruct the user's key from this file. This is an effective form of corporate key escrow that doesn't compromise any individual.

Other key-escrow plans involve adding to each message a special field that includes the session key encrypted with some master key. If the master key is compromised, then all communications are shut down. Entrust's master file can also be stolen, but you can protect it by physical means. There's no way to mount an attack by gathering the special fields encrypted with the special escrow key.

The Entrust Client can encrypt, decrypt, or sign files using either DES or Nortel's proprietary CAST algorithm. The public-key encryption uses the Rivest-Shamir-Adleman (RSA) algorithm. Especially nice is the ability to encrypt a file so that several people, or a group, can read it. The file is encrypted with a session key, which in turn is encrypted with the public key of each of the recipients. This allows you to place a file in a public directory and give access to any number of people.

The software also interacts with Microsoft Mail and cc:Mail, although we think it could be made more invisible. We'd like to



A work in progress: As Entrust encrypts a set of files, it keeps the user informed.

be able to set it to routinely encrypt all information without requiring intervention.

The package we tested was Entrust Lite, a cut-down version aimed at companies with up to 200 users. Entrust Lite maintains public-key certificates in a simple file on a central server. The full-strength version can handle much larger systems that stretch across multiple domains and networks, and it supports a full X.509 certificate-maintenance system.

Entrust is one of the most thorough encryption and key-maintenance systems available. The key-backup system allows an organization to recover lost keys without involving a third party. The software is designed to work seamlessly across borders. The export version may be limited to 40-bit keys, but it works with the full-strength U.S. version. This makes it a good choice for managing keys around the world.

Entrust's greatest weakness could also be considered a strength. It's a stand-alone mechanism that must be invoked by the user or by customized software using the Nortel API. Some programs, like Lotus Notes, offer much more transparent encryption, but only for their own documents. Entrust can handle any document—if you remember to use it. ■

Peter Wayner is a BYTE consulting editor living in Baltimore, Maryland. You can reach him on the Internet at pcw@access.digex.net.

Two Key Pairs

The Entrust system uses two pairs of public and private keys: one for digital signatures and the other for encryption. The designers did this for a number of reasons. First, and most important, the U.S. government is much more accepting of export systems used for authentication than of those used for secrecy. Thus, Entrust's export version offers full-strength digital signatures while providing weaker encryption.

Another interesting reason is to prevent repudiation. Only the private encryption key is escrowed in the central location, not the private half of the signature pair. This makes it much harder for someone to deny signing a document, because the only copy of the private signing key is on that person's machine.

Product Information

Entrust Lite for Windows . . . single user, \$125; five users, \$375; more than 50 users, \$50 per user (all prices include manager software) (for Windows 3.1x, 95, and NT; Unix; Mac)
Nortel (Northern Telecom)
Secure Networks Group
Ottawa, Ontario, Canada
(613) 765-5607
fax: (613) 765-3520
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Help-Desk Helpers

When you're supporting a large number of PC users and applications, a little automation helps a lot in tracking and resolving problems

DAVID SEACHRIST

Maintaining a help desk to solve users' problems in a large organization calls for just that, organization—of knowledge about hardware, software, schedules, and past experience. This job can be aided considerably by special-purpose software.

NSTL narrowed its focus to single-user applications that are meant for departmental use. The products are DKHelpDesk and DKInventory Manager (DK Systems), bundled as a single product and called DKHelpDesk here; Heat Professional for Windows (Bendata); HelpTrac (Monarch Bay Software); Professional Help Desk Premium, here called Professional Help Desk (PHD); Q-Support (Datawatch); and SupportMagic (Magic Solutions).

Our tests are based on supporting internal clients only. We looked at system installation and setup, logging and tracking of calls, finding answers to questions, automated call logging, and tracking the configuration of hardware and software.

Choosing the right software for a help desk is a highly individualized proposition. One help-desk manager we talked to *wants a product* that emphasizes ease of use and entering call data. Another needs flexibility, largely because the help-desk analysts are experienced users.

However, NSTL's overall ratings favor usability over flexibility and performance. Because many companies reengineer their help desks to place junior-level analysts at the first contact level without compromising support, it's important to provide tools that are easy to learn and operate.

How It Works

Help-desk software is a customized database application that facilitates storage and retrieval of information about users, their

computer hardware and software, the calls they make to the support center, and some means for support personnel to create and access a pool of information that will help them answer the questions asked. The process varies considerably, depending on such variables as:

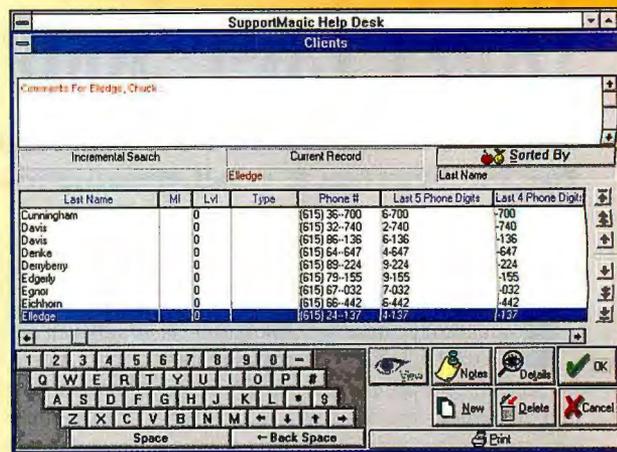
- Who the client is (internal employee or external customer).
- How the call is submitted.
- The nature of the problem (hardware or software).
- How urgent the problem is.
- What analysts can take the call.
- What information is available.

All six programs tested let analysts assess these factors quickly by searching for information in the help database. Response time improves when the analyst can access the user, configuration, and call-history information in one application.

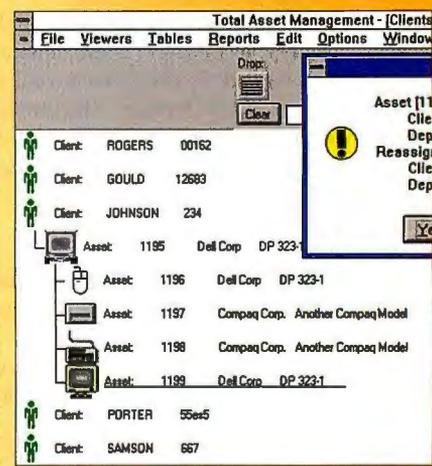
But if a help-desk program is only a database, why not build one from scratch? First, with these programs available, users don't have to spend the effort and money to design the database. Second, although call logging and asset management are database functions, problem resolution gets into the more difficult area of expert systems. Third, the documentation that comes with these packages can be helpful in running a help desk.

System Setup and Administration

When you're setting up a help-desk application, you need to think about how you're



These two screens show different capabilities of the two best help-desk products tested. Above, SupportMagic's client history database. At right is a screen from Professional Help Desk's asset management module.

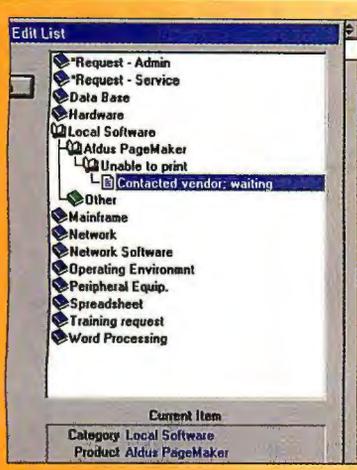


going to enter analyst data and assign access rights to the database, customize the program, and set the hours of operation. All the tested programs allow you to restrict access based on passwords. For example, you might want to restrict junior analysts from creating standard problem solutions.

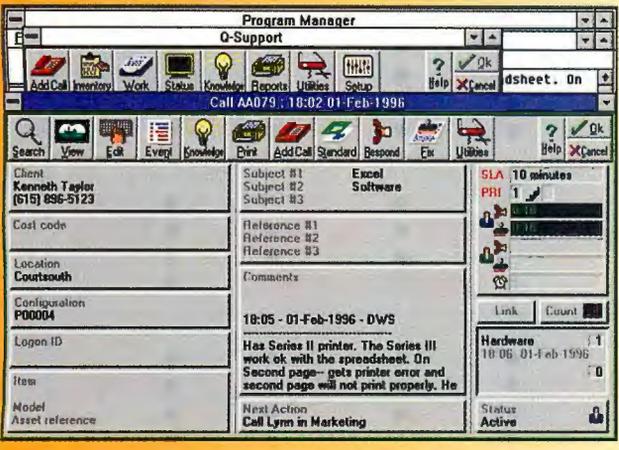
In a given environment, predesigned databases nearly always require some type of data or a form that the program's designer didn't foresee. A program that allows data-table and data-form customization gives the administrator tremendous flexibility.

The ability to attach work hours to individual analysts helps track availability. This helps avoid forwarding calls to analysts who are unavailable.

Although most of the information in help-desk databases is entered by analysts as they receive calls for help, the ability to import existing client and configuration data is a great help in getting these programs up and running. The majority of the programs tested claim to offer easy-to-use data-import utilities. However, NSTL's



At left is the hierarchical problem-solving information tree from previously logged calls, as used in Heat Professional for Windows. Below, the call-logging screen from Q-Support 3.32 records details of the caller, problem, hardware and software, solutions, and history.



hits with no way of determining which ones are most pertinent. The analyst has to browse through them one by one.

Statistical searches are more useful at sifting through the large amounts of text likely to be found in a call database. A statistical search counts the number of times a search phrase is encountered and then ranks the records by their relevance to the search criteria. In addition, these search engines let you exclude "noise" words from the search and specify synonyms.

DKHelpDesk and DKInventory Manager 1.2A

This package is strong in inventory management and escalation features, and its data-import utility offers effective data mapping. Unfortunately, the problem-resolution tools aren't so good.

The underlying database is Quadbase-SQL (single-user version); the multiuser version supports industry-standard databases, such as DB2, Oracle, SQL Server, and Sybase. DKHelpDesk uses Computer Associates' CA-Ret for creating reports.

DKHelpDesk uses four well-documented diagnostic services: keyword searches, similar type calls (both methods require an established base of calls), solution steps

(which must be added ahead of time), and links to Casepoint databases.

Heat Professional for Windows 2.1

Although its first-level support module uses a hierarchical tree metaphor to list common problems and allows attaching of notes, graphics, and video files, Heat's interface is nonetheless cumbersome. Its call-logging and inventory screens are harder to use than those of PHD and SupportMagic, the top-rated programs.

Heat uses Microsoft Access for its default database, although it can access any database that complies with Open Database Connectivity (ODBC). It currently allows both forms design and data-table creation. Importing data files is hard because, as with HelpTrac, the lack of data mapping means you need to determine the order of fields in existing data and construct new database files. The product ships with Crystal Report Writer 4.0.

HelpTrac 4.0

HelpTrac uses color and graphics well to highlight important information, and it was the fastest product tested. However, it lacks problem-resolution and reporting tools, and some of its call-logging and escalation capabilities aren't as complete as those of the other programs.

HelpTrac uses Paradox database files and the Crystal Report Writer. It lets you create lists and information trees, but its knowledge-acquisition functions are tedious compared to those of other programs.

Professional Help Desk Premium 3.1

PHD offers user-friendly tools for call logging, problem resolution, and inventory management, and it's slightly easier to learn than SupportMagic. PHD's interface

testing showed that there are some serious deficiencies.

Who's Got the Answer?

Once an analyst receives client and call information, the next step is to fix the problem. These help-desk programs use two basic data sources to solve problems: knowledge databases created over time—as the analysts enter problem descriptions and resolutions—and third-party, ready-made knowledge bases that provide "canned" data on specific topics.

The key to using these knowledge bases to solve problems in real time is a quick and powerful retrieval engine that ranks information by its relevance. The most common approach is to use the database's normal search engine to look at historical records of clients with similar problems that have already been fixed. This method can be useful, but it has one hitch: Simple database searches tend to result in many

HOW GOOD ARE THE HELPERS?						
RATING	NAME	VERSION	PERFORMANCE			PRICE
			VERSION	PERFORMANCE	VERSATILITY	
★★★	SupportMagic	2.13	■	▲	▲	\$2995
★★★	Professional Help Desk	3.1	■	▲	▲	\$2995
★★	Heat Professional for Windows	2.1	▼	▲	■	\$3000
★★	DKHelpDesk/DKInventory Manager	1.2A	▼	▲	▲	\$2995
★★	HelpTrac	4.0	▲	■	■	\$895
★★	Q-Support	3.32	■	▲	■	\$3000

KEY

★★★★ Outstanding
 ★★★ Excellent
 ★★ Average
 ★ Below average
 ★ Poor

▲ Good
 ■ Fair
 ▼ Unacceptable

HELP-DESK FEATURES COMPARED

	DKHELPDESK/ DKINVENTORY MANAGER	HEAT PROFESSIONAL FOR WINDOWS	HELPTTRAC	PROFESSIONAL HELP DESK	Q-SUPPORT	SUPPORTMAGIC
GENERAL						
Database format	Quadbase	Access	Paradox	dBase	dBase	Btrieve
Tie-in to third-party databases	1	2	○	2	○	3
Notification via pager	●	●	●	●	●	●
CUSTOMIZATION						
Floating toolbar	○	○	●	●	●	●
Link to external applications	●	●	●	●	●	●
Access Windows help files	●	○	○	●	○	●
User-designed forms	○	●	○	○	○	●
User-designed tables	○	●	○	○	○	3
User-defined fields	●	●	●	●	●	●
CALL LOGGING						
Assign analysts according to expertise	●	●	●	●	●	●
Forward calls	●	●	●	●	●	●
Date-/time-stamp call	●	●	●	●	●	●
Open new second call window while first is still open	○	○	○	●	●	●
Record elapsed time on call	●	●	●	●	●	●
Call priority, status, history	●	●	●	●	●	●
Client name	●	●	●	●	●	●
Problem description	●	●	●	●	●	●
Solution description	4	●	●	●	●	●
QUERYING						
Query by example	○	○	○	●	○	●
Save queries by name	○	●	●	●	●	●
Keyword searches	●	●	○	●	●	●
Search on any field in call-logging screen	○	○	●	○	○	●
ASSET MANAGEMENT						
Inventory management	●	●	●	●	●	●
Track maintenance information, warranties	●	●	●	●	●	●
Track equipment location	●	●	●	●	●	●
Track purchase information	●	●	●	5	●	●
Track lease information	●	5	●	5	●	5
EXPERT SYSTEMS						
Build knowledge base	●	●	●	●	●	●
Case-based reasoning	○	●	○	●	○	○
Decision tree (rules-based)	○	●	○	●	○	●
Neural network	○	○	○	●	○	○
Statistical search engine	○	○	○	●	○	●
Tie-in to third-party knowledge bases	●	●	○	●	●	3
ESCALATION						
Manual and automatic escalation	●	●	●	●	●	●
Notify supervisor of calls without being logged in	●	●	○	●	●	●
Set default priority	●	●	●	●	●	●
Escalation triggers (time, conditions)	T,C	T,C	T	T	T	T,C
Escalation actions (modify record, send mail, launch program)	M,S	●	6	M,S	●	●
REPORTS						
Number of predefined reports	93	75	62	17	34	250
Custom reports	●	●	○	Add-on	●	○
Call reports	●	●	●	●	●	●
Client/customer profiles	●	●	●	●	●	●
Equipment lists	●	●	●	●	●	●
Technician availability	○	●	●	○	●	●
Purchase requests/orders	●	○	○	○	○	●

● = yes; ○ = no.

1 Multiuser version supports industry-standard databases.

2 Any ODBC-compliant database: dBase, SQLServer, Oracle, and so forth.

3 To be included in SupportMagic SQL, scheduled for release in the first quarter.

4 No specific solution description in call screen, but solution-steps list can be displayed.

5 User-modifiable.

6 Program uses alerts, audibles, and screen color to notify user of call escalation.

allows quick and easy access even to its most powerful features. The program already supports a wide range of databases, and the next release (due before press time) will offer telephony support and a means to interface with the Internet.

PHD uses dBase and can access any ODBC-compliant database, but it doesn't include any data-import utilities, which is our major complaint with this product. The company offers a data-import service, but at an additional fee. The package comes with Crystal Report Writer 4.0.

PHD's problem-resolution tools are the most complete of the group. Its rapid resolution module allows quick access to solutions of common, previously solved problems. The experience-based resolution module uses a statistical search of past problems. Both tools are easy to operate. The package uses a graphical tree-based method for tracking configurations. To reassign assets, for example, you simply drag an equipment icon from one client name to another.

Q-Support 3.32

A very capable product, Q-Support seems flexible once you have learned your way around it, but its user interface relies heavily on hierarchical screens that are tedious to navigate. Q-Support uses dBase files; Datawatch offers an import utility, Q-Import, for an additional \$1500. You can tie Q-Support's knowledge-base module into extra-cost KnowledgePaks, available from ServiceWare (Pittsburgh, PA).

SupportMagic 2.13

SupportMagic is our top-rated product because its call logging, problem resolution,

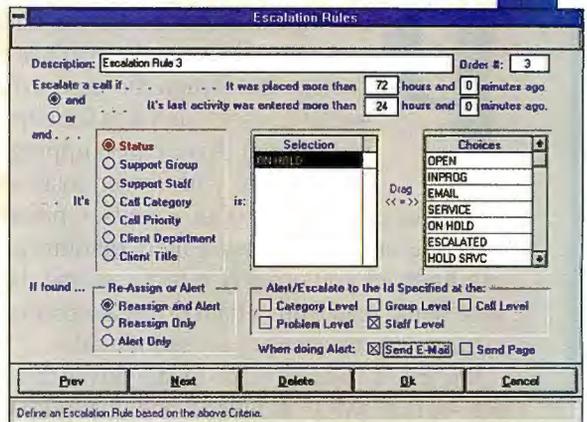
Kicking Calls Upstairs

Handling calls in an efficient and timely fashion is crucial when life gets hectic on the help desk. You have to open call records easily, get pertinent information at a glance, and access detailed information as needed.

Once you've logged a call, how long can it sit unanswered or unresolved? Here's where escalation comes into play. Manual escalation occurs when an analyst recognizes that a call is both urgent and beyond his or her experience and then forwards the call to a more experienced analyst and raises the call's listed priority (see the screen from PHD below).

All six products tested here allow automatic escalation, but they're all difficult to learn how to set up. It takes a concentrated effort to understand how escalation works in each program. It's also important to consider carefully how to structure levels of escalation to match your company's organization, needs, and culture. Determining the proper timing before escalating a call is a delicate business; users don't want to escalate calls prematurely, but they also don't want to wait too long. Often factors besides elapsed time should be taken into account before escalating a call. Products that escalate strictly on the basis of elapsed time are the easiest to learn, but those that also allow conditional triggers are likely to be more useful in the long run.

asset management, and reporting are flexible and easy to use. SupportMagic currently supports only one database format, Btrieve. The next version will support Watcom SQL, and it will support Oracle, Sybase, and SQL Server by the end of the year. This is one of only two products—the other being DKHelpDesk—to offer acceptable import utilities. Both programs handle importing by mapping fields in the source



data file to fields in the database table.

SupportMagic currently allows you to design forms, but you won't be able to create data tables until the next release. The program also offers a statistical search engine. Add-on modules include a hyper-text search system and a rules-based decision tree. Crystal Report Writer 4.0 is available at additional cost, but because SupportMagic ships with 250 report formats, you may never need that option. ■

David Seachrist has tested software for NSTL for nine years. You can send E-mail to him in care of editors@bix.com.

This report contains partial results from a recent issue of Software Digest, a monthly publication of NSTL, Inc. To purchase a copy of the full report, contact NSTL at 625 Ridge Pike, Conshohocken, PA 19428; (610) 941-9600; fax (610) 941-9950; on the Internet, editors@nstl.com. For a subscription, call (800) 257-9402. BYTE magazine and NSTL are both operating units of The McGraw-Hill Companies, Inc.

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HelpTrac 4.0\$895
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Professional Help Desk Premium 3.1\$2995
Professional Help Desk
Stamford, CT
(800) 474-3725
fax: (203) 869-2990
Info@prohelpdesk.com
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Q-Support 3.32\$3000
Datawatch Corp.
Wilmington, MA
(800) 988-4739
fax: (508) 988-0697
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SupportMagic 2.13\$2995
Magic Solutions, Inc.
Paramus, NJ
(201) 587-1515
fax: (201) 587-8005
http://www.magicsolutions.com
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HANDS-ON TESTING

16 DRIVES FOR FAST

Are you constantly running out of hard drive space? Back up your data with one of the drives tested here. The media is removable, has a long shelf life, and offers low per-megabyte storage costs.

CHANDRIKA MYSORE

Picking the right media for backing up and archiving your data isn't as easy as it used to be. Magnetic tape drives have been PC users' de facto backup solution, but optical drives are slipping into the mainstream with lower costs and better performance than past optical units. Optical alternatives are enticing because their random-access capabilities let you quickly retrieve stored data as if it were being read from a hard drive; in contrast, streaming tape drives access data sequentially.

We tested 16 removable-media drives that use magneto-optical (MO), magnetic, and dual-purpose phase-change technology. Out of the 16 external drives that we tested, 12 use a 5¼-inch form factor and four use a 3½-inch form factor. The 5¼-inch MO drives range in capacity from 1.3 to 2.6 GB (except for Panasonic's phase-change drive), and the 3½-inch drives have

100-MB to 1-GB removable media. Pinnacle Micro's 5¼-inch Apex is a 4.6-GB optical drive—the largest capacity of the bunch (see the text box "Pinnacle's Apex 4.6GB Serves Up a Heaping Platter" on page 144).

For the purposes of this review, we rate only those optical drives that have a 5¼-inch form factor. For details about the performance and cost on alternative devices, refer to the table "The Tale of the Tape" on page 146.

Drives using optical media are attractive because they have an incredibly long shelf life (estimated at 30 years). Sony says that its two optical drives—the CMO-R531 and the CMO-R544—use 5¼-inch disks that will last for 100 years. Some vendors, including Pinnacle Micro, are touting optical disks as replacements for traditional magnetic disks, but don't expect many systems vendors to jump at the technology; the drives

are still too slow. The Plasmon Data RF7030e is the most expensive 5¼-inch drive we tested at \$3100; the average price of the 12 5¼-inch drives is \$2285.

With its low price of \$649 and support for a standard quad-speed CD-ROM, Panasonic's PD/CD-ROM LF-1000AB, a dual-purpose, phase-change optical drive, might be better suited for mass-market storage solutions. The phase-change cartridge, which holds over 600 MB of data, is rewritable a half million times. Phase-change media offer a reliable

How to use this guide

We selected the best removable-media drives by evaluating performance (sequential throughput rates and read/write speeds) as well as features and usability characteristics.

The 5¼-inch optical drives that we tested range in price from \$649 to \$3100, with an average price of \$2285. The 3½-inch drives are relatively inexpensive at between \$200 and \$599, but they only have a fraction of the storage capacity of the larger drives.

BEST OVERALL Pinnacle Micro Apex 2.6GB

The Apex 2.6GB is our best-overall choice for storing big video or digital audio files and graphics for desktop publishing. The drive features an LCD on the front panel and includes a fast SCSI-2 connector, a vendor-specified sustained data transfer rate of 6 MBps, and 1 MB of read-ahead buffer, which help explain its outstanding performance in the benchmarks. We found the user documentation that comes with the Apex 2.6GB to be the best, which bolstered its high-usability score. The 2.6-GB cartridges cost about \$200 each.



DRIVE #	PRICE	BEST OVERALL	FEATURES	USABILITY	CAPACITY (GB)	AVERAGE SEEK TIME (MS)	ADDITIONAL BENCHMARKS
DRIVE #1	Pinnacle Apex 2.6GB	\$1495	7.85	AA	2.6	17	6
DRIVE #2	Plasmon Data RF7030e	\$3235	6.49	A	2.6	39	4
DRIVE #3	Optique M25540E/Panasonic 2000	\$2198	6.47	A	2.6	26	3
DRIVE #4	Sony CMO-R544	\$2995	6.10	A	2.6	25	3

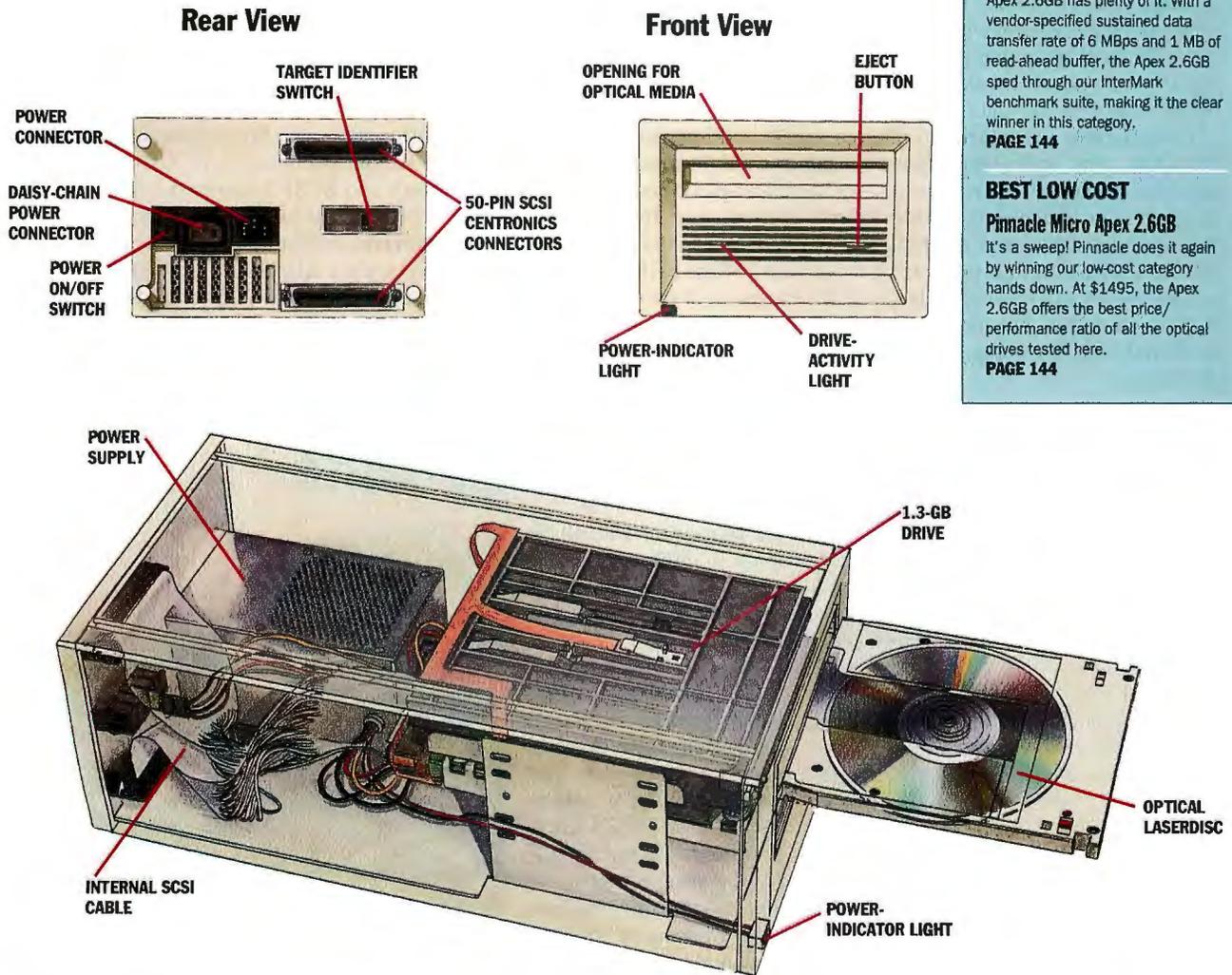
The latest optical drives, like Pinnacle Micro's Apex 2.6GB 5¼-inch unit, support a speedy 6-MBps maximum burst-transfer rate that moves data faster than ever before. It appears that optical drives aren't as slothlike as many users perceive and may someday replace the magnetic hard drive on the desktop.

The 5¼-inch optical drives have 1.3- and 2.6-GB storage media (except for Panasonic's PD drive). The smaller 3½-inch drives are more eclectic, with 100-MB, 135-MB, 230-MB, and 1-GB cartridges.

The vendor-provided time, in milliseconds.

DATA BACKUP

An Optical View



BEST OVERALL

Pinnacle Micro Apex 2.6GB

With its outstanding performance and excellent usability, the Pinnacle Micro Apex 2.6GB is a must-have drive for storing large video or digital audio files and graphics for desktop publishing.

PAGE 144

BEST HIGH PERFORMANCE

Pinnacle Micro Apex 2.6GB

The name of the game is high performance, and Pinnacle Micro's Apex 2.6GB has plenty of it. With a vendor-specified sustained data transfer rate of 6 MBps and 1 MB of read-ahead buffer, the Apex 2.6GB sped through our InterMark benchmark suite, making it the clear winner in this category.

PAGE 144

BEST LOW COST

Pinnacle Micro Apex 2.6GB

It's a sweep! Pinnacle does it again by winning our low-cost category hands down. At \$1495, the Apex 2.6GB offers the best price/performance ratio of all the optical drives tested here.

PAGE 144

means of data storage, as they aren't affected by magnetic fields. This technology will let drives like Panasonic's support the emerging high-density digital video-disc (DVD) CD-ROM format for the entertainment industry.

Iomega and SyQuest build compact 3½-inch devices using Winchester-type magnetic media that can hold up to 1 GB of data. Iomega's Jaz SCSI drive (\$599) is

a breakthrough product that uses a 1-GB medium that isn't much wider than a 1.4-MB floppy drive and only about twice as thick. SyQuest's EZ135 is another small-media drive that holds 135 MB of data. Olympus's PowerMO 230, using MO media, offers a 230-MB capacity. These smallish disks are ideal for taking storage-hungry image, sound, and video multimedia files on the road. The average price of these small drives is \$310.

THE BEST IN REMOVABLE STORAGE

5¼-INCH OPTICAL DRIVES

Magneto-optical (MO) drives are a durable, transportable medium for backing up and archiving large amounts of data permanently. For this reason, digital audio and video, graphics, color-prepress, medical, and other professionals have chosen high-capacity optical drives as a standard backup solution.

In a way, MO drives provide limitless storage capacities, because you can remove the cartridges after they run out of space and replace them with new ones. You could say that the sky's the limit when you hear about optical-storage solutions like Pinnacle Micro's optical-library systems, which can hold up to 5 TB of backup data.

Despite their advantages of random access and low per-megabyte costs, optical drives have not gained widespread acceptance, because when compared to traditional magnetic hard drives, they've been high on price and short on performance. The 5¼-inch drives that we compared range in price from \$649 to \$3100, with the average price being about \$2285. Tape-backup devices are still less expensive, with the exception of some 8-mm tape drives. But the performance of optical drives has improved, and their storage capacities should be even greater in the future.

During our hands-on tests, the 5¼-inch drives with the fastest throughput in NSTL's InterMark benchmarks fared best. We found this evident in our best-overall choice and high-performance winner, the Pinnacle Micro Apex 2.6GB drive (\$1695), which zoomed through our suite of benchmarks. Coming in second and third in performance were the Olympus Image Systems PowerMO 2600 (\$2199) and Maxoptix T4-2600 (\$2525) drives, respectively. With a capacity of 2.6 GB, the T4-2600 exhibits excellent read-and-write service times with little CPU utilization. The PowerMO 2600 and the T4-2600 (both SCSI-2 units) had a throughput of 2.39 and 2.18 MBps, respectively, in our sequential tests.

Sony's CMO-R544 (\$2995) and CMO-R531 (\$2695) are also two strong performers—the first supports a capacity of 2.6 GB, while the second is limited to 1.3 GB—with 3600-rpm rotational speeds and SCSI-2 connectors. While there's no way for us to substantiate the claim without tearing a rift in the space/time continuum, Sony says the rewritable media will last 100 years. Panasonic's LF-7300A (\$2995) is a 1.3-GB drive with a SCSI-2 connector and 512 KB of read-ahead buffering that boosted its performance to sixth-best.

The Pinnacle Micro Sierra 1.3GB (\$1495), Liberty Systems 115M01.3 (\$1999), and Plasmon Data RF6920e (\$2275) are

PINNACLE'S APEX 4.6GB SERVES UP A HEAPING PLATTER

Pinnacle Micro's new Apex 4.6GB drive is a breakthrough in optical-storage technology. It's currently the only drive that offers 4.6 GB of storage, the highest capacity on a single 5¼-inch medium. Pinnacle Micro markets this drive in both external and internal configurations; the 5¼-inch drive requires only a half-height drive bay.

The Apex 4.6GB external drive comes with fast SCSI-2 connectors on the rear and cool LCD and drive-activity indicators on the front bezel. The desktop model that we tested, a pre-production model, has a list price of \$1695. The Apex drive is compatible with both 2.6- and 4.6-GB media.

We did not compare the test results generated using the 4.6-GB media with any other drives we tested for this report, because the Apex unit is the only drive that supported the 4.6-GB capacity. We used the results that we obtained during testing with its 2.6 GB of storage capacity in

our comparison with all the other 5¼-inch drives in the review. The results appear in the Roll Call on pages 150 and 151.

Pinnacle Micro has invested considerable effort in the design enhancements for the Apex drive. The company has added more user area on the disk by designing a smaller actuary arm to seek closer to the spindle and by using a higher numerical aperture that employs a smaller bit size. This design also decreases the average seek time to 17 milliseconds,



Using a single-write-pass technology, Pinnacle Micro's Apex 4.6GB rewritable magneto-optical drive offers near-hard-drive performance and has a low per-megabyte cost.

compared to more than 25 ms.

All these desirable features make the Apex 4.6GB an innovative, breakthrough optical drive with superior performance and enormous capacity. The Apex 4.6GB could be an alternative to a

magnetic hard drive due to its reliability, 30 years of archival shelf life, portability, and large capacity. It also comes with a one-year warranty and a \$395 extended warranty.

Pinnacle Micro is still upgrading the performance and compatibility of the drive for its final release, which was scheduled for March. The Apex 4.6GB drive should be well into production by the time you read this article.

Product Information

Apex 4.6GB drive\$1695
Pinnacle Micro
Irvine, CA
(800) 553-7070
(714) 789-3000
fax: (714) 789-3150
<http://www.pinnaclemicro.com>
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Outstanding performance and usability

BEST OVERALL

Pinnacle Micro Apex 2.6GB



The Apex 2.6GB is our best-overall choice for storing big video or digital audio files and graphics for desktop publishing. The drive features an LCD on the front bezel and includes a fast SCSI-2 connector, a vendor-specified sustained data transfer rate of 6 MBps, and 1 MB of read-ahead buffer, which help explain its outstanding performance in the benchmarks. We found the user documentation that comes with the Apex 2.6GB to be the best, which bolstered its high-usability score. The 2.6-GB cartridges cost about \$200 each.



The Apex 2.6GB is our best-overall choice for storing big video or digital audio files and graphics for desktop publishing. The drive features an LCD on the front bezel and includes a fast SCSI-2 connector, a vendor-specified sustained data transfer rate of 6 MBps, and 1 MB of read-ahead buffer, which help explain its outstanding performance in the benchmarks. We found the user documentation that comes with the Apex 2.6GB to be the best, which bolstered its high-usability score. The 2.6-GB cartridges cost about \$200 each.

		PRICE	BEST OVERALL	FEATURES	USABILITY	CAPACITY (GB)	AVERAGE SEEK TIME (MS)	ASYNCHRONOUS BURST-TRANSFER RATE (MBps)
BEST	Pinnacle Apex 2.6GB	\$1495	7.86	▲▲	▲▲▲▲	2.6	17	5
RUNNER-UP	Maxoptix T4-2600	\$2525	6.49	▲	▲▲▲	2.6	39	4
RUNNER-UP	Olympus MOS540E/PowerMO 2600	\$2199	6.47	▲	▲▲	2.6	<26	3
RUNNER-UP	Sony CMO-R544	\$2995	6.10	▲	▲▲▲	2.6	25	3

Raw-speed leader

HIGH PERFORMANCE

Pinnacle Micro Apex 2.6GB



This \$1495 SCSI-2 device has a rotational speed of 3755 rpm and a data transfer rate of 6 MBps. The 5¼-inch storage media holds 2.6 GB of data for a 30-year lifetime. The Olympus PowerMO 2600 is the next-highest-performance drive at \$2199. This drive has a rotational speed of 3600 rpm and a vendor-specified sustained read-transfer rate of 4.6 MBps, and it utilizes a SCSI-2 connector. This MO drive and the Apex 2.6GB are the closest to magnetic hard drives in performance.

		PRICE	HIGH PERFORMANCE	FEATURES	USABILITY	CAPACITY (GB)	AVERAGE SEEK TIME (MS)	ASYNCHRONOUS BURST-TRANSFER RATE (MBps)
BEST	Pinnacle Apex 2.6GB	\$1495	8.00	▲▲	▲▲▲▲	2.6	17	5
RUNNER-UP	Olympus MOS540E/PowerMO 2600	\$2199	7.14	▲	▲▲	2.6	<26	3
RUNNER-UP	Maxoptix T4-2600	\$2525	6.78	▲	▲▲▲	2.6	39	4
RUNNER-UP	Sony CMO-R544	\$2995	6.34	▲	▲▲▲	2.6	25	3

For the best price/performance ratio

LOW COST

Pinnacle Micro Apex 2.6GB



In determining the low-cost category, we placed the cutoff price at \$2300. Out of all the drives that fell under this price, only two were of the 2.6-GB capacity: the Pinnacle Micro Apex 2.6GB and the Olympus Image Systems PowerMO 2600. Our winner—and the most cost-effective drive in this category—was the Pinnacle Apex 2.6GB. It offers the best in features and overall performance.

		PRICE	BEST OVERALL	FEATURES	USABILITY	CAPACITY (GB)	AVERAGE SEEK TIME (MS)	ASYNCHRONOUS BURST-TRANSFER RATE (MBps)
BEST	Pinnacle Apex 2.6GB	\$1495	7.86	▲▲	▲▲▲▲	2.6	17	5
RUNNER-UP	Olympus MOS540E/PowerMO 2600	\$2199	6.47	▲	▲▲	2.6	<26	3
RUNNER-UP	Panasonic PD/CD-ROM LF-1000AB	\$649	5.33	▲	▲▲▲▲	650 MB	165	3.3
RUNNER-UP	Liberty 115M01.3	\$1999	5.10	▲	▲▲▲	1.3	19	2
RUNNER-UP	Pinnacle Sierra 1.3GB	\$1495	5.09	▲▲	▲▲▲	1.3	19	5

allows a single-write pass instead of a two-write pass, which makes writes the same speed as reads.

Today's MO drives also use red-laser technology, the lowest frequency on the light spec-

trum. The development of blue-laser opticals later this decade will expand the bandwidth so that optical drives will be able to support 100 GB of data. Exciting technological advances like these have ana-

KEY

Ratings from 1 to 4: ▲ is the lowest; ▲▲▲▲ is the highest.

lysts predicting a tenfold increase in optical-drive sales over the next two years.

relatively inexpensive drives that showed lower-end performance in our tests. The three opticals have rotational speeds between 3000 and 3600 rpm, which could explain their close performance scores. Although they didn't knock us over with high-performance numbers, they're more cost-effective solutions for grabbing big chunks of data with random-access searches.

A newer lower-cost, but

lower-capacity, technology is phase change. Panasonic's PD/CD-ROM LF-1000AB drive is the only dual-purpose, phase-change (PD) drive that we tested. You can use the desk-

top unit as a quad-speed CD-ROM drive for your system, and it also reads and writes to 650-MB removable optical disks (a pack of five disks costs \$300).

The PD/CD-ROM drive—which stood up to most MO drives in random-write service and data transfer rates but had the slowest random-read service times in our tests—is a good

data-storage format for multimedia files. Compaq plans to incorporate the drive into its Pentium Pro multimedia computers. It's a cost-effective, dual-purpose drive that costs \$649 and has 650-MB capacities.

Finally, we're seeing the latest advances in optical technology, and the data transfer rates of optical drives are being boosted even more. These new advances stand out in Pinnacle's latest offering, the Apex 4.6GB drive (see the text box "Pinnacle's Apex 4.6GB Serves Up a Heaping Platter" on page 144). The drive uses Direct Overwrite media, which applies an MO technology called Light-Intensive Modulation Method (LIMM). This

Weighting for Best Overall

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EASE OF USE 20%

FEATURES 10%

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LOW-COST ALTERNATIVES

3½-INCH REMOVABLE MEDIA

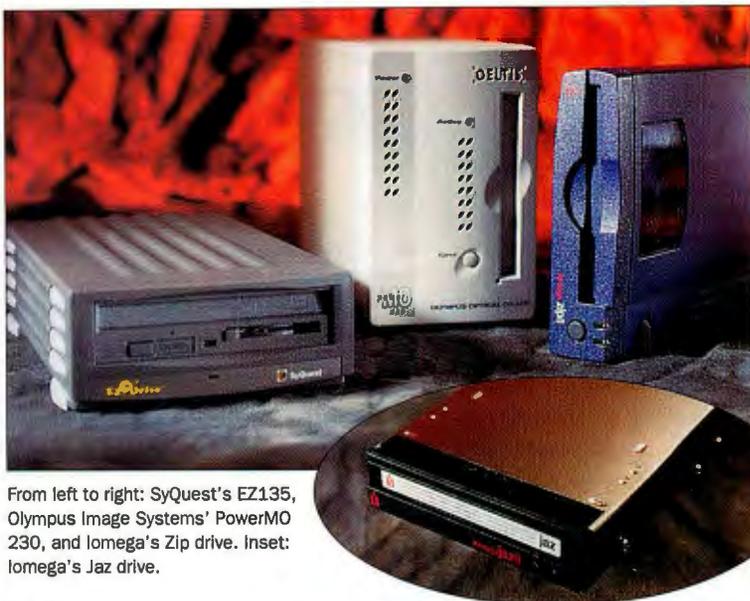
The four 3½-inch portable removable drives that we tested are inexpensive alternatives to the more costly 5¼-inch units. Iomega's Zip (\$199.95) and Jaz (\$599) drives, the Olympus Image Systems PowerMO 230 (\$589) drive, and the SyQuest Technology EZ135 (\$250) drive cost much less than the 5¼-inch drives, but they don't back up data at such grand proportions as the others do. These 3½-inch drives are therefore ideal for storing, transporting, and playing multimedia files or other large files.

An affordable drive at \$250, the SyQuest EZ135 is the fastest in overall performance compared to the other three units; however, its high performance comes with a trade-off: a 135-MB capacity. If performance is your only concern, then the inexpensive SyQuest EZ135 is all you need. But if you have to back up your entire hard drive, for about \$350 more, the Iomega Jaz, with the largest capacity of 1 GB, is also very fast. The EZ135 fits 35 MB more data on each 3½-inch cartridge than the Iomega Zip 100-MB media, which costs \$50 less.

With its attractive \$199.95 entry point into removable storage, Iomega's Zip drive got our attention. The Zip, which is available as a SCSI or parallel-port drive, is the ultimate in portability: It weighs just under 1 pound, and its removable cartridges can fit into a shirt pocket.

The small drive is in such vogue that the third-party company Maxell has begun production of the 100-MB cartridges, which have reportedly been scarce in retail channels. The Zip cartridges aren't big enough to back up today's hard drives or to use for primary backup, but this may prove to be the floppy drive of the future.

Iomega's Jaz is a different story. According to Iomega, you can back up your entire hard drive in about 5 minutes on the device's 1-GB magnetic media. You can also plug the Jaz into a system's SCSI port for a second hard drive. Its performance was only second-best to that of the SyQuest EZ135 in our



From left to right: SyQuest's EZ135, Olympus Image Systems' PowerMO 230, and Iomega's Zip drive. Inset: Iomega's Jaz drive.

throughput performance tests.

It has the fastest random-read scores, and it bothers the CPU the least among the 3½-inch drives. A software cataloging tool keeps track of all the files on all the disks that you've stored media on.

The Olympus PowerMO 230 falls between the Iomega Zip drive and the SyQuest EZ135 in terms of performance. The PowerMO 230 costs over twice what you'd pay for the EZ135 (\$589), but it can pack more data on its media (95 MB more, for a total capacity of 230 MB). The performance of the PowerMO was faster than that of the Iomega SCSI Zip drive in our throughput tests.

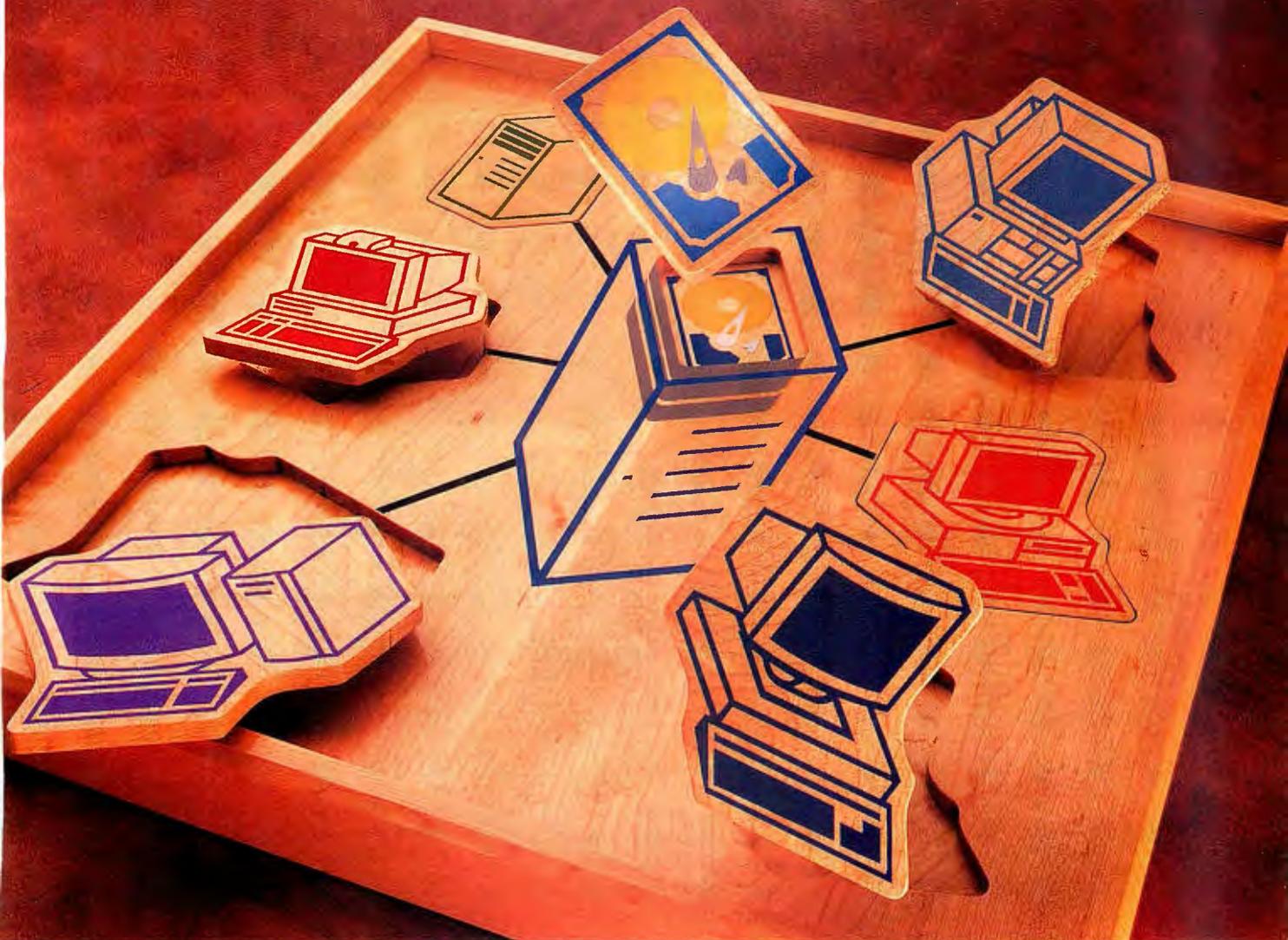
We were surprised that the PowerMO 230—which has the fastest rotational speed (4500 rpm) and a vendor-specified data transfer rate of 1.8 MBps—didn't do better in our performance tests. The PowerMO 230, however, is a bargain when you consider that it costs only about 9 cents per megabyte per cartridge with its low \$20 media costs.

THE TALE OF THE TAPE

The Zip, PowerMO 230, and EZ135 are listed twice because we tested those drives with two different attachments. The Zip drive, for instance, has a faster data rate when tested with the SCSI adapter than when tested with the parallel port.

MODEL	PRICE	CAPACITY	ADAPTER/BUS	COST PER MEGABYTE PER CARTRIDGE	COST PER CARTRIDGE	DATA RATE (MBPS)	CPU UTILIZATION (PERCENT)
Iomega Jaz	\$599	1 GB	AHA-2940W/PCI	10¢	\$99	1.11	4.78
Iomega Zip/Z100P*	\$199.95	100 MB	System port	20¢	\$20	0.06	8.32
Iomega Zip/Z100S	\$199.95	100 MB	AVA-1502E/ISA	20¢	\$20	0.50	26.96
Olympus MOS321E/PowerMO 230	\$589	230 MB	AHA-2940W/PCI	9¢	\$20	0.75	5.45
Olympus MOS321E/PowerMO 230	\$589	230 MB	AVA-1505/ISA	9¢	\$20	0.75	17.03
SyQuest EZ135	\$250	135 MB	AVA-1505/ISA	15¢	\$20	1.19	16.89
SyQuest EZ135	\$250	135 MB	AHA-2940W/PCI	15¢	\$20	1.31	4.83

* We tested the Iomega Zip parallel-port drive on a Toshiba Satellite Pro 410 Series Pentium notebook with 16 MB of RAM; the parallel port was set to bidirectional.



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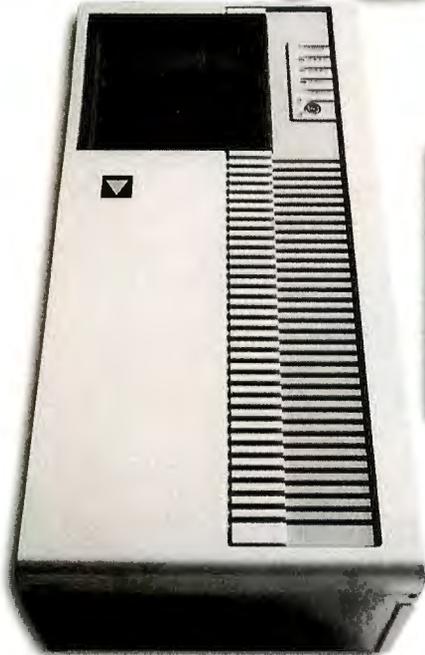
For details, call 408-438-8111. Or visit our Internet home page at <http://www.seagate.com>. And see how HAWK 2XL disc drives can make all your upgrade puzzles fall into place.

	Model	Capacity	Interface	Transfer Rate	RPM	Avg. Seek
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HAWK 2XL	ST31051	1.050 GB	SCSI-3, 8/16 bit	up to 20 MB/sec	5411	9/10.5
HAWK 2XL	ST32155	2.147 GB	Ultra SCSI 8/16 bit	up to 40 MB/sec	5411	9/10.5
HAWK 2XL	ST31055	1.050 GB	Ultra SCSI 8/16 bit	up to 40 MB/sec	5411	9/10.5

Seagate

THE DATA TECHNOLOGY COMPANY

the UNDISPUTED PRICE/ PERFORMANCE LEADER



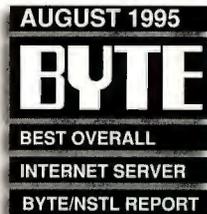
PC Computing rates SAG, "one of the top direct vendors in the US." January 1996.



February 20, 1996
SAG STF 166 Pentium



February 20, 1996
SAG STF 150 Pentium



Internet Server SFT Alpha



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PC Magazine

"This system takes top honors based on its performance, expandability, and low price tag."

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AT&T on-site and 4 year extended warranties are available. Lease options available. Returns may be subject to restocking fee. RMA# must be acquired. Some devices have not been approved by the Federal Communications Commission. These devices are not, and may not be, offered for sale or lease, or sold or leased until the approval of the FCC has been obtained.



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How We Tested

We tested the performance of the 16 removable-media drives with NSTL's InterMark benchmarks. The tests measure the drives' throughput, CPU utilization, and sequential and random read/write capabilities. To round out the evaluation, our product testers check the drives for ease of use and features.

We ranked the 5¼-inch optical drives in three categories: best overall, best high performance, and best low cost. The best-overall selection is based on a formula of performance scores (70 percent), as well as ease of use (20 percent) and features (10 percent) ratings. The best high-performance drive has the highest performance numbers, without any consideration for usability or features. The best low-cost drive incorporates the best-overall formula of performance, usability, and features scores, but there's a \$2300 price cutoff.

TEST METHODOLOGY

To test the optical drives, we used an Adaptec AHA2940W PCI SCSI adapter to attach the drives to a Windows 95-based workstation with an S.A.G. 133-MHz Pen-

tium CPU, 32 MB of RAM, a SCSI-based 2-GB hard drive, and a SCSI-based CD-ROM drive. Six of the drives came bundled with a SCSI adapter. We tested these drives with both the standard Adaptec adapter and the one that shipped with the product. For our evaluation, however, we used just the test scores obtained using the standard adapter.

We connected the optical drives externally to the system via a SCSI adapter. The system's hard drive and CD-ROM also connected internally to the same SCSI adapter. Windows 95 recognized the SCSI hard drive, external optical drive, and the CD-ROM, assigning drive letters at boot time; the OS noted the external optical drive as a removable-media device in the "My Computer" listing.

Testers formatted the optical drives with one large partition before starting performance testing. Nine of the drives arrived with a software utility to format the media and create partitions. In these cases, we used the vendor-supplied software to format and create partitions on the media. We used Windows 95 to format all those drives that did not come with any software tools.

EASE OF USE AND FEATURES

To evaluate ease of use, we made sure that the vendor-supplied documentation had clear installation procedures, intricate hardware specifications, and a well-organized table of contents and index to guide the reader through the manual. Testers also checked to see if status indicators and buttons were easily recognizable and considered how easy it was to set up and configure the units. The features scores reflect the range of supported software and hardware platforms, reliability specifications, SCSI drive controller specifications, and other options.

Contributors

Chandrika Mysore, Project Manager/NSTL

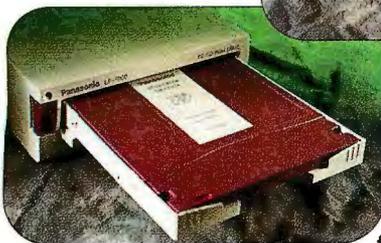
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HONORABLE MENTIONS

Panasonic's PD/CD-ROM LF-1000AB drive wears two hats: It can read and write to a 650-MB rewritable optical disk, and it can also read common quad-speed CD-ROMs—all in the same tray. For PD mode, you insert a cartridge into the



phase-change drive's tray; for CDs, you remove the PD cartridge and simply drop a CD into the tray. Supported CD formats include Kodak

Photo CD, Video CD, CD-DA, and CD-I FMV. This is the only drive we tested that supports standard CDs as well as a phase-change cartridge. Phase-change cartridges are nonmagnetic media that offer reliable long-term storage.

Pinnacle Micro's Apex 4.6GB optical drive uses a

tiny LCD to deliver drive-status information, while the other drives use plain-old blinking-light indicators. The LCD reports the drive's data transfer rate, read verify, capacity of the media contained in the drive, and termination. In the future, Pinnacle Micro will add diagnostics information, such as whether the drive is running too hot, as well as what type of media is in the device when the drive supports other types of media (e.g., WORM cartridges).



Talk about portability. We already mentioned that Iomega's Zip 3½-inch removable cartridges can slip into a shirt pocket, but the drive unit itself is so compact (at less than 1 pound) that you can stuff it into your suitcase and take it on the road.

5¼-inch Removable-Media Drives

	LIBERTY SYSTEMS, INC. 115N01.3	MAXOPTIX CORP. T4-2600	MICRO DESIGN INTERNATIONAL, INC. SCSI EXPRESS 1300NXE	OLYMPUS IMAGE SYSTEMS, INC. MOS540E/POWERMO 2600	PANASONIC COMMUNICATIONS & SYSTEMS CO. LF-7300A	PANASONIC COMMUNICATIONS & SYSTEMS CO. PD/CD-ROM LF-1000AB	PINNACLE MICRO, INC. APEX 2.6GB
Test-configuration price	\$1999	\$2525	\$2995	\$2199	\$2995	\$649	\$1495
Performance score	4.72	6.78	4.60	7.14	5.82	4.88	8.00
Usability score	7.38	7.08	7.38	5.54	7.38	8.04	9.17
Features score	3.23	3.27	4.21	3.69	3.41	3.04	4.32
MEDIA CHARACTERISTICS							
3½-inch cartridge design	○	○	○	○	○	○	○
5¼-inch cartridge design	●	●	●	●	● (not ISO-compatible)	●	●
Storage capacity (GB)	1.3	2.6	1.3	2.6	1.5	650 MB	2.6
1024-byte/sector cartridge available	●	●	●	●	●	○	●
Defect management scheme 1/scheme 2	●/●	●/●	●/●	●/●	○/○	○/○	●/●
Number of usable cartridge sides	2	2	2	2	2	1	1
Continuous servo tracking/format method	●	●	●	●	●	Continuous spiral groove/zoned CAV	●
Sampled servo tracking/format method	○	○	○	○	○	Continuous spiral groove/zoned CAV	○
Constant Angular Velocity rotational mode	●	●	○	●	○	●	○
Constant Linear Velocity rotational mode	●	●	●	○	○	○	○
Media manufacturer(s) used	Maxoptix	Maxoptix	Sony	Various ISO media	Panasonic	3M, Panasonic, Plasmon	MCC, Sony, Hitachi, DOT, 3M, Maxell
DRIVE-PERFORMANCE SPECIFICATIONS							
Average seek time (ms)	19	39	23.5	<26	45	165	17
Average access time (ms)	39	49	36	33.3	57.5	165	17
Asynchronous burst-transfer rate (MBps)	2	4	3	3	3.3	3.3	6
Synchronous burst-transfer rate (MBps)	4	5	5	5	5	5	10
Maximum sustained read/write transfer rate (MBps)	2/1	4.6/1.6	1.6/0.8	4.6/1.9	1.56/1.56	1.14/1.14	4.4/4.3
Rotational speed (rpm)	3000	3000	2400	3600	2400	2026	3755
Rotational delay (average latency)(ms)	10	2	12.5	8.3	12.5	14.8	4.17
Multiple interleaved use and spare data bands	N/A	N/A	●	●	●	○	N/A
RELIABILITY SPECIFICATIONS							
Read-after-write verification	●	●	●	●	●	●	●
Automatic bad-sector reallocation on read	●	●	●	○	○	●	●
Automatic bad-sector reallocation on write	●	●	●	●	●	●	●
Drive MTBF (hours)	100,000	100,000	80,000	100,000	80,000	30,000+	150,000
Drive design life (years)	5	5	5	12	15	3	17
Cartridge archival (with recorded data) (years)	30	50	30	30	15	30	30
SCSI DRIVE-CONTROLLER SPECIFICATIONS							
Conforms to SCSI common command set	●	●	●	●	●	●	●
Uses vendor-unique SCSI commands	○	○	○	○	○	○	●
SCSI disconnect/arbitrate/reconnect support	●	●	●	●	○	●	●
Asynchronous data transfer protocol support	●	●	●	●	●	●	●
Synchronous data transfer protocol support	●	●	●	●	●	●	●
Maximum asynchronous transfer rate (MBps)	2.2	4	3	3	3.3	3.3	6
Maximum synchronous transfer rate (MBps)	4	5	5	5	5	5	10
SCSI-2 compatible	●	●	●	●	●	●	●
SUBSYSTEM CHARACTERISTICS							
External drive subsystem available	●	●	●	●	●	●	●
Internally mounted drive subsystem available	○	●	●	●	●	●	●
Partition editor provided	●	N/A	●	●	○	●	●
Selective partition activation/deactivation	●	N/A	●	●	●	○	●
Selective write-protect of partitions	●	N/A	○	●	●	●	●
Cartridge initialization/format utility	●	N/A	●	●	●	●	●
Maximum DOS-partition size on media	1.3 GB	2.6 GB	650 MB	1239 MB	750 MB per side	650 MB	2.2 GB
Maximum number of partitions	10	N/A	8	Varies	●	Varies	Varies
Caching software included	●	N/A	○	○	●	●	●
Diagnostic software included	○	N/A	○	●	●	●	●
Write-once file-system capability	○	N/A	●	○	●	○	●
Write-once historical file management/retrieval	○	N/A	●	○	●	○	●
PHYSICAL CHARACTERISTICS							
Dimensions (height x width x depth) (inches)	1.875 x 6.75 x 9	1.6 x 5.7 x 8	5.5 x 7.75 x 13.9	4.7 x 6.6 x 10.8	2 x 8 x 12	2.25 x 6.12 x 12.5	1.62 x 5.75 x 8.32
Weight (pounds)	4	9	6	8	8.8	5.5	5.6
Interface	SCSI-1	SCSI-2	SCSI-2	SCSI-2	SCSI-2	SCSI-2	SCSI-2
FCC class rating	B	A	A&B	B	A	B	A; submitted for B
Drive manufacturer/model number	Maxoptix T4-1300	Maxoptix 5000091	Hewlett-Packard C1716T	Olympus MOS540E	Matsushita LF-7300A	Panasonic LF-1000AB	Apex OHD-4600
SALES AND SUPPORT							
Length of warranty (months)	12	12	12	24	12	12	12
Phone	(408) 983-1127	(510) 353-9700	(407) 677-8333	(516) 844-5000	(201) 348-7000	(201) 348-7000	(714) 789-3300
Toll-free phone	N/A	(800) 848-3092	(800) 228-0891	(800) 347-4027	(800) 742-8086	(800) 742-8086	(800) 553-7070
On-line address	http://www.libertyinc.com/	http://www.maxoptix.com	http://www.microdes.com	OlympusMO@aol.com	http://www.panasonic.com	http://www.panasonic.com	http://www.pinnaclemicro.com
Inquiry number	1127	1128	1129	1131	1132	1142	1133

 = BYTE Best. ● = yes; ○ = no; N/A = not applicable.

3½-inch Removable-Media Drives

PINNACLE MICRO, INC. SIERRA 1.3GB	PLASMON DATA, INC. RF6920E	PLASMON DATA, INC. RF7030E	SONY ELECTRONICS, INC. CMO-R531	SONY ELECTRONICS, INC. CMO-R544	IOMEGA CORP. JAZ	IOMEGA CORP. ZIP/Z100P	IOMEGA CORP. ZIP/Z100S	OLYMPUS IMAGE SYSTEMS, INC. MOS321E/ POWERMO 230	SYQUEST TECHNOLOGY EZ135
\$1495	\$2275	\$3100	\$2695	\$2995	\$599	\$199.95	\$199.95	\$589	\$250
4.48	4.42	4.78	6.16	6.34	5.44	5.55	2.50	5.43	5.46
7.62	6.49	7.08	6.37	6.37	6.43	5.12	5.24	8.45	7.20
4.31	3.55	3.25	3.91	3.91	3.41	3.51	3.52	3.03	2.91
○	○	○	○	○	●	●	●	●	●
●	●	○	●	●	○	○	○	○	○
1.3	1.3	1.5	1.3	2.6	1	100 MB	100 MB	230 MB	135 MB
●	●	●	●	●	N/A	N/A	N/A	N/A	N/A
●/●	●/●	○/○	●/●	●/●	N/A/N/A	N/A/N/A	N/A/N/A	●/●	●/●
1	2	2	2	2	1	N/A	N/A	1	1
●	●	●	●	●	N/A	N/A	N/A	●	Embedded servo
○	●	○	○	○	N/A	N/A	N/A	○	Embedded servo
○	○	○	●	●	N/A	N/A	N/A	●	●
○	○	○	○	○	N/A	N/A	N/A	○	○
MCC, Sony, Hitachi, DOT, 3M, Maxell	Plasmon, 3M, Verbatim, Phillips, Sony	Plasmon, Panasonic	Sony	Sony	Iomega	Fuji	Fuji	Various ISO media	Seagate, Akashic
19	29	45	39	25	10	29	29	<26	13.5
28	37.5	57.5	47	33	1.2	29	29	32.7	13
5	3	8.3	3	3	4	4	4	3.3	4
10	5	5	5	5	10	N/A	N/A	5	2.4
1.42/1.36	2.3/2.3	1.56/1.56	2.4/1.2	4/2	6.7/6.7	N/A/N/A	N/A/N/A	1.6/550 MBps	2/1.9
1800 to 3600	3500	2400	3600	3600	5304	2941	2941	4500	3600
4.32	8.5	12.5	8.33	8	5.6	10.2	10.2	6.7	8.3
N/A	●	●	N/A	N/A	●	1.6 MB	1.6 MB	●	●
●	●	●	●	●	●	●	●	●	●
●	●	●	●	●	●	●	●	○	○
●	●	●	●	●	●	●	●	●	○
40,000	180,000	80,000	100,000	100,000	250,000	100,000	100,000	50,000	100,000
4.5	5+	5+	20	20	5	5	5	6	5
30	15	15	100	100	10	10	10	30	30
●	●	●	●	●	●	●	●	●	○
●	●	●	●	●	●	●	●	○	○
●	●	●	●	●	●	●	●	●	○
●	●	●	●	●	●	●	●	●	○
●	●	●	●	●	●	○	○	●	○
5	3	3.3	3	3	4	4	4	3	○
10	5	5	5	5	4	N/A	N/A	5	○
●	●	●	●	●	●	●	●	●	○
●	●	●	●	●	●	●	●	○	○
●	●	●	●	●	●	●	●	○	○
●	●	●	●	●	●	○	○	○	○
●	●	●	●	●	●	○	○	○	○
●	●	●	●	●	●	○	○	○	○
587 MB	N/A	N/A	N/A	N/A	1 GB	100 MB	100 MB	217 MB	135 MB
Varies	N/A	N/A	N/A	N/A	1	1	1	Varies	Unlimited
●	N/A	N/A	●	●	○	○	○	○	○
●	N/A	N/A	●	●	●	●	●	●	●
●	N/A	N/A	●	●	●	●	●	●	●
●	N/A	N/A	●	●	N/A	●	●	○	○
●	N/A	N/A	●	●	N/A	N/A	N/A	○	○
1.62 x 5.75 x 8.32	3 x 9.5 x 12.7	3 x 9.5 x 12.7	2.7 x 9.7 x 10.7	2.7 x 9.7 x 10.7	5.33 x 1.5 x 8	1.47 x 5.35 x 7.10	1.47 x 5.35 x 7.10	5.5 x 3.5 x 8.2	1.8 x 4.5 x 8.1
7.4	8.6	8.6	11.4	11.4	2	1.05	1.05	5.6	2
SCSI-2	SCSI-2	SCSI-2	SCSI-1	SCSI-1	SCSI-2	Parallel	SCSI-1	SCSI 2	Parallel
A; submitted for B	A	A	B	B	B	B	B	B	B
Sierra OHD-1300	IBM 0632-CHA	Panasonic LF-7394	Sony CMO-R544	Sony CMO-R544	Iomega 10134	Iomega Z100P	Iomega Z100S	Olympus MOS321E	Syquest
12	12	12	12	12	12	12	12	24	24
(714) 789-3300	(408) 474-0100	(408) 474-0100	(408) 432-0190	(408) 432-0190	(801) 778-1000	(801) 778-1000	(801) 778-1000	(516) 844-5000	(510) 226-4000
(800) 553-7070	(800) 445-9400	(800) 445-9400	(800) 352-7669	(800) 352-7669	(800) 697-8833	(800) 697-8833	(800) 697-8833	(800) 347-4027	(800) 295-2278
http://www.pinnaclemicro.com	marketing@plasmonca.com	marketing@plasmonca.com	http://www.sel.sony.com/SEL/ccpg	http://www.sel.sony.com/SEL/ccpg	http://www.iomega.com	http://www.iomega.com	http://www.OlympusMO@iomega.com	http://www.aol.com	http://www.syquest.com
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Of Cables and Cards

The Diamond Flower, Inc. (DFI) dual-Pentium Doubleshot 133 is the quietest machine at Chaos Manor. It's not the fastest. That honor belongs to the Intergraph TDZ-400, a dual-Pentium Pro 150, which also boasts 128 MB of main memory and 12 MB of video memory. The TDZ-400 is a blooming wonder—it won BYTE's Comdex Best of Show Award for hardware. I'll have more about it another time when computer artist David Em and others who use high-end systems have finished testing it.

The TDZ-400 is at the high end of the spectrum of machines I write about. The Doubleshot 133 has the most bang for the buck of any system here; it's really a little jewel. It now runs OS/2 SMP 2.11. Soon, through the miracles of System Commander and Partition Magic, it will also boot up Windows NT. Both OSes, like Unix and NetWare, recognize the dual processors.

The Doubleshot 133 arrived just too late to be in competition for the Chaos Manor User's Choice Awards. Despite being extremely well packaged in "whoopee cushions," it wouldn't boot; there weren't even power-on self test (POST) code beeps to indicate an error. I called DFI, and we went through the usual troubleshooting exercises like reseating boards and checking the power supply. Since it was working when it left DFI, the inference was transit damage, but there was nothing obvious. DFI was concerned enough to send a technician with a replacement. The replacement worked perfectly, so we turned our attention to the original machine, going through the usual checkups, including swapping the memory chips around.

Then we reseated the Pentium chips. Voilà! Either the DFI shipping department had packed the tower-configuration system upside down, or the shipping company hadn't obeyed the This Side Up markings. Each Pentium chip had its own chip fan, and the weight was enough to unseat the chips despite the lever-lock of the zero-insertion-force (ZIF) chip socket. The result of this experience is that DFI has changed from chip-mounted fans to a fan that clips on the socket, so you won't have that problem.

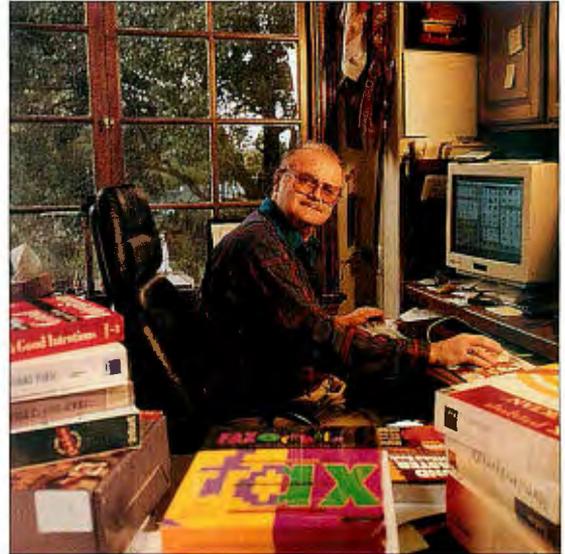
Once past that, the Doubleshot 133 worked splendidly. I networked it into the system using IBM OS/2 LAN Server, and that worked.

More when I get a PCI-bus network card that has both OS/2 and NT drivers. Then I'll expand the hard drive space. The Doubleshot 133 comes with a Western Digital Caviar 1.5-GB hard drive, and the unique case arrangement makes it easy to install a second drive. As usual in modern systems, there are two IDE outlets on the motherboard; each can support two devices. At the moment, we have the Caviar hard drive and a six-speed CD-ROM drive, so the BIOS will support two more IDE hard drives.

Everything about this system says quality. Start with DFI's unusual and rugged tower case. There's a spacious main bay in which you can mount peripherals like the CD-ROM drive or full-height 4-GB hard drives. Above the main bay is a small separate compartment that will hold one half-height floppy drive and two Caviar hard drives. This is a very space-economical arrangement, but I have two quibbles. First, if you want to remove the memory, you must unplug the drive cables from the motherboard. Second, the Pentium chips are placed so that it's impossible to use more than one full-length ISA board. PCI boards can be as long as you like, but two of your ISA boards must be short. These are minor difficulties, and you wouldn't have either with a DFI single-processor system.

The power supply is made in Taiwan by DFI. The system runs cool, and despite all the fans is *extremely* quiet. Even with the cover off, it's literally so quiet you don't know it's on.

Most DFI dual-processor systems ship with NT. That system is called the Landmarq P133 VPM Doubleshot. The company sent another Caviar hard drive with NT installed, and it was simple to substitute it for the Caviar with OS/2. Once I test NT, we will expand the disk space, install the latest version of OS/2 LAN Server, and use the Doubleshot 133 as the Chaos Manor



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network server. OS/2 is an extremely reliable OS for critical networking missions, and the IBM network-server software is reliable and well designed. It networks well with Windows and Windows 95. Network service is a good test of a system's endurance.

DFI didn't design this as a server, in that it has no RAID hardware. Of course, NT supports RAID in software, but this model is intended to be a cost-effective, high-performance business system for running financial programs, such as programmed trading controllers that need dual-processor power, or a fast CAD or other high-end graphics workstation. I also have physics and business-modeling programs that need the extra computing power of dual Pentiums.

Just now I'm using Win 95, but sometime this year I'll switch to NT, mostly.

Not entirely, because NT won't run Win 95-specific games; on the other hand, NT doesn't have the annoying "hesitations" Win 95 has on even the fastest systems. I hate it when I'm typing and the system suddenly won't respond for half a second. When I change, the Doubleshot 133 with NT may become my main writing machine. If quiet, cost-effective high performance is what you need, look at the DFI line. Recommended.

I didn't have the space for all the User's Choice Awards last issue. A User's Choice Award goes to PhoneDisc PowerFinder '95. Five CD-ROMs include just about every listed phone number in the U.S. Simple to install. Search by name or town or address. Blazingly fast. It's one of the most useful programs I have.

The second belated User's Choice Award goes to Drag and File, a file manager utility for Windows and Win 95 that really works. You can call up a little floating toolbar that stays on your desk with buttons for all drives, including networked drives. The display is better than Explorer. When you drag and drop files, you can specify copy or move, overwrite warning or not. You can specify later files only, useful for updating your laptop for a trip; and you can do operations to several disk drives at once. It works the way File Manager ought to. Recommended.

Sometimes you learn the hard way. Eric Pobirs, the new Chaos Manor intern, got the job of installing SCSI devices in either SuperCow, the ISA Gateway 2000 486DX2

running Windows for Workgroups (W4WG), or RacingCow, the Gateway P5-133. RacingCow has both PCI and ISA slots, but all the ISA slots are filled.

First, he tried to install an Adaptec ISA SCSI board for a Syquest EZ135 removable-cartridge hard drive on SuperCow. Adaptec SCSI boards always work, so installation should have been simple; but it didn't work. I was busy working on *Star-swarm*, my new novel (later this year from Tor), so I didn't see what he'd done. Meanwhile, Eric found our QLogic PCI-bus

SCSI board and tried installing it on RacingCow. That didn't work either: the system found the board, but the board found no devices. It's odd, because we've never had problems with QLogic boards before.

Alex came over after Eric left. He looked at the cable used on both systems, a SCSI-2 cable with dozens

of tiny pins. Two were bent, and they couldn't be straightened. The remedy was simple: tie a knot in it and throw it in the trash. Next day I told Eric: "There was nothing wrong with the boards. Nine times out of 10 with SCSI, the problem is a cable, and a Granite Digital SCSIVue Gold Diagnostic Cable will solve all problems."

With a good cable, the system could see the SCSI devices. Alas, the CD-ROM drive that runs off the Sound Blaster card in SuperCow stopped working, and I was due to go to the beach house. SuperCow goes with me, and, yes, I understand about portables and I don't want to talk about it. We removed the SCSI card. Still no CD-ROM. I took the CD-ROM drive out of SuperCow. It looked all right.

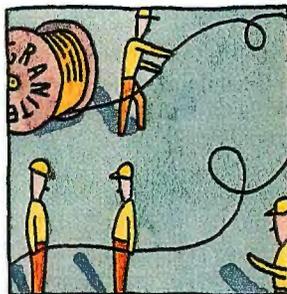
About then, Larry Niven came over for a hike. Larry doesn't like waiting while I work on computers. More to the point, our dog knows that when Larry is here in hiking shoes, it's time to go to the hills, and there's no living with him.

"Just trying to get this CD-ROM drive working," I said. "Nine times out of 10 it's the cable..."

"So you're trying everything else first?" Niven asked.

I cursed, and went to the cable room to find a new flat internal CD-ROM drive cable. Connected it up. Watched the CD-ROM drive work. Walked the dog.

We still have problems. On RacingCow, the QLogic PCI SCSI board with the Granite Digital cable found the devices, but the Syquest EZ135 didn't work. While I got on the Internet through EarthLink Total Access and searched for new Syquest drivers,



Eric tried installing the Windows 3.11 drivers on the Win 95 machine. There was a warning that you shouldn't do that; it's right on. Not only doesn't it work, but it left a toolbar that appeared at start-up and couldn't be removed.

Searching for files with the name "Syquest" did no good. Eventually I searched for all files with "qu" in them and found that LOAD=WSQUTIL.EXE had been inserted in the win.ini file. Remarketing it out stopped the loading of the Syquest utility. I tell you this not because Syquest didn't warn us about installing the Windows 3.11 version in Win 95, but because I had forgotten that Win 95 has a win.ini file that you can manually edit.

We downloaded the new Syquest drivers, and lo!, the drive worked fine. Alas, the PCI SCSI board interferes with the ISA sound board. If they were both PCI-bus boards, the PCI system logic would detect the problem and software-reconfigure one of the boards to resolve the problem. If they were both ISA-bus boards, Win 95 might see the conflict. If this were NT, we'd be required to find and set the interrupt request (IRQ), port addresses, and DMA channels for each board ourselves;

no Plug and Play (PnP) for a while.

If you go into the BIOS and tell the system which IRQ numbers are assigned to ISA, PnP usually works; but it won't in this case, because *all* the IRQs from 0 to 15 are in use. If we want to add a SCSI card—and we do—until there's new engineering to integrate some peripherals, we must disconnect some other device.

There are two possibilities: remove the internal modem and use an external modem on a serial port or disable one of the serial ports. The Gateway P5-133 has a PS/2 mouse. (That's a bit like a bus mouse, but with a different connector, and unlike the bus mouse, it is fixed at IRQ 12.) Anyway, I could spare a serial port to free up an IRQ for the QLogic SCSI board to run the Pioneer DRM-604X six-pack CD-ROM player, a scanner, an optical drive, or the Syquest EZ135.

When IBM added hard drives to the PC, they set the stage for what later became IDE. But IDE supports only two devices per IRQ. SCSI costs more, but you get seven devices per IRQ (15 with Fast-and-Wide SCSI), and it's faster than IDE. Since we're stuck with only 16 IRQs, it's pretty clear that complex systems with lots of

peripherals will need SCSI.

We put the Syquest EZ135—it's very fast for a removably-cartridge hard drive; more when we've used it more—on the AST Bravo running Windows 3.11. It works fine there, provided that we have a good SCSI cable. The moral of this story is simple: when you do a SCSI installation, keep a Granite Digital SCIVue Gold Diagnostic Cable around—and use it.

The niftiest new program I've seen recently is ASAP WordPower from Software Publishing, the people who brought you Harvard Graphics. Incidentally, if you wonder whatever happened to Stanford Graphics, Software Publishing bought that company and incorporated their best features into Harvard ChartXL; a smart move.

ASAP WordPower is not just "yet another" presentation creation program. The difference is, with ASAP you can get on a plane in Los Angeles with the uninstalled program and a laptop, and by the time you reach Washington, D.C., have created a professional-looking briefing.

Software Publishing's Maurice Hamoy brought this over to Chaos Manor a few weeks ago. I was impressed by the demon-

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Developers circle 255, End Users circle 256 on Inquiry Card.

stration. Later, I was faced with a sudden need to create a complex briefing. I found ASAP WordPower in the pile of new stuff and handed it to Eric. "I remember this was pretty nifty," I said. "See what you can make of it."

He sat down at SuperCow while I got to work on my novel. I heard mutterings. Then, about 10 minutes later: "Now I get it." Half an hour later, he had created a complicated presentation on how to skin a cat. It included methods, philosophical implications, the impact of cat-skinning ex-

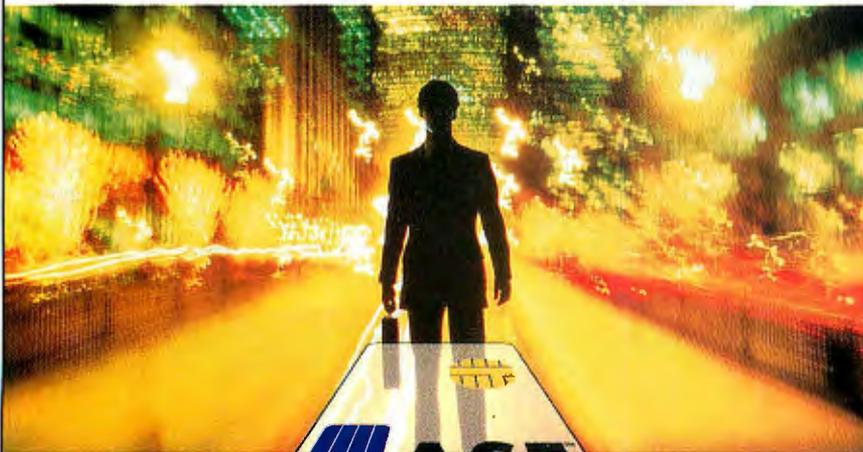
perience on career advancement—and despite the silliness of the subject, it was a good-looking presentation.

ASAP WordPower offers a wide variety of presentation formats, such as Pro & Con, Pyramid, Agenda, standard bullet chart, and Flow Table. There are many style choices—choose a style, and all the charts will look that way. You can change



styles and templates in a flash, so it's easy to experiment. There are print options, including making handout sets. All this is so easy that you'll have to play with the program to appreciate how it changes the way you think about presentations. If you make presentations, you need ASAP WordPower. Highly recommended.

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I've just spent two days experimenting with PC Cards (née PCMCIA cards) and portables. Actually, I was trying to get SpaceCalf, the Gateway 2000 Liberty subnotebook, working again. One feature of the Liberty is a removable hard drive, which isn't as good an idea as it sounds. When carrying SpaceCalf—the name comes from the wallpaper of a cow on the moon—I've more than once activated the catch that holds the hard drive in place. This can corrupt files.

Also, I used to keep two PC Cards in place, a Xircom Performance Series CreditCard Ethernet Adapter IIps and a Megahertz 28.8 PC Card Data/Fax Modem with XJack. That's a mistake: the two cards generate heat, and I don't use the Ethernet card on the road. For a year there was no problem, but recently I added 16 MB of memory—it's very easy to do with the Liberty.

I don't know if the memory plus two cards caused a heat problem, or if the hard drive got slightly displaced despite the duct tape over the catch, but suddenly SpaceCalf wouldn't network. If I tried to access a networked disk through File Manager, the computer would reboot.

The network was working in DOS. If I booted up and ran C:\windows\net start, I could do the command NET VIEW, log on, and send files. I couldn't add new connections, but I could send to those previously mapped in W4WG. I sent everything over the network to an optical disk, rebooted, and reformatted the portable's hard disk.

Even then it was flaky, so I used FDISK to completely remove the disk partition and started over. That did it. It took a few minutes to reinstall W4WG and then all the special software—power management, screen resolutions, PC Card configuration, the SpaceCalf wallpaper—but once that was done, it worked like a charm.

At this point, I must have taken leave of my senses. I have a dozen PC Cards. Some are Ethernet, some are 28.8-Kbps modems, and a few combine both. I decided to do some testing.

While it's only annoyingly difficult to

install one card, it's a bright royal pain to do a bunch of them. Modems are bad enough. Your PC Card services' fatware will set the slot to expect certain values for addresses and IRQs. Your communications software expects your serial ports to have certain addresses and IRQs. When you load W4WG, the SYS.INI file can and often does reconfigure the port address and IRQ—and every blasted setup program thinks it has to put port configuration statements in SYS.INI.

Some of them look for previous statements and remark them out. Others just blandly put in their own values, leaving contradictory values as well. Some, if you run them twice, will detect their own previous statements as a conflict and install yet another set of values. It's entirely possible for a communications program and modem card to work in DOS and fail in Windows. Then there's nothing for it but to hand-edit your SYS.INI file, making sure that Windows sets the serial port to what your software expects and your PC Card is set for.

Finding those settings depends on your software. Procomm Plus tells you what it expects and offers ways to change the expected port IRQ and address. Some PC Card modem packages come with diagnostics programs that show current settings for modems and card slots. The Gateway card management software has a program to configure the slots.

My only advice is to keep fooling around. Eventually, you'll know what values you need, and you can put them in SYS.INI. They'll look like COM1Irq=4 and COM1Base=03F8. Once you have inserted them, be sure to eliminate contradictory statements.

In the Liberty, the PC Card slots are COM3 and COM4, IRQ 4 and 3, respectively; they share IRQs but not addresses with COM1 and COM2. This arrangement goes back to the IBM PC and is the cause of many of our installation problems. You must have an IRQ *per COM port*, but IBM defined only two IRQs, so everyone defines the other two differently. The moral of the story is, if you change PC Cards, you probably have to uninstall its software. The bad news is that most of them don't come with uninstallation programs.

I had little joy with combination cards. If the Xircom card worked, the Megahertz card generally wouldn't install easily. I would have tried harder, but most of those cards put out more heat than I want inside my portable. Some get too hot to handle.

I won't go through all the cards I rejected. The ones I've chosen to use are a 3Com EtherLink III LAN+Modem PC Card. This has a modem built in, but I

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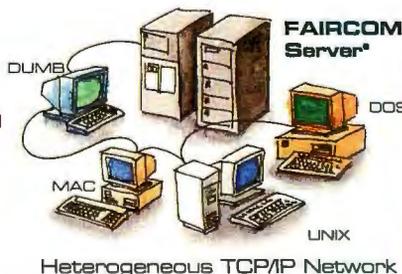
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don't like it. I'm not fond of the connector plug they use, and while with some difficulty I got the computer to recognize the modem, it wasn't reliable on my noisy phone lines. The Ethernet link, on the other hand, works splendidly. The card heats to about 96°F after a few hours of use; it hasn't been a problem. In hotter weather it might be, but the 3Com is the coolest of the Ethernet cards I have.

I use the Megahertz 28.8 PC Card Data/Fax Modem with XJack. It runs about as warm as the 3Com EtherLink card; together, the two would generate more heat than I want, but I don't simultaneously run Ethernet and a modem on my portable. It's easy enough to swap cards. This is one of the few reasons for running the "hot plug" fatware for PC Cards. If you're not going to change cards often, chuck those stupid "card service" drivers and go with card-specific drivers that are much smaller and faster.

The Megahertz 28.8 Data/Fax Modem PC Card installs easily and comes with neat diagnostic software. The XJack connector lets you plug a standard phone line into the modem card, so you can't lose the connecting cable. Recommended.

Xircom also makes a combination Ethernet/modem card, but, alas, that was one of those I rejected for excessive heat. Their straight Ethernet card—the Performance Series CreditCard Ethernet Adapter Ips—on the other hand, installs easily, works well, and runs cool; the only reason I'm not using it is that I tested the 3Com card after the Xircom card.

And if you *really* want reliable communications on the road, carry a Supra or U.S. Robotics external modem in your checked luggage.

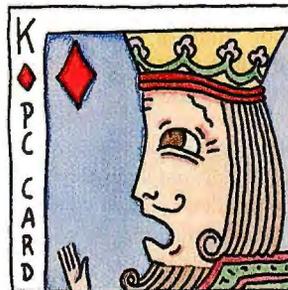
I recently discovered a "feature" of Win 95. In My Computer and Explorer, there's a

View menu item. In it is an item called Options, and in that is another View. In that second View, you can choose to display all files or exclude those with certain extensions like DLL. If you haven't selected View All Files, the FIND command on the toolbar will also ignore those excluded files.

You will never see them unless you search with Norton Commander or some other DOS file manager that doesn't know this silly trick. Note that the default is to exclude several kinds of files. That's stupid.

LapLink for Windows 95 works: I recently ran it on a portable connected to the Ethernet at 28.8 Kbps (more or less) through Netcom. I used it to control Pentafluge connected on a separate modem and 28.8-Kbps phone line to Ethernet through EarthLink. Editing a big Word document that way isn't much fun, but you can do it; provided you're patient, you can make the home machine do almost anything you could do if you were seated at it.

There's also a chat mode and a kind of E-mail you can use with your Win 95 network. More on this another time, but it does work, and if you haven't upgraded your LapLink in a while, it's time to do it again. LapLink for Windows 95 is good.



Product Information

ASAP WordPower (\$99), Software Publishing Corp., San Jose, CA, (800) 336-8360 or (408) 537-3000, fax (408) 537-3500, <http://www.spc.com>. Circle 1114 on Inquiry Card.

Doubleshot 133 (with OS/2 SMP 2.11) or Landmarq P133 VPM Doubleshot (with Windows NT) (\$6349), Diamond Flower, Inc., Sacramento, CA, (800) 808-4334 or (916) 568-1234, fax (916) 568-1233, <http://www.dffusa.com>. Circle 1115 on Inquiry Card.

Drag and File for Windows 95 (\$35), Canyon Software, San Rafael, CA, (800) 280-3691 or (415) 453-9779, fax (415) 453-6195, <http://www.canyonsw.com>. Circle 1116 on Inquiry Card.

EtherLink III LAN+Modem PC Card (\$549), 3Com Corp., Santa Clara, CA, (800) 638-3266 or (408) 764-5000, fax (408) 764-5001, <http://www.3com.com>. Circle 1117 on Inquiry Card.

LapLink for Windows 95 (\$199), Travelling Software, Inc., Bothell, WA, (800) 343-8080 or (206) 483-8088, fax (206) 487-1284, <http://www.travsoft.com>. Circle 1118 on Inquiry Card.

Megahertz 28.8 PC Card Data/Fax Modem with XJack (\$349), Megahertz Corp., Salt Lake City, UT, (800) 527-8677 or (801) 320-7000, fax (801) 320-6010, <http://www.megahertz.com>. Circle 1119 on Inquiry Card.

PhoneDisc PowerFinder '95 (\$199), Digital Directory Assistance, Inc., Bethesda, MD, (800) 284-8353 or (301) 657-8548, fax (301) 652-7810, <http://www.dda-inc.com>. Circle 1120 on Inquiry Card.

SCSIVue Gold Diagnostic Cables (\$39 to \$149), Granite Digital, Union City, CA, (510) 471-6442, fax (510) 471-6267, <http://www.scsipro.com>. Circle 1121 on Inquiry Card.

The Train Pak CD-ROM (Mac or Windows, \$69.99), Abracadata, Ltd., Eugene, OR, (800) 451-4871 or (541) 343-2324, fax (541) 683-1925, 70751.620@compuserve.com. Circle 1122 on Inquiry Card.

Warhammer: Shadow of the Horned Rat (\$79.95), Mindscape, Inc., Novato, CA, (800) 234-3088 or (415) 897-9900, fax (415) 897-2747, <http://www.mindscape.com>. Circle 1123 on Inquiry Card.

The book of the month is a magazine: *The World and I*, edited by my friend Morton Kaplan. It used to be about \$100 a year. Now it's a bargain at \$90 for three years. It has more content than you may read, but what you do read will be worth the price. It covers arts, science, literature, poetry, education, culture, and once in a while has an article by me (*The World and I*, Washington, D.C., (800) 822-2822 or (202) 636-1628; fax (202) 526-3497).

The shameless plug of the month is *Janissaries* by Jerry Pournelle, recently reissued by Baen Books.

Two real books of the month: *Plug-N-Play Netscape for Windows* by Angela Gunn and Joe Kraynak (Sam's, ISBN 1-57521-010-x), a painless way to learn Netscape and get connected through EarthLink Total Access. EarthLink Network is the Internet service provider (ISP) I presently recommend, and their Total Access software, which comes on disk with the book, is what I use.

The other book of the month is *Politics on the Net* by Bill Mann (Que, ISBN 0-7897-0286-x). It's astonishing just how much political information (as well as polemic) there is on the Net, and this is a good survey.

When I was at the Hackers' Conference last fall, I saw radio-controlled electric trains with computer-controlled operations. You can also simulate model railroads on your computer. Real train fanatics will love Train Engineers/Design Your Own Railroad, both on The Train Pak CD-ROM by Abracadata. You can design as complicated a layout as you like, then sit in the cab as you drive trains on the layouts you've built. For train nuts only, but for those it's a must.

Two games this month: a repeat of MicroProse Software's *This Means War*. I'd be ashamed to say how much time I spent on that. The other is *Warhammer: Shadow of the Horned Rat* from Mindscape. It's a medieval fantasy role-playing game that's pretty good for that genre.

Next month, the Intergraph TDZ-400, new graphics and financial suites, and a report on political developments in science policy. ■

Jerry Pournelle is a science fiction writer and BYTE's senior contributing editor. You can write to Jerry c/o BYTE, One Phoenix Mill Lane, Peterborough, NH 03458. Please include a self-addressed, stamped envelope and put your address on the letter as well as on the envelope. Due to the high volume of letters, Jerry cannot guarantee a personal reply. You can also contact him on the Internet at jerry@bix.com.

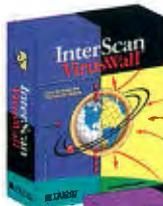
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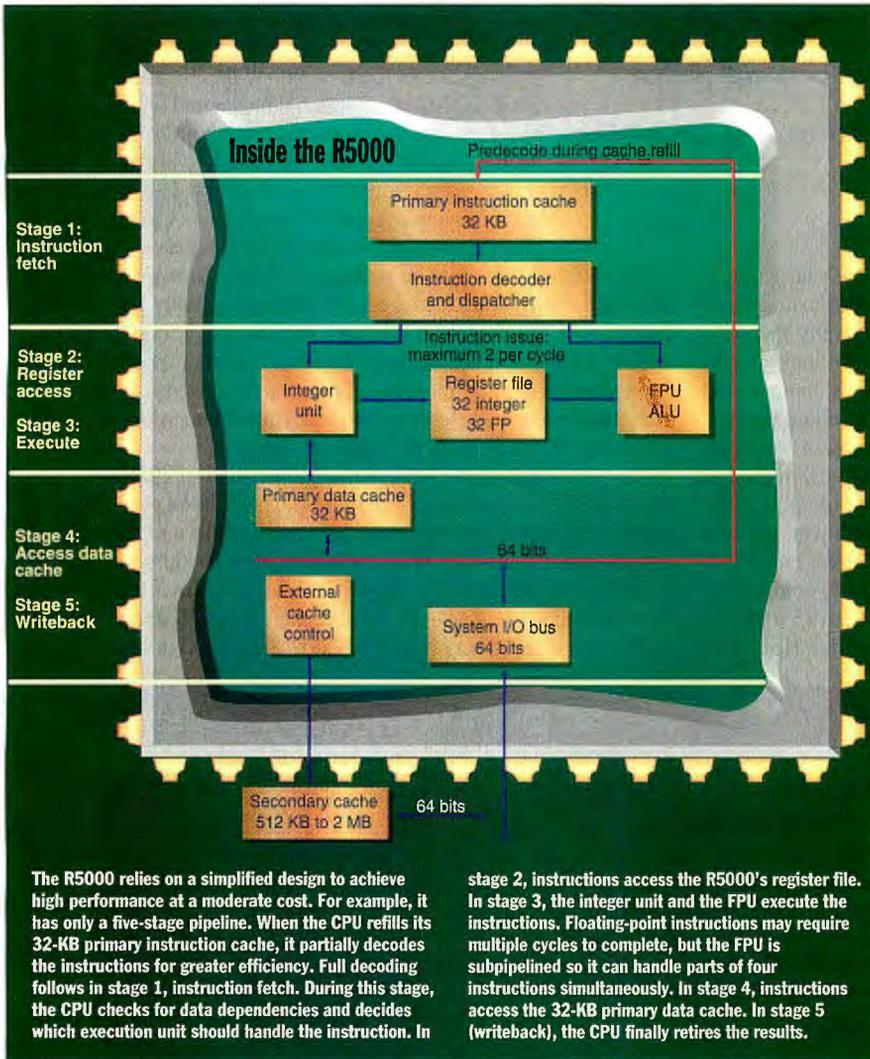
and single-precision floating-point operations.

As a result, the R5000 can execute a single-precision FP and any *dissimilar* instruction simultaneously. In other words, one instruction in the pair must be an integer-type or load/store operation; the R5000 cannot execute two single-precision FP instructions at once. Unduly restrictive? Mips engineers took into account how real-world graphics software works.

addition components of a matrix problem in parallel. Once the R5000's five-stage pipeline is primed, there can be a MADD instruction in a different state of completion in every pipe stage. So the R5000 can repeatedly issue a new MADD instruction every cycle. The R5000 can also process an integer or load/store instruction at the same time as a single-precision MADD. For every MADD executing in the FP pipeline, an accompanying load/store instruction can be flowing through the second pipeline.

Result: a highly tuned microarchitecture that rips through 3-D geometry calculations at speeds you'd normally expect from a more expensive processor. Ordinary FP benchmarks may not tell the whole story because they're not specifically measuring this performance. Mips claims that 3-D graphics software such as Pro-Engineer and UltraCAD will run faster on the R5000 than on similarly benchmarked CPUs like the Pentium Pro.

BYTE hasn't yet verified those claims, but Mips' parent company, Silicon Graphics (Mountain View, CA), is reporting significant performance gains on its latest R5000-based Indy workstations. According to SGI, the new Indys run 3-D graphics software about 83 percent faster than existing R4400-based systems. And because they use early versions of the R5000 that run at 150 to 180 MHz, greater gains lie ahead when the R5000 achieves its target clock speed of 250 MHz.



The R5000 relies on a simplified design to achieve high performance at a moderate cost. For example, it has only a five-stage pipeline. When the CPU refills its 32-KB primary instruction cache, it partially decodes the instructions for greater efficiency. Full decoding follows in stage 1, instruction fetch. During this stage, the CPU checks for data dependencies and decides which execution unit should handle the instruction. In

stage 2, instructions access the R5000's register file. In stage 3, the integer unit and the FPU execute the instructions. Floating-point instructions may require multiple cycles to complete, but the FPU is subpipelined so it can handle parts of four instructions simultaneously. In stage 4, instructions access the 32-KB primary data cache. In stage 5 (writeback), the CPU finally retires the results.

Cutting Corners

To hold down costs, Mips left several advanced features out of the R5000 chip. Having fewer pipelines is just one example. The R5000 also cannot execute instructions speculatively or out of order. This greatly reduces the chip's complexity because it doesn't have to bother with tricky techniques to retire instructions in their original program order.

The R5000 doesn't support dynamic branch prediction, either. However, it does have several branch-likely instructions that smart programmers and compilers can use as a sort of poor man's substitute. There's also an FP conditional-move instruction that saves a branch.

In another cost-cutting measure, Mips eliminated the 128-bit secondary-cache bus found on the R4000 and R10000. The R5000 accesses its secondary cache over the general I/O bus, which is 64 bits wide. The maximum cache size is 2 MB. This is similar to the Pentium's cache interface, except the R5000's bus can run at 100 MHz, compared to the Pentium bus's top speed of 66 MHz.

All these economies significantly reduce the R5000's pin count. And the R5000's die is downright tiny: 84 sq mm on a .32-micron process. A smaller die means higher yields, lower manufacturing costs, and faster clock speeds. With CPUs, that's the whole ball game. ■

MADD About Math

Consider the math behind 3-D geometry processing. To calculate the vertices of a 3-D object, a graphics program typically multiplies a 4x4 transform matrix of single-precision FP values against a 1x4 matrix of similar values representing a single vertex. The result is another 1x4 matrix. The graphics program must repeat this operation for every vertex in the object—potentially tens of thousands of times for a complex object in a CAD drawing.

To do this kind of math, the Mips IV instruction set includes both a single-precision and a double-precision multiply-add (MADD) operation that's similar to the multiply-accumulate (MAC) instruction in a DSP. The main difference is that MADD uses four operands instead of MAC's three ($A*B+C=D$ instead of $A*B+C=C$).

As implemented in the R5000, the single-precision MADD instruction has a repeat rate of one cycle and a latency of four cycles. The FPU is subpipelined, so it can calculate the multiplication and

Where to Find

Mips Technologies
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Tom R. Halfhill is a senior editor based in BYTE's San Mateo, California, bureau. You can send E-mail to him at thalfhill@bix.com.

The Be-All of Operating Systems

Be, Inc., hopes that abandoning legacy systems to create a modern OS will draw developers to the BeBox computer

REX BALDAZO

Imagine the frustration of trying to develop a modern 32-bit OS that can still run 10-year-old DOS games. Microsoft made it happen with Windows 95, but the compromises it made to achieve this are legion. It's amazing that the company pulled it off as well as it did.

Imagine instead that you could start anew. What if you could forgo compatibility with legacy applications and create a brand-new OS that incorporated the latest advances in OS research and object-oriented programming and ran on the latest hardware? What if you made it inherently multiprocessing? And what if you put that OS in a box with a consumer-friendly price?

Be, Inc., is attempting to do just that, with its new BeBox due to ship by the time you read this. The basic configuration is a dual-PowerPC 603 with built-in support for a multitude of I/O buses and ports, including Peripheral Component Interconnect (PCI), SCSI, and a "Geek-Port" to give hardware experimenters an easy I/O interface to the BeBox.

A Be Bop-a-loo-bop

Harnessing all this hardware muscle is the job of the new Be OS. The OS is built in three layers:

- A *microkernel*;
- A number of *servers*; and
- Shared libraries organized into *kits* that interface to the servers and provide the programming interface for applications (see the figure "How Developers Interact with the Be OS").

The microkernel deals with the specifics of the hardware, much like the hardware abstraction layer (HAL) in Windows NT. The other two layers, the servers and the kits, are the heart of the Be OS.

The servers are the engine running under the hood, while the kits are the transmission and gas pedal. The kits provide the mechanism for requesting new objects, sending messages between objects, and so on. The servers are responsible for providing those requested services.

Applications for the Be OS are written to a set of APIs that have been organized into kits. There is an Application Kit, an Interface Kit, a Storage Kit, and so on. The kits are written in C++ and are in essence an object-oriented framework. Developers don't need to master both the native API and a separate application framework. In Windows

programming, frameworks such as Borland's Object Windows Library (OWL) and Microsoft Foundation Classes (MFC) provide an object-oriented abstraction for the complex Windows API. But in the Be OS, the API and application framework are one and the same.

This duality of kits and servers is not just a convenient organizing picture for the OS—it is an intrinsic part of the architecture. Like any good modern OS, the Be OS is multithreaded (see "Weaving a Thread," October 1995 BYTE). But the servers and kits put these threads to good use throughout the OS. For example, each window in a Be application has two threads—a client thread and a server thread. The client thread receives and dispatches user events such as keystrokes or mouse movements, while the server thread deals with any processing chores requested by the window.

This architecture lets the application take advantage of the dual-processor BeBox without requiring extra work by



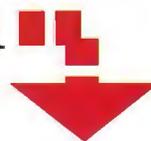
the application programmer. And it can potentially improve performance and responsiveness, since the server thread can be run on one processor while the client runs on the other. That's assuming that the thread scheduler is able to put the two threads on separate processors. That might not be the case if, say, an intensive and high-priority process is already running on one of the processors.

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You Could Actually Learn Something

CORE TECHNOLOGIES Operating Systems

The OS is simply crawling with threads. For example, during boot-up, separate threads are instantiated to handle kernel debugging, turning off the floppy drive motor, and managing the disk cache. There's also a special thread called psycho_killer, which is used to terminate other threads.

Even the boot process itself takes advantage of the inherently multiprocessor nature of the BeBox. While CPU 0 goes searching the available disk drives for an OS kernel, CPU 1 displays the Be logo on the screen.

Being There

Many compatibility problems in today's OSES can be traced to various other system-level extensions. Extensions are supposed to add some functionality to a system, such as a device driver or a network protocol stack. In a legacy OS such as Windows,



The multitasking, multithreaded Be OS automatically assigns each window two threads. In addition, every object is stored in a built-in relational database, with its attributes (1). You can query the database on any attribute (2).

some extensions can be loaded dynamically as needed, in the form of DLLs. Others have to be installed in a remnant of DOS, the CONFIG.SYS file. While both mechanisms extend the basic OS, conflicts between the two are inevitable and too common.

Be's solution is to devise a new OS where all extensions are dynamically loaded, shared code. It probably won't eliminate all software-related conflicts, but a consistent approach to OS extensions should make it easier to get various device drivers and shared libraries to coexist more peacefully.

The Be OS features additional innovations and interesting components. Just as each window in a Be application runs in a separate thread, each window also gets its own graphics environment. So every window can draw to any color depth, and the Application Server handles either dithering down to 8 bits or expanding to 24/32 bits, depending on the depth you've set on your display.

One of the more interesting features in the Be OS is the built-in relational database. You treat everything stored on a disk drive as if it is in a relational database. The database can have tables with information on files (e.g., size, creator), another table with information on your E-mail (e.g., date received, from), and so on. In addition to traditional file-based views of your data, you have the option of running relational queries to locate pertinent data.

For applications programmers, there is an interface to the database in the Storage Kit. Users can interact directly with the data-

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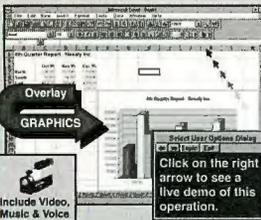
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CORE TECHNOLOGIES Operating Systems

base through the built-in Be OS Browser, which is somewhat analogous to the Mac Finder. A Find option in the Browser lets you search for any entity in the database; the query results remain "live" until the window is closed. So if you have queried for all JPEG files that are larger than 25 KB, the Browser updates the query window appropriately when you delete an existing file or create a new file that matches the criteria.

And despite the stated goal of breaking free from legacy systems, Be OS developers have managed to steal some good ideas from present-day OSes. The libposix shared library emulates some of the Posix API to simplify porting Unix-flavored software.

Development Tools

Developing the Be OS has, of course, required development tools, most notably, a compiler. The Be OS is written in C++ and compiled using a version of the Metrowerks CodeWarrior compiler. Version 8 of that development system for the Mac also cross-compile for both Win32 and Be OS. CodeWarrior and the Be OS have evolved together, which has put some limitations on the Be OS. Because of its Mac heritage, CodeWarrior has not traditionally generated thread-safe exceptions. Version 8 fixes this shortcoming, but because Be developed the OS using earlier versions, it does not yet incorporate C++ exceptions.

Currently, a native Be version of the CodeWarrior integrated development environment (IDE) ships only on the Be OS CD but not with the commercially available CodeWarrior 8 CD. The native Be version still lacks some tools, such as a source-level debugger. For now, Be developers have to cross-debug their Be applications from a Mac—the application runs on the BeBox, while the debugger runs on the Mac. A native Be debugger should be available soon, possibly by the time you read this.

Though it may still be a bit immature, the native Be IDE already shows off features not possible with the Mac version. Brian Stern, the Metrowerks software engineer who is developing the native Be IDE for CodeWarrior, is especially proud of the multithreaded compilation. After an initial parse identifies dependencies in the source code, separate compilation units can be handed off to separate threads to allow concurrent compilation. The current version supports four concurrent compilation threads, but further development will lift that limit.

Will You Be There?

There's no question that the Be OS is packed with cool stuff. But is that enough to make a go of it in a Windows-dominated world? The former Apple executive who started and still runs Be, Inc., Jean-Louis Gassée, has stated that he does not want to go after the corporate desktop. He envisions the BeBox as a perfect machine for emerging markets that demand responsive computing, such as multimedia development and digital video editing.

Of course, to succeed in any market requires software. There are plenty of Be enthusiasts out there: Just check out news:comp.sys.be. But will there be enough Be developers to create the applications to take advantage of the Be OS? While it is too early to tell if this is the next revolution in computing or simply son-of-Amiga, the new Be OS is a nifty piece of software. ■

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Parallel Computing—Windows Style

A cluster of PCs working in parallel can speed up some operations

ALEXANDRE ALVES

Windows Parallel Virtual Machine (WPVM) is an implementation of PVM for Microsoft Windows. PVM is a software system that creates the abstraction of a parallel machine from a cluster of computers connected by a network. This “virtual machine” appears as a single, manageable resource to the programmer. The original PVM—developed by ORNL, Emory University, the University of Tennessee, Carnegie Mellon University, and the Pittsburgh Supercomputer Center—ran under Unix; WPVM brings that power to PCs running Windows.

Personal computers are hardly used 24 hours a day, so it would be quite promising to exploit all the idle CPU cycles available in a network of Windows PCs. Imagine a large cluster of PCs used during prime-time hours for office and interactive jobs unleashed during nonprime time for scientific and mathematical computing jobs.

PVM is a flexible message-passing environment that allows the programmer to build applications based on the

multiple processor, multiple data (MPMD) paradigm. An application consists of several functional components that run in parallel. Processes of a PVM application cooperate with each other by sending and receiving messages. Though each PC may “belong” to only one virtual machine, each virtual machine can execute several PVM applications simultaneously.

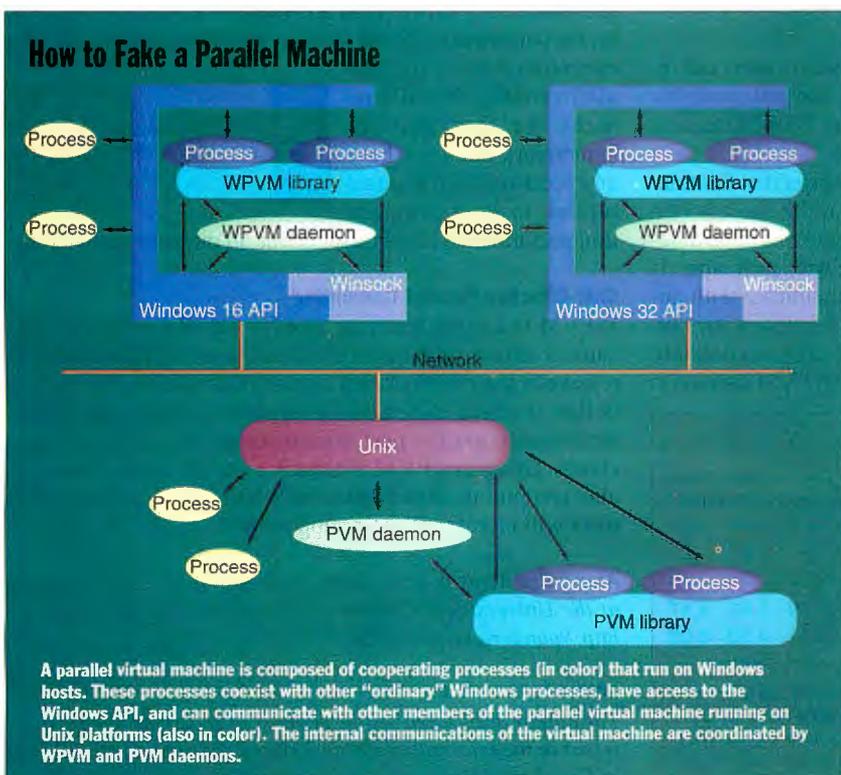
WPVM supports dynamic process creation and virtual-machine management. It offers basic point-to-point, as well as one-to-many, communications. Like the original PVM, the WPVM programming model supports the concept of *group*. A process belonging to a specific group can synchronize and broadcast messages to all the other group members. Obviously, a process can belong to several different groups.

Daemons on the Loose

WPVM consists of a programming library and a daemon that runs in each PC. The daemon is responsible for communication and process management. This daemon has an error-message log window and a graphical console that enables you to execute the original PVM console commands. WPVM supplies routines that enable a Windows process to enroll and leave the virtual machine, to configure the virtual machine by adding and deleting hosts, to spawn and kill processes, and to get information about the actual configuration and the running processes. A WPVM process can ask the virtual machine to be notified about special events: tasks exiting, deletion or failure of a host, and addition of a host.

The communications library of WPVM offers routines that allow a process to send messages to other PVM/WPVM processes, either one-to-one or one-to-many (i.e., multicast). Processes can send messages either directly (via TCP) or through the WPVM daemon. (Note that WPVM hosts can interact with Unix hosts running PVM.)

A process can specify one of two coding methods to transmit the data: raw or via external data representation (XDR). If a process specifies raw coding, this implies that the receiving process has an identical data-format architecture. On the other hand, XDR coding translates the data into a kind of universal format. The receiving end will properly decode the XDR-format data; this allows,



for example, systems with different types of processors to be able to correctly exchange data.

Processes in WPVM also understand the concept of groups. Groups simplify the development of libraries and the collective synchronization and communication between a set of processes. There are primitives to let a WPVM process join or leave a named group, synchronize processes in the same group, and broadcast messages to group members. A group daemon that is unique to the entire virtual machine implements group functionality.

Design Philosophy

PVM offers to the user a kernel of functionally complete primitives above which programmers may add higher abstraction layers. For example, the portion of WPVM that implements groups is layered on top of the core WPVM routines.

Communication between different WPVM daemons and between daemons and user processes is via UDP/TCP sockets. In particular, WPVM uses the BSD sockets variant available on 16- and 32-bit Windows platforms, Winsocket.

A host table, describing the configuration of the actual virtual machine, is maintained on each host system. These tables are issued by the master WPVM daemon and kept synchronized across the virtual machine.

Each daemon maintains a task table of all the tasks under its management. Because WPVM uses UDP sockets to communicate between daemons, there's the possibility that packets can be lost, duplicated, or delivered out of order. Consequently, WPVM incorporates its own acknowledgment and retry mechanism. (We chose UDP sockets as the communication mechanism between remote daemons for scalability's sake.)

A WPVM daemon shuts down when it loses contact with the master, is deleted from the current virtual machine, or is killed. Before dying, the slave daemon kills any tasks running in its host and informs the other daemons listed in the host table.

Provision for Dynamic Environments

PC clusters are a very unstable environment because users can reboot or switch off their machines at any time. We anticipate this will happen often: Users will probably kill the WPVM daemon when they want full control of their machines.

This issue is of paramount importance; it implies that fault-detection and recovery mechanisms are vital for the success of a WPVM application. Consequently, WPVM daemons have timeout capabilities while they are communicating with each other. If a daemon times out when it's trying to communicate with another daemon, it assumes the peer is down and terminates any outstanding operations with that peer. A daemon also can possibly notify tasks that are interested in that event. A WPVM daemon is

able to recover from the loss of any remote daemon (except for the master daemon, which acts as a kind of central coordinator).

The Slowest Machine Hurts the Most

The table at the bottom of this page shows the performance results for WPVM running atop a TCP/IP stack on Windows 95. We used a cluster of Pentium-based systems, each with 16 MB of RAM, connected through a 10-Mbps Ethernet network. The table also shows the same tests running in PVM on a collection of Unix systems. The Unix cluster consisted of a Sparc 10 and a Sparc 5 running SunOS and two Alpha-based stations running OSF. Each system had 64 MB of main memory. For tests, we used two of the Numerical Aerodynamic Simulation (NAS) benchmarks developed at NASA Ames Research.

- **Quick Sort:** This benchmark sorts N keys in parallel. It tests both integer computation speed and communication performance. In our test there are $N=220$ keys in the range $[0, 2048]$.

- **Embarrassing Parallel:** In this benchmark, two-dimensional statistics are accumulated from a large number of Gaussian pseudorandom numbers, which are generated according to a particular scheme well-suited for parallel computation. This problem requires almost no communication.

You can see that workstation or PC clusters running PVM are not suitable to solve problems like the Quick Sort benchmark. Communication-intensive applications do not accelerate in these environments because communication becomes a bottleneck. However, in applications with a good computation/communication ratio, like the Embarrassing benchmark, we can expect very promising results.

Note that with PVM for Unix, when we used two Alpha workstations, we observed a reduction in program execution time. However, when we used all four Unix machines (two Sparcs and two Alphas), we recorded a slower execution time than with the sequential version. The explanation is quite simple: The Sparc 5 is considerably slower than an Alpha workstation. Consequently, the performance of the slowest machine undermines the total execution time of the parallel version. This illuminates the fact that the benchmark does not have any load-balancing capabilities, making computation performance highly dependent on the slowest machine.

Where to Find

WPVM is available on the Web at: <http://student.del.ac.pt/wpvm>.

Cost-Effective Parallel Computing

WPVM is a good teaching tool for parallel programming because it allows students to use the network of PCs they're likely to have in their laboratories already. Considering the millions of dollars invested in personal computers, it represents a cost-effective solution for performing scientific parallel computing chores. Given that PVM is already a widely used system for parallel computing, the adoption of WPVM by Windows programmers will increase PVM's support. ■

Alexandre Alves is a graduate student in informatics engineering at the University of Coimbra in Portugal. You can reach him at hp://pandora.ac.pt/~alves.

ACKNOWLEDGMENT

The author acknowledges the support of João Gabriel Silva, a professor in the Informatics Engineering Department at the University of Coimbra in Portugal.

NAS Benchmarks Performance

Number of processors	Quick Sort				Embarrassing Parallel			
	1	2	3	4	1	2	3	4
Windows	0.86	2.06	1.72	2.03	11.18	7.09	5.89	4.47
Unix	0.61	3.38	4.30	3.28	4.96	3.31	4.30	5.05

Performance results for parallel virtual machines under Windows 95 and Unix. Results show that communication-intensive applications don't get a speed boost in a PVM cluster, but applications with a good computation/communication ratio do. Times shown are in milliseconds.

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Looking for ways to achieve more with less? More performance with less hardware? More productivity in less time? More bang with less buck?

Presenting the Photon microGUI™. QNX's full-featured windowing system that can give even your smallest PC-based realtime systems a phenomenal front end.

Breakthrough Architecture

Photon is built around a 45K microkernel and modular processes, so you can easily add or remove graphics functionality to fit your target.

The cornerstone of Photon's event-driven architecture is the QNX realtime OS. Which means Photon applications inherit



QNX's scalability, message-based IPC, and network-distributed processing. The result is a realtime graphical platform never before seen in the PC world.

...a window into your embedded system from an X workstation.

Breakthrough Connectivity

Imagine being able to see into your embedded device — and control it — from a remote QNX box. Or from an X workstation. Or from a Windows-based PC.

Photon's *jump-gate connectivity™* even lets you "beam" or transport an application from one QNX node to another!

Breakthrough Efficiency

Photon can deliver high-end, workstation-class graphics even on low-cost PC hardware. It uses memory wisely. And it comes with a low runtime price tag.

You can also expect to save development time, thanks to Photon's easy-to-use API and extensible widget library.

And when you use the code-generating Photon Application Builder, you won't have to spend any time coding your interface by hand — and it won't cost you an arm and a leg either.

Breakthrough Performance

Imagine the power of a high-end graphics system, but with the agility of a realtime executive. With

Photon's impressive drawing speeds (even across phone lines!) and intuitive UI design, your embedded PCs will look and feel

like turbo-charged workstations.

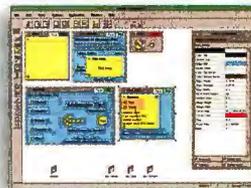


...a window into your embedded system even from within MS-Windows.

Photon Takes You Places

With Photon's phenomenal performance, incredible efficiency, unique jump-gate connectivity... there's no telling how far you can go. And since Photon supports

Unicode, you'll be able to take your realtime solutions anywhere in the world.



The Photon Application Builder beats tedious hand-coded GUI building hands down!

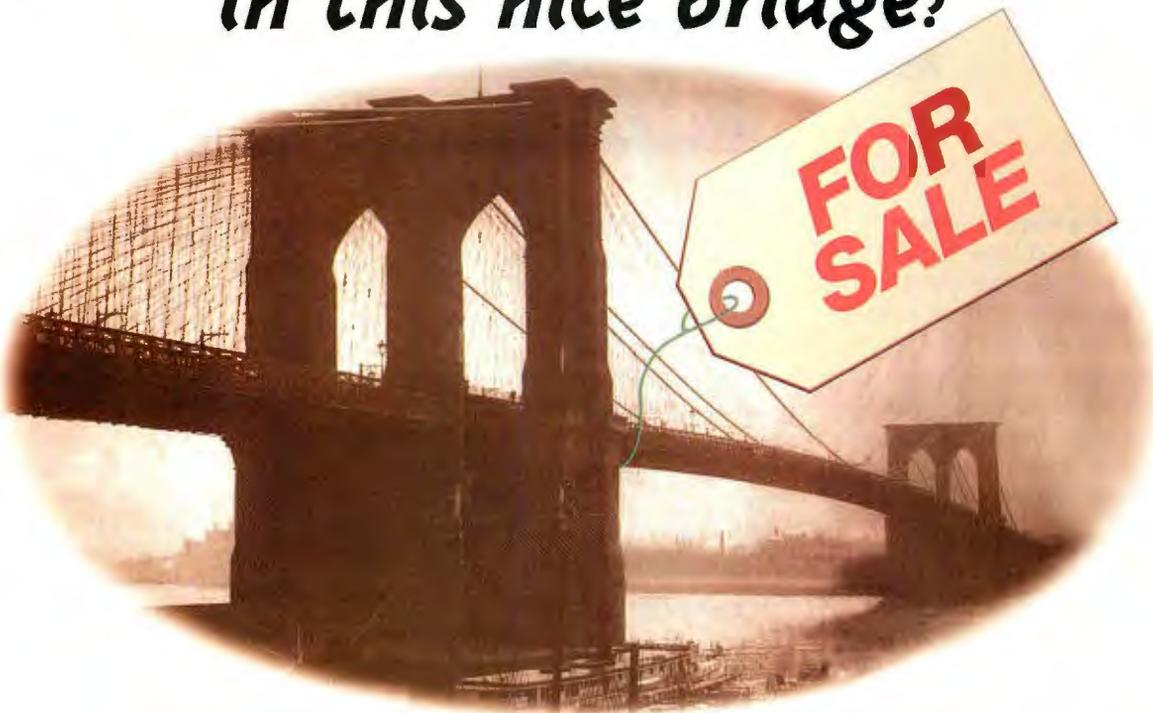
At last, a window into the black box. Photon lets you monitor and control your embedded system from remote computers — even from non-QNX platforms.



The Leading Realtime OS for PCs

To find out more about the leading realtime OS for PCs, call **800 676 0566** or **613 591 0931**. (EXTENSION #1024) Or reach us via email at info@qnx.com or on the web at <http://www.qnx.com>.

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Fibre Channel: Fast and Flexible

While it's still ideal for connecting high-speed peripherals, Fibre Channel now fits into many high-speed network architectures

DOUG ANDERSON

The processing power of computer chips doubles every 18 months, theorized Intel's founder Gordon Moore. And that phenomenon has proved remarkably constant over the last 20 years. But now Moore's law has run smack into Amdahl's law, which posits that 1 Mbps of I/O is required for every MIPS of processing power.

This collision of truths is causing problems for network managers as powerful machines and bandwidth-hungry applications outstrip I/O capacity. One solution to such problems is Fibre Channel.

Despite its name, Fibre Channel is more than a channel and runs on more than just fiber. Channels, such as ESCON and SCSI, are designed for high performance and high reliability, using dedicated, short-distance connections between computers or between computers and peripherals. Traditional networks, on the other hand, offer more flexibility and greater distance capabilities. Fibre Channel integrates features of both: the speed and reliability of channels with the flexibility and connectivity of networks. The result is a high-speed ANSI-standard transport mechanism for data, voice, and video.

Some 80 companies are now members of the Fibre Channel Association, including Hewlett-Packard, IBM, Kodak, Seagate, Silicon Graphics, and Sun Microsystems. Many of these member companies are making and delivering a range of Fibre Channel products, such as network interface cards (NICs), storage devices, routers, and switches.

Under the Hood

Fibre Channel moves data at very high rates. Currently available products run at 266 or 1062 Mbps—enough to handle even demanding applications, such as uncompressed, full-motion, high-quality video. Fibre Channel can be deployed as a simple point-to-point connection, a loop, or a switched fabric.

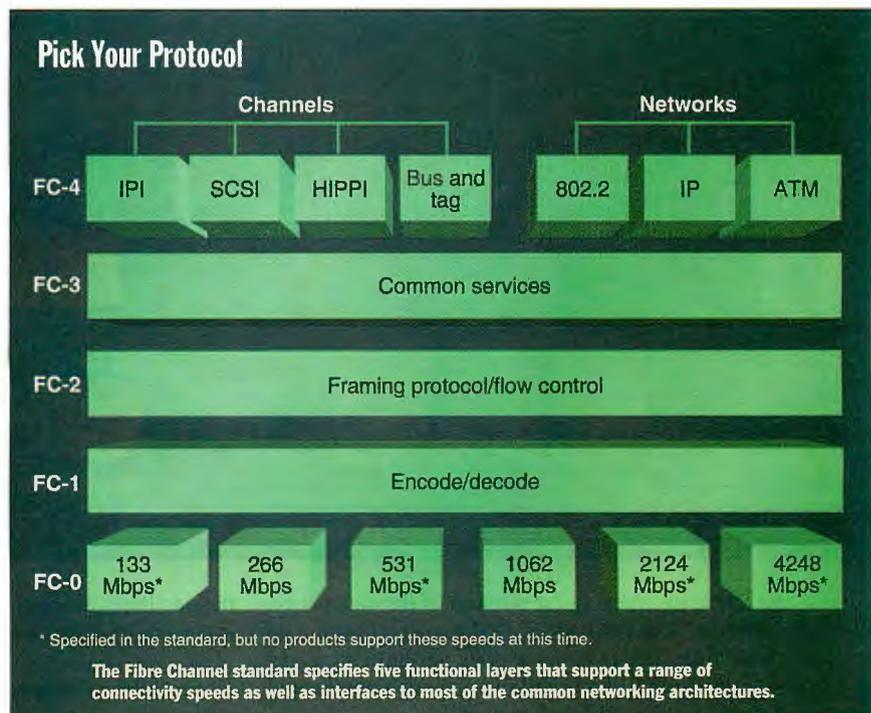
A point-to-point configuration is the simplest topology, connecting two Fibre Channel systems directly. Arbitrated loops are Fibre Channel ring connections that provide shared access to bandwidth via arbitration. Switched Fibre Channel networks, called fabrics, yield the highest performance by

leveraging the benefits of cross-point switching. For example, when fabric users add ports to their network, they increase the aggregate capacity of the network. The aggregate data rate of a fully configured Fibre Channel network can be in the terabit-per-second range.

The ANSI specification that defines Fibre Channel distributes its functions among five layers that in many ways parallel the Open Systems Interconnection (OSI) model (see the figure "Pick Your Protocol" below). FC-0 is the physical layer, which can use single-mode fiber, multi-mode fiber, or copper. For the fiber interfaces, Fibre Channel uses a low-cost duplex SC connector. Shielded twisted-pair media use a nine-pin connector. And coaxial-cable systems use a TNC receiver and a BNC transmitter.

The next layer, FC-1, specifies byte synchronization and an encoding/decoding scheme, where 8 bits of data are encoded in 10-bit groups. A unique "comma character" ensures proper word and byte alignment; the encoding also handles error correction.

continued



The transport mechanism is defined in Fibre Channel by the FC-2 layer. Each N_port (node port) on a connected device can be an originator of a message, a responder, or both, and each port has a unique address.

FC-3 defines a set of common network functions that span multiple N_ports. One function is striping, in which multiple N_ports use multiple links to transmit data (thereby boosting bandwidth). Another function is hunt groups, which allow sets of N_ports to be attached to a single node. This lets any of these ports receive data for that node if another port is busy.

The FC-4 layer gives Fibre Channel its ability to handle virtually any payload, including both channel and network traffic. It does this by specifying the way various upper-layer protocols are mapped to Fibre Channel. These specifications ensure interoperability among different implementations. Several channel and network protocols have already been mapped, including SCSI, High Performance Parallel Interface (HIPPI), IP, IPI, AAL5, LE, Single Byte Command Code Set Mapping (bus-and-tag protocol), and IEEE 802.2 (the data-link-layer standard for Ethernet).

Weaving the Strands Together

Central to Fibre Channel is the use of switching fabrics to connect devices like workstations, PCs, servers, routers, mainframes, and storage devices that have Fibre Channel interfaces. In some ways, the fabric works like the traditional phone system. Each originating

Because fabrics can handle more than 16 million addresses, Fibre Channel can accommodate very large networks. You can start with a small network and increase the number of ports. As you add ports, Fibre Channel's nonblocking characteristic means that the network increases in capacity. That's because the aggregate bandwidth scales linearly with the number of ports.

Fibre Channel has features that make it useful in large networking environments. For example, Fibre Channel offers you a choice of three networking services. Class 1 provides an acknowledged connection service with guaranteed delivery and end-to-end flow control. It works like a physical channel. Class 2 is a frame-switched service that does not use a dedicated connection. It provides guaranteed data delivery and buffer-to-buffer flow control. If the receiving node is busy, the sender tries again. Class 3 is a connectionless service that is especially useful for broadcast transmission of datagrams.

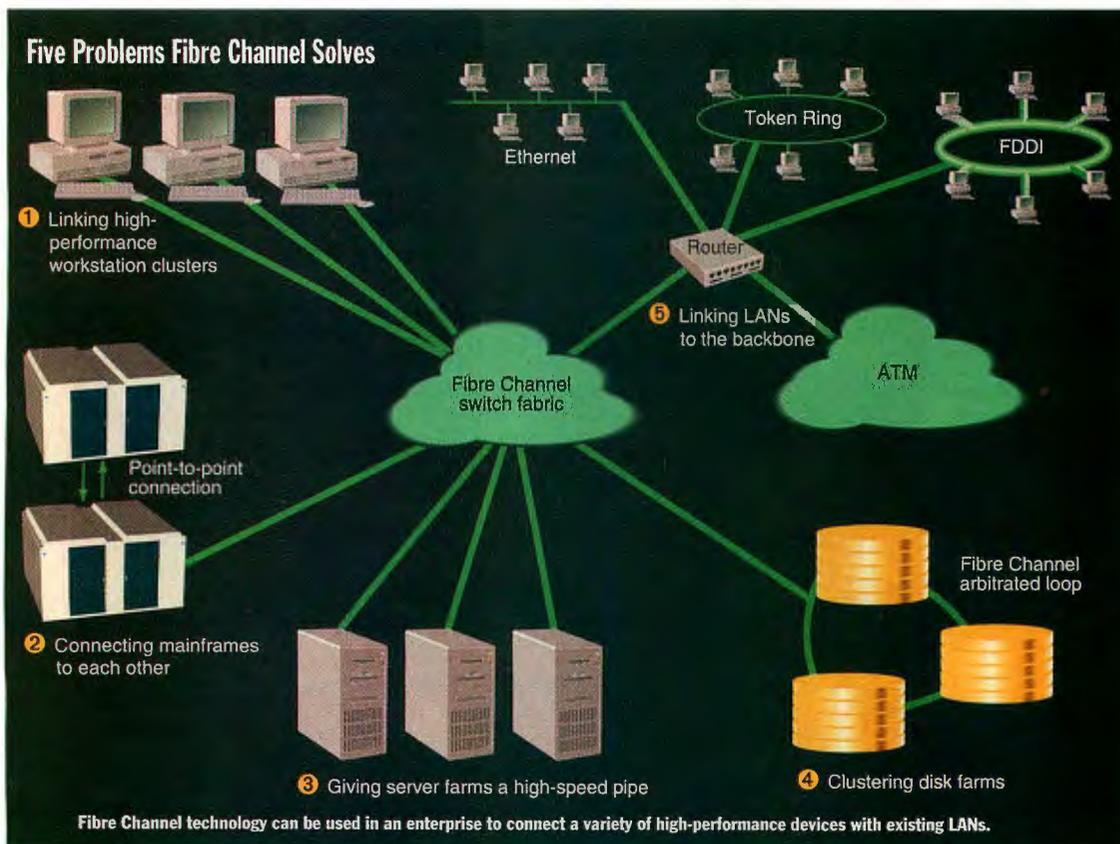
Getting into the Action

With its high data rates, Fibre Channel is well suited for use in a number of very different types of applications, including moving large files across building or campus backbones, imaging, multimedia, videoconferencing, and storage.

For example, when serving as a backbone, Fibre Channel provides a big pipe where it's needed the most: the focal points of LAN internetworks. Fibre Channel NICs are available for popular server architectures, and routers are available to link the Fibre Channel backbone desktop LANs, including Ethernet, Switched Ethernet, Token Ring, Fiber Distributed Data Interface (FDDI), and asynchronous transfer mode (ATM). When Fibre Channel is used in this type of application, throughput for the entire enterprise is improved by virtue of off-loading server-to-server or router traffic from desktop LANs (see the figure "Five Problems Fibre Channel Solves" at left).

Basically, Fibre Channel technology offers much more than its name implies. Today's technology goes beyond basic channel connectivity and fits in with the networking needs of many organizations. ■

Doug Anderson is a product manager with Ancor Communications (<http://www.ancor.com>). You can reach him at douga@ancor.com.



port "calls" the fabric by entering the address of the destination port in a frame header. The fabric does all the work of setting up the desired connection. The originator does not have to worry about complex routing algorithms, and there are no complicated Permanent Virtual Circuits (PVCs) to set up.

beyond basic channel connectivity and fits in with the networking needs of many organizations. ■

Doug Anderson is a product manager with Ancor Communications (<http://www.ancor.com>). You can reach him at douga@ancor.com.

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PREVIEW DIGITAL CAMERA

EpixPro Integrates Work Flow for Easier Photo Management

Epix Imaging Systems improves upon a major benefit of digital cameras—quick and easy input of images into your PC—by building work-flow management capabilities, a 486 processor, and a PC Card slot into its EpixPro. The EpixPro digital camera targets applications, such as real estate sales and insurance-claim processing, that involve associating numerous photos with specific database records.

The digital camera's 486 processor runs software for transparently managing functions that are usually addressed by a host computer. For example, you can associate each picture with an account number or name, making it easy to attach digital snapshots to a text file or database record. This eliminates the time-consuming task of importing images into your PC one at a time.

The EpixPro's PC Card slot scores another point for camera-to-PC connectivity by letting you store up to 20 images on a 2.5-MB flash disk card or about 1000 images on a 131-MB PC Card hard drive. You can also transfer images over a serial connection via an optional modem interface.

The Windows utility software includes several features that make it easier to integrate photos with your business applications. In addition to letting you associate photos with specific customers or projects as you snap them, you can designate which file format—JPEG, BMP, or TIFF—the camera should use to store your photos. This step-saving feature eliminates the need to convert photos into Windows-standard image file formats.

The EpixPro's 24-bit-color, 768- by 494-pixel image resolution is similar to that of other digital cameras in this price range. A through-the-lens viewfinder gives you a WYSIWYG display, but you can't review pictures that you just snapped at the scene. The 1½-pound camera supports shutter speeds ranging from one-thirtieth to one ten-thousandth of a second. A C-mount lens adapter lets you use standard interchangeable lenses from Canon, Minolta, and Nikon.

Digital cameras in this price range (around \$1500) can't yet match the photo-resolution quality of a typical 35mm camera, but they avoid the extra time and expense involved in developing film. The EpixPro takes this camera-to-PC connectivity advantage one step further. —*Dave Andrews*



EpixPro about \$1500
Epix Imaging Systems, Inc.
Santa Clara, CA
(408) 562-0901
fax: (408) 562-0919
meredith@mindspring.com
Circle 1068 on Inquiry Card.

1.3-GB REMOVABLE-CARTRIDGE HARD DRIVE

Packaged in a slim-line design, the 3½-inch 1.3-GB SyJet drive (from \$499) offers internal Enhanced IDE and external SCSI configurations. The removable-cartridge hard drive provides a minimum transfer rate of 4 MBps and an average seek time of less

than 11 ms. An accelerated mode increases the minimum transfer rate, assisting refresh rates for data-intensive applications, such as video.

Contact: SyQuest Technology, Fremont, CA, (800) 245-2278 or (510) 226-4000; <http://www.syquest.com>.

Circle 1075 on Inquiry Card.

200-MHZ PENTIUM PRO WORKSTATION

Based on a 150- or 200-MHz Pentium Pro processor with an 8-KB internal L1 processor cache and 256 KB of L2 write-back cache, the ALR Evolution 6 workstation comes with 16 MB of 60-ns Fast Page Mode memory, which is expandable to 128 MB; a quad-speed CD-ROM drive; a 1.44-MB 3½-inch floppy drive; a bidirectional ECP/EPP; two 16550-compatible serial ports; and a lockable mini-tower chassis with six drive bays. The system board has an integrated bus-master dual-channel PCI IDE interface that can support up to four PIO Mode 4 IDE mass-storage peripherals. The system (from \$3495) is compatible with Windows NT and 95, Novell NetWare, SCO Unix, UnixWare, IBM OS/2 and Warp, and Banyan Vines.

Contact: Advanced Logic Research, Inc., Irvine, CA, (800) 444-4257 or (714) 581-6770; <http://www.alr.com>.

Circle 1071 on Inquiry Card.

1200-DPI COLOR LASER PRINTERS ▶

The Color LaserJet 5 (about \$5995) and Color LaserJet 5M (about \$7695) printers feature Image Resolution Enhancement technology that uses color-control and toner-blending techniques to deliver 1200-dpi-equivalent image quality. Designed for DOS, OS/2, and Windows 3.1, 95, and NT, the Color LaserJet 5 comes with 20 MB of RAM and a bidirectional parallel port. The Color LaserJet 5M, which is for networked, mixed, and Macintosh environments, comes with 36 MB of RAM, Adobe PostScript Level 2, and

Ethernet and LocalTalk interfaces. Both laser printers include a 40-MHz AMD 29040 RISC processor; print speeds of 10 ppm in black or one toner color and 2 to 3 ppm in full color; enhanced HP PCL 5 with color; a 500-sheet-capacity paper tray; support for letter, A4, and legal-size plain paper, glossy media, and transparencies; and 11- by 17-inch black-and-white printing capability.

Contact: Hewlett-Packard Co., Santa Clara, CA, (800) 752-0900 or call local HP dealer; <http://www.hp.com>.

Circle 1072 on Inquiry Card.

35-GB DLT DRIVE

Designed for use with high-end workstations, midrange systems, and network servers, the Quantum DLT 7000 (about \$8000) is a 5¼-inch tape drive with a capacity of 35 GB (native) and a sustained data transfer rate of 5 MBps (native). The DLT 7000 comes with a SCSI-2 fast/wide interface and supports Unix, Novell NetWare, Windows NT, and high-end IBM-based OSes.

Contact: Quantum Corp., Milpitas, CA, (800) 624-5545 or (408) 894-4000; <http://www.quantum.com>.

Circle 1073 on Inquiry Card.





MULTILINE FAX BOARD

A multiport direct-inward-dialing (DID)

product, the GammaFax CPD/220 fax board (\$2995) supports two DID ports and two analog ports. It has a 20-MHz processor with 512 KB of RAM. With eight boards installed in a PC, a total of 32 ports can simultaneously receive at 14.4 Kbps with advanced MR, MMR compression, Error Correction Mode, and on-the-fly PCX, DCX, and TIFF conversion.

Contact: *GammaLink, Sunnyvale, CA, (800) 329-4727 or (408) 744-1400; http://www.gammalink.com.*

Circle 1081 on Inquiry Card.

29-INCH MULTIMEDIA MONITOR

You can use the ViewSonic 29GA PerfectSound (\$3995) as a TV screen and as a computer display. Features include support for resolutions up to 1024 by 768 pixels with a refresh rate of 80 Hz, dual 5-W speakers integrated into the bezel, a wireless remote control, and front controls

for power, contrast, color saturation, sharpness, color temperature, image size and position, audio input, volume, and mute.

Contact: *ViewSonic Corp., Walnut, CA, (800) 888-8583 or (909) 869-7976; http://www.viewsonic.com.*

Circle 1080 on Inquiry Card.

TWO COURIER MODEMS FOR THE MAC

The Courier V. Everything for Macintosh modem (\$595) offers V.34 for data transfer speeds up to 33.6 Kbps, plus backward compatibility. The Courier I-Modem for Macintosh (\$895) is an ISDN terminal adapter that includes an integral modem with all the features of the analog V. Everything modem. A Universal Connect feature automatically identifies the equipment on the remote end of the connection and transparently makes the highest-speed ISDN or analog connection possible.

Contact: *U.S. Robotics, Skokie, IL, (800) 881-7256 or (708) 982-5001; http://www.usr.com.*

Circle 1079 on Inquiry Card.

TECHNITRON SERIES MONITORS

The Advanced Technitron Series of color monitors, including the 15-inch DX15T (\$499) and the 17-inch DX17T (\$899), feature advanced Trinitron CRTs with a vertically flat display surface, Plug and Play to support Win-



dows 95, and VESA's new communications standard for the Display Data Channel. The monitors include ultrahigh resolutions up to 1280 by 1024 pixels noninterlaced, refresh rates up to 75 Hz at 1024 by 768 pixels, and a super-fine 0.25mm aperture pitch.

Contact: *MAG InnoVision, Inc., Santa Ana, CA, (800) 827-3998 or (714) 751-2008; http://www.maginnovision.com.*

Circle 1074 on Inquiry Card.

BAR CODE SCANNER ON A RING ▲

The WS 1000 (\$3495) consists of two separate components: the RS 1 Ring Scanner, a 2-ounce aim-and-shoot device that you wear on your index finger, and the WU 1000, a 9-ounce wrist-mounted DOS-compatible micro-computer. The WU 1000 comes with 640 KB of RAM; 512 KB of nonvolatile memory; a four-row by 20-column display; a 27-key alphanumeric keyboard; a lithium-ion battery pack that can operate for a full 8-hour shift on a single charge; and a Symbol Spectrum One radio card for real-time, two-way wireless data communications.

Contact: *Symbol Technologies, Inc., Bohemia, NY, (800) 722-6234 or (516) 563-2400; http://www.symbol.com.*

Circle 1077 on Inquiry Card.

DSDV SINGLE-LINE MODEM

Based on a flexible software-defined DSP architecture, the NewTalk 2000 (\$239) has the ability to dynamically change to respond to your application program's demands.

The unit's single-line DSDV technology offers simultaneous voice and data transfer at rates ranging from 300 bps to 28.8 Kbps for data and up to 14.4 Kbps for fax send/receive. In addition, the NewTalk 2000 device offers support for modem AT commands, fax Class 1 AT commands, Group 3 fax, and V.42/V.42bis for data compression and error correction.

Contact: *NewCom, Inc., Westlake Village, CA, (800) 563-9266 or (818) 597-3200; http://www.newcominc.com.*

Circle 1078 on Inquiry Card.

MIDRANGE MAC CLONES

Available in low-profile and desktop configurations, the PowerCurve 601/120 (low-profile model, from \$1849; desktop model, from \$1899) is a midrange, CPU-upgradable Mac OS system based on the 120-MHz PowerPC 601 microprocessor. A base configuration for the low-profile PowerCurve 601/120 includes 8 MB of RAM, expandable to 256 MB via four DIMM slots; an 840-MB hard drive; three PCI expansion slots; 2 MB of video memory; a 3½-inch floppy drive; one front-accessible drive bay; one internal 3½-inch full-height drive bay; a Mac 15-pin and SVGA graphics connector; on-board AAUI and 10Base-T Ethernet; an extended keyboard; and a mouse. The desktop model (\$1849) includes two front-accessible bays and one internal 3½-inch full-height or two 3½-inch half-height drive bays.

Contact: *Power Computing Corp., Round Rock, TX, (800) 999-7279 or (512) 246-7807; http://www.powercc.com.*

Circle 1070 on Inquiry Card.



WHAT'S NEW Hardware

150-MHZ PENTIUM PRO WORKSTATION

Optimized for 32-bit OSES and applications, the standard-model Z-Station GT (from \$5243) includes a 150-MHz Pentium Pro processor with 256 KB of internal L2 cache; 32 MB of integrated RAM (with two open SIMM slots for memory expansion to 128 MB); a 1.6-GB EIDE Mode 4 hard drive; a Diamond Stealth64 graphics accelerator card; a 3½-inch 1.44-MB floppy drive; a quad-speed CD-ROM drive; and Windows NT Workstation and Netscape Internet browser software. The minitower chassis features six slots for three full-length PCI cards, two full-length ISA cards, and one PCI/ISA combination card, as well as six drive bays for three 5¼-inch and one 3½-inch external drive and two 3½-inch internal drives. Options include 28.8-Kbps modems, Ethernet and Token Ring cards, tape backups, and hard drives.

Contact: Zenith Data Systems, Buffalo Grove, IL, (800) 533-0331 or (847) 808-5000; <http://www.zds.com>.

Circle 1069 on Inquiry Card.



MULTIFUNCTION OFFICE PRODUCT ▼

The Lumina 2000 (about \$399) is a plain-paper fax machine, scanner, and copier. As a stand-alone fax machine, the Lumina 2000 handles scheduled, group, and broadcast faxes; polling; and speed dialing. An included OCR utility converts faxes into text for further editing on a parallel-port-connected computer. Two different models of the Lumina 2000 are available: a basic unit with a 9600-bps modem and an eight-page storage capacity, and a midrange model that comes with a 14.4-Kbps modem and a 60-page storage capacity.

Contact: Lumina Office Prod-



ucts, Sunnyvale, CA, (800) 586-4620 or (408) 992-1088; <http://www.lumina2000.com/>.

Circle 1076 on Inquiry Card.

HIGH-SPEED DATA ACQUISITION BOARD

A plug-in ISA-bus board, the dsp-DAQ (from \$5600), from R. C. Electronics, performs high-speed data acquisition, antialiasing filtering, instrumentation-quality amplification, and DSP-based signal conditioning across 16 channels. The board provides a 90-kHz analog-frequency response; 16-bit A/D (eight or 16 channels per card) real-time thermal calibration; and a programmable gain amplifier. Each channel has its own DSP and uses an independent A/D, providing simultaneous sampling with no delays between successive channels.

Contact: R. C. Electronics, Inc., Santa Barbara, CA, (805) 685-7770; 74642.2774@compuserve.com.

Circle 1083 on Inquiry Card.

WINDOWS BAR CODE PRINTER ▼

The Tharo Gemini (\$1395) has a print resolution of 203 dpi and a print speed of 2 inches per second on media measuring up to 4½ inches wide. The bar code printer supports direct-thermal and thermal-transfer label, tag, and ticket materials on rolls measuring up to 6 inches in diameter. Tharo's Windows print driver lets you create bar code labels from within your Windows applications.

Contact: Tharo Systems, Inc., Brunswick, OH, (216) 273-4408.

Circle 1084 on Inquiry Card.

128-BIT GRAPHICS ACCELERATORS

The TwinTurbo-128 series of graphics accelerator cards (\$319 to \$799) use a 32-/64-bit PCI bus interface and a 64-/128-bit memory bus, resulting in color-fill operations occurring at rates up to 3 billion pixels per second and image-redraw rates exceeding 100 million pixels per second. The cards come with 2 or 4 MB

of video memory; a 32- or 64-bit RAMDAC; a video-playback accelerator, which enables you to resize small video clips to fill the screen; hardware color-space conversion, to allow software MPEG video playback on Pentium-based PCs; and support for screen resolutions from 640 by 480 pixels up to 1600 by 1200 pixels.

Contact: Integrated Micro Solutions, San Jose, CA, (408) 369-8282; imsteksup@aol.com.

Circle 1082 on Inquiry Card.

DATA ACQUISITION SERVER

The NetAcquire 3000 (\$8495) acquires, processes, and updates real-time analog data at a rate of over 750,000 samples per second. A TCP/IP Ethernet interface allows data acquisition from various client computers and OSES, including Unix and Windows 3.1, 95, and NT. The unit is also Internet compatible, allowing remote data acquisition and control from anywhere in the world. The basic model of the



NetAcquire 3000 comes with a 486 processor, 4 MB of program memory, 2 MB of buffer memory, 16 analog inputs (expandable to 512), two analog outputs (expandable to 64), and 16 digital I/Os (expandable to 256).

Contact: Real Time Integration, Inc., Redmond, WA, (206) 883-7563; realtimeint@realtimeint.com.

Circle 1085 on Inquiry Card.

Before you invest in the hardware, make sure you're compatible.



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National Software Testing Laboratories puts hardware and software through the most rigorous testing in the industry. Our exclusive compatibility tests, using real world equipment like yours, ensure that components will talk to each other, work together, get along great — or they can't carry the Seal. And that's true for everything from drivers and servers, to applications, adapters and printers.



For more information about the NSTL Seal or a list of manufacturers who have earned it, call 800-220-NSTL or 610-941-9600. Before you walk down the aisle.

WHAT'S NEW Software

PREVIEW WEB DEVELOPMENT TOOLS

Do-It-Yourself Web Site

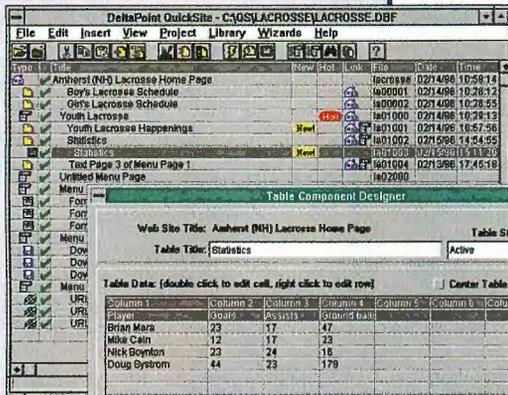
You can create and publish a World Wide Web site in minutes with DeltaPoint's QuickSite, an end-user Web creation and management package for Windows. The program's point-and-click interface, plus helpful Wizards that guide you through the process of creating your site, insulate you from having to know Hypertext Markup Language (HTML). Yet by using QuickSite, you can create a site with consistent menus, flags notifying Web surfers of new features, buttons for submitting E-mail, and forms that you typically find in other robust Web sites.

QuickSite, which runs on Windows 3.x and 95, provides prebuilt site structures and templates that you can easily modify by inserting tables (see the screen), forms, or new pages. As you go through the page-creation process, you can select backgrounds, graphics, lines, bullets, and other formatting styles. Throughout the process, you type in the words that you want to appear on your page. As you create other pages, QuickSite automatically establishes and maintains links.

QuickSite's Publishing tool should appeal to developers who want to create sites for numerous clients. When you've finished your site, you can publish it and send it to an Internet service provider.

QuickSite offers a wide array of features, but it's not for everyone: Although it includes an order-submission form, it doesn't support secure transactions. A self-documenting feature and an open database API that lets other Web users dynamically update your Web site via HTML forms are features reserved for a professional version (\$295), which is slated to ship later this quarter. Nevertheless, QuickSite's capabilities and ease of use are impressive, and, at only \$99, this program is quite a bargain.

—Dave Andrews



QuickSite \$99
DeltaPoint, Inc.
Monterey, CA
(800) 446-6955
(408) 648-4000
fax: (408) 648-4020
<http://www.deltapoint.com>
Circle 1042 on Inquiry Card.

Talk, NetWare, or TCP/IP network to retrieve files and text from Windows 3.1, 95, NT, and Macintosh System 7.x desktops. The

program allows you to maintain indexes for documents on your local hard drive, network drives, or dismantled storage media; execute file operations, such as move, copy, rename, and delete file; and print or copy the results of a search.

Contact: On Technology Corp., Cambridge, MA, (800) 767-6683 or (617)

374-1400; <http://www.on.com>.

Circle 1046 on Inquiry Card.

WEB BROWSER FOR NEWTON 2.0

NetHopper (\$49.95) connects communications peripherals that run under the Newton 2.0 OS to the World Wide Web via Internet service providers that support PPP/SLIP connections. The Mosaic-like browser supports hypertext links, HTML forms, radio buttons, and landscape and portrait modes; allows wireless hand-held connection to the Web; saves the history of your 25 most recently visited Web pages; and caches pages for viewing off-line.

Contact: AllPen Software, Inc., Los Gatos, CA, (408) 399-8800; <http://www.allpen.com>.

Circle 1055 on Inquiry Card.

DESKTOP REPORTING TOOLS FOR COBOL

Correlate (stand-alone package, \$500; client/server package for a minimum of four users, \$300 per user) allows ODBC-enabled applications to access COBOL data files through popular report-creation and development tools, such as Crystal Reports, Excel, Impromptu, and Visual Basic. You can also add client/server access

to COBOL applications and run COBOL applications alongside Correlate to simultaneously view the application and a graphical representation of the data.

Contact: Micro Focus, Palo Alto, CA, (800) 872-6265 or (415) 856-4161; <http://www.microfocus.com>.

Circle 1047 on Inquiry Card.

OBJECT-ORIENTED TEAM DEVELOPMENT

Created for teams of C/C++ and Java programmers working in Windows 3.x, NT, and 95, the HOPE (Human Oriented Programming Environment) system (\$995 per seat) includes collaborative features such as information-sharing between team members, locking of fine-grained objects, process-oriented SCM, smart merge tools, full control of the development project, and real-time change management. When it's time to merge code written by different team members, HOPE automatically detects conflicts and resolves them.

Contact: Aladdin Software Engineering, Ltd., New York, NY, (800) 223-4277 or (212) 564-5678; <http://www.aks.com>.

Circle 1048 on Inquiry Card.

CONVERT DOCUMENTS TO WEB PAGES

With HTML Transit (\$495), you can convert and reformat word processing documents into hypertext-linked Web pages. The program's reusable templates store the control settings for producing an electronic publication, including which input files to translate, which output files to generate, and how the publication will appear and behave. You can specify the location and criteria for hypertext links, as well as such elements as hot-spot icons and thumbnail graphics.

Contact: InfoAccess, Inc., Bellevue, WA, (206) 747-3203; <http://www.infoaccess.com>.

Circle 1050 on Inquiry Card.

ENTERPRISE FIREWALL SECURITY FOR WINDOWS NT

A suite of security products, Eagle NT (50 users, \$6500; 200 users, \$11,000; unlimited users, \$15,000) offers access control, authentication, encryption, a real-time Suspicious Activity Monitor, and detection, alarm, and reporting capabilities. Eagle NT lets you create, monitor, and maintain a security policy across an enterprise network, from Internet and workgroup LANs to

remote offices and mobile PCs.

Contact: Raptor Systems, Inc., Waltham, MA, (800) 932-4536 or (617) 487-7700; <http://www.raptor.com>.

Circle 1045 on Inquiry Card.

FIND FILES FAST ON NETWORKS

With On Location for Networks (Server Indexer, \$999; Viewer Clients, from \$49 per user; Indexer Clients, from \$99 per user), you can search over an Apple-

MACINTOSH ANTIVIRUS SOFTWARE

VirusScan for the Macintosh (\$65) provides point-and-click detection and removal of more than 99 percent of the known Mac viruses, streamlined installation and configuration, automatic scanning at system start-up and file execution, and a virus encyclopedia. VirusScan informs you of the progress of each scan and lets you save or print the results. *Contact: McAfee Associates, Santa Clara, CA, (408) 988-3832; <http://www.mcafee.com>.*

Circle 1058 on Inquiry Card.

SEARCH DOWNLOADED INTERNET DOCUMENTS

HotSearch (\$39) for Windows helps you locate information in documents you've downloaded from the Internet. You can find documents using ranked retrieval in order of relevance, fuzzy searching, agent searching, Bool-

ean searching, and range searching of date and number fields. HotSearch highlights the search words within a document.

Contact: Executive Technologies, Inc., Birmingham, AL, (205) 933-5494; <http://www.cris.com/~eti/>.

Circle 1052 on Inquiry Card.

FIX WINDOWS 95 SOFTWARE-CONFIGURATION PROBLEMS

Now you can fix over 10,000 Windows 95 and 3.1 software-configuration problems. The First Aid 95 program (\$49.95) fixes problems with the Windows 95 Registry; slims down bloated applications to make room for Windows 95; solves setup and configuration problems for the top 50 multimedia cards; and fixes problems with modems and online access to The Microsoft Network, CompuServe, America Online, Prodigy, and the Internet. *Contact: CyberMedia, Inc.,*

Century City, CA, (800) 721-7824 or (310) 843-0800; <http://www.internet-is.com/cybermedia>.

Circle 1059 on Inquiry Card.

DESIGN AND OPERATE PROCESS FACILITIES

PlantSpace consists of the Engineering Series (from \$2950), the Plant Design Series (from \$2250), the Drafting Series (from \$950), and the Integration Series (from \$950). You can enter and manage conceptual and schematic plant representations, parametric 3-D models, and detailed plant drawings, as well as incorporate and unify all plant information and systems, including enterprise-wide data and tools from other sources. PlantSpace supports Windows 3.x, NT, and 95 for Intel-based, DEC Alpha AXP, HP RISC, and SGI computers.

Contact: Bentley Systems, Inc., Exton, PA, (610) 458-5000; <http://www.bentley.com/>.

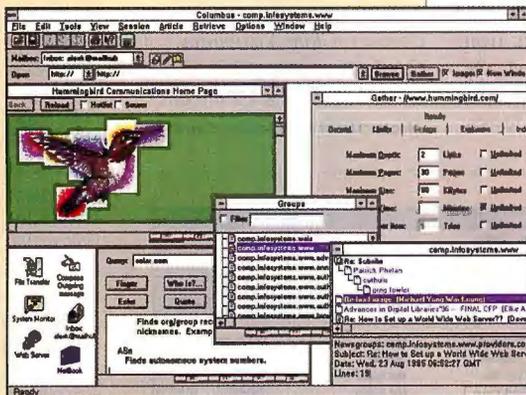
Circle 1049 on Inquiry Card.

WINDOWS INTRANET DESKTOP SOFTWARE

To provide access to the Internet and enterprise intranets, Columbus (single user, \$245) integrates protocols and Internet tools, including a World Wide Web browser with gopher capabilities; a Web server; E-mail with POP3, SMTP, and MIME support; a drag-and-drop FTP application; a VxD TCP/IP stack; telnet and News Reader clients; a gather facility; an activity manager and scheduler; a system monitor; and NetBook, which stores URL hot lists, E-mail addresses, and names and locations of host servers. DigitalPaper technology lets you convert legacy documentation to a portable document format for enterprise-wide distribution and collaborative computing and documentation development.

Contact: Hummingbird Communications, Ltd., North York, Ontario, Canada, (416) 496-2200; <http://www.hummingbird.com>.

Circle 1043 on Inquiry Card.



MERGE WINDOWS AND DOS DATA

Now you can merge your DOS accounting data with more than 30 Windows documents, spreadsheets, contact management databases, and Avery label templates. WordMerge Plus (\$295) lets you add as many custom-designed merge documents as you need. You can also execute

Windows operations from your DOS accounting system; these include performing dynamic lookups and record inserts in TeleMagic, Act, and GoldMine; generating ASCII files and Excel and Lotus 1-2-3 spreadsheets; and auto-dialing your telephone.

Contact: WinGate Technologies, Morristown, NJ, (201) 539-2727; <http://www.wingate.com>.

Circle 1054 on Inquiry Card.

Software Update

TextBridge 3.0 Professional Edition for Macintosh includes Instant Access OCR, which enables you to reproduce scanned-in documents with fully editable text, tables, and graphics within your favorite word processor; improved document recognition; better page segmentation; Full Document Recomposition; and Dynamic Training, which allows you to view, confirm, and correct difficult-to-recognize words and special symbols. \$349.

Contact: Xerox Corp., Palo Alto, CA, (800) 428-2995 or (415) 813-6800; <http://www.xerox.com/XSoft/XSoftHome.html>.

Circle 1061 on Inquiry Card.

An integrated suite of productivity tools, **COBOL Workbench 4.0** for OS/2 and Windows 3.x, NT, and 95 provides a 32-bit compiler that supports mainframe COBOL dialects and object-oriented COBOL; a Source Code Management Facility; an Advanced Organizer for imaging work flows; and an enhanced programmer's interface. \$2500.

Contact: Micro Focus, Palo Alto, CA, (800) 872-6265 or (415) 856-4161; <http://www.microfocus.com>.

Circle 1065 on Inquiry Card.

An alternative to HSM for Novell NetWare 4.x environments, **EZ•Express 2.0** installs on your primary server and manages the migration of data from hard disks to optical media. Version 2.0 can de-migrate information back to the primary device based on data usage, providing faster access to files that become more active. \$1595 to \$5995.

Contact: Micro Design International, Inc., Winter Park, FL, (800) 228-0891 or (407) 677-8333; <http://www.microdes.com>.

Circle 1063 on Inquiry Card.

WHAT'S NEW Software

OLE COMPONENTS FOR DATABASE FRONT ENDS

You use the 16- and 32-bit OLE Controls in Data Widgets 2.0 (\$139) to develop front ends for database applications. You can edit entire record sets on-screen without writing any code; drag and drop cells; use AddItem at design time; attach a DataGrid cell to a drop-down list of values from another source of data; reposition any row in a record set; create command buttons that perform database functions; create multiline captions and pictures; and bind data fields to a series of option buttons for a representation of field values with a set number of options for a particular field.

Contact: *Sheridan Software Systems, Inc., Melville, NY, (800) 823-4732 or (516) 753-0985; <http://www.shersoft.com>.*

Circle 1053 on Inquiry Card.

HANDLE MAC FILES IN WINDOWS 95

MacDrive 95 (about \$70) makes files on Macintosh disks accessible from Windows 95 applications. The program enables Windows 95 to handle Mac-format floppy disks and removable-me-

dia cartridges in the same way that it handles other disks, making them appear on the Windows 95 desktop and in all applications' Open and Save dialog boxes. You can use MacDrive 95 with high-density floppy disks, removable-media cartridges, and external hard, Zip, Jaz, EZ135, SyQuest, Bernoulli, optical, floptical, and CD-ROM drives that you can interface with Windows 95 systems.

Contact: *Media4 Productions, Inc., West Des Moines, IA, (515) 225-7409; mediafour@media4.com.*

Circle 1056 on Inquiry Card.

INTEGRATE DISPARATE NETWORK MANAGEMENT TOOLS

An event-correlation application, Seagate NerveCenter Pro (enterprise license, \$15,000) employs behavioral models to correlate network conditions, identify critical problems, filter out superfluous events, and take appropriate actions. In addition to correlating SNMP events, the program manages and correlates Hewlett-Packard OpenView OperationsCenter messages from Unix systems and Seagate LAN-Alert messages from Windows NT and NetWare servers. Nerve-

Center Pro can also send notification of correlated events to OpenView Network Node Managers or OpC consoles.

Contact: *Seagate Enterprise Management Software, Inc., Cupertino, CA, (408) 342-4500; <http://www.sems.com>.*

Circle 1057 on Inquiry Card.

ACCESS APPLICATIONS DESPITE SYSTEM FAILURE

With GeoHA (which stands for Geographic High Availability), users get continuous access to critical applications and data despite system failure or even actual site loss. You place open systems applications servers, configured into a cluster of PCs, in widely separated geographic locations, each with an identical but separate image of the application and data. In the event of a disaster, GeoHA automatically switches users, applications, and data to another location. GeoHA (four-node cluster in two locations, from \$150,000) is available for IBM RS/6000 workstations and servers running the AIX OS.

Contact: *Clam Associates, Cambridge, MA, (617) 621-2542; <http://www.clam.com>.*

Circle 1060 on Inquiry Card.

Software Update

A face-based 3-D building modeler that runs inside AutoCAD release 12 or 13, **Facade 3.0** includes a Wall from Path command, which creates multiple 3-D walls in a single step; a multiple-floor command; improved roof creation; Boolean operations on walls, floors, and roofs; a library of 3-D furniture, vehicles, trees, and people; a library of architectural hatch patterns; editable walls, roofs, floors, stairs, dormers, and other building components; saving and restoring of layer configurations; faster wall creation; additional door and window types; and improved selection of various building objects. \$289.

Contact: *Eclipse Software, Inc., Bellingham, WA, (800) 758-6779 or (360) 676-6175; 73417.167@compuserve.com.*

Circle 1067 on Inquiry Card.

TeleFinder BBS 5.0, an Internet server for the Macintosh, adds server support for World Wide Web documents; a POP3 mail server; support for HTML commands and Java; User Manager control over mail gateways at the Access Group level; native support for Open Transport TCP/IP in TeleFinder User client software; and support for AppleScripting, scheduling of utility programs, Usenet news-group support via NNTP Sucker, and relaying of SMTP messages on behalf of other servers. System operators can create personal Web Spaces for their BBS users as well as monitor and bill for both page storage and usage. Subscribers can create their own home pages and then maintain them via telephone, ISDN, LAN, or Internet connections. \$675.

Contact: *Spider Island Software, Irvine, CA, (714) 453-8095; <http://www.spiderisland.com>.*

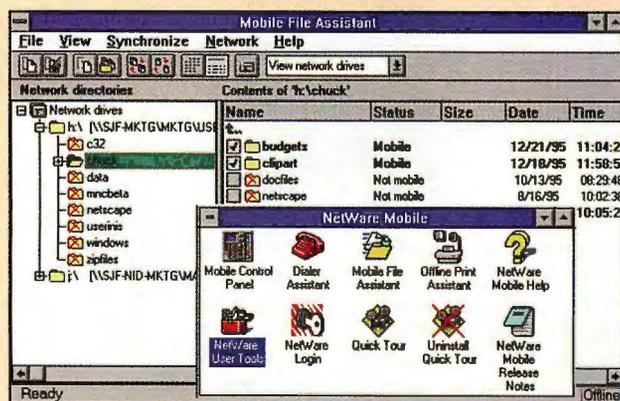
Circle 1066 on Inquiry Card.

REMOTE ACCESS TO NETWARE LANS

Now you can access your NetWare network anywhere in the world, whether you're remotely connected to the network or working off-line. NetWare Mobile (single user, \$129) enables you to transfer selected network data to mobile computers and then automatically update and synchronize files when you reconnect to the network. To reduce remote connection costs, NetWare Mobile updates only those parts of your files that have changed.

Contact: *Novell, Inc., Orem, UT, (800) 638-9273 or (801) 429-5588; <http://www.novell.com>.*

Circle 1044 on Inquiry Card.





BYTE

BUYER'S GUIDE

**Essential Products
and Services for
Technology Experts**

Mail Order

Top mail-order vendors offer the latest hardware and software products at the best prices.

184

Hardware/Software Showcase

Your full-color guide to in-demand hardware and software products, categorized for quick access.

209

Buyer's Mart

The BYTE classified directory of computer products and services, organized by subject so you can easily locate the right product.

218



HP ScanJet 4c

The perfect tool for capturing high-quality color and monochrome images to create impressive presentations, reports and promotional materials.

- Resolution: 600 dpi optical, 2400 dpi interpolated
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- 1-year warranty

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*After \$40 mail-in rebate for version upgrades from a previous version of Microsoft Office, Office Professional, Word, Excel, PowerPoint or Access. Competitive upgrades do not qualify for this offer. Offer valid through 12/31/96.

HARDWARE, SOFTWARE & PERIPHERALS AT DISCOUNT PRICES

SOFTWARE

Adobe PageMaker V6.0 WIN	549.29
Adobe PageMaker V6.0 WIN upg.	133.86
Arcade Backup for Windows 95	58.17
Corel OmniPage Pro V6.0 WIN upg.	117.55
Connect RAM Doubler for WIN	79.80
Corel Gallery 2 WIN CD	63.10
Corel Print House V1.0 WIN95 CD	25.04
CorelDRAW V5.0 to V6.0 WIN95 upg CD	228.62
CorelDRAW V6.0 WIN95 CD	441.20
Datagram Procomp Plus V2.01 DOS	92.98
Datagram Procomp Plus V2.11 WIN	123.17
Delrina WinFAX PRO V4.0 WIN	74.58
Delrina WinFAX PRO V7.0 WIN95	77.58
Symantec Communications Suite WIN95 CD	97.74
Symantec WinFAX Pro V7.0 WIN95 CD	70.41
Intuit QuickBooks V4.0 WIN	85.23
Intuit QuickBooks Deluxe V5.0 WIN CD	87.82
Lotus 1-2-3 V5.0 WIN	209.89
Lotus 1-2-3 V5.0 WIN upgrade	93.82
Lotus cc-Mail Mobile V2.2 WIN	126.18
Lotus Organizer V2.1 WIN	89.18
Lotus Organizer V2.1 WIN vers upg	49.60
McAfee VirusScan V2.2 WIN	45.19
Microcom Carbon Copy V3.0 WIN95	86.92
Microhelp Uninstaller V3.0 WIN	33.56
Microsoft Access V2.0 WIN	298.85
Microsoft Access V2.0 WIN dev kit	298.85
Microsoft Access V2.0 WIN upg	113.02
Microsoft Access WIN95 upg	92.14
Microsoft Encarta Encyclopedia 1996 WIN CD	45.52
Microsoft Excel V5.0 WIN	291.59
Microsoft Excel V5.0 WIN comp upg	112.83
Microsoft MS-DOS V6.22 upg	49.61
Microsoft Office Pro V4.3 WIN	541.71
Microsoft Office Pro V4.3 WIN	541.71
MS Office Pro V4.3 WIN CD w/Bookshelf	541.71
Microsoft Office Pro V4.3 WIN license	139.18
Microsoft Office Pro V4.3 WIN upg	356.53
Microsoft Office Pro w/Bookshelf WIN95 CD	528.75
MS Office Pro w/Bookshelf WIN95 upg CD	316.32
Microsoft Office Std WIN95 CD	451.78
Microsoft Office Std WIN95 upg	221.69
Microsoft Office Win/Wkgrp V3.11 license	49.26
Microsoft Office V4.2 WIN	461.92
Microsoft Office V4.2 WIN license	384.51
Microsoft Office V4.2 WIN upg.	287.43
Microsoft Plus! WIN95	45.28
Microsoft Plus! Win/Wkgrp V3.11	48.26
Microsoft Project V4.0 WIN	408.72
Microsoft Project WIN95 upg	131.04
Microsoft Publisher CD Deluxe WIN95	68.24
Microsoft Publisher V2.0 WIN	69.99
Microsoft Visual Basic Pro V4.0 WIN CD	448.35
MS Visual Basic Pro V4.0 WIN vers upg CD	39.79
Microsoft Visual C++ Subscription WIN95	449.82
Microsoft Win NT Server V3.51 CD	632.08
MS Win NT Server V3.51 single client license	38.79
Microsoft Win NT Server V3.51 upg from V3.5	31.96
Microsoft Win/Wkgrp V3.11	45.21
Microsoft Win/Wkgrp V3.11 resource kit	45.87
Microsoft Windows V3.11	29.91
Microsoft Windows V3.11 resource kit	179.93
Microsoft Windows 95 upg	89.36
Microsoft Windows 95 upg CD	89.36
Microsoft Windows V3.11 license	89.58
Microsoft Windows V3.11 license	79.30
Microsoft Word V6.0 WIN	298.85
Microsoft Word V6.0 WIN upg	113.40
Microsoft Works V3.0 WIN	46.16
Norton Lambert Close-Up V6.0	116.93
Novell PerfectOffice Std V3.0 WIN vers upg	182.41
Novell Quattro Pro V6.0 WIN upgrade	47.33
Novell WordPerfect V6.1 WIN	245.40
Novell WordPerfect V6.1 WIN comp upg	114.95
Novell WordPerfect V6.1 WIN vers upg	83.21
Parade Accounting V3.5 WIN CD + 3.5"	105.51
ProCD Select Phone 1996 WIN/MAC CD	84.58
Quark QuarkXPress V3.32 WIN	578.57
Quartermack Clean Sweep V2.0 WIN95	27.74
Quartermack CLEAN V2 WIN95/WIN3.1	92.79
Symantec ACT V2.0 WIN	172.59
Symantec Norton AntiVirus V3.0 DOS/WIN	51.38
Symantec Norton AntiVirus WIN95	72.87
Symantec Norton AntiVirus WIN95 upg	32.48
Symantec Norton Utilities V6.0 DOS/WIN	112.25
Symantec Norton Utilities WIN95	116.80
Symantec Norton Utilities WIN95 upg	56.55
Symantec pcANYWHERE V2.0 WIN	119.98
Symantec pcANYWHERE V2.0 DOS	121.20
Symantec pcANYWHERE32 WIN95/NT	132.85
Symantec pcANYWHERE32 WIN95/NT upg	83.33
Visio Technical V4.0 WIN95	258.27
Visio V4.0 WIN95 CD	133.74

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Novell	
Netware V4.1	
5 User CD	594.50
10 User CD	1345.64
25 User CD	1889.20
100 User CD	4131.66
Netware V4.1 upgrade	
5 User to 5 User CD	249.74
5 User to 10 User CD	564.33
5 User to 25 User CD	1552.09
5 User to 50 User CD	2282.67
10 User to 25 User CD	1316.84
10 User to 50 User CD	1722.52
10 User to 25 User CD	169.00
25 User to 50 User CD	1402.81
25 User to 100 User CD	2359.90
50 User to 100 User CD	1004.69
50 User to 100 User CD	2002.45
100 User to 100 User CD	1402.61
Netware V3.12	
5 User 3.5"	656.75
10 User 3.5"	1441.21
25 User 3.5"	2282.67
50 User 3.5"	2967.88
100 User 3.5"	4131.86
Microsoft BACKOFFICE MICROSOFT WINDOWS NT	
Windows NT Server Value Pack	901.04
Windows NT Server CD	532.08
Single client license	36.79
20 client license pack	606.61
MICROSOFT SQL SERVER	
SQL Server, CD	693.85
SQL Server upgrade, CD	248.58
Single client license	14.36
20 client license pack	132.61
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SMS Server, CD	586.95
SMS Server upgrade, CD	573.55
Single client license	48.76
MICROSOFT SNA SERVER	
SNA Server, CD	361.80
Single client license	58.04
20 client license pack	871.42
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Mail Server, CD	233.48
Mail Server upgrade, CD	296.85
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3C509B Etherlink II coax	113.71
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3C16570 Linkbuilder FMSII 12 port	538.34

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SNAP add-on transmitter	49.80

IBM	
Token Ring Auto Adapter 16/4 ISA	
IBM Token Ring MAU	398.42

Intel	
EtherExpress PRO/100Mbps PCI	219.19
EtherExpress PRO/100Mbps PCI 5pk	998.26
EtherExpress PRO/100Mbps ISA	219.19
EtherExpress PRO/10 Fish 10BT	108.01
EtherExpress PRO/10 Fish 5pk	419.88
EtherExpress PRO/10 Fish combo	272.00
EtherExpress PRO/10 Fish combo 5pk	1033.04
EtherExpress 16 10BT	103.04
EtherExpress 16 5pk	454.64
EtherExpress MCA 10BT	166.62
EtherExpress 16 combo	122.33
EtherExpress 16 combo 5pk	454.64
EtherExpress EISA, coax	128.17
EtherExpress Fish combo	129.79
EtherExpress Fish combo 5pk	454.05
TokenExpress PRO ISA LAN adapter	249.84
NetportExpress EL Ethernet	376.90

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Bay Networks	
SynOptics System 800 10BT 8-port hub	196.67
SynOptics System 800M 10BT 8-port hub	325.09
SMC	
EtherEZ 10BT	94.47
EtherEZ coax	94.47
TC605C Combo 10/100BT PCI	149.50
EtherPower 10/100BT PCI 5pk	234.62
EtherPower 10BT PCI	149.50
EtherPower 10BT 5pk	526.98
EtherPower coax PCI	149.97
TigerHub TP12 12 port + AUJ	164.24
TigerHub TP6 6 port + AUJ	179.97
3608 Ethernet 8 port hub 10BT	344.99
3512 Ethernet 12 port hub 10BT	548.55
PC6005 ARCNET 100Mbps	119.93
ARCNET 8 port active hub coax	229.41
TokenCard Elite 16/4	321.27

TERMINALS	
TC6246 ARCNET coax	179.99
TC605C Ethernet 8 port hub 10BT	336.28
TCVG045 AnyLAN ISA adapter	214.38
TCVG047 AnyLAN EISA adapter	239.69

TERMINALS	
Link MC80 14" color	499.33
Link MC5 amber/green/white	244.84
Wys6 40 amber/green/white	476.83
Wys6 160 amber/green/white	378.84

Xircom	
PE310BC pocket Ethernet coax	517.28
PE310B2 pocket Ethernet coax	271.51
PE310B1 pocket Ethernet 10BT	271.51
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T1000E 800MB parallel port	194.40
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Tape Stor 800MB Travan parallel	257.16
Tape Stor 350MB parallel	274.68
Tape Stor 800MB internal	309.83
Tape Stor 4GB internal	495.47

iomega	
Zip drive 100MB parallel interface	199.00
Zip drive 100MB SCSI interface	199.00
Zip disks 100MB, 3pk	49.00
Jaz drive 1GB external SCSI-II interface	599.00
Jaz drive 1GB external SCSI-II interface	499.00
Jaz drive one 1GB cartridge	124.00
Ditto Easy 800MB Travan tape drive external	149.00
Ditto Easy 800MB Travan tape drive internal	119.95

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Backuppack 3.5 1.44MB floppy parallel	146.32
Backuppack 800T 800MB Travan parallel	157.26

SyQuest	
EZ135 135MB internal IDE interface	194.42
EZ135 135MB external SCSI interface	229.90
Microolutions 4X CD parallel	297.88
EZ135 135MB external parallel interface	259.83

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Creative Labs	
Discovery CD 4x PnP multimedia kit	283.56
Blaster CD 4x kit	257.88
Sound Blaster Value CD 4x kit	239.14
Phone Blaster 1.44K internal w/software	185.16
Audio Blaster Multimedia edition (IDE)	309.83
Sound Blaster 16 SCSI-2	167.90
Sound Blaster AWE32 PnP	225.41

ADS VGA to TV Elite internal	134.99
ADS VGA to TV Elite external	198.83
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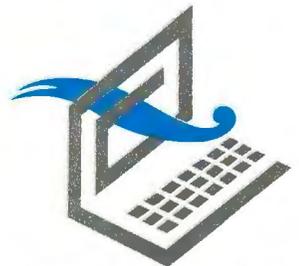
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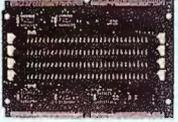
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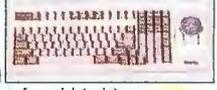
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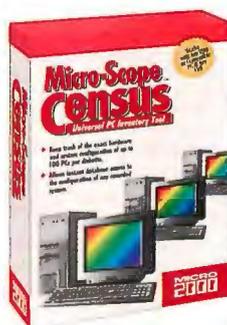
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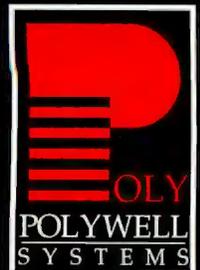
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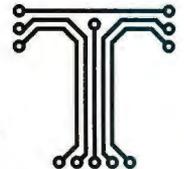
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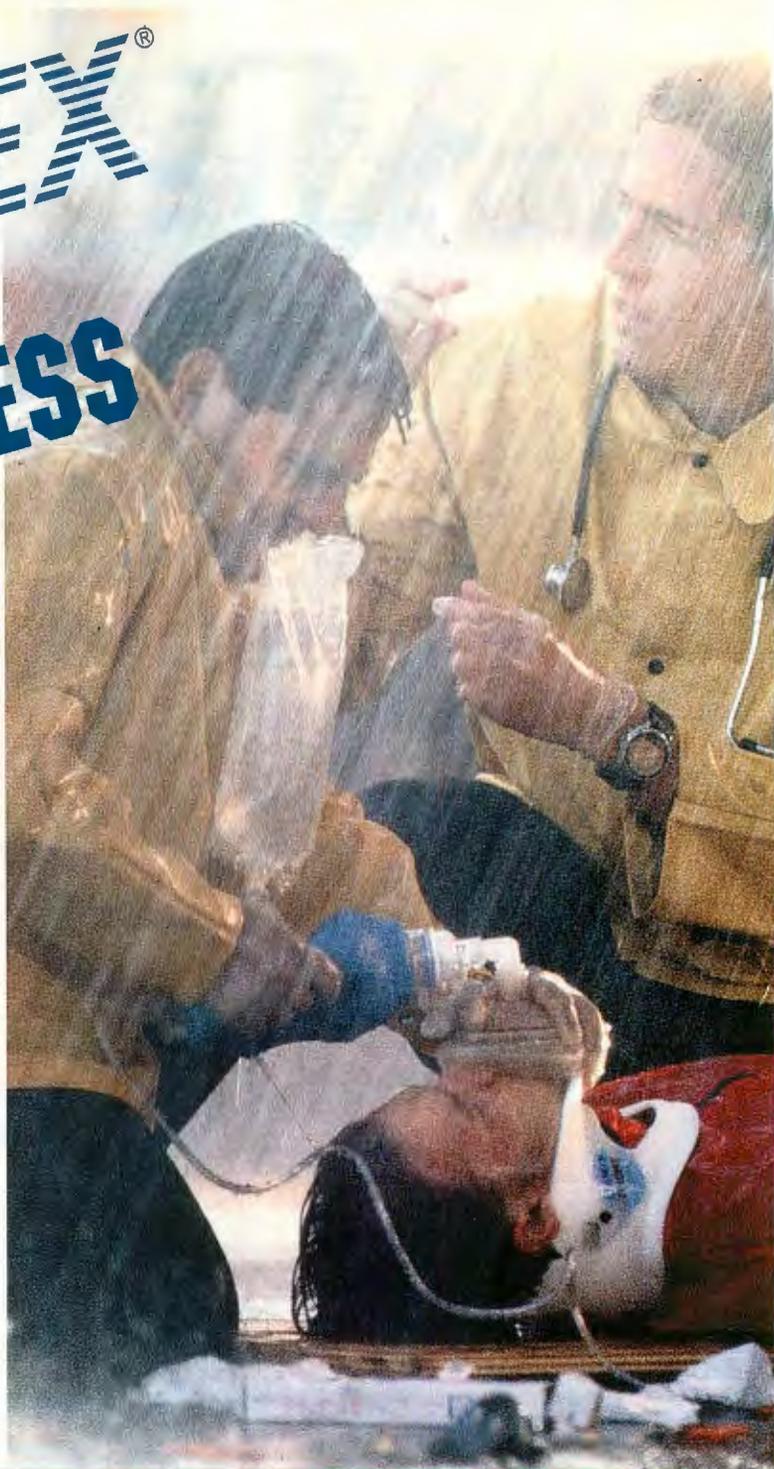
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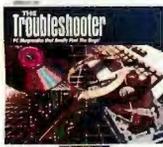
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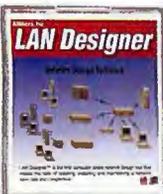


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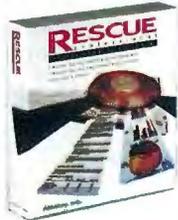
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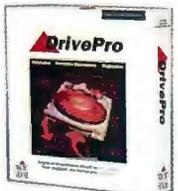
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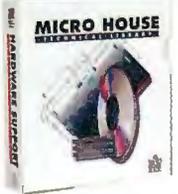
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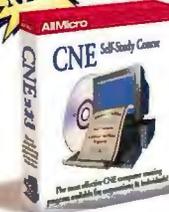


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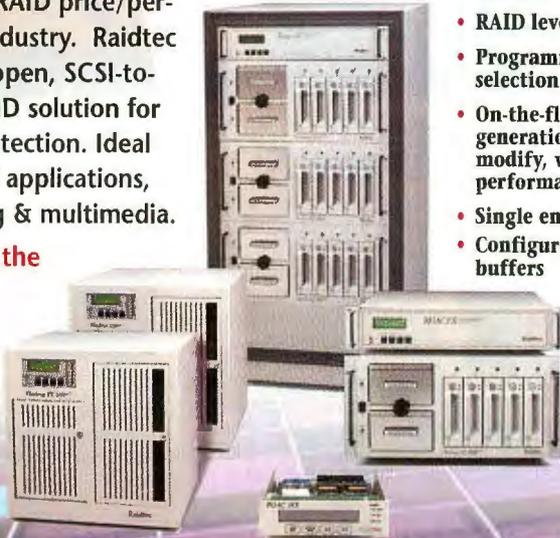
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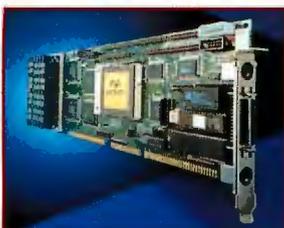
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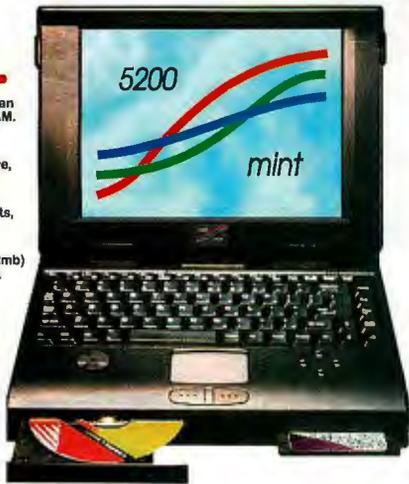
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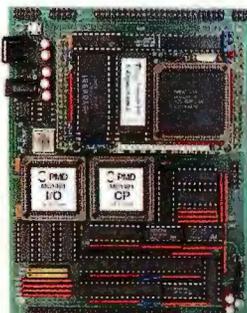
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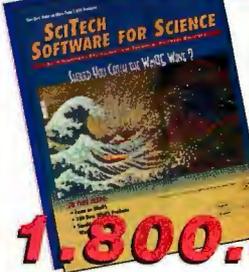
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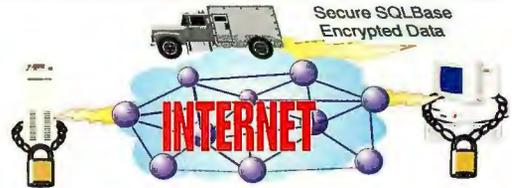
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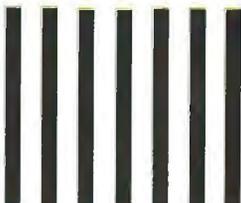
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Wake-Up Call

When it comes to digital telecommunications technology, the U.S. should listen to Europe

Europe got it right with digital cellular communications. GSM, the Global System for Mobile Communications, is the de facto worldwide standard—except in the U.S.

The U.S. telecommunications industry got it wrong. AT&T brought out analog cellular in 1980. Advanced Mobile Phone Service (AMPS) quickly became a standard, but not in Europe. Europe ended up with an analog cellular mess, with different countries going off in different directions (except for those in Scandinavia).

But when it came time to talk digital, the Europeans thrashed out a far-sighted standard: GSM. GSM is optimized for mobile data and is scalable to 64 Kbps. Cable a GSM phone up to a notebook PC or personal digital assistant (PDA), and you get great E-mail, faxing, and on-line access to the Internet. You can even hook a Nokia phone to a Hewlett-Packard palmtop.

The U.S. industry came up with D-AMPS (the *D* stands for digital), but performance was poor. Like GSM, it used time division multiple access (TDMA) technology, but it increased capacity by only a factor of 3. In the early 1990s, Qualcomm came up with code division multiple access (CDMA), which promised much-higher capacities.

Ironically, what CDMA really brought to the table was FUD. And that left the field wide open to GSM. So, while the gripping TDMA-versus-CDMA debate went on inside the U.S. telecommunications industry (and it hasn't stopped yet), the rest of the world was implementing GSM, investing over \$50 billion in the infrastructure.

GSM is up and running on 120 live networks in 70 countries. Every month, 750,000 new subscribers sign up. Roaming agreements let you use your phone for voice and data communications in different countries: Calls are charged to your regular account back home.

GSM has reached critical mass. There is no point in trying to trash the technology. GSM will continue to improve; rates will go up, and tariffs will come down. More and more countries are voting with their feet every month, and GSM-ready phones have already become a consumer commodity. Now's the time for fine-tuning and improvements: higher data rates, data compression, bandwidth on demand, packet data, and all kinds of future goodies.

Hope for the U.S. consumer comes from the deployment of the new wireless Personal Communication Services (PCS). PCS networks will come in different flavors. PCS 1900 is the one based on GSM technology. The figure 1900 in the name indicates the frequency in megahertz; the discerning reader may know that GSM operates at 900 MHz. However, this isn't a major issue



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since it's fairly easy to make a dual-mode phone. So, in principle, anyone who owns a PCS device will be able to use it in the rest of the world. And vice versa for GSM.

But what is an issue in the U.S. is the fact that there isn't going to be ubiquitous access to digital cellular networks. It's going to be PCS 1900 in some areas, CDMA (eventually) in others, and TDMA (D-AMPS) elsewhere. Thus, the U.S. isn't just going to be out of sync with the rest of the world; it's going to be out of sync with itself.

The only way around this problem is to make dual-mode phones for use within, not outside, the U.S. And the only way to get true ubiquitous coverage is to integrate analog and digital technology, which is a real kludge and pure Kafka. You can always rent a phone when you travel. And in the future you'll probably be able to remove the smart identity card and use it in the rented phone.

GSM does the modulation on the network, not on the PC Card you use for telecommunications with your notebook or PDA. Regular communications software sees a data card as a modem, but the functionality is different. Data stays digital until it reaches the network switch. It's modulated if the call is to go over the regular public network, but it stays digital if you ring an ISDN number.

This means that you have an end-to-end digital link. Setup times are a few seconds, versus the current modem-handshaking nonsense that takes 30 to 40 seconds (high overhead if you want to send a few E-mail messages). And now you can use V.42bis data compression over GSM's air interface, so what was 9.6 Kbps shoots up to 30 to 40 Kbps. When multiple-time-slot services come into operation in a couple of years, these transmission rates will be in the hundreds of kilobits per second, so mobile multimedia will be both feasible and affordable.

European technology is looking very cool right now on the digital communications front. Forgive me if I gloat. ■

Bob Emmerson writes frequently about telephony issues for BYTE's international edition. He lives in the Netherlands. You can reach him at 73252.1364@compuserve.com.

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- 6X Multi-session EIDE CD-ROM Drive
- MS Office Professional with Bookshelf for Windows 95
- Microsoft Windows 95/30 Days Free Support/MS Mouse
- ★ Upgrade to a 17LS (15.7" v.i.s.) monitor for only \$300 more.

\$2899

Business Lease: \$107/Mo.
Order Code #500226

DELL DIMENSION XPS P166c 166MHz PENTIUM PROCESSOR

- Mini Tower Model
- 16MB EDO Memory (128MB Max RAM)
- 512KB Pipeline Burst Cache
- 2GB Hard Drive [10.5ms]
- 17LS Monitor (15.7" v.i.s.)
- 9FX Motion Graphics Accelerator with 2MB VRAM (128-bit 4MB VRAM Max)
- 6X Multi-session EIDE CD-ROM Drive
- MS Office Professional with Bookshelf for Windows 95
- AWE32 Wave Table Sound Card
- Altec Lansing ACS-31 Speakers
- Microsoft Windows 95/30 Days Free Support/MS Mouse
- ★ Add the HP LaserJet 5L for only \$479 more.

\$3299

Business Lease: \$122/Mo.
Order Code #500225

DELL DIMENSION XPS P166 166MHz PENTIUM PROCESSOR

- Mini Tower Model
- 16MB EDO Memory (128MB Max RAM)
- 256KB Pipeline Burst Cache
- 1.6GB Hard Drive [10ms] (2GB Max)
- 15TX Trinitron Monitor (13.7" v.i.s.)
- 64-bit PCI 2MB DRAM Video (128-bit 4MB VRAM Max)
- 6X Multi-session EIDE CD-ROM Drive
- MS Office Professional with Bookshelf for Windows 95
- Microsoft Windows 95/30 Days Free Support/MS Mouse
- ★ Upgrade to 32MB of EDO Memory for only \$550 more.

\$2579

Business Lease: \$95/Mo.
Order Code #500224

PICTURED SYSTEM

DELL DIMENSION XPS P133c 133MHz PENTIUM PROCESSOR

- Mini Tower Model
- 16MB EDO Memory (128MB Max RAM)
- 512KB Pipeline Burst Cache
- 2GB Hard Drive [10ms] (2.5GB Max)
- 17LS Monitor (15.7" v.i.s.)
- 9FX Motion Graphics Accelerator with 2MB VRAM (128-bit 4MB VRAM Max)
- 6X Multi-session EIDE CD-ROM Drive
- MS Office Professional with Bookshelf for Windows 95
- AWE32 Wave Table Sound Card
- Altec Lansing ACS-31 Speakers
- Microsoft Windows 95/30 Days Free Support/MS Mouse

\$2999

Business Lease: \$111/Mo.
Order Code #500223



DELL DIMENSION XPS P133c 133MHz PENTIUM PROCESSOR

- Mini Tower Model
- 16MB EDO Memory (128MB Max RAM)
- 256KB Pipeline Burst Cache
- 1.6GB Hard Drive [10ms] (2GB Max)
- 15LS Monitor (13.7" v.i.s.)
- 64-bit PCI 2MB DRAM Video (128-bit 4MB VRAM Max)
- 6X Multi-session EIDE CD-ROM Drive
- MS Office Professional with Bookshelf for Windows 95
- Microsoft Windows 95/30 Days Free Support/MS Mouse
- ★ Add a 1.6GB/3.2GB Travan EIDE tape backup for only \$249 more.

\$2199

Business Lease: \$81/Mo.
Order Code #500222



DELL DIMENSION P100t 100MHz PENTIUM PROCESSOR

- Desktop Model
- 16MB EDO Memory (128MB Max RAM)
- 256KB Cache
- 1.6GB Hard Drive [10ms] (2GB Max)
- 15LS Monitor (13.7" v.i.s.)
- 64-bit PCI 1MB DRAM Video (2MB DRAM Max)
- 4X Multi-session EIDE CD-ROM Drive
- Microsoft Windows 95/30 Days Free Support
- ★ Add a 3Com EtherLink III Network Interface Card for only \$79 more.

\$1879

Business Lease: \$70/Mo.
Order Code #500221



DELL DIMENSION P100t 100MHz PENTIUM PROCESSOR

- Desktop Model
- 8MB EDO Memory (128MB Max RAM)
- 256KB Cache
- 850MB Hard Drive [12ms] (1.6GB Max)
- 14XE Monitor (13.19" v.i.s.)
- 64-bit PCI 1MB DRAM Video (2MB DRAM Max)
- 4X Multi-session EIDE CD-ROM Drive
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Dell Dimension P100t

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DELL LATITUDE XPi P120ST 120MHz PENTIUM PROCESSOR

- 10.4" SVGA Active Matrix Color Display
 - 8MB RAM (24MB Max RAM)
 - 256KB L2 Cache
 - 540MB Removable Hard Drive (1.2GB Max)
 - Smart Lithium Ion Battery with Advanced Power Management
 - 32-bit Local-bus Video, 1MB Video RAM
 - 2 Type II/1 Type III PCMCIA Slots
 - 6.2 Pounds
 - Extendable 1 Year Warranty
- ★ Upgrade to a 1.2GB hard drive for only \$400 more.

\$3599[†]

Business Lease: \$130/Mo.
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DELL LATITUDE LX 4100T 100MHz INTEL DX4™ PROCESSOR

- 10.4" Active Matrix Color Display
 - 8MB RAM (24MB Max RAM)
 - 128KB L2 Cache
 - 420MB Upgradeable Hard Drive (810MB Max)
 - \$99 More for 2nd NiMH Battery (Slides into floppy drive to achieve extended battery life)
 - 32-bit Local-bus Video, 1MB Video RAM
 - 2 Type II/1 Type III PCMCIA Slots
 - 6.2 Pounds
 - Extendable 1 Year Warranty
- ★ Upgrade to 12MB of RAM for only \$99 more.

\$1999[†]

Business Lease: \$74/Mo.
Order Code #800033

DELL LATITUDE XPi P120D 120MHz PENTIUM PROCESSOR

- 10.4" Dual Scan Color Display
 - 8MB RAM (40MB Max RAM)
 - 256KB L2 Cache
 - 540MB Removable Hard Drive (1.2GB Max)
 - Smart Lithium Ion Battery with Advanced Power Management
 - 32-bit Local-bus Video, 1MB Video RAM
 - 2 Type II/1 Type III PCMCIA Slots
 - 6.2 Pounds
 - Extendable 1 Year Warranty
- ★ Add a 28.8 XJACK/Cabled Modem for only \$259 more.

\$2599[†]

Business Lease: \$96/Mo.
Order Code #800036

DELL LATITUDE XPi P75D 75MHz PENTIUM PROCESSOR

- 10.4" Dual Scan Color Display
- 8MB RAM (40MB Max RAM)
- 256KB L2 Cache
- 540MB Removable Hard Drive (1.2GB Max)
- 14.4 XJACK Modem
- Smart Lithium Ion Battery with Advanced Power Management
- 32-bit Local-bus Video, 1MB Video RAM
- 2 Type II/1 Type III PCMCIA Slots
- 6.2 Pounds
- Extendable 1 Year Warranty[†]

PICTURED IN COLUMN AT LEFT

\$2199[†]

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Dell's featured computer artist is Mick Wiggins.

If you're impressed by Windows 95, you should see it running on the Dell Dimension XPS P133c and the Dell Dimension P100t. These Dell® systems were just judged the best for running Windows 95 by *PC Magazine*.

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- 1.6GB Hard Drive [10ms] (2GB Max)
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- 64-bit PCI 2MB DRAM Video (128-bit 4MB VRAM Max)

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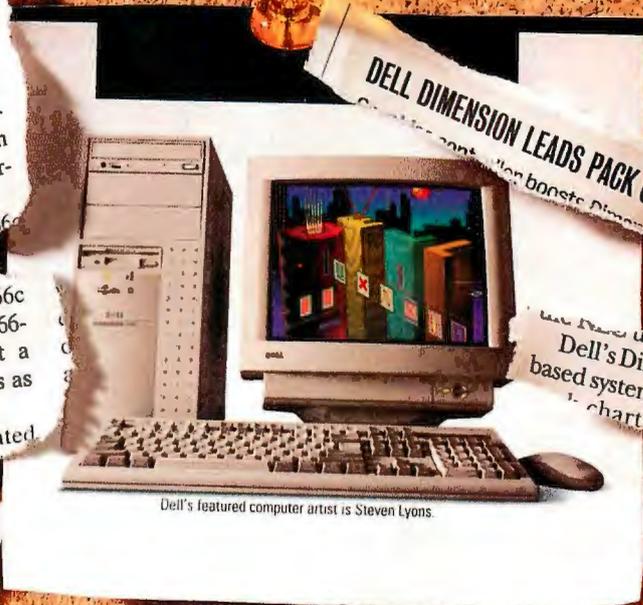
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The Dimension XPS P166c makes the most of Intel's 166MHz Pentium processor at a competitive price and stands as the system to beat.—JM
 Dimension XPS P166c. Estimated

PC MAGAZINE
 1/23/96



Dell's featured computer artist is Steven Lyons.

DELL DIMENSION LEADS PACK OF 166MHZ PENTIUM DESKTOP SYSTEM

Dell's Dimension unit will begin shipping next month. Dell's Dimension paced the 166MHz Pentium based systems in PC Week Labs' tests (see benchmark chart, below).

PC WEEK
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